U.S. Department of Transportation
Federal Highway Administration

South Dakota Division

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March 7, 2019

In Reply Refer To:
HDA-SD

Mr. Steve Gramm, P.E.
Planning Engineer
South Dakota Department of Transportation
700 East Broadway Avenue
Pierre, SD 57501-3110

Subject: Interchange Modification Justification Report (IMJR); I-229, Exit 9 Benson Road

Dear Mr. Gramm:

The Federal Highway Administration has completed our review of your March 4, 2019 submittal requesting final approval of an access modification to Interstate 229 at Exit 9 Benson Road in Minnehaha County.

Based on an engineering and operational review of the justification report, we hereby find the proposed modifications acceptable. Final approval of the IMJR will be granted upon satisfactory completion of the environmental process, provided there are no major design changes to the selected alternative. Once the environmental document is approved, Federal funds can then be used for final design, right-of-way acquisition, and construction of the project.

If you have any questions, please feel free to call Mark Hoines at 605-776-1010.

Sincerely,

R. Kirk Fredrichs
South Dakota Division Administrator

E-Copies: Mike Behm, SDDOT, Planning and Engineering
Mark Leiferman, SDDOT, Project Development
Mark Hoines, FHWA
Mark Clausen, FHWA
Brett Hestdalen, FHWA

Interchange Modification Justification Report

I-229 Exit 9 (Benson Road)

I-229 Benson Road Interchange Modification Study

Project # IM2292(98)67N, PCN 04XK

Sioux Falls, South Dakota

January, 2019

City of Sioux Falls
SOUTH DAKOTA

SouthDakota DOT
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SIOUX FALLS MPO
METROPOLITAN PLANNING ORGANIZATION
SOUTH DAKOTA

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Abbreviations

AASHTO	American Association of State Highway Transportation Officials
CATEX	Categorical Exclusion
CMF	Crash Modification Factor
CRM	Critical Rate Factor
FHWA	Federal Highway Administration
HCS	Highway Capacity Software
HOT	High Occupancy Transit
HOV	High Occupancy Vehicle
HSM	Highway Safety Manual
IMJR	Interchange Modification Justification Report
LOS	Level of Service
MRM	Mileage Reference Marker
MPO	Metropolitan Planning Organization
MSA	Metropolitan Statistical Area
SDDOT	South Dakota Department of Transportation
STIP	Statewide Transportation Improvement Program
TAZ	Traffic Analysis Zone
TIP	Transportation Improvement Program

1.0 Executive Summary

This Interchange Modification Justification Report (IMJR) provides technical analysis related to proposed changes to the existing Benson Road interchange (Exit 9) on Interstate 229 (I-229) in Sioux Falls, SD.

The proposed action is a reconfiguration of the existing Benson Road Interchange on I- 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 in the Recommendations section of this report and summary responses to the requirements associated with the Policy on Access to the Interstate System, dated May 22, 2017 are provided below.

The proposed change is a reconfiguration of an existing interchange and improvements to the existing crossroad facility (Benson Road). The changes will address current and future capacity needs of the Benson Road Interchange and along the Benson Road Corridor, as well as improve accessibility for non-automobile transportation modes along Benson Road. The proposed change does not result in any new access points on the Interstate Highway System.

The concept alternatives involve changes to the geometric design of an existing diamond interchange and changes to the crossroad arterial street (Benson Road) to meet the transportation needs in the study area. 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 nor HOV facilities will provide sufficient relief to future travel demand within the study planning horizon.

The operation and safety analysis contained in this study shows that the proposed build alternatives are not expected to adversely affect the safety or efficiency of the Interstate system. The build alternatives are also expected to improve access management on the crossroad in the vicinity of the interchange.

Conceptual signing plans were prepared for each interchange alternative and for the Benson Road arterial corridor on each side of I-229.

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 using current standards and further design using current standards is anticipated and will receive additional reviews throughout the next steps of the design.

This proposal is the result of land use and transportation plans prepared within the MPO process, including the Sioux Falls MPO Long Range Transportation Plan, the SDDOT 2010 Decennial Interstate Corridor Study, the I-229 Major Investment Corridor Study, and the I-229 Exit 9 Crossroad Corridor Study. The Benson Road Interchange project PE is programmed in the Statewide Transportation Improvement Program (STIP) for 2022 with construction in the 2023-2025 timeframe.

Analysis techniques included an evaluation of operational capacity using Highway Capacity Manual 2010 techniques via HCS 2010. 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 the South Dakota Department of Transportation and Federal Highway Administration participants in February 2018 and modified as necessary throughout the study. The Methods and Assumptions document is included in **Appendix 2**.

2.0 Introduction

2.1 Background and Project Need

The I-229 Exit 9 interchange (Benson Road) is located in northeast Sioux Falls, SD and serves as one of the primary access points to the Sioux Falls Regional Airport and one of the region's largest industrial areas. The interchange currently experiences high peak-hour demand as drivers commute to and from industrial-area jobs. This high peak-hour use and continued job growth around the interchange have driven demands for interchange improvements.

The South Dakota Department of Transportation (SDDOT), the City of Sioux Falls, the Sioux Falls MPO, and the Federal Highway Administration (FHWA) conducted a Major Investment Study for the I-229 corridor which was finished in 2017. That study, which included a sub-study component for Exit 9, recommended improvements at the Exit 9 interchange and identified two alternatives for further consideration:

- A modified diamond interchange with a northbound-to-westbound loop in the northeast quadrant
- A diverging diamond interchange

The Major Investment Study identified several specific issues/needs for Exit 9:

- Congestion at the Benson Road/I-229 interchange
- Future growth along Benson Road east of I-229
- Need for improved pedestrian connectivity
- Need for a possible connection to the Veterans Parkway corridor

This Interchange Modification Justification Report seeks to provide the necessary analysis for approval of the interchange modification action. A companion environmental document will provide environmental analysis and determine a recommended alternative.

The primary need of this project is to improve traffic operations and safety and to enhance mobility for other modes of transportation at the Benson Road Interchange and along the Benson Road Corridor. The Purpose and Need statement is included in **Appendix 1**.

The 2017 Benson Road Corridor Study concluded that improvements were necessary along Benson Road and at the Benson Road Interchange to address existing congestion issues and to accommodate planned growth which are expected to worsen traffic operations at the interchange along Benson Road.

The study continues the previous planning work and provides the necessary analysis for consideration by SDDOT and FHWA.

2.2 Study Area

The study area is shown in **Figure 1**. It includes I-229 from Rice Street (Exit 7) to Interstate 90 (Exit 10), including the interchanges at Exit 7, Exit 9 and Exit 10. The crossing arterial street at Exit 9, Benson Road, is included from its intersection with Cliff Avenue on the west to its intersection with Sycamore Avenue on the east. The crossing arterial street at Exit 7, Rice Street, is included from its intersection with Cliff Avenue on the west to its intersection with Bahnson Avenue on the east.

The following arterial street intersections were included in the study analysis:

- Benson Road/Cliff Avenue
- Benson Road/Lewis Avenue

- Benson Road/Potsdam Avenue
- Benson Road/I-229 southbound
- Benson Road/I-229 northbound
- Benson Road/Hall Avenue
- Rice Street/Cliff Avenue
- Rice Street/Wayland Avenue
- Rice Street/I-229 southbound
- Rice Street/I-229 northbound
- Rice Street/Bahnson Avenue

2.3 Methods and Assumptions

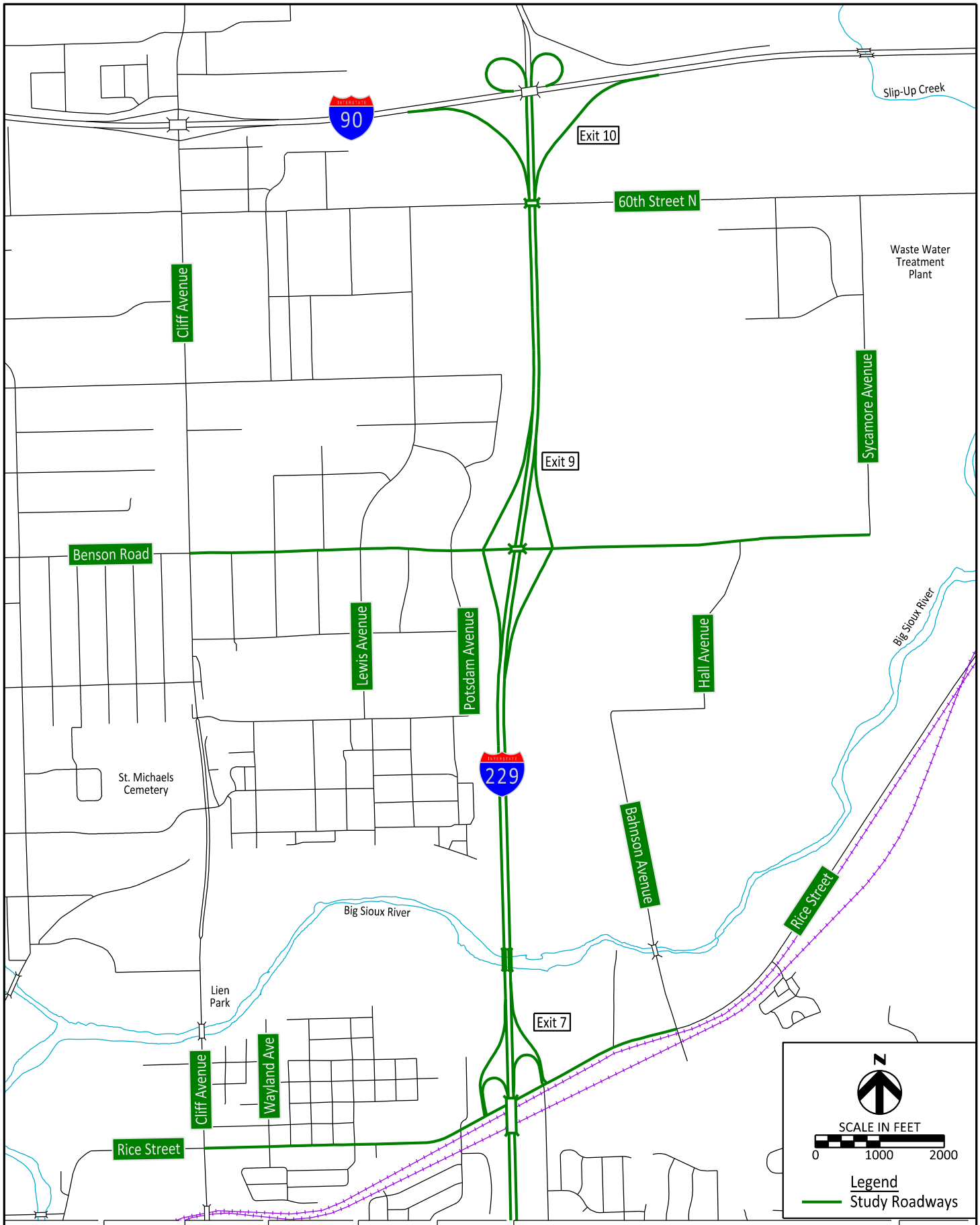
Preparation of this report included the following work tasks:

- Data Gathering
- Review previous Interstate studies and coordinate with preparation of the environmental studies, including feasible alternatives and the recommended alternative.
- Determine existing and future operational characteristics of Interstate and local street facilities.
- Prepare a deliverable report.

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

This IMJR Document is organized in accordance with FHWA's Policy on Access to the Interstate System – May 22, 2017.

The analysis methods and assumptions used in this study are documented in a separate Methods and Assumptions document that was negotiated between the supervising agencies and the consultant. A copy of the Methods and Assumptions document is provided in **Appendix 2**.



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Drawn By: BRM
Date: 1/30/2018
Chked By: DLH
Date: 1/30/2018
Revision: 8/23/2018

Study Area

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 1

3.0 Operational and Safety Analysis

3.1 Existing Conditions Analysis

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 2% - 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 (MSA) 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 currently near 2% in Sioux Falls, compared with a statewide rate of 2.7%, regional rate of 3.0%, and a national unemployment rate of 5.0%.

Existing Land Use

Land use around the Exit 9 interchange and along Benson Road is a mix of agriculture, industrial, office, and commercial development. The study area Traffic Analysis Zones (TAZ's) currently reflect the existing population and employment inputs. The area is in transition, in particular east of I-229 which has been designated as a growth area. The future year TAZ's show infill of uses similar to those currently existing in the study area.

The future land use plan for Sioux Falls shows continued development of light industrial land uses for this portion of the urban area.

Existing Roadway Network

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

- I-229 – from Interstate 90 to Exit 7 (Rice Street)
- Benson Road – from Cliff Avenue to Bahnson Avenue/Hall Avenue
- Rice Street – from Cliff Avenue to Bahnson Avenue

The following major intersections were analyzed:

- Benson Road/Cliff Avenue
- Benson Road/Lewis Avenue
- Benson Road/Potsdam Avenue
- Benson Road/I-229 SB Ramp Terminal
- Benson Road/I-229 NB Ramp Terminal
- Benson Road/Hall Avenue
- Rice Street/Cliff Avenue
- Rice Street/Wayland Place
- Rice Street/I-229 SB Ramp Terminal
- Rice Street/I-229 NB Ramp Terminal
- Rice Street/Bahnson Avenue

Alternative Travel Modes

Travel within the study area is primarily by automobile. The 2017 Benson Road Corridor Study recommended building sidewalks along Benson Road to provide pedestrian access for the planned growth along the corridor. Multimodal level of service (LOS) analysis was completed for the build alternatives for pedestrian, bicycle and transit modes along Benson Road and discussed in the report.

Interchanges

Interchanges in the study area include:

- I-90/I-229 Interchange (I-90 Exit 400) – Partial Cloverleaf Interchange
- I-229/Benson Road (Exit 9) – Diamond Interchange with signalized control at NB ramp terminal.
- I-229/Rice Street (Exit 7) – Folded Diamond Interchange with signalized control at both ramp termini.

Existing Data

Traffic counts on the Interstate roadway segments were gathered by SDDOT in 2017. Traffic counts on the arterial street system were obtained from the City of Sioux Falls and HDR counts from 2015 and 2017. Count data were assembled and balanced to produce a representation of peak hour traffic flows through the study area. Peak hour traffic volumes are shown in **Figures 2, 3** and **6**.

Operational Performance

Operational 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 level of service "B" through "E" describing increasingly more congested conditions and level of service "F" describing the highest congestion or saturation. 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 (HCM), published by the Transportation Research Board.

The existing study area roadways were evaluated using the HCM methodologies for Interstate highways and urban streets. SDDOT has established a minimum level of service standard of "C" for interstate facilities, including ramp terminal intersections. The City of Sioux Falls has established minimum level of service standard of "D" for arterial signalized intersections.

Level of service on I-229 was calculated for mainline, ramp merge-diverge, and weave areas for peak hours under 2017 conditions. The level of service results are shown in **Figure 6**. Note that several Interstate mainline segments were analyzed both as regular mainline segments and weaving segments. If it was determined that the segment satisfied the conditions for weaving, the weaving level of service was reported and indicated by an asterisk (*) next to the level of service result.

The Interstate system operates at acceptable levels of service within the study area.

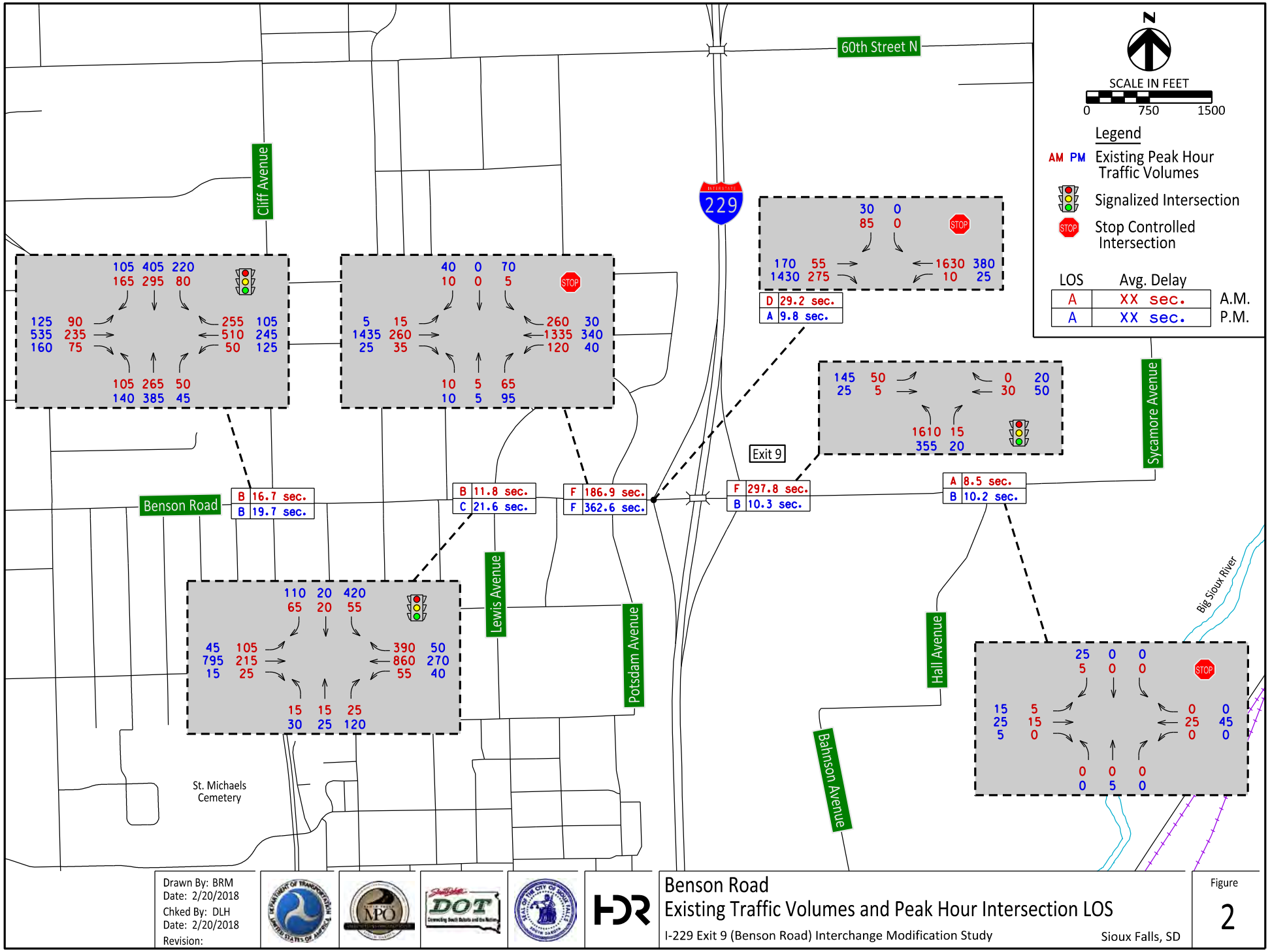
Intersection turning volumes and level of service for peak hours under 2018 conditions are shown in **Figures 2** and **3** for the Benson Road and Rice Street arterial corridors. Multimodal levels of service for the Benson Road and Rice Street arterial corridors are shown in **Figures 4** and **5**. The Existing Conditions Traffic Memo is included for reference in **Appendix 3**.

The arterial street system experiences peak hour congestion at the following locations:

- Benson Road/Potsdam Avenue
- Benson Road/I-229 Southbound Ramp Terminal
- Benson Road/I-229 Northbound Ramp Terminal
- Rice Street/I-229 Southbound Ramp Terminal
- Rice Street/I-229 Northbound Ramp Terminal

Certain movements experienced low levels of service or queues that exceeded the length of the available storage during particular peak hours. The southbound left turn at Rice Street/Cliff Avenue is an example of this characteristic, with the left turn queue extending through the Bennett Street/Cliff Avenue intersection at times.

Multi-modal level of service varies widely throughout the Benson Road and Rice Street corridors. The lowest levels of service are related to locations with the absence of specific facilities for pedestrians and bicyclists in these corridors.


60th Street N
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Benson Road
Lewis Avenue
Potsdam Avenue
Exit 9
Sycamore Avenue
Hall Avenue
Bahnson Avenue
Big Sioux River
St. Michaels Cemetery
105 405 220
165 295 80
125 90
535 235
160 75
255 105
510 245
50 125
105 265 50
140 385 45
40 0 70
10 0 5
5 15
1435 260
25 35
260 30
1335 340
120 40
10 5 65
10 5 95
30 0
85 0
170 55
1430 275
1630 380
10 25
D 29.2 sec.
A 9.8 sec.
145 50
25 5
0 20
30 50
1610 15
355 20
110 20 420
65 20 55
45 105
795 215
15 25
390 50
860 270
55 40
15 15 25
30 25 120
25 0 0
5 0 0
15 5
25 15
5 0
0 45
0 0
0 0 0
0 5 0
B 16.7 sec.
B 19.7 sec.
B 11.8 sec.
C 21.6 sec.
F 186.9 sec.
F 362.6 sec.
F 297.8 sec.
B 10.3 sec.
A 8.5 sec.
B 10.2 sec.
N
SCALE IN FEET
0 750 1500
Legend
AM PM Existing Peak Hour Traffic Volumes
Signalized Intersection
Stop Controlled Intersection
LOS Avg. Delay
A XX sec. A.M.
A XX sec. P.M.
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Date: 2/20/2018
Chked By: DLH
Date: 2/20/2018
Revision:
Benson Road
Existing Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD
Figure
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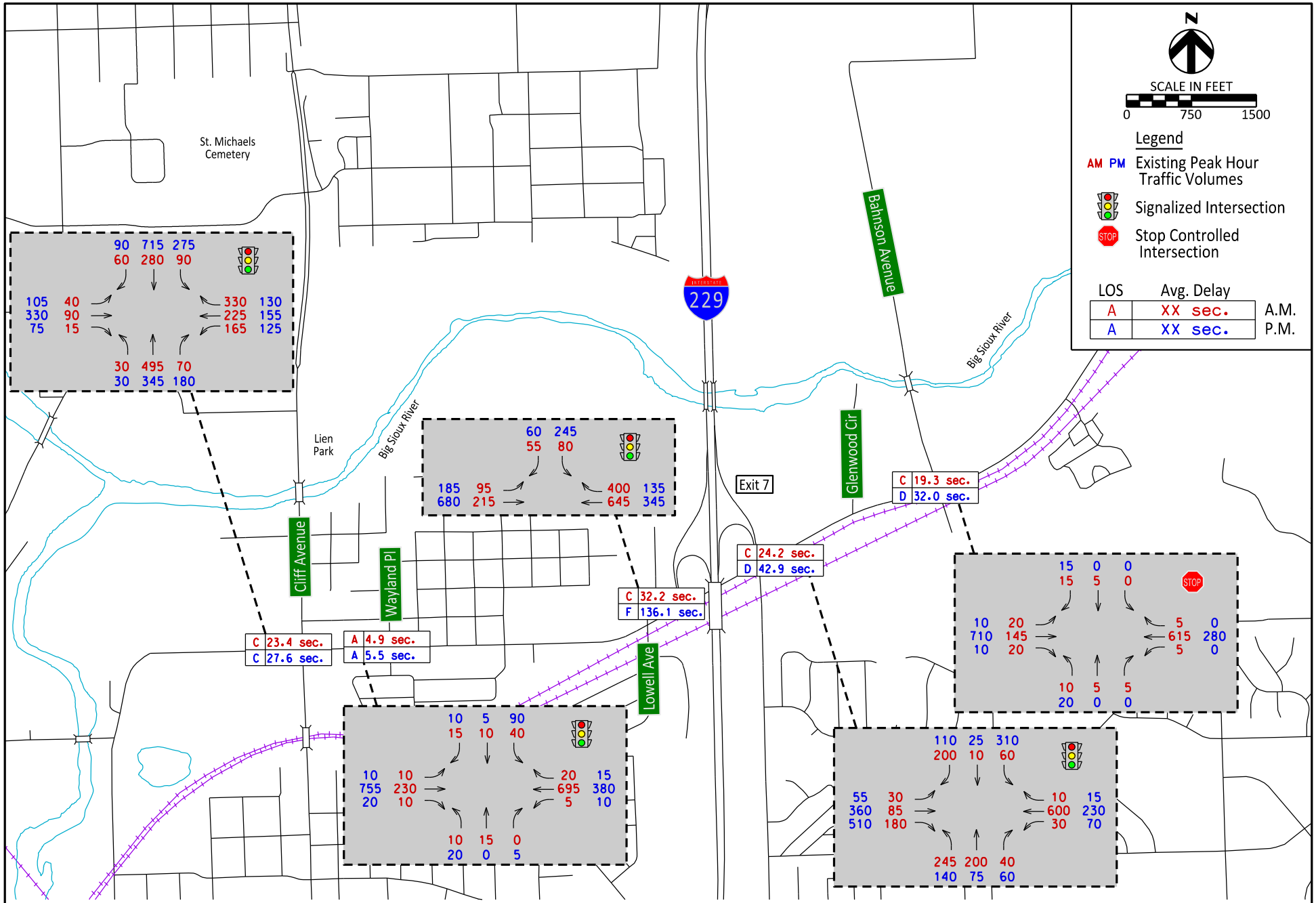

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Rice Street
Existing Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 3

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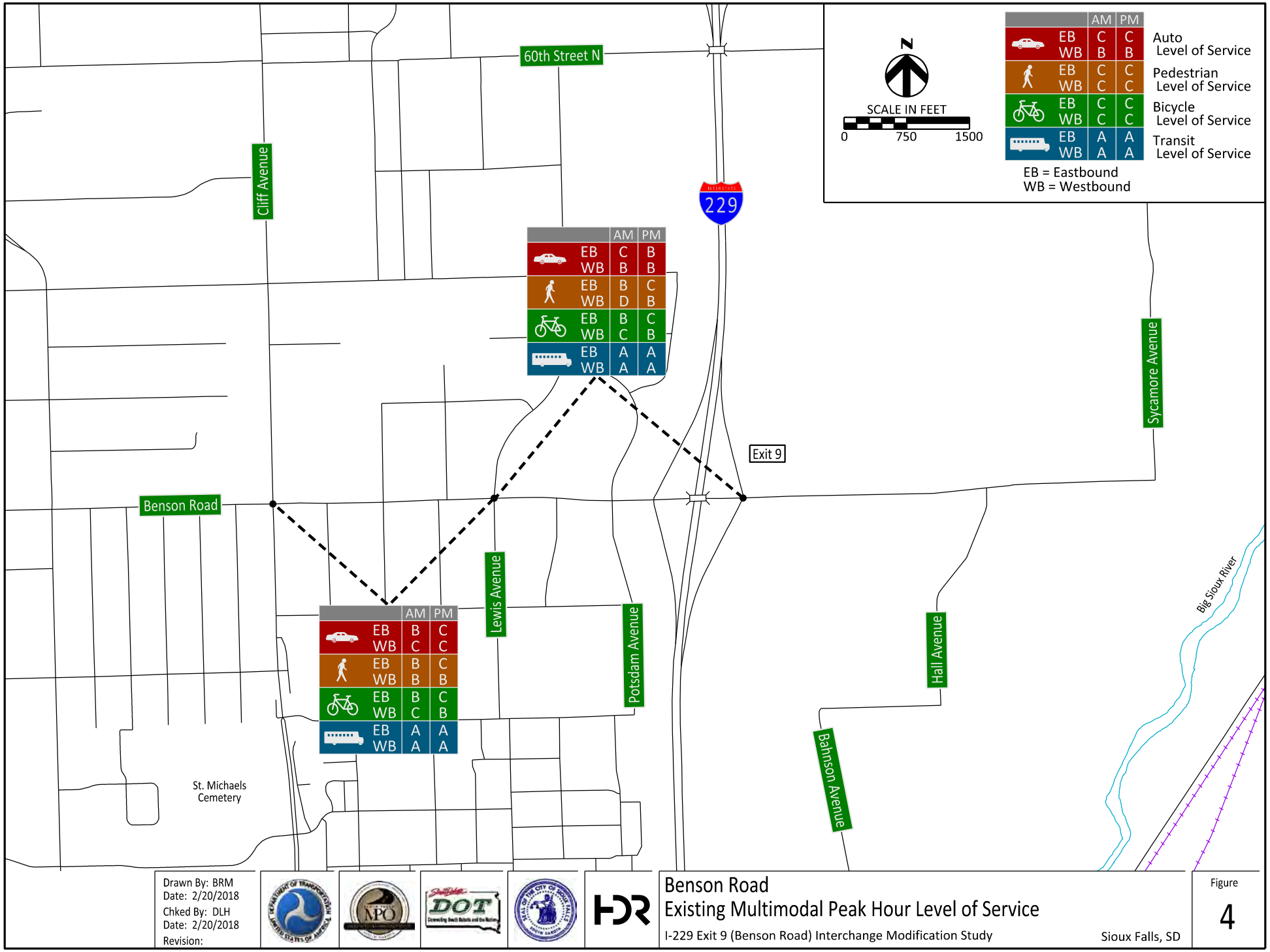

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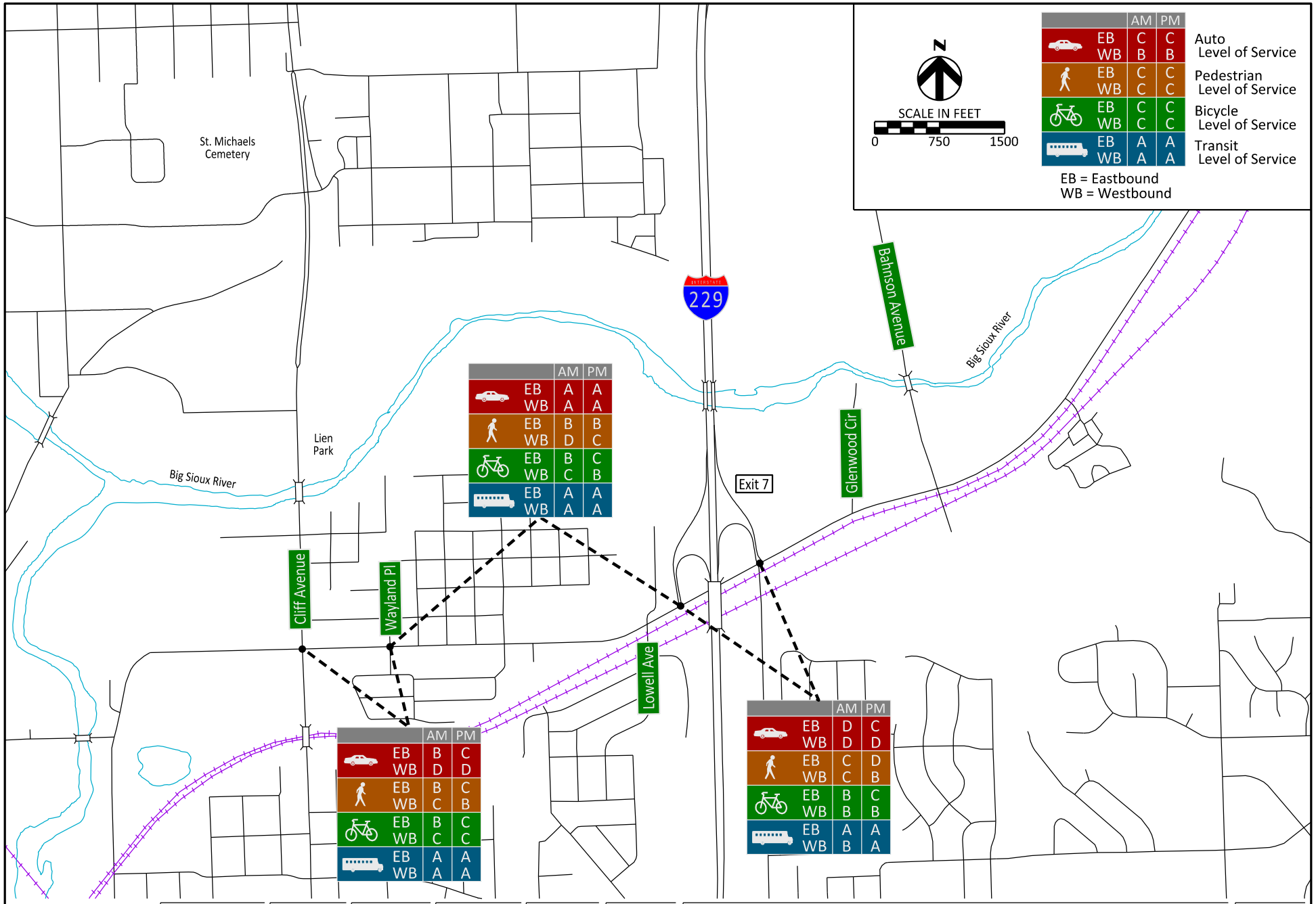
Benson Road
Existing Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 4



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Rice Street
Existing Multimodal Peak Hour Level of Service
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 5

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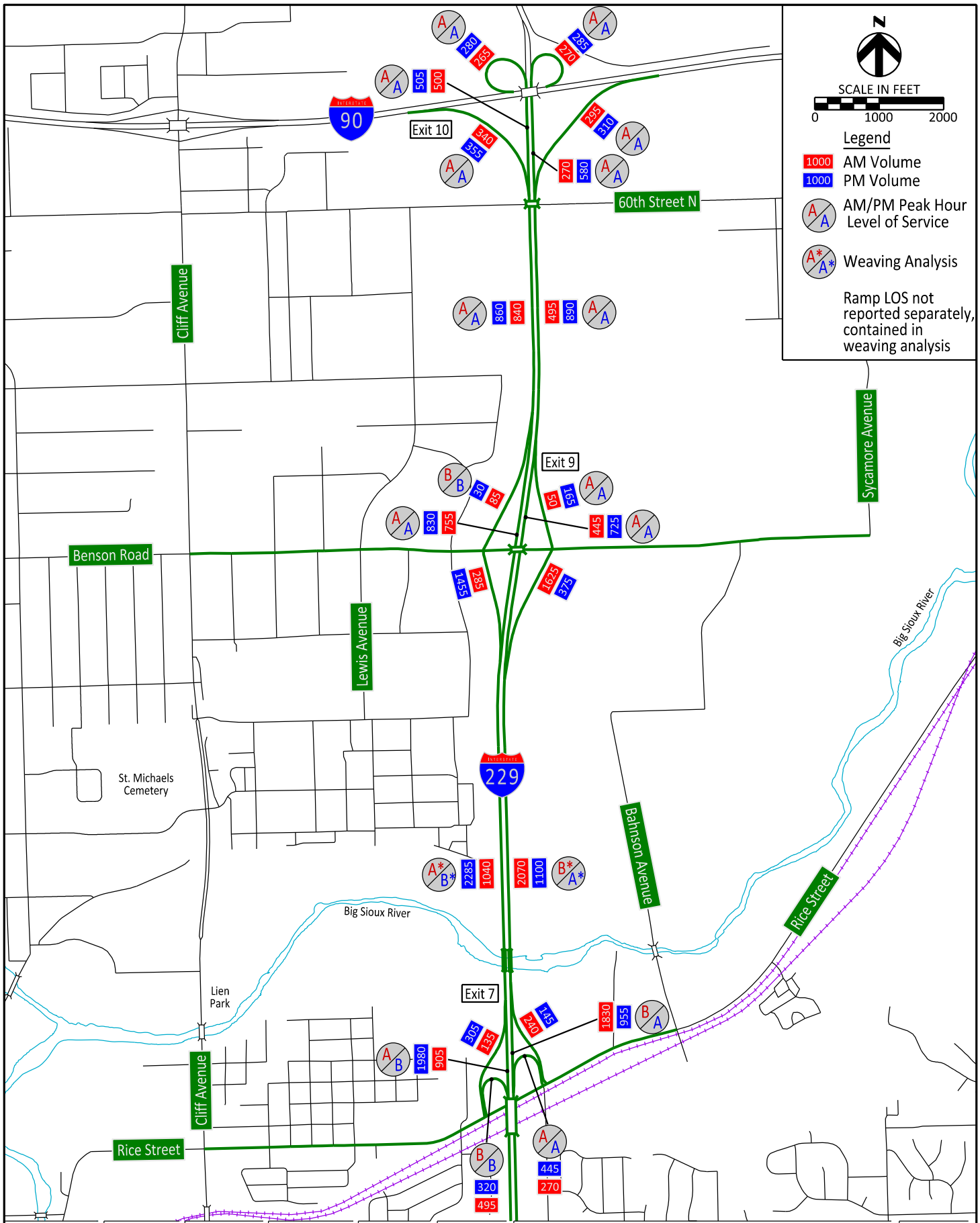

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Existing Peak Hour Balanced Traffic Volumes and Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 6

Existing Safety Conditions

An analysis of existing safety conditions was conducted based on crash records provided by SDDOT. The analysis was conducted using the Critical Rate Method, as described in the Highway Safety Manual (HSM), published by the American Association of State Highway and Transportation Officials (AASHTO).

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.*

Crash data for the years 2013 through 2017 were provided by SDDOT and reviewed to identify any existing crash concentrations/crash trends and develop potential crash mitigation measures. Analysis were conducted for the following roadway facilities:

- Arterial street intersections
- Arterial street segments
- Interstate mainline segments
- Interstate ramp segments

Critical crash rates were calculated for each segment, ramp, or intersection and used to identify portions of the study area that displayed crash rates higher than the critical rate. Each of the above-critical locations is discussed in subsequent sections of this report.

Segment, Ramp and Intersection Crash Rates

The study area was divided into segments representing:

- Interstate mainline segments (Figure 7, Table 1)
- Interstate ramp segments (Figure 8, Table 2)
- Arterial street intersections (Figures 9 & 10, Table 3)
- Arterial street segments (Figures 11 & 12, Table 4)

Mainline and ramp sections were each analyzed separately to allow calculation of representative crash rates and critical rates for each type of Interstate feature.

The study arterial street intersections and intervening arterial street segments were each grouped for calculation of crash rates and critical rates.

Details of the crash records for each segment and intersection are contained in **Appendix 4**.

Segment and Intersection Critical Crash Rates:

Critical crash rates were calculated based on the statistical populations in each spreadsheet, using the methods shown in the Highway Safety Manual (American Association of State Highway and Transportation Officials (AASHTO), 2010). Those segments and intersections that lay outside the critical rates are shown in red coloration in the last column of each spreadsheet. All the segments and intersections that lay within the critical limits are shown in green. The locations of non-critical or critical crash rates are also illustrated on the figures.

Crash Trends:

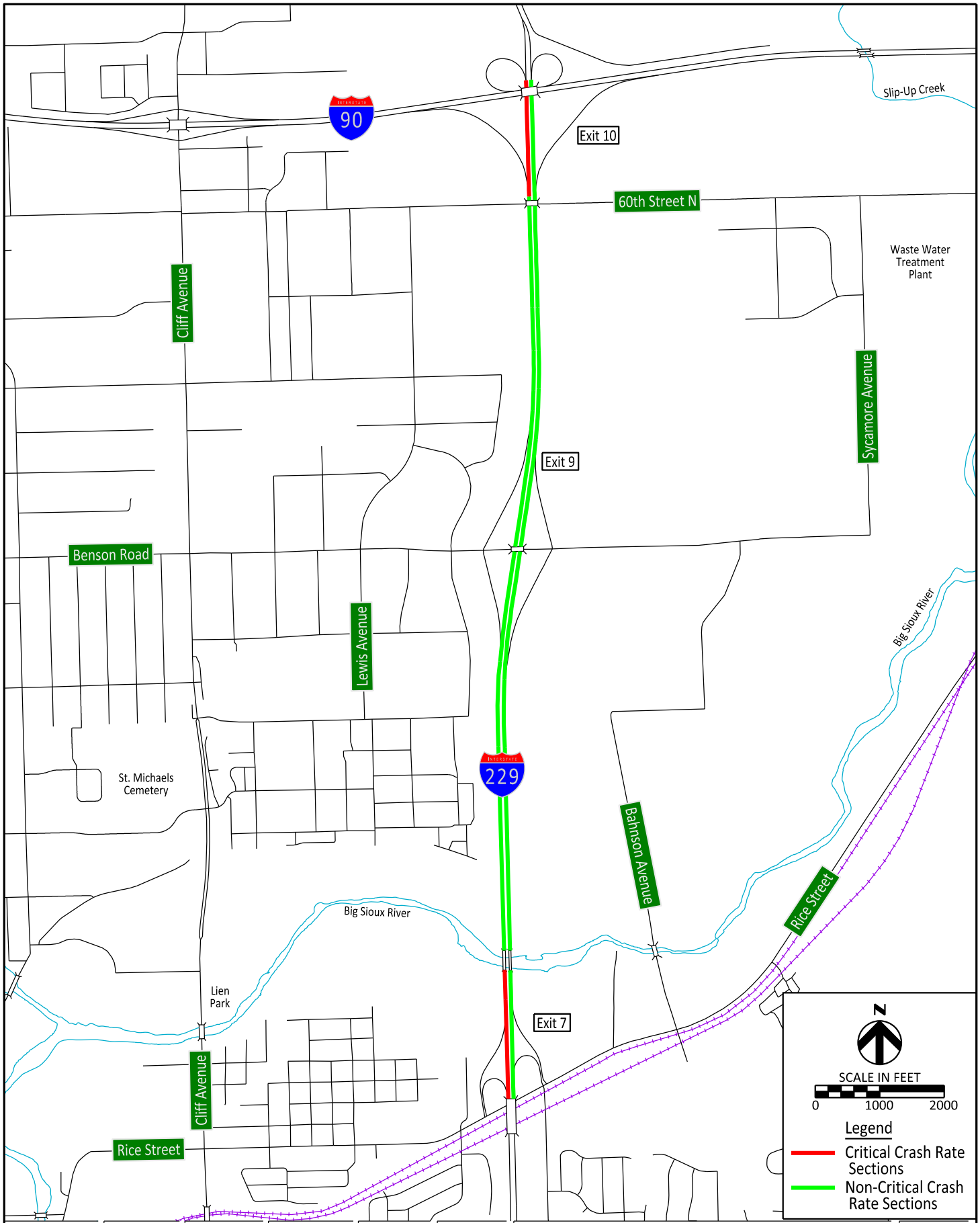
Review of the crash summaries for each Interstate and arterial street section revealed a few crash trends:

- Slightly elevated incidence of single vehicle crashes on southbound I-229 at I-90 during inclement weather events.
- A short-term concentration of crashes on southbound I-229 at Rice Street, likely during construction activities.
- Single-vehicle run-off crashes on the northbound Rice Street off-ramp during inclement weather (only 5 in the 5-year period, but enough to appear outside the critical rate boundary).
- Concentrations of angle crashes at the Benson/Cliff and Rice/Cliff intersections.
- A concentration of crashes involving parked cars on Rice between Wayland and I-229 SB.

Potential Mitigation Measures:

The general crash trends identified above suggest several potential strategies for reducing crash rates with the study area:

- Consider ITS-related means of communicating slippery roadway conditions to drivers and continue aggressive winter maintenance.
- Addition of high-friction surface courses on bridges, curves, and weaving areas may help reduce crashes that occur during inclement weather.
- Consider work zone traffic control that doesn't require drivers to enter high speed traffic from a stop condition.
- Conduct road safety audits of the Benson/Cliff and Rice/Cliff intersections to consider ways to reduce angle crashes.
- Consider a wider edge line to delineate the parking lane along Rice Street.



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Interstate Segments for Crash Analysis (See Table 1)

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 7

TABLE 1 - INTERSTATE SEGMENT CRASH RATES (2013-2017)

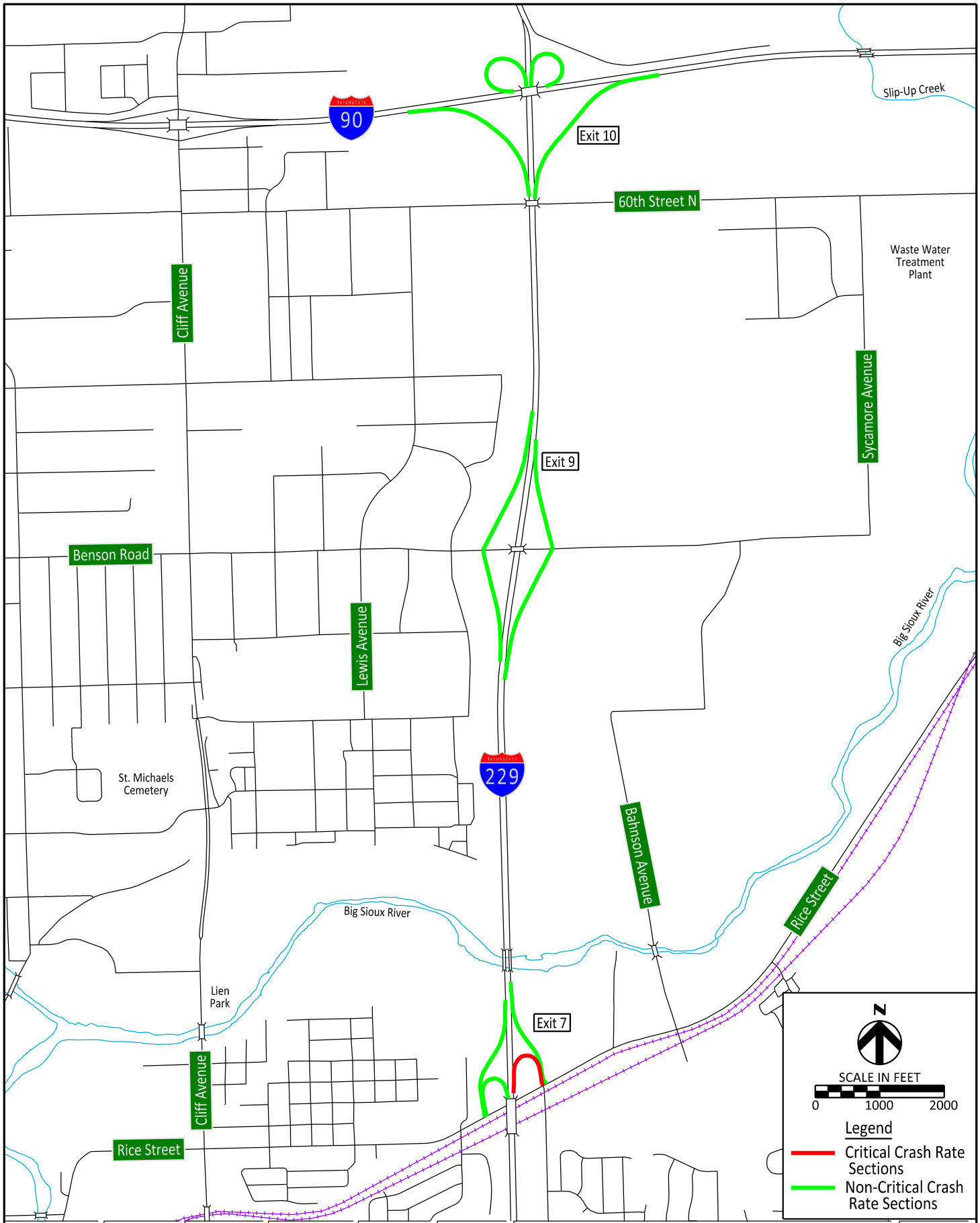
I-229/BENSON INTERSTATE ACCESS STUDY

TRAVEL DIRECTION	SEGMENT	NUMBER CRASHES	SEGMENT LENGTH	DAILY VOLUME	MVMT[1]	CRASH RATE	*TEV*R*[2]	CRITICAL RATE	CRASH/CRITICAL RATIO
SB	I-90 INTERCHANGE AREA	11	0.331	4265	2.58	4.27	18209.66	2.89	1.48
SB	I-90 TO BENSON	16	0.686	7900	9.89	1.62	12780.06	2.14	0.76
SB	BENSON INTERCHANGE AREA	2	0.692	7170	9.05	0.22	1583.66	2.18	0.10
SB	BENSON TO RICE	22	1.080	13775	27.15	0.81	11161.85	1.86	0.44
SB	RICE INTERCHANGE AREA	16	0.205	12270	4.59	3.49	42766.46	2.50	1.40
NB	RICE INTERCHANGE AREA	5	0.189	12190	4.20	1.19	14495.90	2.55	0.47
NB	RICE TO BENSON	35	0.974	13775	24.49	1.43	19690.02	1.88	0.76
NB	BENSON INTERCHANGE AREA	3	0.652	8740	10.40	0.29	2521.22	2.12	0.14
NB	BENSON TO I-90	2	0.771	7900	11.12	0.18	1421.39	2.10	0.09
NB	I-90 INTERCHANGE AREA	7	0.357	4745	3.09	2.26	10744.02	2.75	0.82
	COLUMN TOTAL			92730			135374.24		
	WEIGHTED AVERAGE RATE					1.46			

[1]MVMT = MILLION VEHICLE MILES TRAVELED

[2]TEV*R = TOTAL ENTERING VEHICLES PER DAY, TIMES OBSERVED CRASH RATE

SOURCE: HIGHWAY SAFETY MANUAL, FIRST EDITION, 2010, AASHTO



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Date: 2/28/2018
Revision:

Interstate Ramps for Crash Analysis (See Table 2)

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 8

TABLE 2 - INTERSTATE RAMP CRASH RATES (2013-2017)

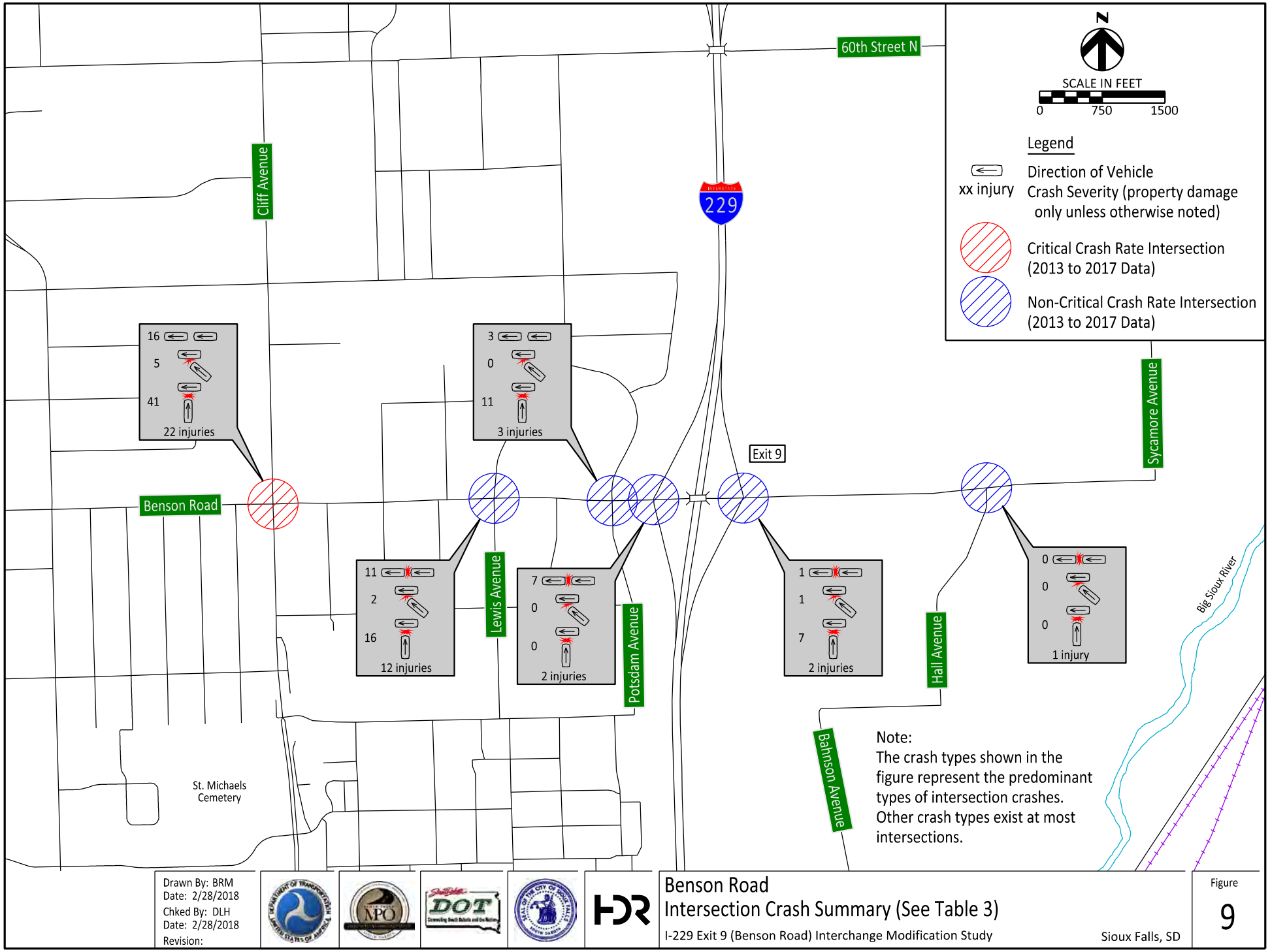
I-229/BENSON INTERSTATE ACCESS STUDY

TRAVEL DIRECTION	SEGMENT	NUMBER CRASHES	SEGMENT LENGTH	DAILY VOLUME	MVMT[1]	CRASH RATE	*TEV*R*[2]	CRITICAL RATE	CRASH/CRITICAL RATIO
SB	I-90 WB ON RAMP	4	0.234	2840	1.21	3.30	9366.58	4.91	0.67
SB	I-90 EB ON RAMP	0	0.367	3635	2.43	0.00	0.00	4.04	0.00
SB	BENSON OFF RAMP	2	0.371	730	0.49	4.05	2953.88	6.78	0.60
SB	BENSON ON RAMP	4	0.283	5140	2.65	1.51	7744.81	3.96	0.38
SB	RICE OFF RAMP	1	0.270	1505	0.74	1.35	2029.43	5.79	0.23
SB	RICE ON RAMP	1	0.173	2735	0.86	1.16	3167.31	5.49	0.21
NB	RICE OFF RAMP	5	0.152	2835	0.79	6.36	18024.51	5.67	1.12
NB	RICE ON RAMP	4	0.235	1585	0.68	5.88	9326.73	5.98	0.98
NB	BENSON OFF RAMP	8	0.360	5035	3.31	2.42	12176.56	3.76	0.64
NB	BENSON ON RAMP	0	0.264	970	0.47	0.00	0.00	6.93	0.00
NB	I-90 EB OFF RAMP	3	0.425	3155	2.45	1.23	3867.85	4.03	0.30
NB	I-90 WB OFF RAMP	2	0.189	2895	1.00	2.00	5798.36	5.22	0.38
	COLUMN TOTAL			33060			74456.03		
	WEIGHTED AVERAGE RATE					2.25			

[1]MVMT = MILLION VEHICLE MILES TRAVELED

[2]TEV*R = TOTAL ENTERING VEHICLES TIMES CRASH RATE

SOURCE: HIGHWAY SAFETY MANUAL, FIRST EDITION, 2010, AASHTO



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PLOTTING DATE: 10-09-2018

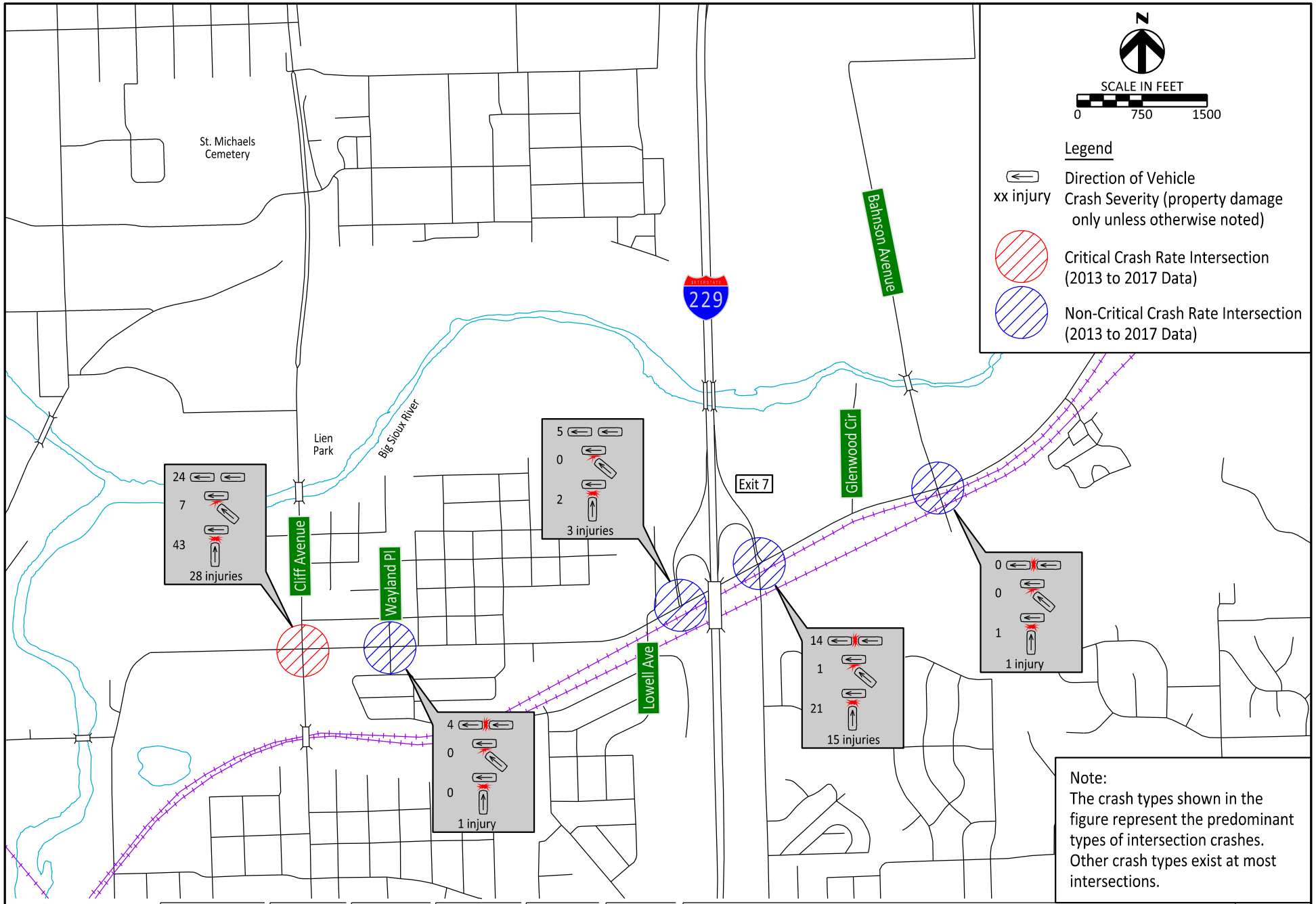
Drawn By: BRM
Date: 2/28/2018
Chked By: DLH
Date: 2/28/2018
Revision:

Benson Road
Intersection Crash Summary (See Table 3)

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 9



Drawn By: BRM
Date: 2/28/2018
Chked By: DLH
Date: 2/28/2018
Revision:

Rice Street
Intersection Crash Summary (See Table 3)
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 10

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PLOTTING DATE: 10-09-2018

TABLE 3 - INTERSECTION CRASH RATES (2013-2017)

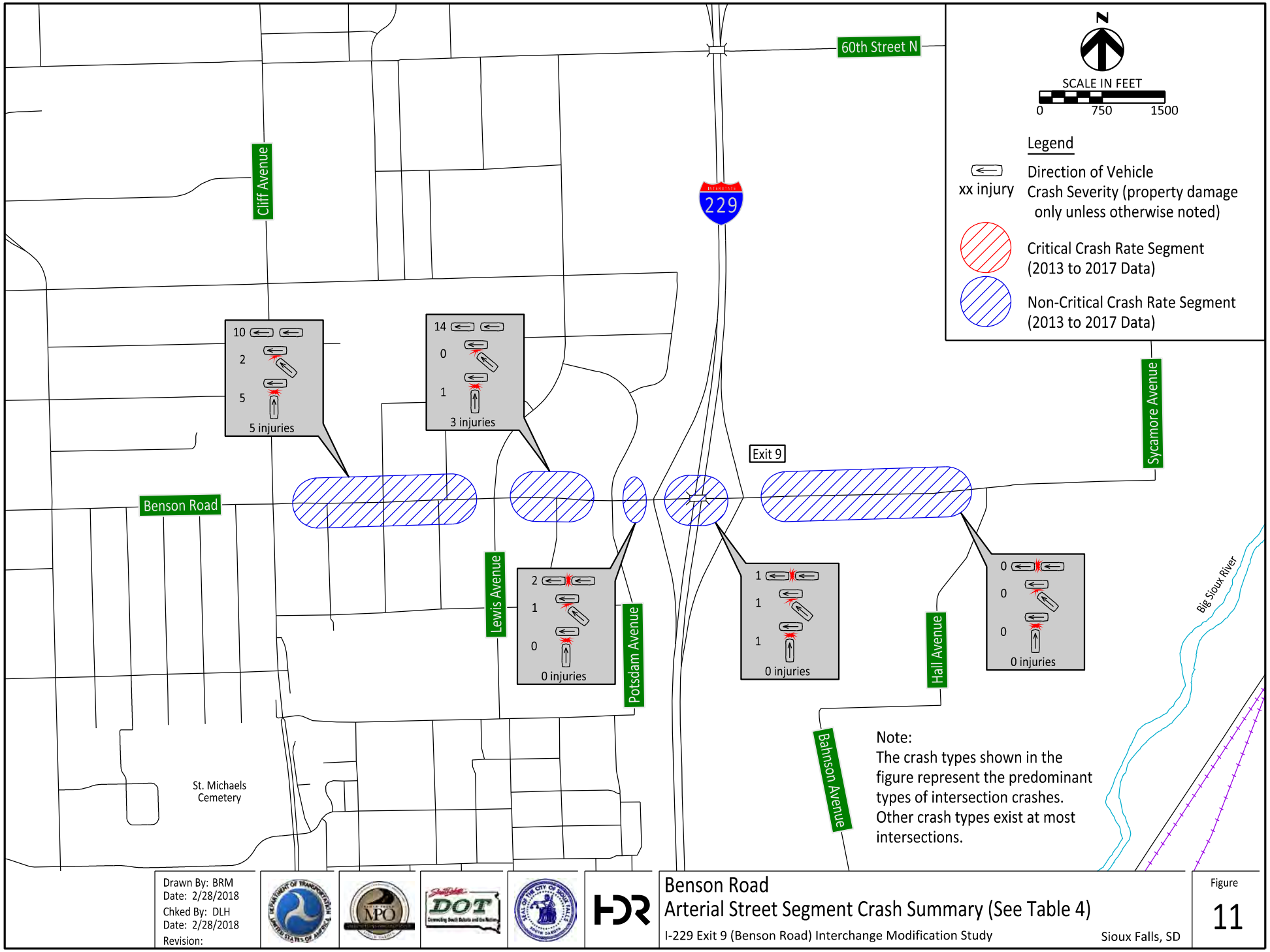
I-229/BENSON INTERSTATE ACCESS STUDY

INTERSECTION	NUMBER CRASHES	DAILY VOLUME	MEV[1]	CRASH RATE	*TEV*R* [2]	CRITICAL RATE	CRASH/CRITICAL RATIO
BENSON/CLIFF	64	25700	46.90	1.36	35068.49	1.10	1.24
BENSON/LEWIS	39	19600	35.77	1.09	21369.86	1.13	0.96
BENSON/POTSDAM	15	16000	29.20	0.51	8219.18	1.16	0.44
BENSON/I-229 SB	9	15600	28.47	0.32	4931.51	1.17	0.27
BENSON/I-229 NB	10	6000	10.95	0.91	5479.45	1.37	0.67
BENSON/HALL	2	1000	1.83	1.10	1095.89	2.27	0.48
RICE/CLIFF	77	27000	49.28	1.56	42191.78	1.09	1.43
RICE/WAYLAND	5	13700	25.00	0.20	2739.73	1.19	0.17
RICE/I-229 SB	7	15400	28.11	0.25	3835.62	1.17	0.21
RICE/I-229 NB	42	21700	39.60	1.06	23013.70	1.12	0.95
RICE/BAHNSON	2	11000	20.08	0.10	1095.89	1.23	0.08
COLUMN TOTAL		172700			149041.10		
WEIGHTED AVERAGE RATE				0.86			

[1]MEV = MILLION ENTERING VEHICLES

[2]TEV*R = TOTAL ENTERING VEHICLES TIMES CRASH RATE

SOURCE: HIGHWAY SAFETY MANUAL, FIRST EDITION, 2010, AASHTO



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PLOTTING DATE: 10-09-2018

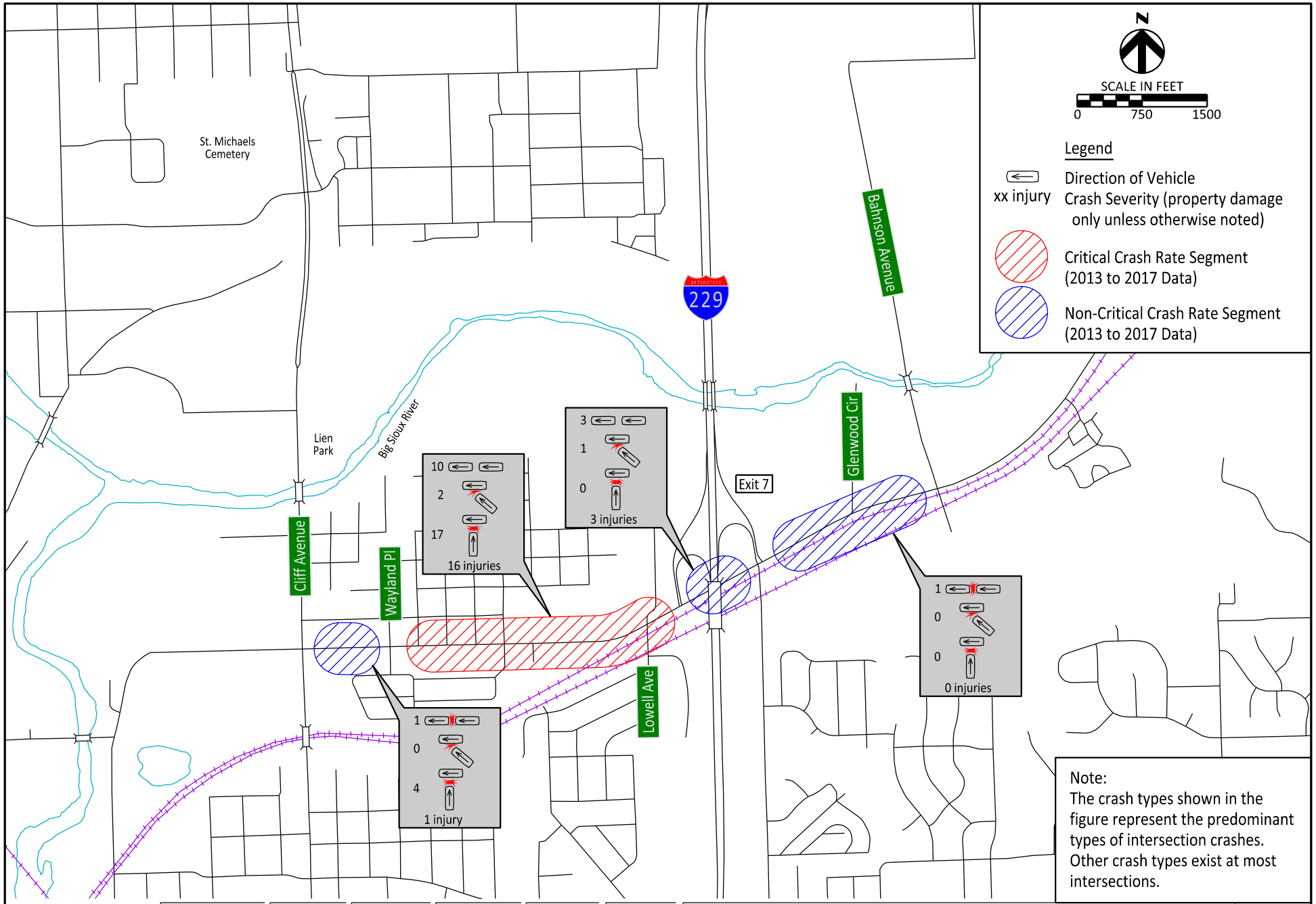
Drawn By: BRM
Date: 2/28/2018
Chked By: DLH
Date: 2/28/2018
Revision:

Benson Road
Arterial Street Segment Crash Summary (See Table 4)

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 11



Drawn By: BRM
Date: 2/28/2018
Chked By: DLH
Date: 2/28/2018
Revision:

Rice Street
Arterial Street Segment Crash Summary (See Table 4)
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 12

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PLOTTING DATE: 10-09-2018

TABLE 4 - ARTERIAL SEGMENT CRASH RATES (2013-2017)

I-229/BENSON RD IMJR

SEGMENT	NUMBER CRASHES	SEGMENT LENGTH	DAILY VOLUME	MVMT[1]	CRASH RATE	*TEV*R* [2]	CRITICAL RATE	CRASH/CRITICAL RATIO
BENSON: CLIFF TO LEWIS	19	0.501	12,200	11.15	1.70	20780.36	2.23	0.76
BENSON: LEWIS TO POTSDAM	15	0.267	14,900	7.26	2.07	30783.44	2.40	0.86
BENSON: POTSDAM TO I-229 SB	3	0.093	14,900	2.53	1.19	17675.65	3.07	0.39
BENSON: I-229 SB TO I-229 NB	3	0.200	14,900	5.44	0.55	8219.18	2.55	0.22
BENSON: I-229 NB TO HALL	1	0.551	1,000	1.01	0.99	994.46	4.12	0.24
RICE: CLIFF TO WAYLAND	5	0.193	12,700	4.47	1.12	14195.47	2.66	0.42
RICE: WAYLAND TO I-229 SB	46	0.655	11,600	13.87	3.32	38481.65	2.16	1.54
RICE: I-229 SB TO I-229 NB	12	0.192	13,900	4.87	2.46	34246.58	2.61	0.94
RICE: I-229 NB TO BAHNSON	2	0.429	10,800	8.46	0.24	2554.52	2.34	0.10
COLUMN TOTALS			106900			167931.30		
WEIGHTED AVERAGE RATE					1.57			

[1]MVMT=MILLION VEHICLE MILES TRAVELED

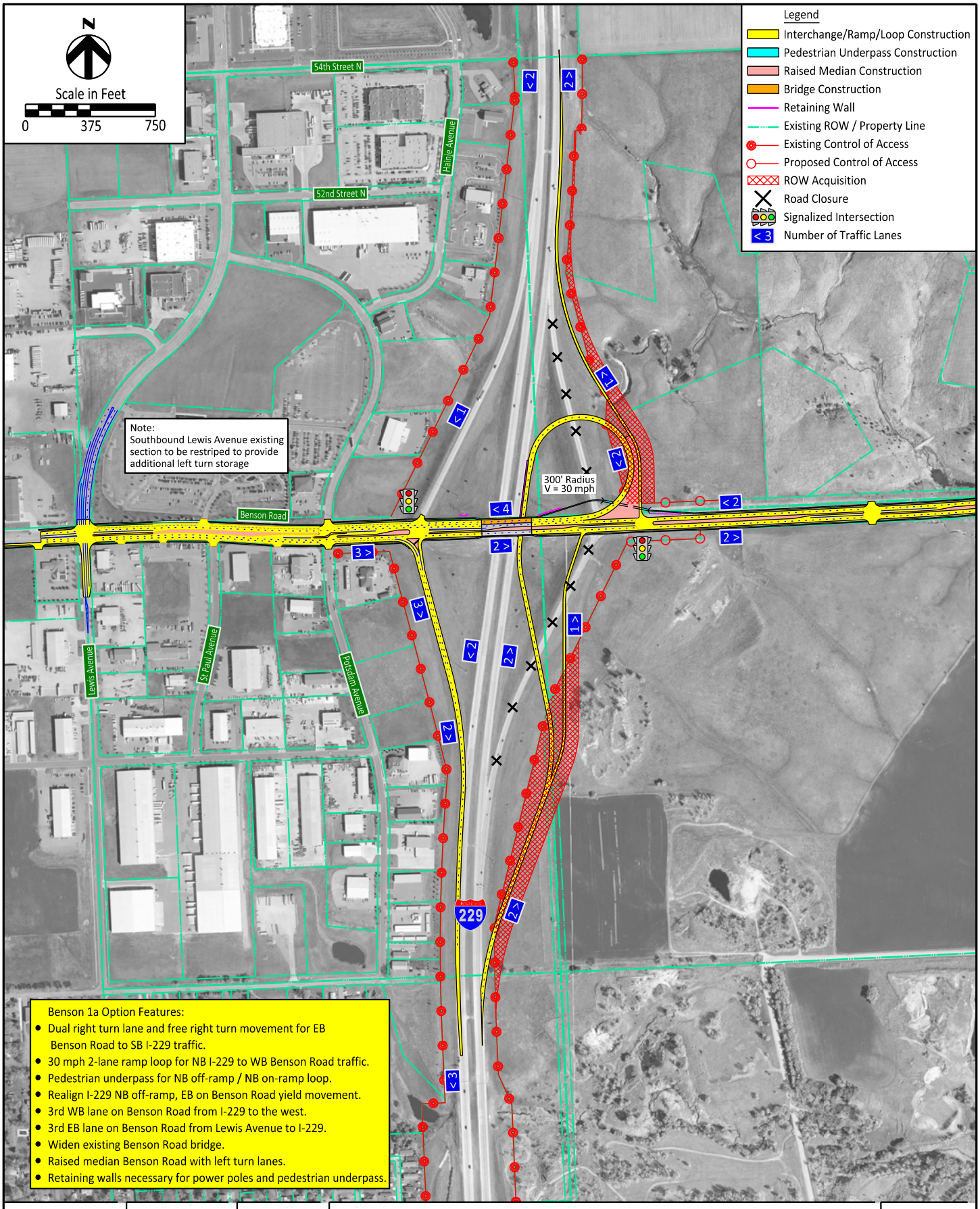
[2]TEV*R = TOTAL ENTERING VEHICLES PER DAY, TIMES OBSERVED CRASH RATE

3.2 Alternatives

Previous studies have identified improvements at the Benson Road Interchange and crossroad to provide adequate roadway capacity and improve safety. The following improvement concepts were developed to address the interchange area needs:

- No-Build
- 2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp
- 2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp
- 2-Lane Collector-Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp
- 2-Lane Partial Cloverleaf Northeast Quadrant with 2-Lane SB On-Ramp
- 2-Lane Partial Cloverleaf Northeast Quadrant with CD lane and 2-Lane SB On-Ramp
- Diverging Diamond Interchange with 3-Lane SB On-Ramp – Add to Existing Overpass (WB Lanes)
- Diverging Diamond Interchange with 3-Lane SB On-Ramp – Separate Structure (EB Lanes)
- Benson Road – WB 3rd Lane from Lewis Avenue to I-229
- Benson Road – 4-Lane Divided Section from I-229 east to Hall Avenue

The interchange alternatives are shown in **Figures I-1 - I-7** and Benson Road crossroad alternatives are shown in **Figures A-1** and **A-2** on the following pages. Each option was evaluated under forecast traffic conditions to determine future traffic operations.



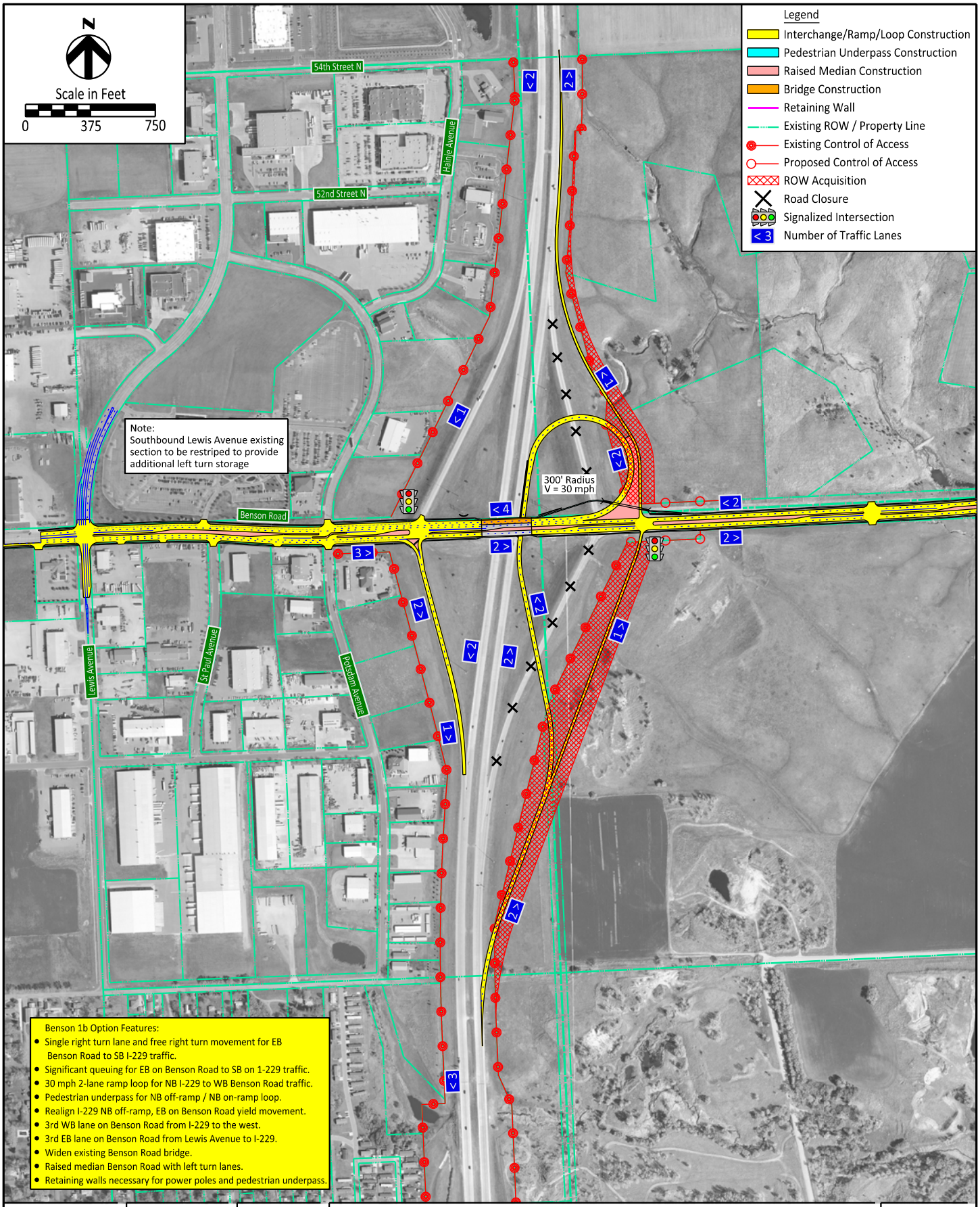
Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 10/8/2018

Alternative Scenario 1a
2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure
I-1



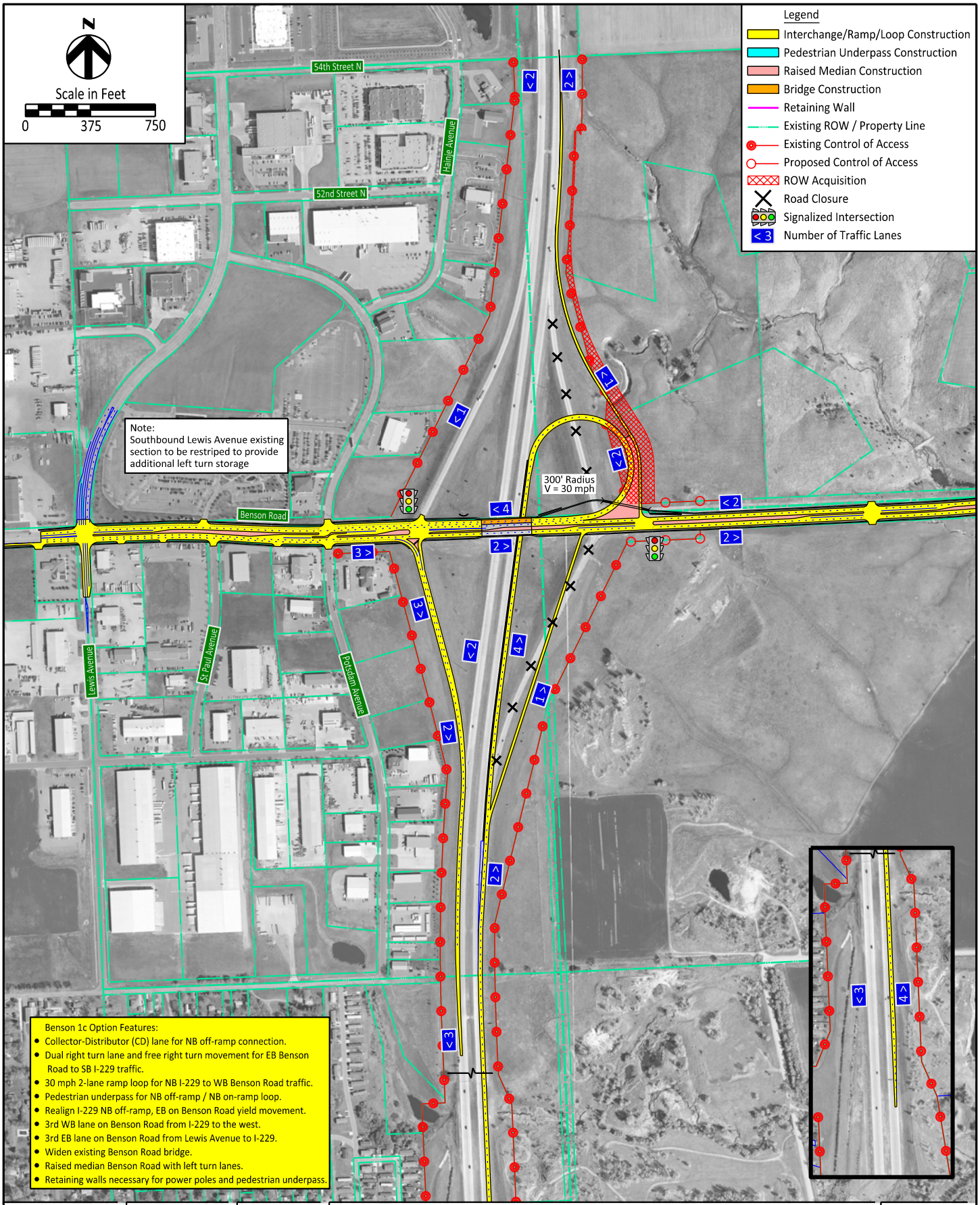
Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 10/8/2018

Alternative Scenario 1b
2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

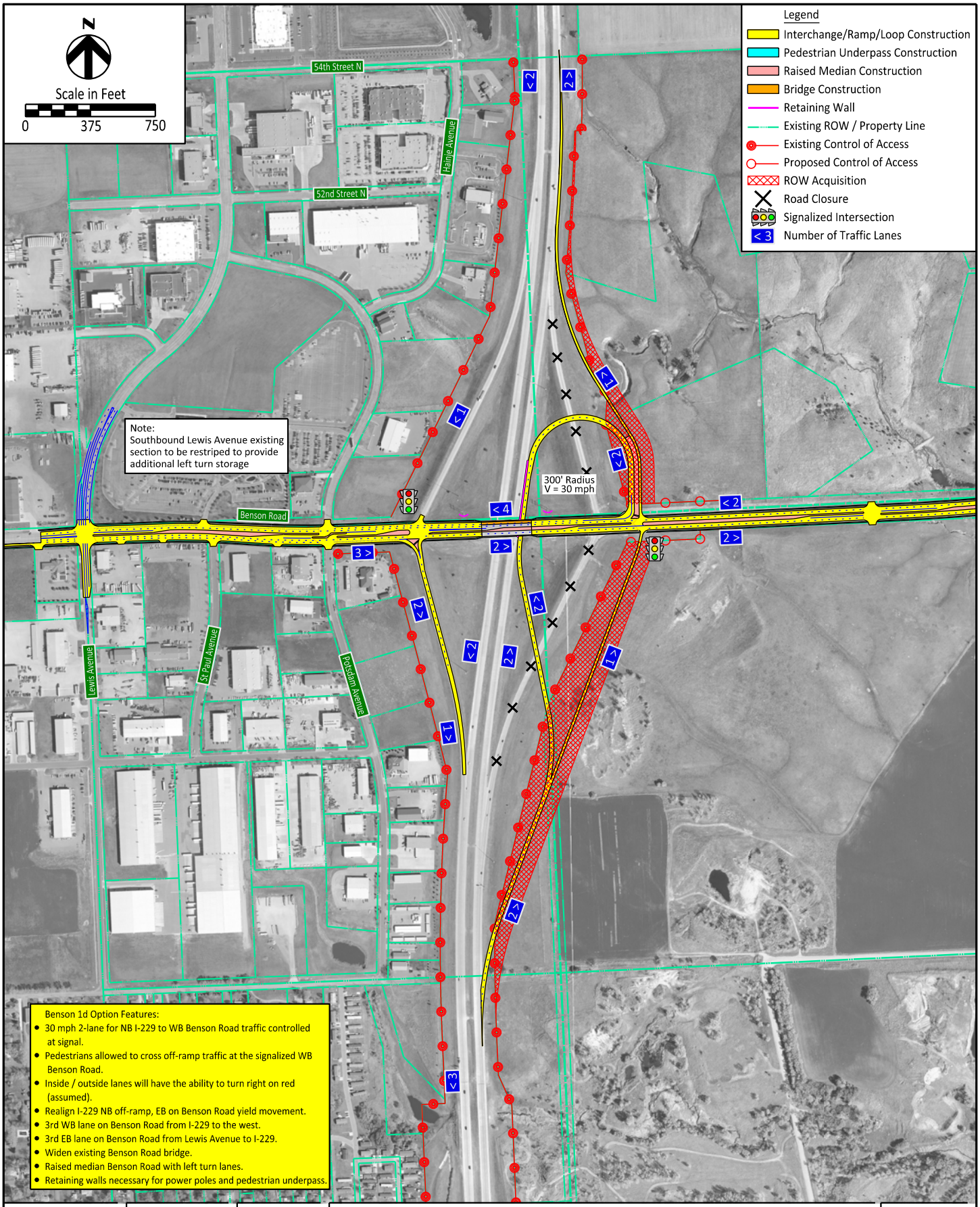
Figure
I-2



Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 10/8/2018

Alternative Scenario 1c
2-Lane Collector - Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

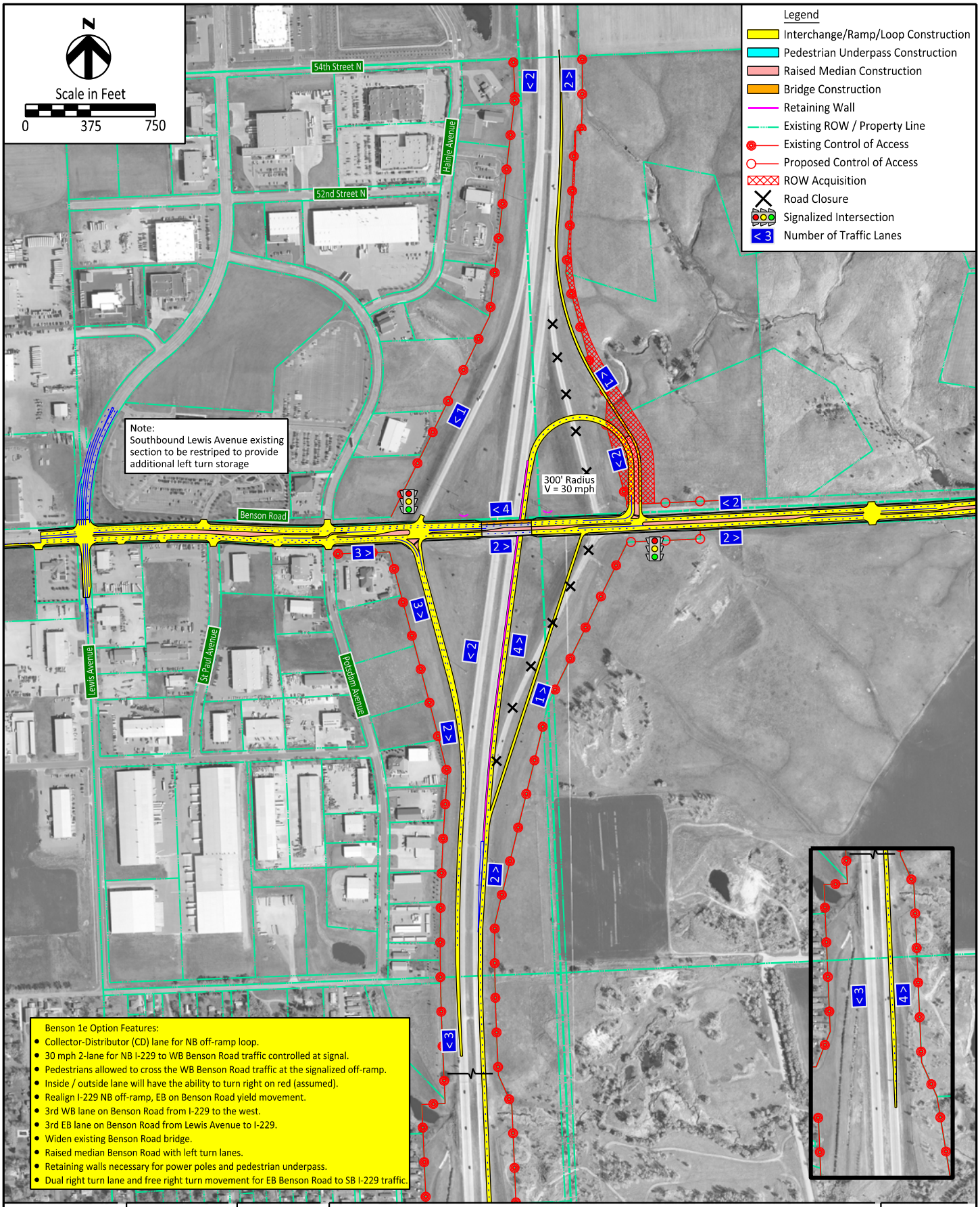
Figure
I-3



Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 10/5/2018

Alternative Scenario 1d
2-Lane Partial Clover Leaf Northeast Quadrant Loop with 2-Lane SB On-Ramp
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

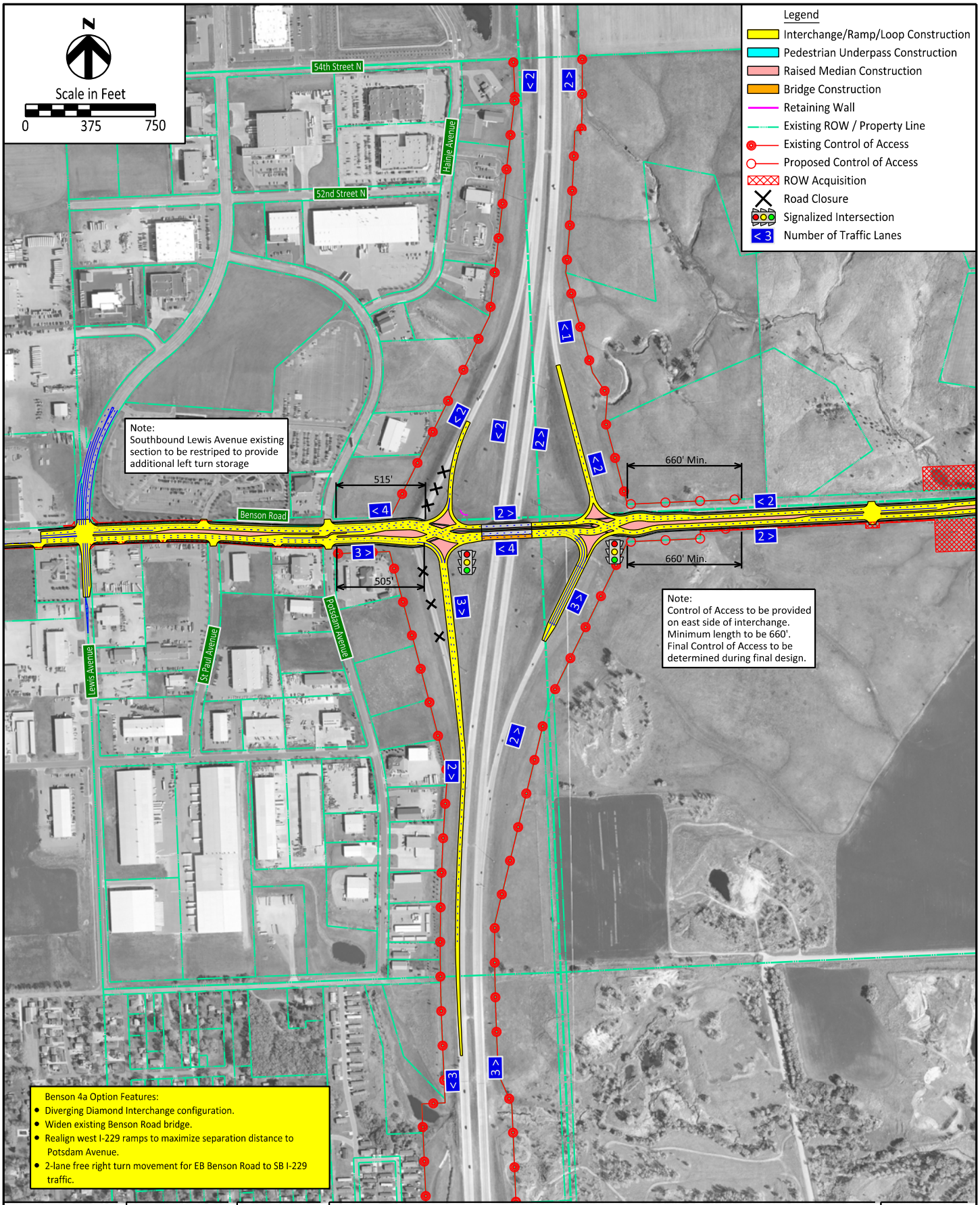
Figure
I-4



Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 10/8/2018

Alternative Scenario 1e
2-Lane Partial Clover Leaf Northeast Quadrant with CD Lane and 2-Lane SB On-Ramp
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

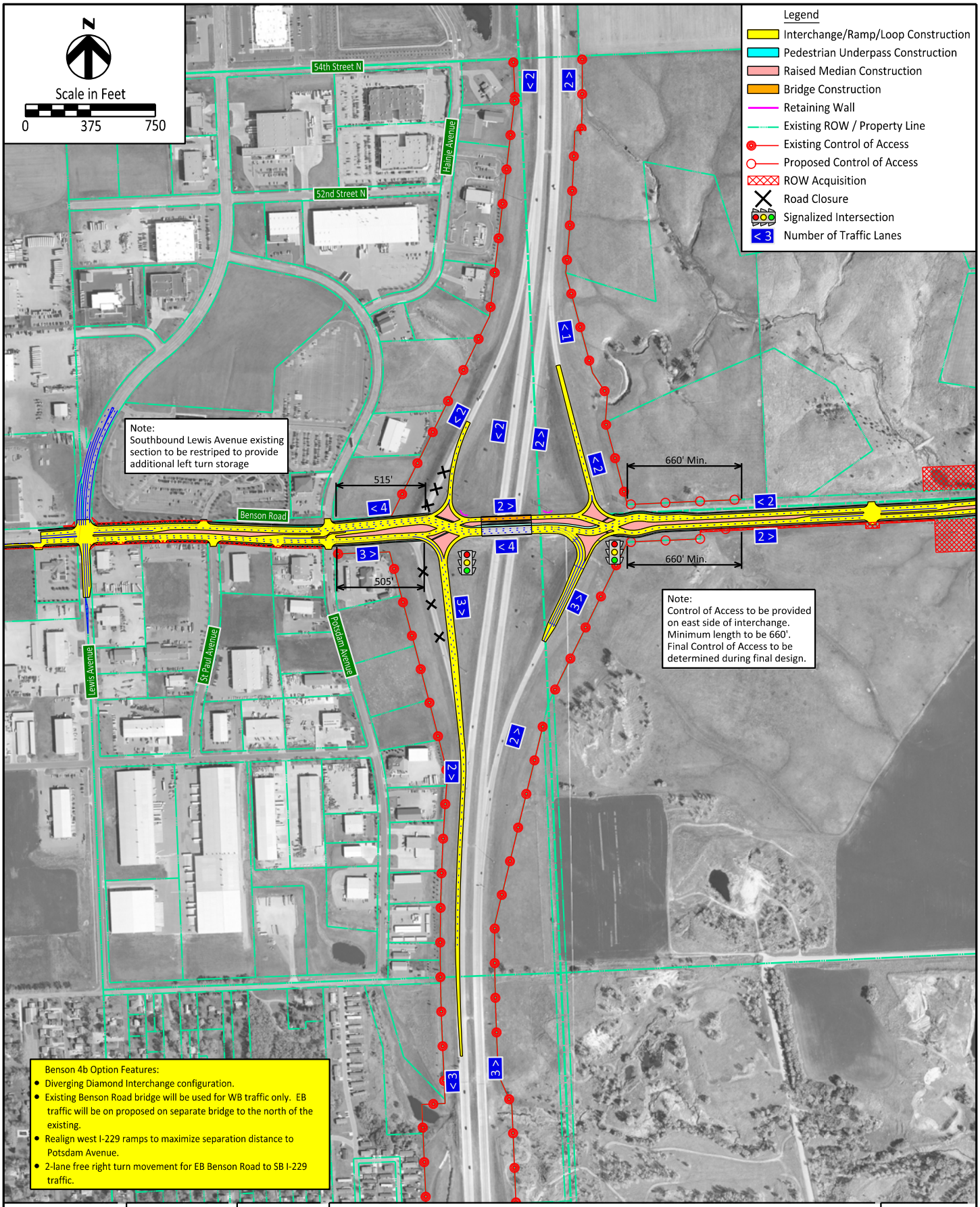
Figure
I-5



Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 12/4/2018

Alternative Scenario 4a
Diverging Diamond Interchange with 3-Lane SB On-Ramp
Add 2 WB Lanes to Existing Overpass.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

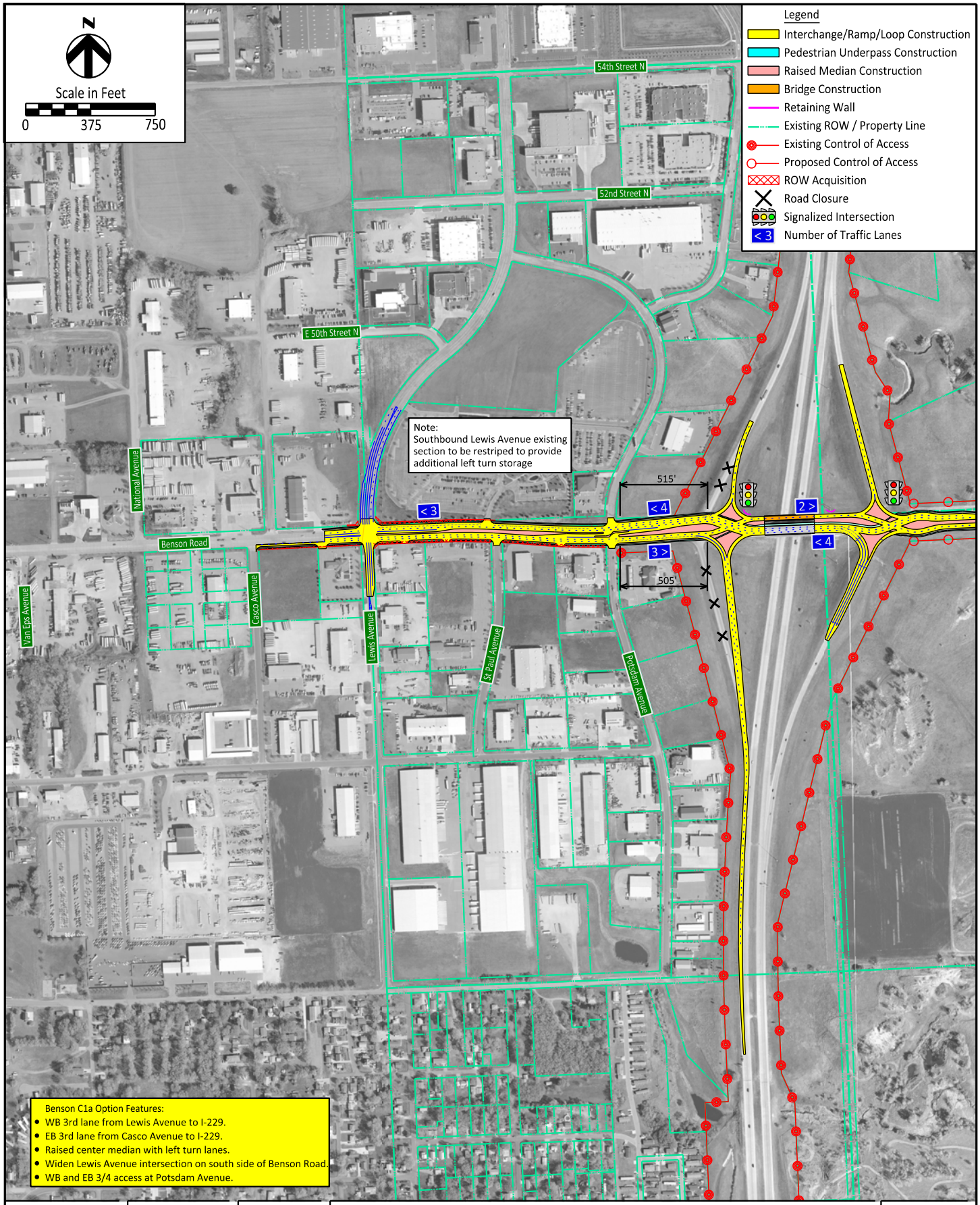
Figure
I-6



Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 12/4/2018

Alternative Scenario 4b
Diverging Diamond Interchange with 3-Lane SB On-Ramp
Add a Separate Structure for 2 EB Lanes
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
I-7



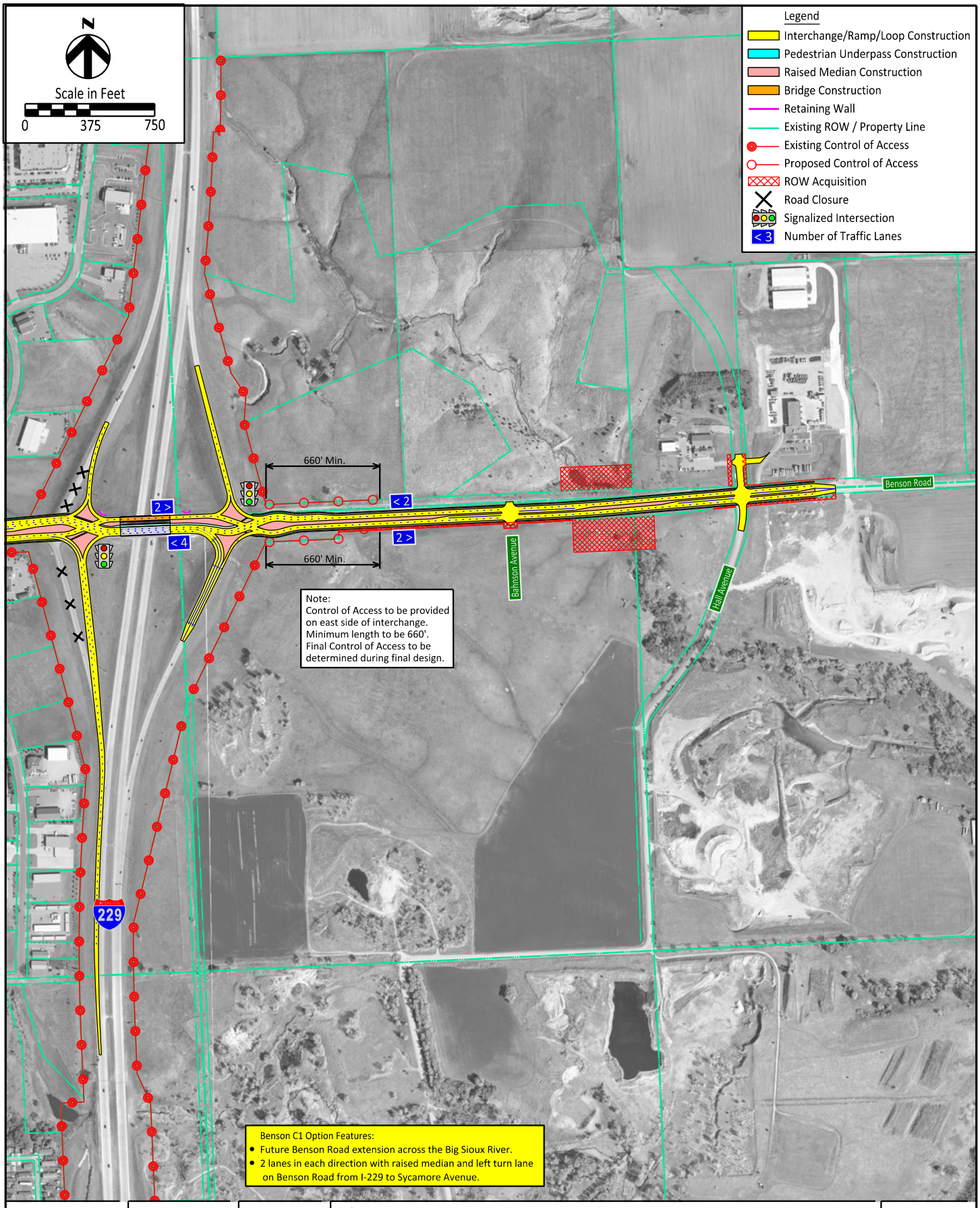
Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 10/8/2018

Alternative Scenario Benson Road
Westbound 3rd Lane from Lewis Avenue to I-229

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure
A-1



Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 12/4/2018

Alternative Scenario Benson Road
4-Lane Divided Section to Hall Avenue east of I-229

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure
A-2

3.3 Future Year Traffic

Traffic forecasts for 2023 and 2045 were prepared using the regional travel demand model maintained by the City of Sioux Falls and the Sioux Falls Metropolitan Planning Organization. The forecasts were based on the latest land development information and modeling updated from the 2040 model used in the I-229 Major Investment Study. Future year traffic demand reflects planned improvements. It is assumed in the 2023 volume projections that a Benson Road extension, east to Rice Street, will not occur prior to 2023. Also, as a result of the build condition with a raised median on Benson Road, the through movements and left turns at Potsdam Avenue were re-routed to the Lewis Avenue intersection and the left turns for the HSBC driveway were also re-routed through the Lewis Avenue intersection.

Operational Performance

Level of service on I-229 was calculated for ramp merge-diverge, and weave areas for peak hours under 2023 and 2045 conditions in the immediate vicinity of the Benson Road interchange. The level of service results for the No-Build scenario are shown in **Figures 13 - 22**. Note that ramp merge-diverge segments for the I-229 SB Benson merge and I-229 NB Benson diverge are reported as part of the weaving segment between Benson Road and Rice Street. If it was determined that the segment satisfied the conditions for weaving, the weaving level of service was reported and indicated by an asterisk (*) next to the level of service result.

Interstate volumes and level of service for peak hours under 2023 and 2045 Build conditions are shown in **Figures 23 - 29**. Intersection peak hour turning volumes and level of service for 2023 and 2045 are shown in **Figures 30-36** and **44-50** respectively for Benson Road. Multimodal levels of service for the Benson Road arterial corridor are shown in **Figures 37 - 43** and **51 – 57**, respectively for 2023 and 2045 Build conditions.

The 2023 operational analysis revealed the following findings:

- Interstate facilities within the Benson Road interchange area continue to operate at an acceptable level of service, LOS C or better for all build conditions scenarios analyzed
- Arterial Street system performs at acceptable level of service for all build conditions scenarios analyzed, with the exception of Alternate 1D and 1E at the I-229 ramp terminals. This is a result of the northbound loop ramp traffic being controlled by the traffic signal at the I-229 northbound ramp terminal and negatively impacts signal timing at the downstream intersection (I-229 southbound ramp terminal). Allowing right on red for the dual southbound rights at the I-229 northbound ramp terminal may improve operations associated with Alternatives 1D and 1E. Alternatives 1A, 1B, and 1C address this deficiency by allowing free right turn movements for the southbound right turn at the I-229 northbound ramp terminal.
- Peak hour congestion (LOS E) or worse is experienced on the arterial network at the following locations:
    - Benson Road/Potsdam Avenue (PM) – STOP controlled intersection
    - Benson Road/Hall Avenue (PM) – STOP controlled intersection

2023 Intersection levels of service for the interchange build alternatives are summarized in **Table 5**.

Table 5: 2023 Build Alternatives Intersection Level of Service

	2023 CONDITIONS																	
	Existing		No Build		Alt. 1A		Alt. 1B		Alt 1C		Alt. 1D		Alt. 1E		Alt. 4A		Alt. 4B	
Intersection	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Benson/Cliff	B	B	B	C	B	C	B	C	B	C	B	C	B	C	C	C	C	C
Benson/Lewis	B	C	B	C	B	C	B	D	B	C	B	C	B	C	B	D	B	D
Benson/Potsdam	F	F	F	F	C	E	C	E	C	E	C	E	C	E	C	E	C	E
Benson/I-229 SB Ramp	D	A	F	C	B	A	B	A	B	A	F	A	F	A	B	A	B	A
Benson/I-229 NB Ramp	F	B	F	C	A	A	B	A	A	A	C	B	C	B	B	B	B	B
Benson/Hall	A	B	B	F	B	F	B	F	B	F	B	F	B	F	B	F	B	F

Certain movements experienced low levels of service or queues that exceeded the length of the available storage during particular peak hours. The southbound left turn during the PM peak hour at Benson Road/Lewis Avenue is an example of this characteristic. Queues however do not impact adjacent streets or accesses and the overall intersection level of service achieves the minimum requirement for LOS D with a specific movement no worse than LOS E. The existing left turn storage could likely be extended over the existing pavement surface by striping modifications.

A northbound right turn lane is necessary at the Benson Road and Lewis Avenue intersection in order to address low levels of service in the PM peak hour. The Benson Road/Hall Avenue intersection low level of service is addressed by the installation of a traffic signal in the 2045 scenario.

Multimodal level of service continues to vary throughout the Benson Road corridor.

The 2045 operational analysis revealed the following findings:

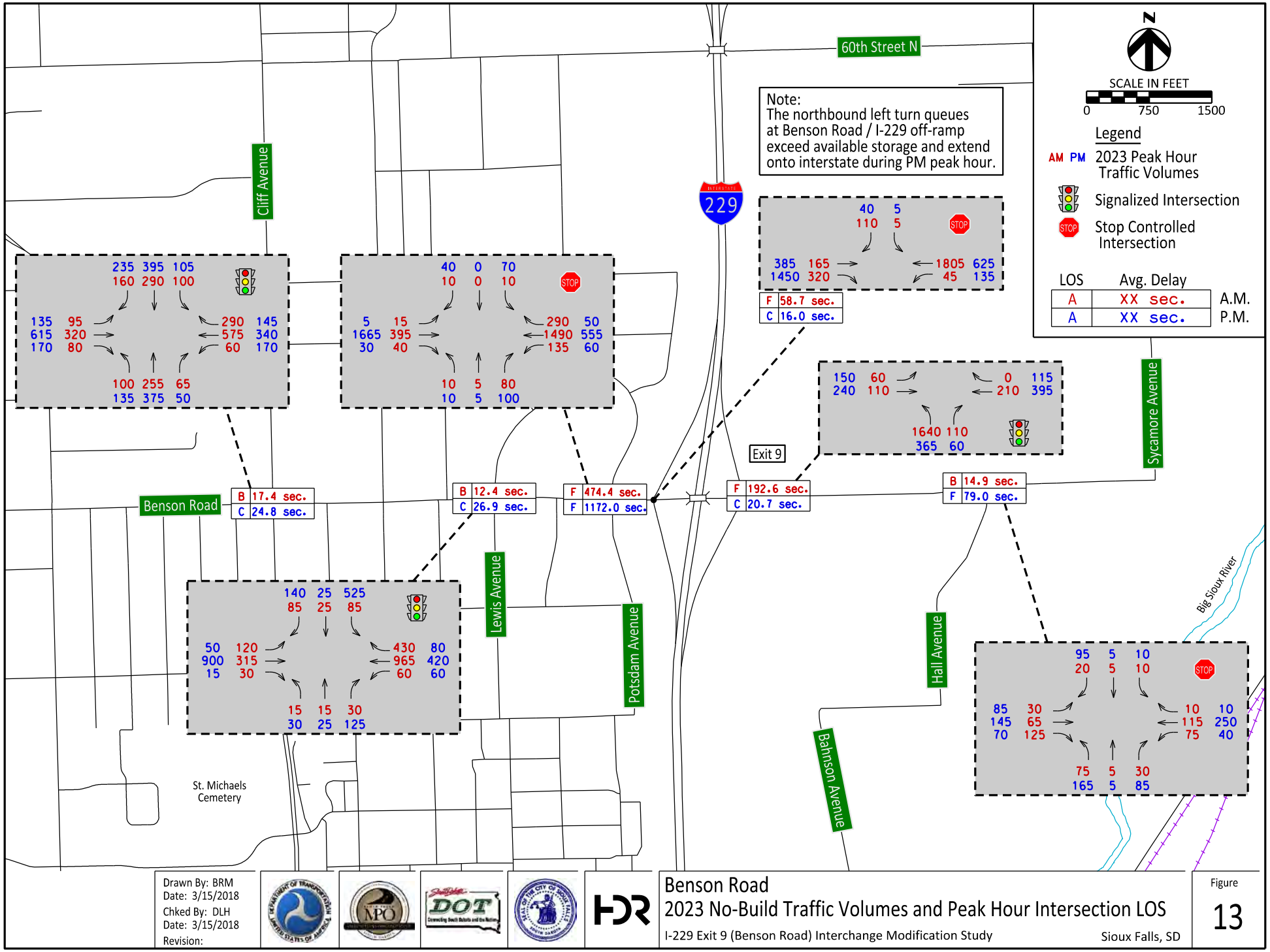
- Interstate facilities within the Benson Road interchange area continue to operate at an acceptable level of service, LOS C or better for all build conditions scenarios analyzed
- The arterial street system performs at acceptable level of service for all build conditions scenarios analyzed, with the exception of Alternatives 1D and 1E at the I-229 ramp terminals. This is a result of the northbound loop ramp traffic being controlled by the traffic signal at the I-229 northbound ramp terminal and negatively impacts signal timing at the downstream intersection (I-229 southbound ramp terminal). Allowing right on red for the dual southbound rights at the I-229 northbound ramp terminal may improve operations associated with Alternatives 1D and 1E. Alternatives 1A, B, and C address this deficiency by allowing free right turn movements for the southbound right turn at the I-229 northbound ramp terminal.

2045 Intersection levels of service under each interchange build alternatives are summarized in **Table 6**.

Table 6: 2045 Build Alternatives Intersection Level of Service

	2045 CONDITIONS																	
	Existing		No Build		Alt. 1A		Alt. 1B		Alt 1C		Alt. 1D		Alt. 1E		Alt. 4A		Alt. 4B	
Intersection	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Benson/Cliff	B	B	B	C	B	C	B	C	B	C	C	C	C	C	C	C	C	C
Benson/Lewis	B	C	B	C	B	C	C	C	B	C	B	C	B	C	B	D	B	D
Benson/Potsdam	F	F	F	F	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Benson/I-229 SB Ramp	D	A	F	F	B	B	B	B	B	B	F	B	F	B	B	A	B	A
Benson/I-229 NB Ramp	F	B	F	B	A	A	B	A	A	A	D	A	E	B	B	B	B	B
Benson/Hall	A	B	F	F	B	B	B	C	B	B	B	B	B	B	C	B	C	B

The analysis for the 2045 traffic forecast conditions requires similar improvements at the Benson Road and Lewis Avenue intersection as under 2023 traffic forecast conditions. The improvements include re-striping of Lewis Avenue to provide additional southbound left turn storage and providing a northbound right turn lane on Lewis Avenue. Additionally, a traffic signal will likely be warranted at the Benson Road and Hall Avenue intersection based upon 2045 forecast traffic volumes.



Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision:

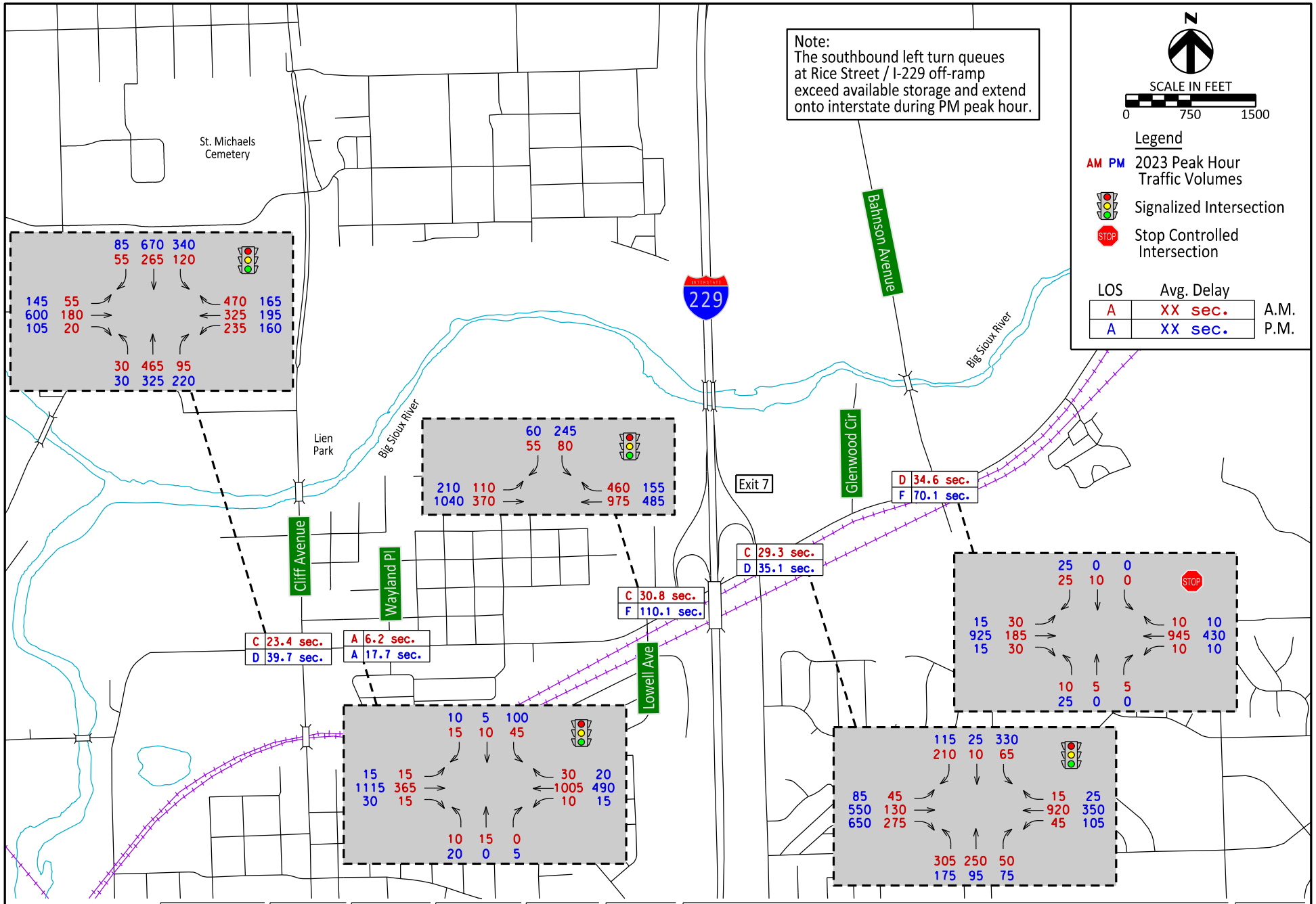
FILE: ...\Figure 13 (Benson 2023).dgn
PLOTTING DATE: 10-09-2018

Benson Road
2023 No-Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 13



Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision:

Rice Street
2023 No-Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 14

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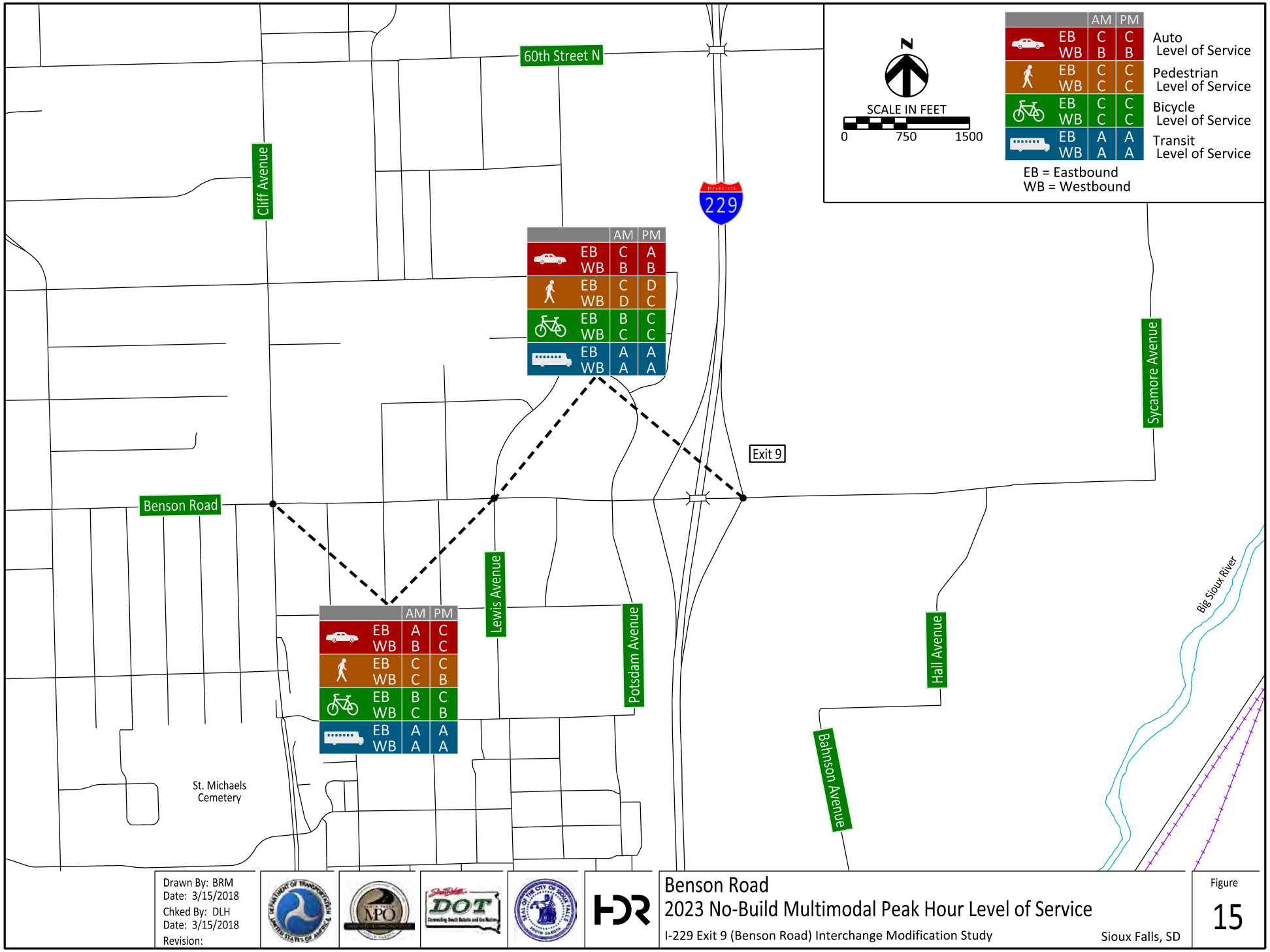
PLOTTING DATE: 10-09-2018



Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision:

Benson Road
2023 No-Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 15

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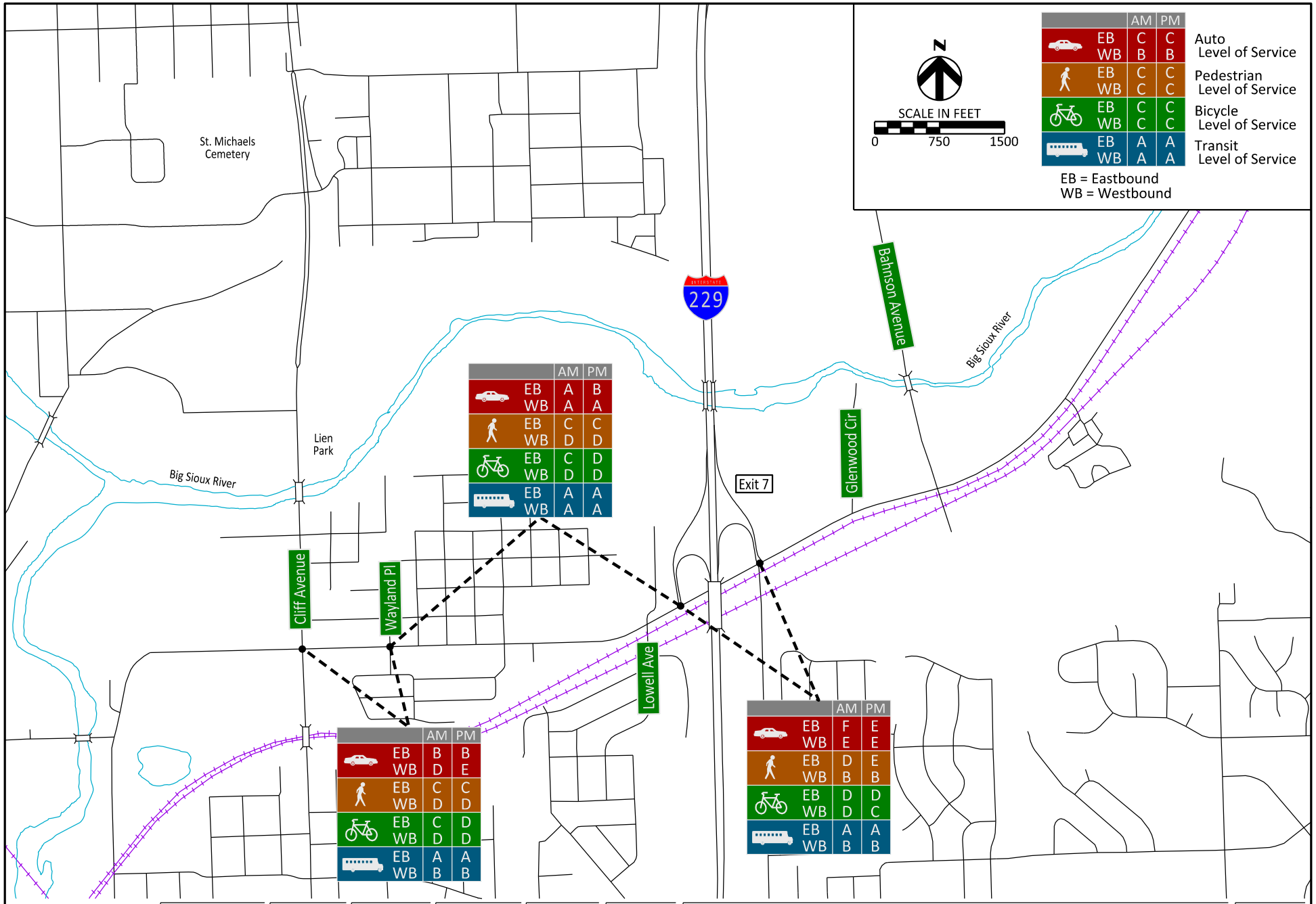
PLOTTING DATE: 10-09-2018



Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision:

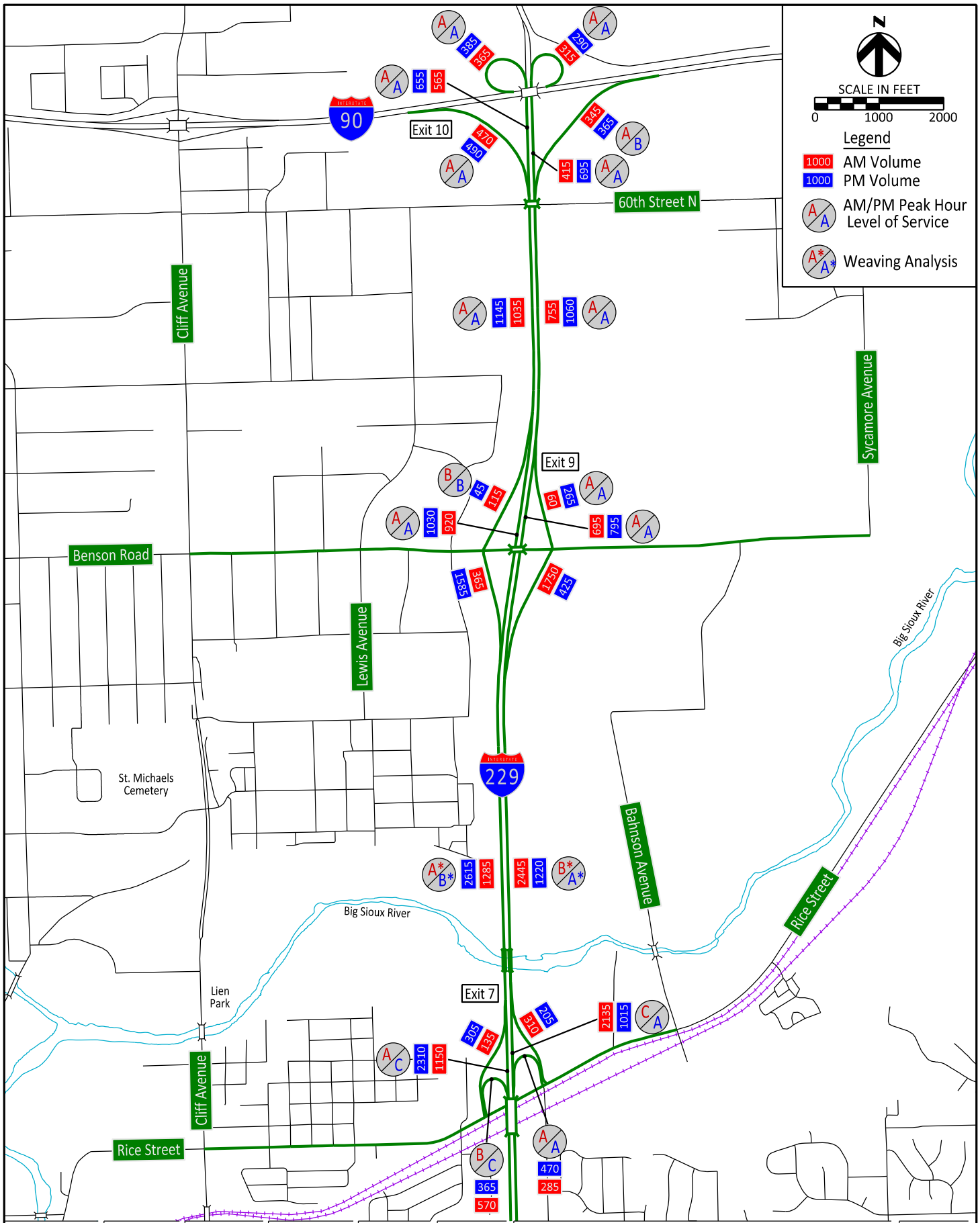
FILE: ...\Figure 16 (Rice 2023).dgn
PLOTTING DATE: 10-09-2018

Rice Street
2023 No-Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 16



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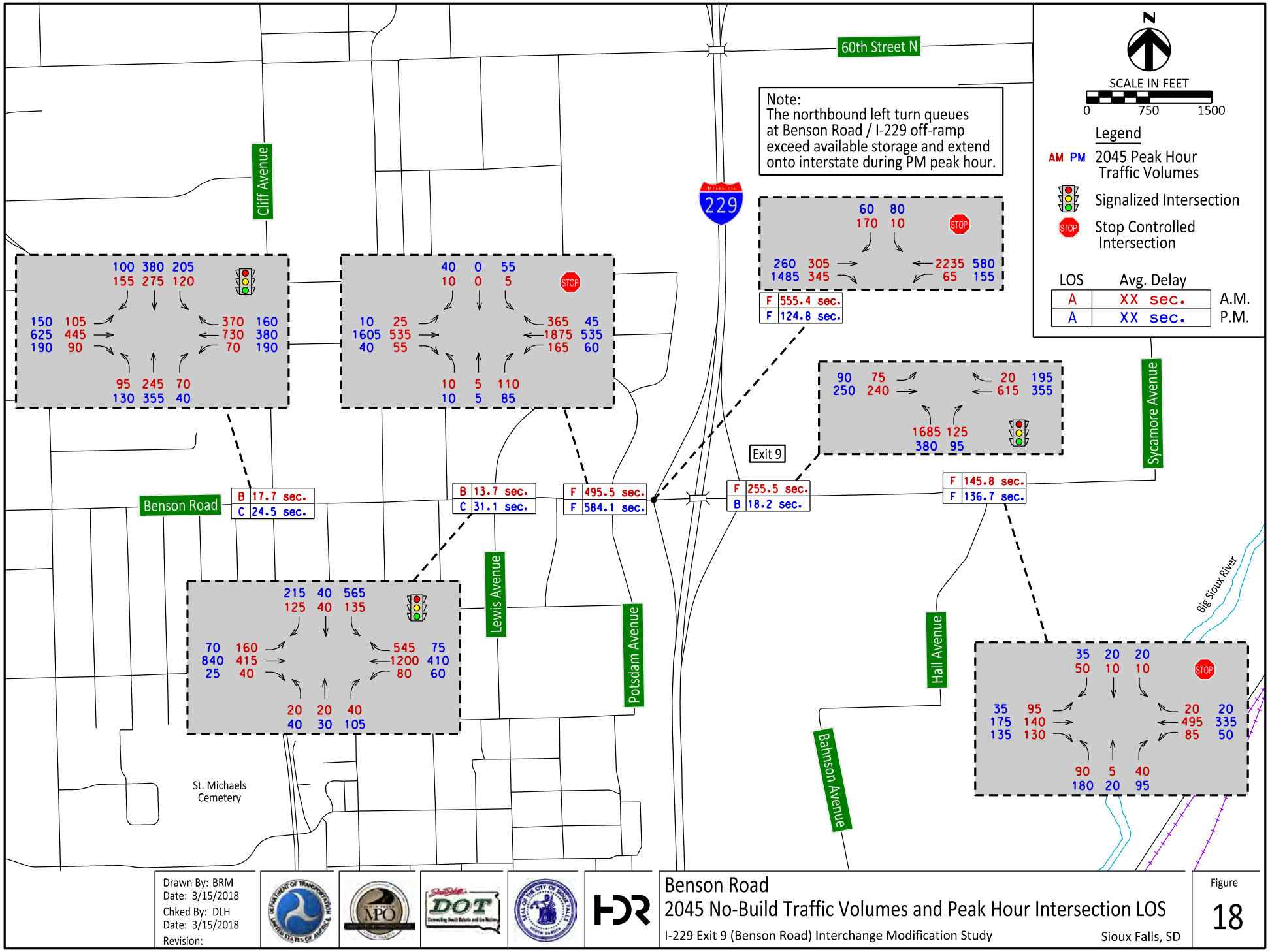
PLOTTING DATE: 10-09-2018

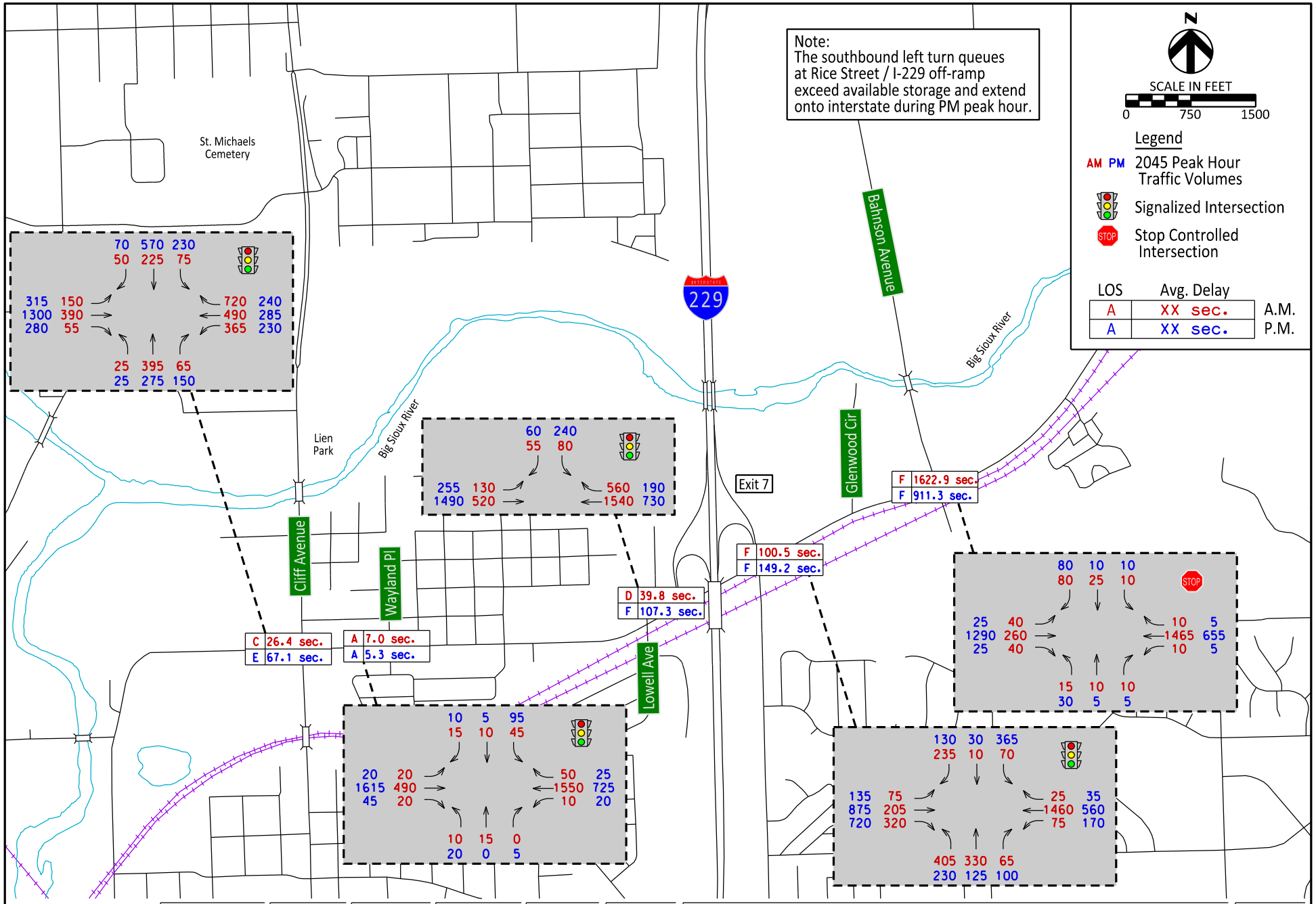
Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision:

2023 No-Build Peak Hour Balanced Traffic Volumes and Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 17


60th Street N
Cliff Avenue
Benson Road
Lewis Avenue
Potsdam Avenue
Exit 9
Sycamore Avenue
Hall Avenue
Bahnson Avenue
Big Sioux River
St. Michaels Cemetery
229
Note:
The northbound left turn queues at Benson Road / I-229 off-ramp exceed available storage and extend onto interstate during PM peak hour.
SCALE IN FEET
0 750 1500
Legend
AM PM 2045 Peak Hour Traffic Volumes
Signalized Intersection
Stop Controlled Intersection
LOS Avg. Delay
A XX sec. A.M.
A XX sec. P.M.
100 380 205
155 275 120
150 105
625 445
190 90
370 160
730 380
70 190
95 245 70
130 355 40
40 0 55
10 0 5
10 25
1605 535
40 55
365 45
1875 535
165 60
10 5 110
10 5 85
60 80
170 10
260 305
1485 345
2235 580
65 155
F 555.4 sec.
F 124.8 sec.
90 75
250 240
20 195
615 355
1685 125
380 95
B 17.7 sec.
C 24.5 sec.
B 13.7 sec.
C 31.1 sec.
F 495.5 sec.
F 584.1 sec.
F 255.5 sec.
B 18.2 sec.
F 145.8 sec.
F 136.7 sec.
215 40 565
125 40 135
70 160
840 415
25 40
545 75
1200 410
80 60
20 20 40
40 30 105
35 20 20
50 10 10
35 95
175 140
135 130
20 20
495 335
85 50
90 5 40
180 20 95
Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision:
Benson Road
2045 No-Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD
Figure
18
FILE: ...\Figure 18 (Benson 2045).dgn
PLOTTING DATE: 10-09-2018

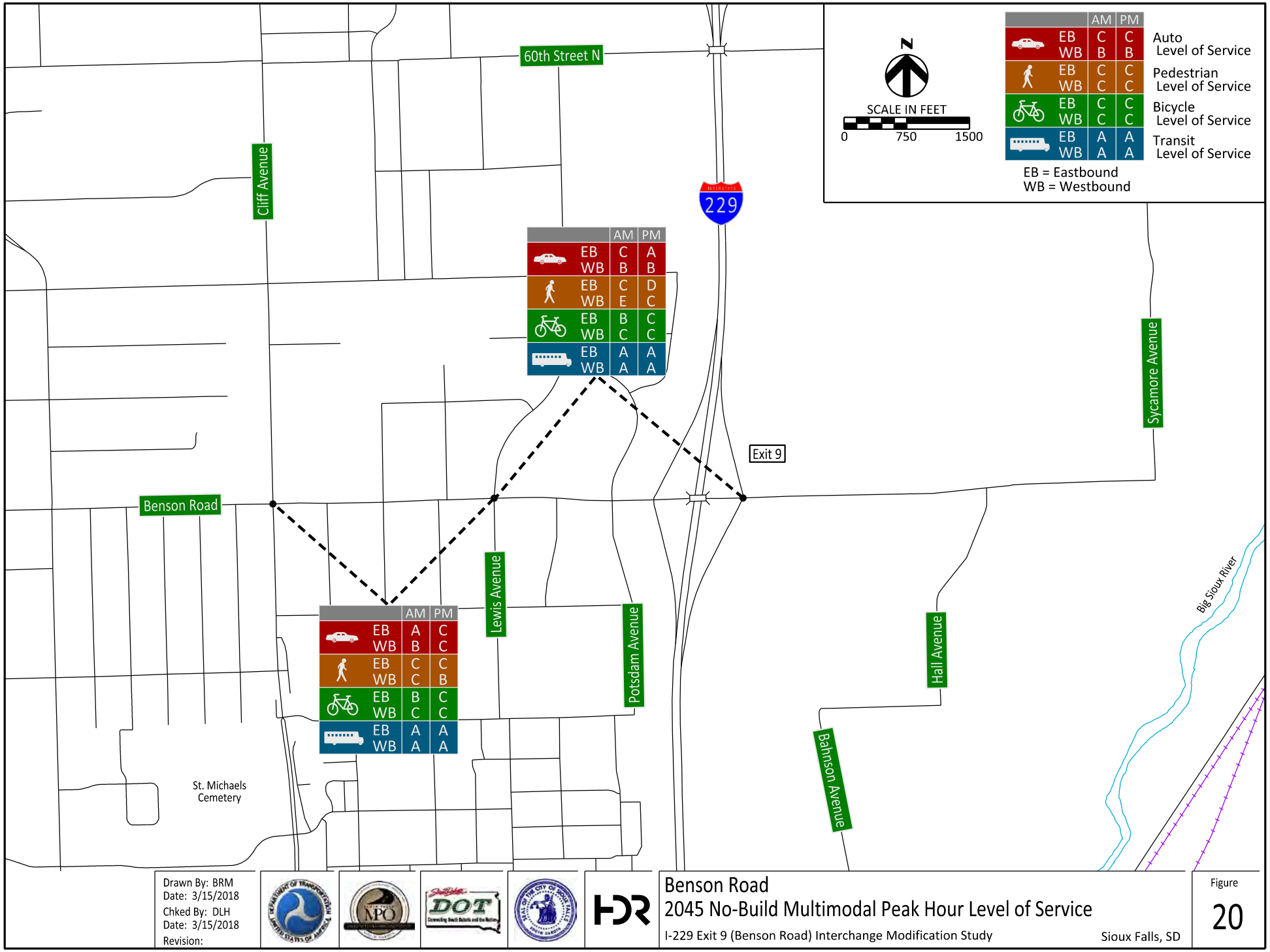


Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision:

Rice Street
2045 No-Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 19

FILE: ...\Figure 19 (Rice 2045).dgn
PLOTTING DATE: 10-09-2018



FILE: ...\Figure 20 (Benson 2045).dgn
PLOTTING DATE: 10-09-2018

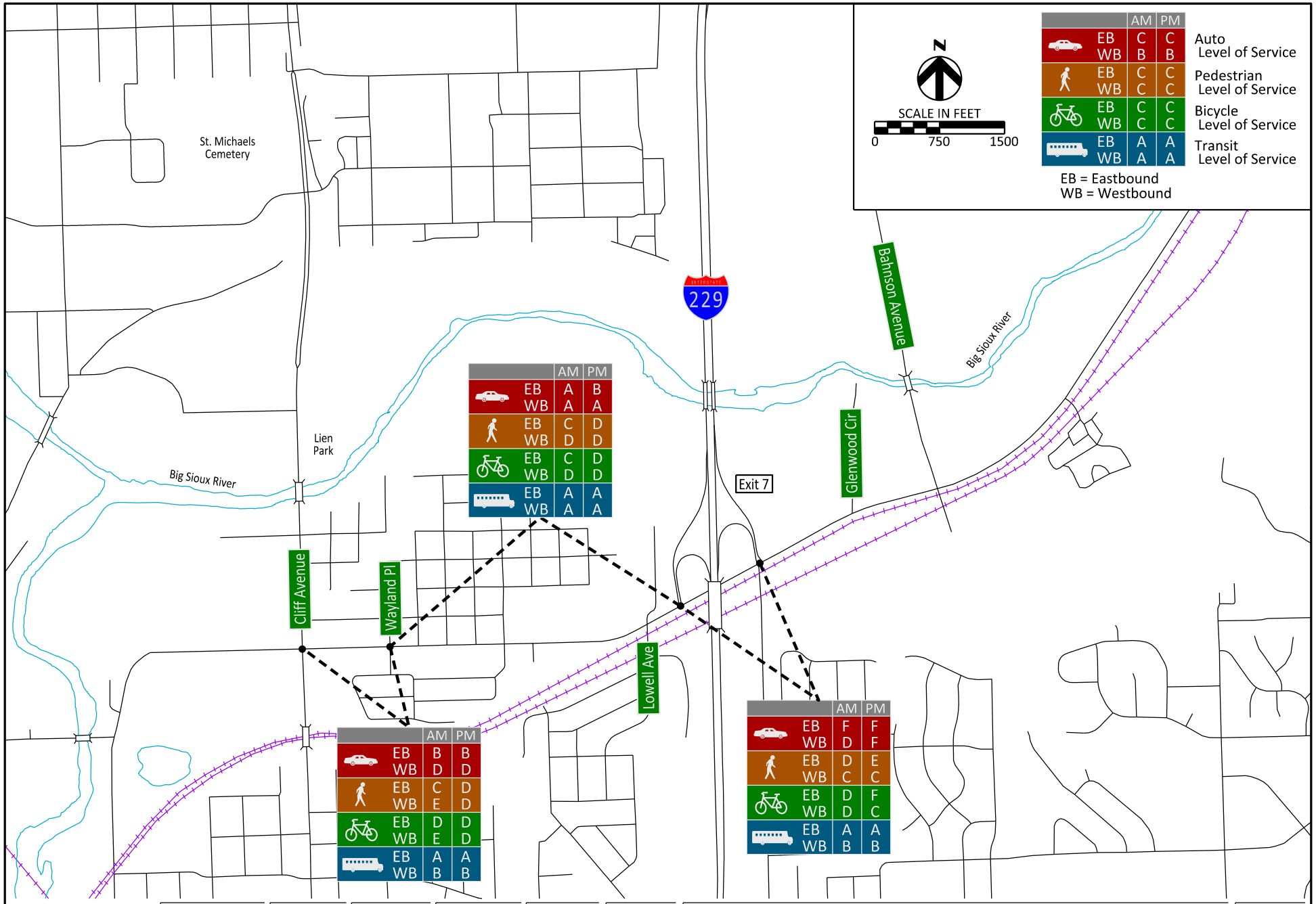
Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision:

Benson Road
2045 No-Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 20

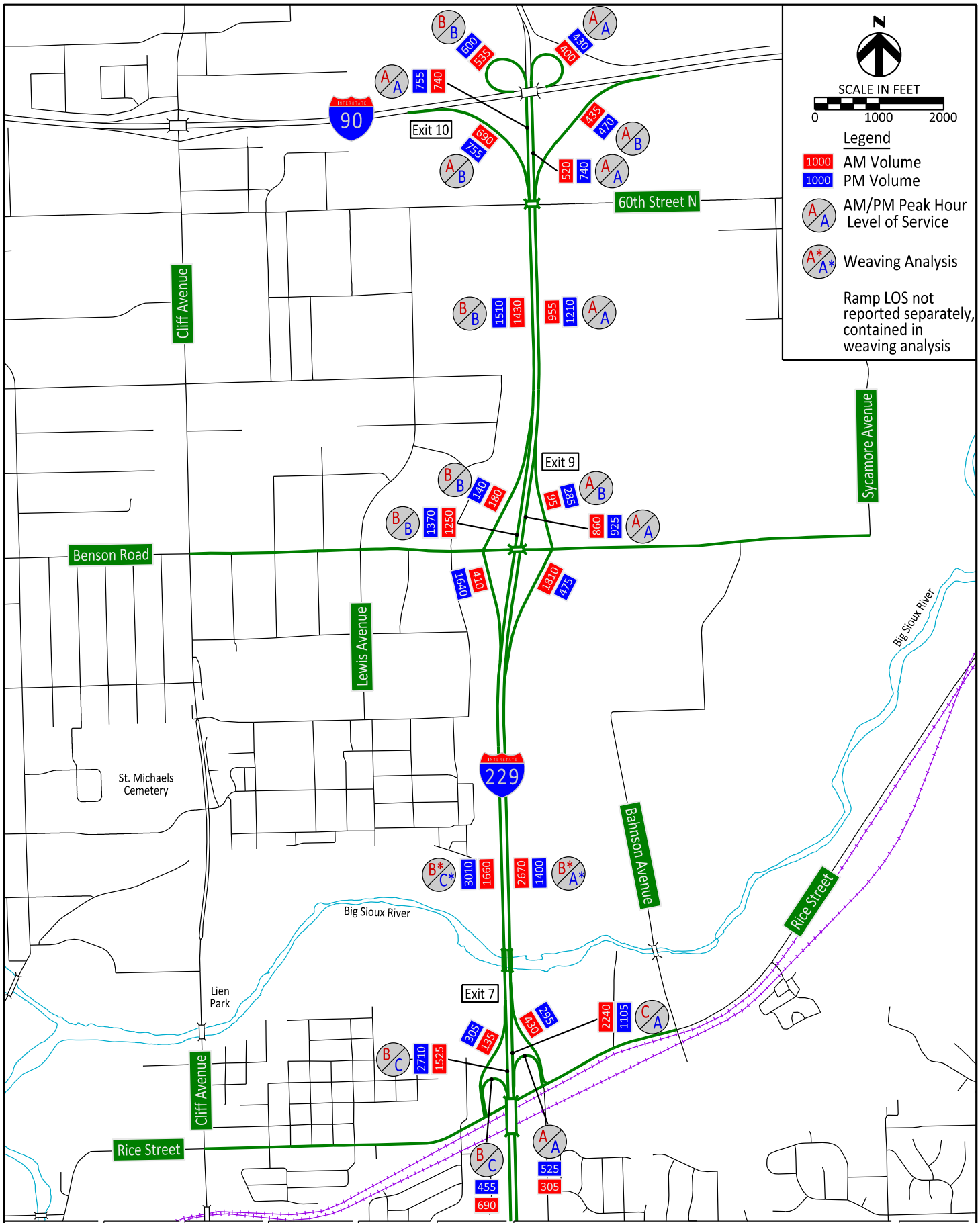


Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision:

Rice Street
2045 No-Build Multimodal Peak Hour Level of Service
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 21

FILE: ...\Figure 21 (Rice 2045).dgn
PLOTTING DATE: 10-09-2018



FILE: ...\Figure 22 (Interstate Vol 2045).dgn
PLOTTING DATE: 10-09-2018

Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision:

2045 No-Build Peak Hour Balanced Traffic Volumes and Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 22

FILE: ...\Figure 23 (Alt 1a).dgn
PLOTTING DATE: 10-09-2018

Drawn By: BRM
Date: 5/29/2018
Chked By: DLH
Date: 5/29/2018
Revision:

Alternative Scenario 1a
2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp.

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure
23

FILE: ...\Figure 24 (Alt 1b).dgn
PLOTTING DATE: 10-09-2018

Drawn By: BRM
Date: 5/29/2018
Chked By: DLH
Date: 5/29/2018
Revision:

Alternative Scenario 1b
2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp.

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure
24

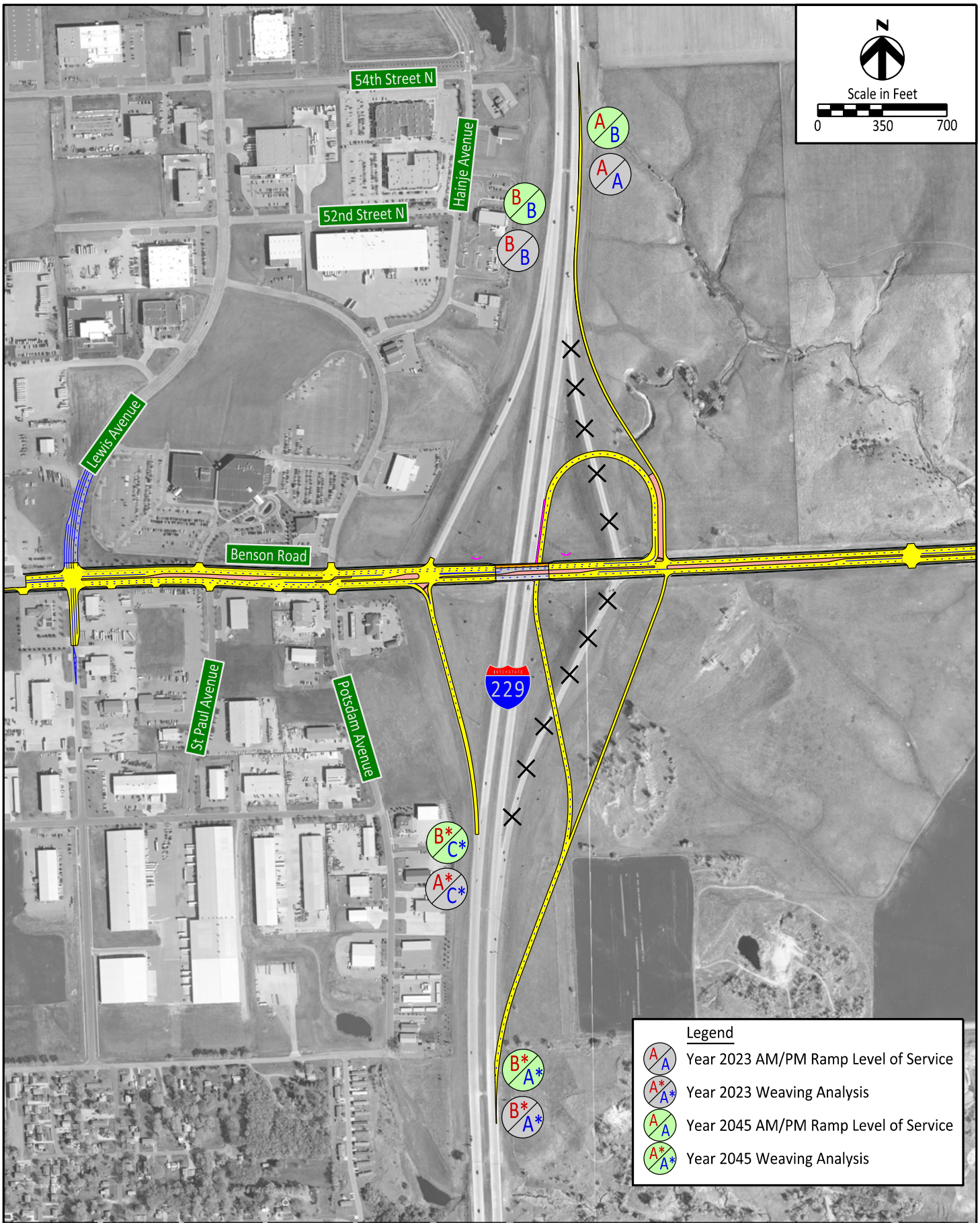
FILE: ...\Figure 25 (Alt 1c).dgn
PLOTTING DATE: 10-09-2018

Drawn By: BRM
Date: 5/29/2018
Chked By: DLH
Date: 5/29/2018
Revision:

Alternative Scenario 1c -- 2-Lane Collector-Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp.

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 25



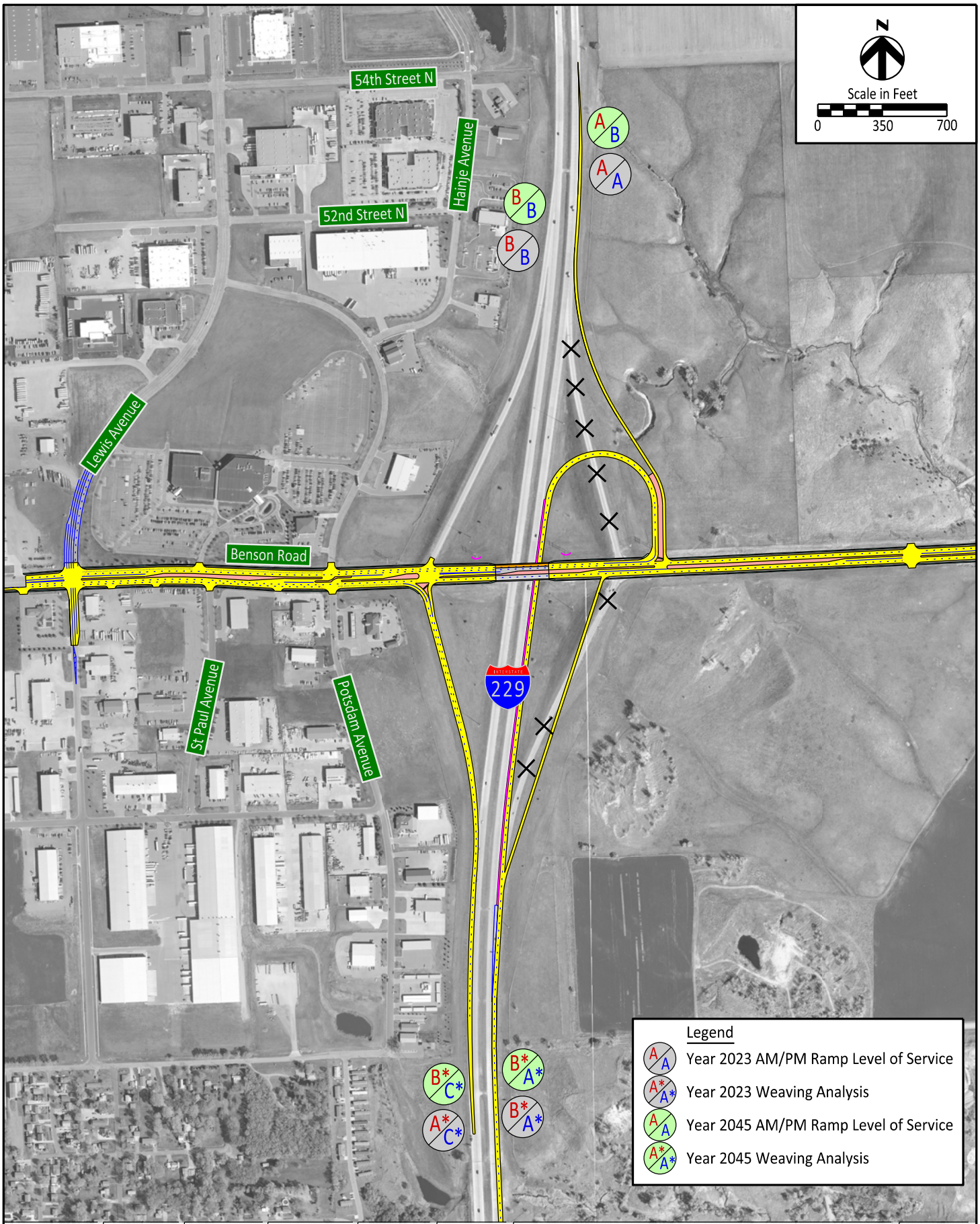
FILE: ...\Figure 26 (Alt 1d).dgn
PLOTTING DATE: 10-09-2018

Drawn By: BRM
Date: 5/29/2018
Chked By: DLH
Date: 5/29/2018
Revision:

Alternative Scenario 1d -- 2-Lane Partial Clover Leaf Northeast Quadrant Loop with 2-Lane SB On-Ramp.

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure
26



FILE: ...\Figure 27 (Alt 1e).dgn
PLOTTING DATE: 10-09-2018

Drawn By: BRM
Date: 5/29/2018
Chked By: DLH
Date: 5/29/2018
Revision:

Alternative Scenario 1e --2-Lane Partial Clover Leaf Northeast Quadrant with CD Lane and 2-Lane SB On-Ramp.

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 27

FILE: ...\Figure 28 (Alt 4a).dgn
PLOTTING DATE: 10-09-2018

Drawn By: BRM
Date: 5/29/2018
Chked By: DLH
Date: 5/29/2018
Revision:

Alternative Scenario 4a -- Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add 2 WB Lanes to Existing Overpass.

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 28

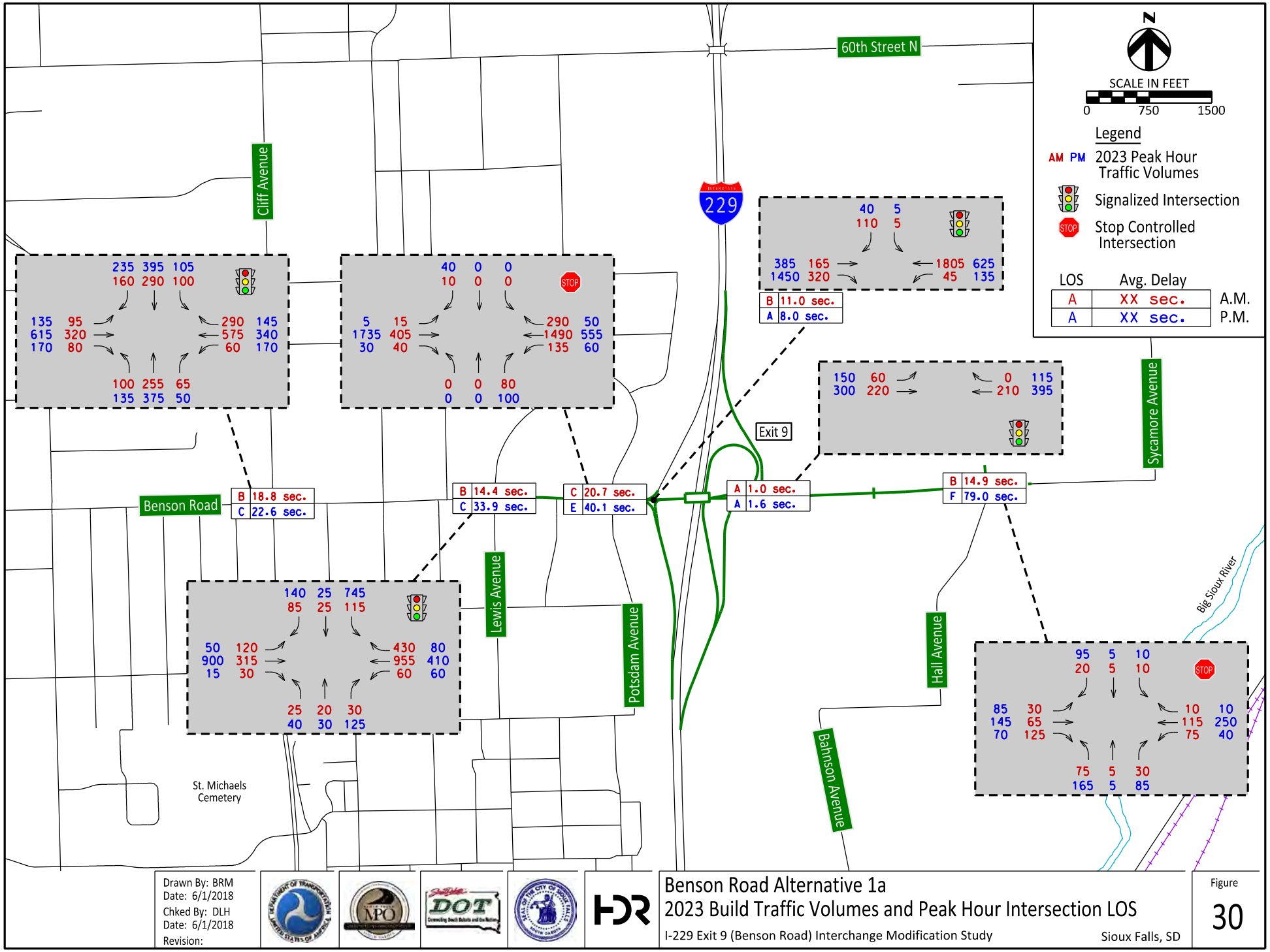
FILE: ...\Figure 29 (Alt 4b).dgn
PLOTTING DATE: 10-09-2018

Drawn By: BRM
Date: 5/29/2018
Chked By: DLH
Date: 5/29/2018
Revision:

Alternative Scenario 4b -- Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB Lanes.

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 29

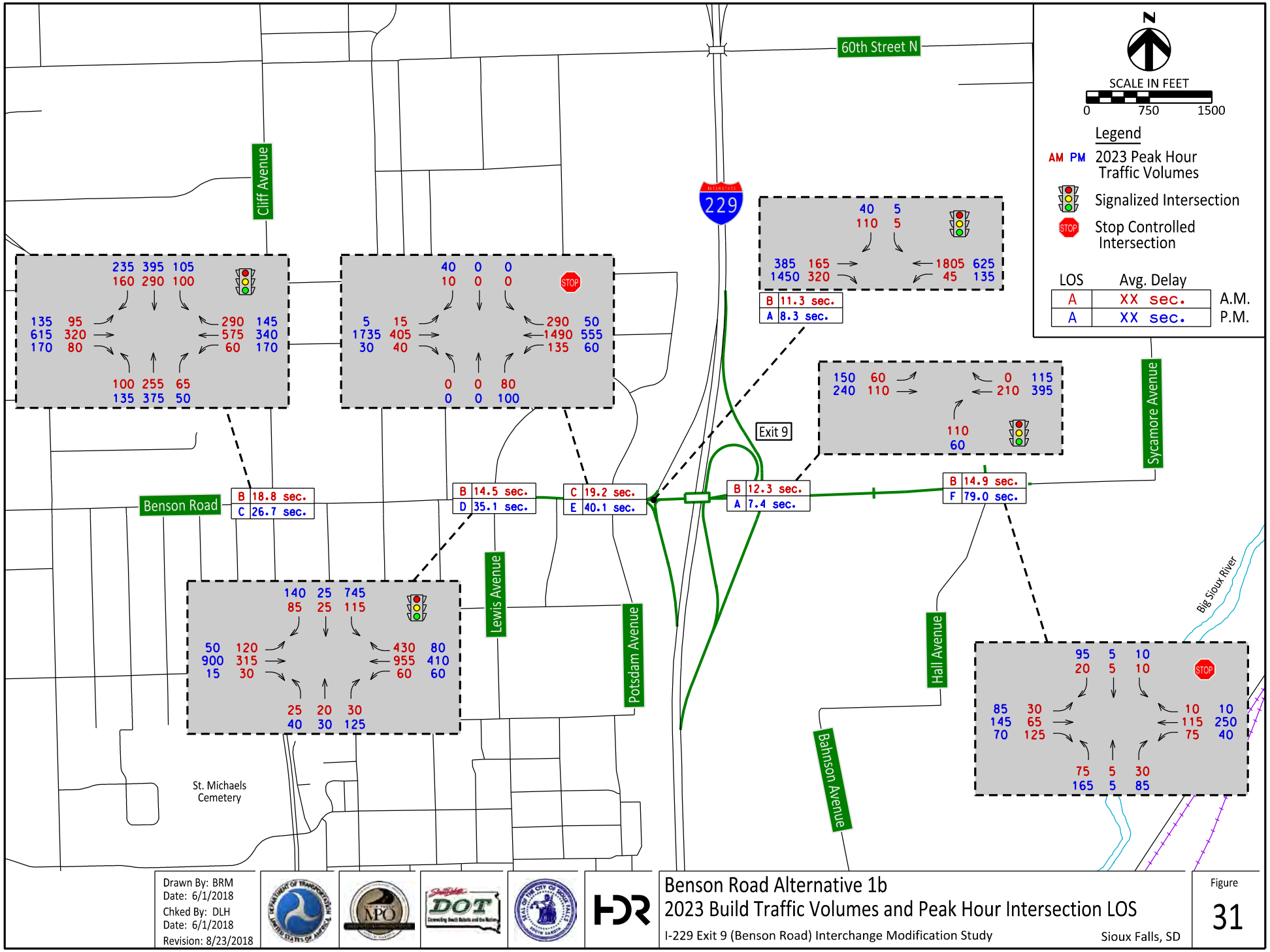


FILE: ...\Figure 30 (2023).dgn
PLOTTING DATE: 10-09-2018

Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1a
2023 Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 30



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision: 8/23/2018

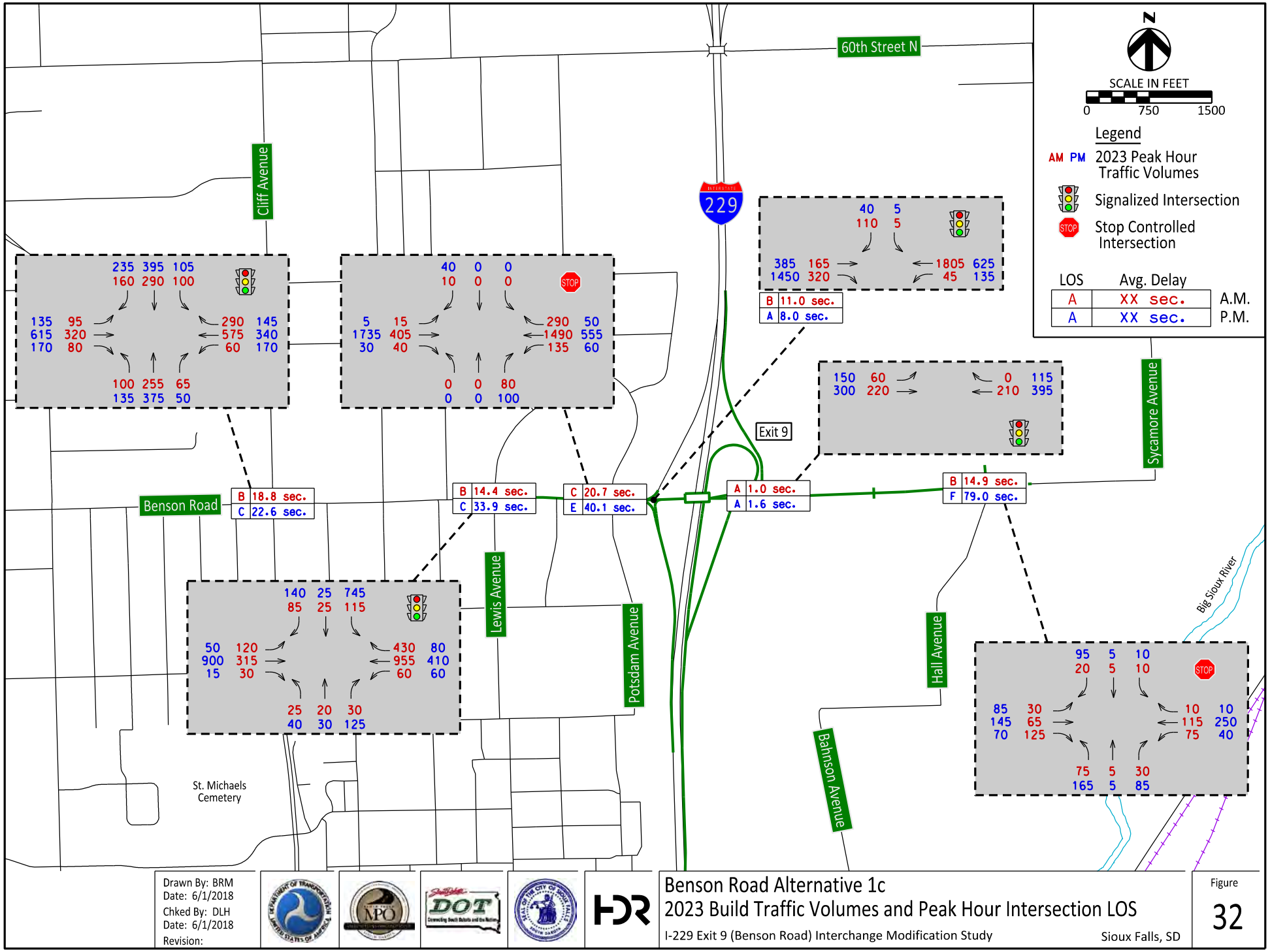
Benson Road Alternative 1b
2023 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 31

FILE: ...\Figure 31 (2023).dgn
PLOTTING DATE: 10-09-2018

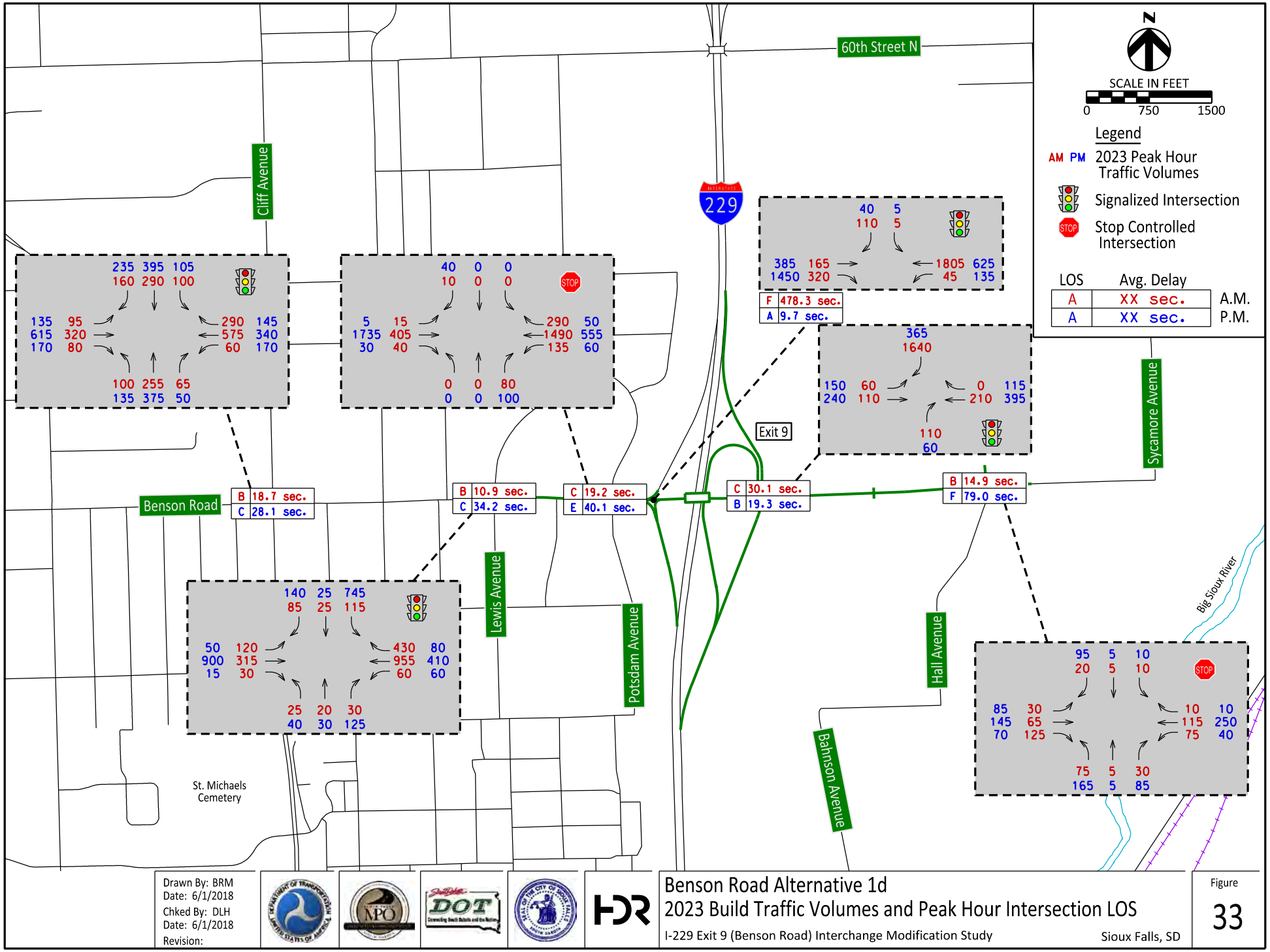


FILE: ...\Figure 32 (2023).dgn
PLOTTING DATE: 10-09-2018

Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1c
2023 Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 32

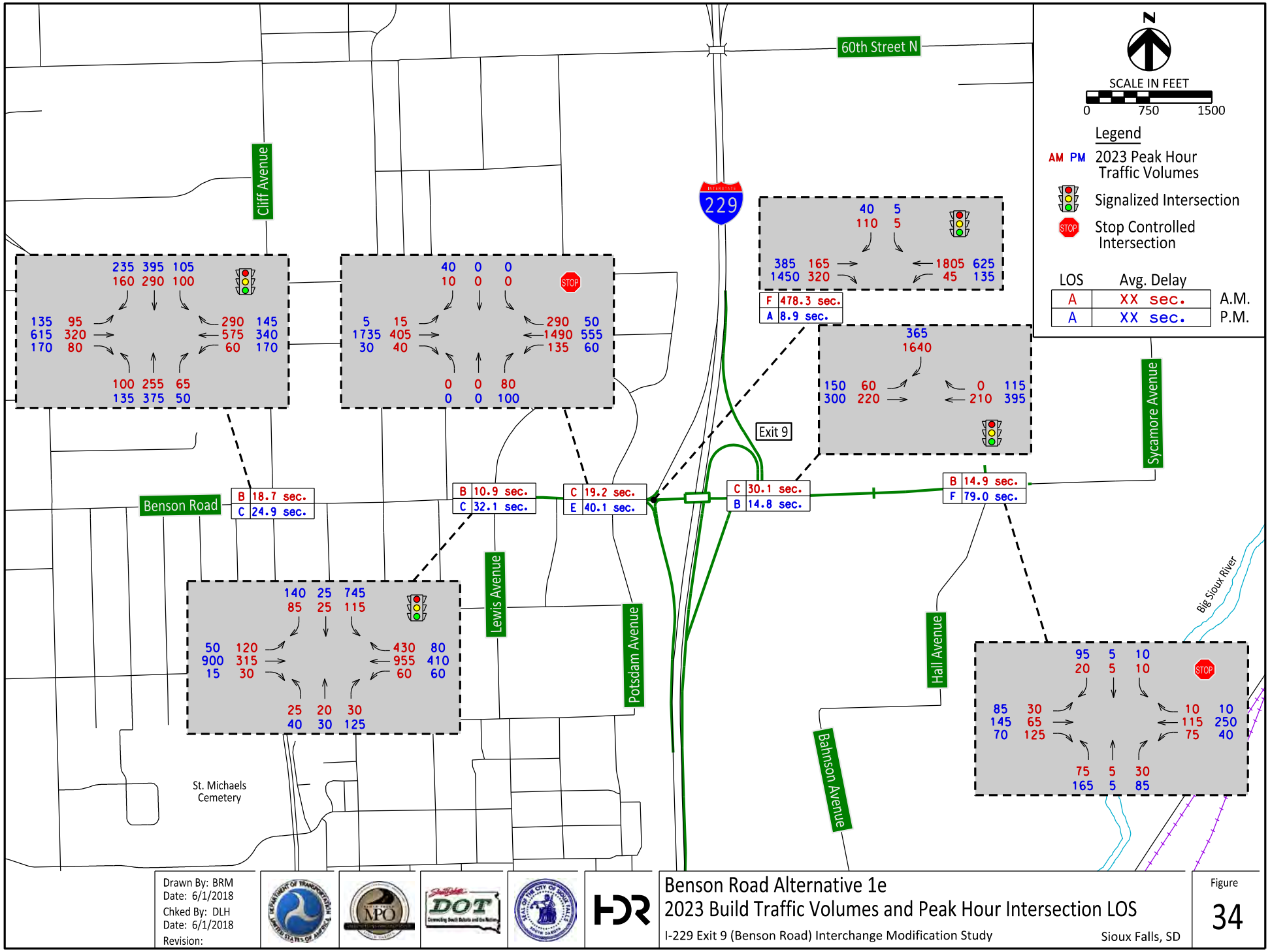


Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1d
2023 Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 33

FILE: ...\Figure 33 (2023).dgn
PLOTTING DATE: 10-09-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

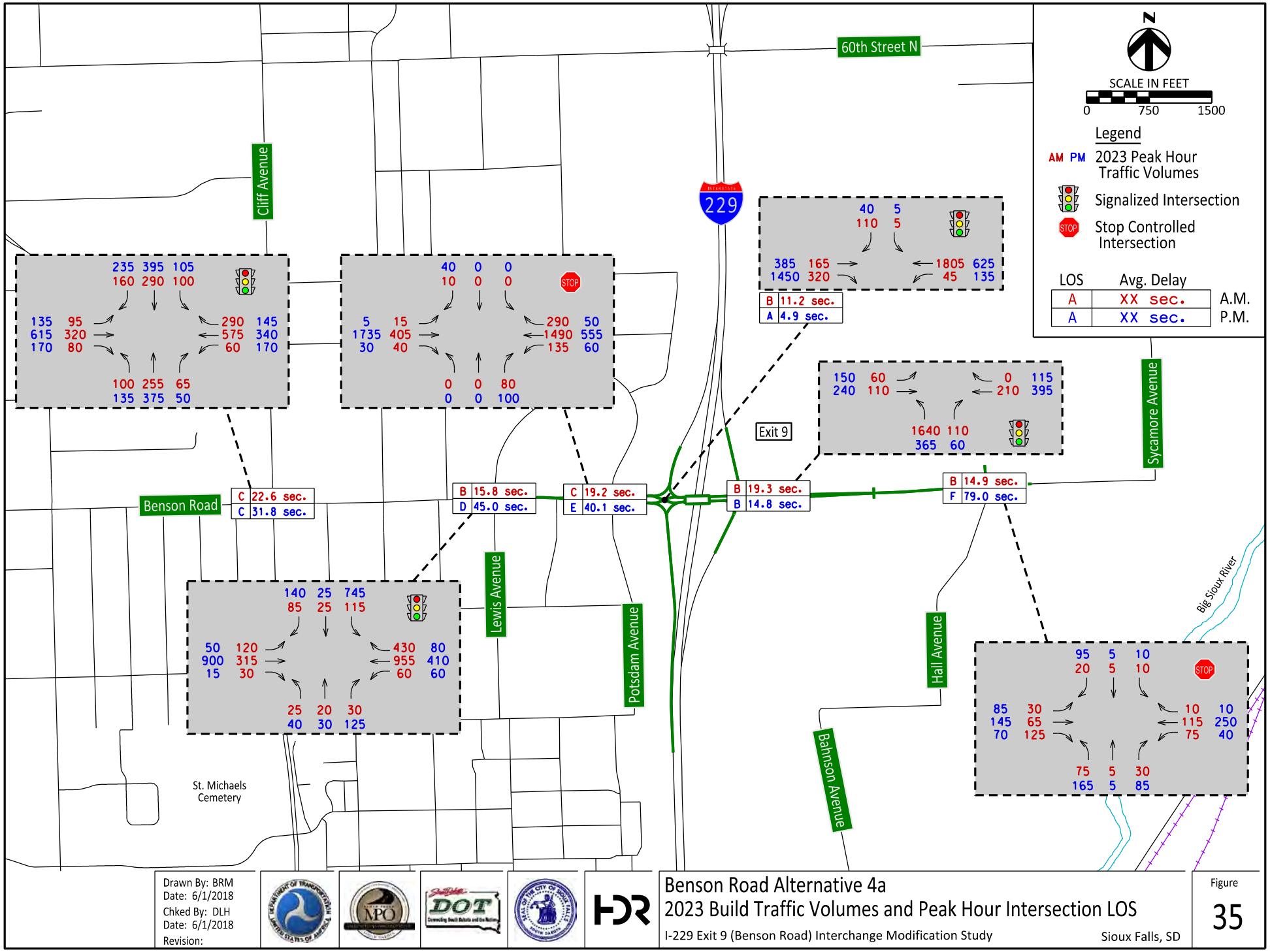
Benson Road Alternative 1e
2023 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 34

FILE: ...\Figure 34 (2023).dgn
PLOTTING DATE: 10-09-2018



FILE: ...\Figure 35 (2023).dgn
PLOTTING DATE: 10-09-2018

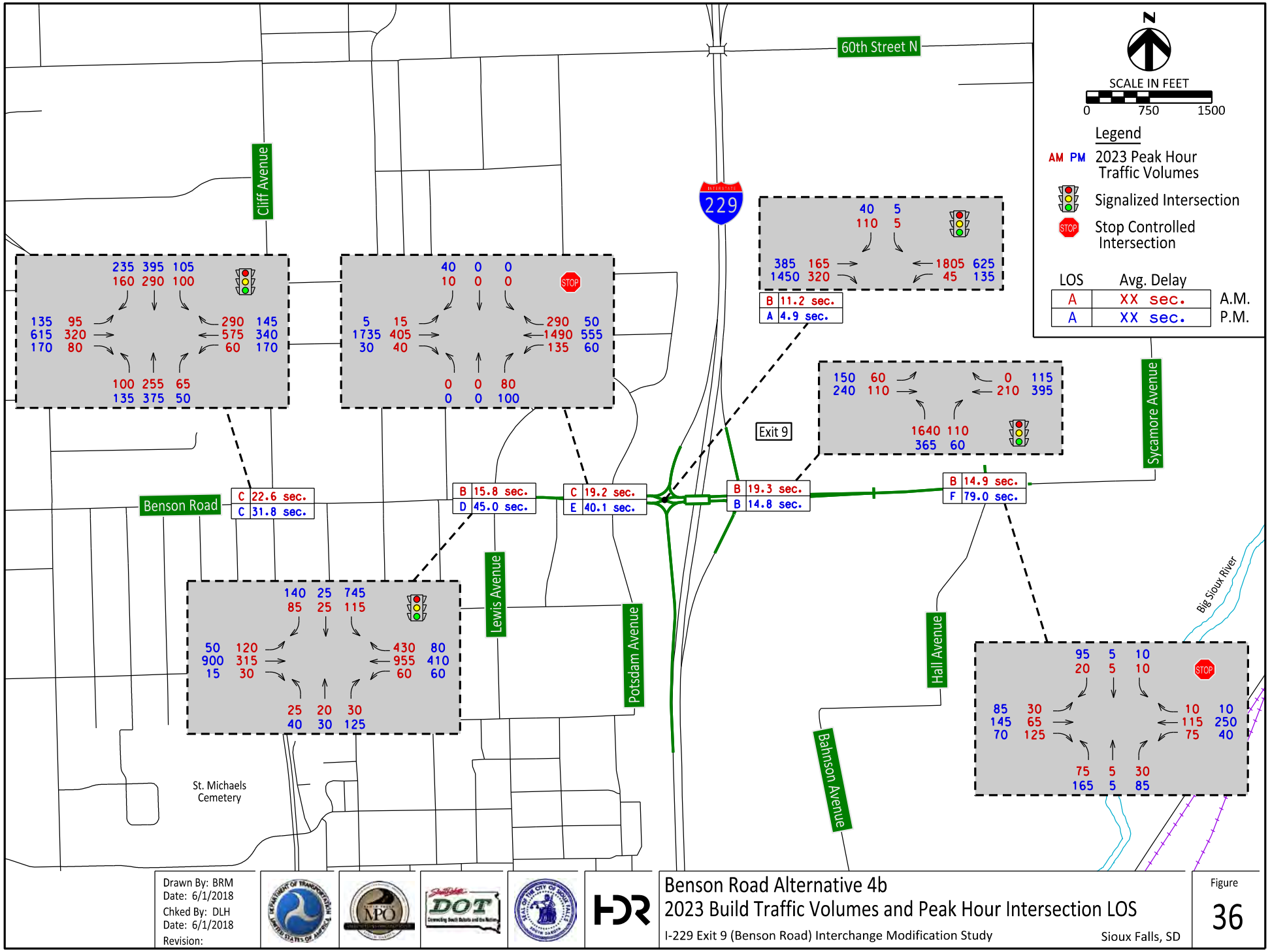
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 4a
2023 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 35



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

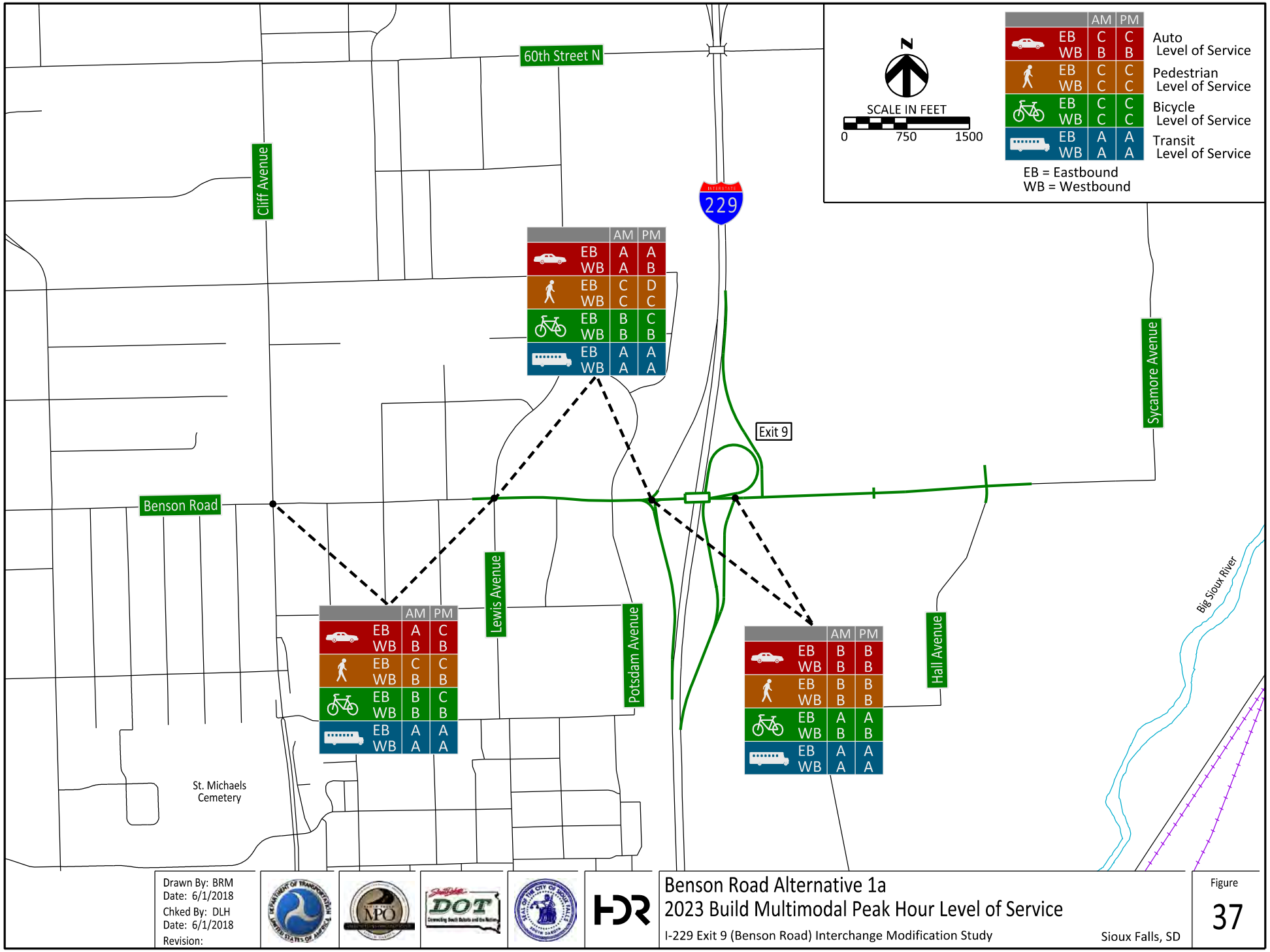
Benson Road Alternative 4b
2023 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 36

FILE: ...\Figure 36 (2023).dgn
PLOTTING DATE: 10-09-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

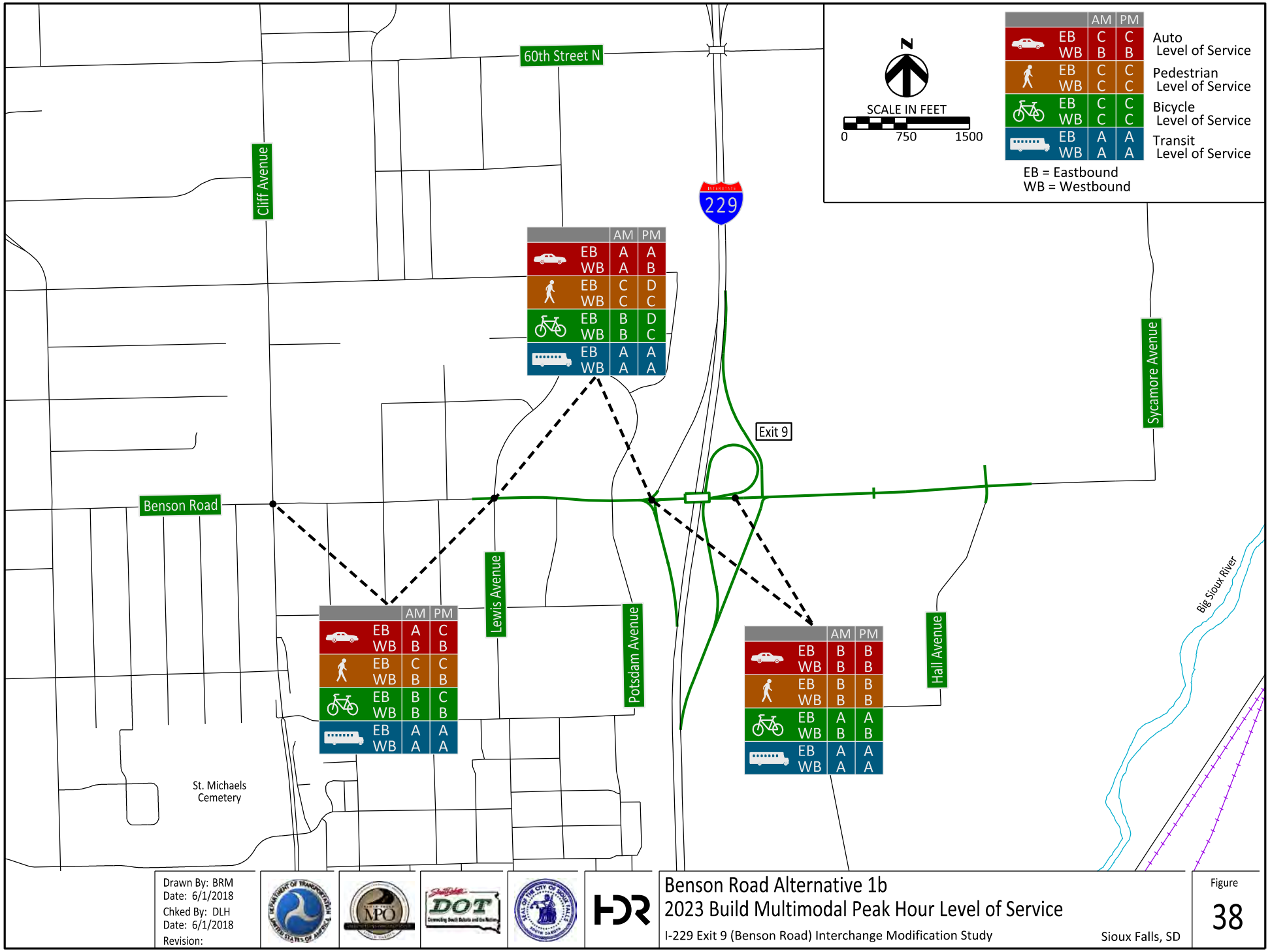
Benson Road Alternative 1a
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 37

FILE: ...\Figure 37 (MM 2023).dgn
PLOTTING DATE: 10-09-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

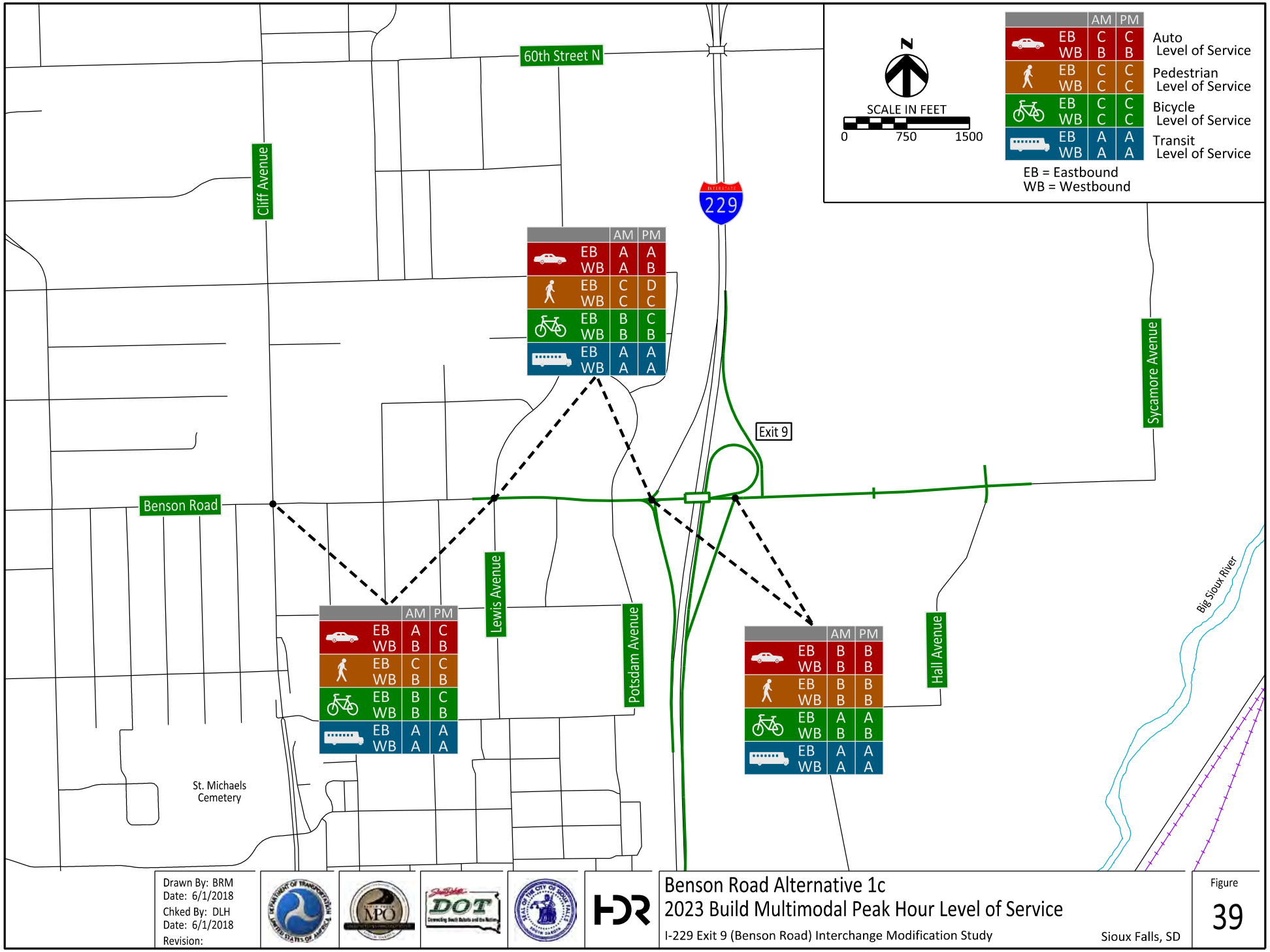
Benson Road Alternative 1b
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 38

FILE: ...\Figure 38 (MM 2023).dgn
PLOTTING DATE: 10-09-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

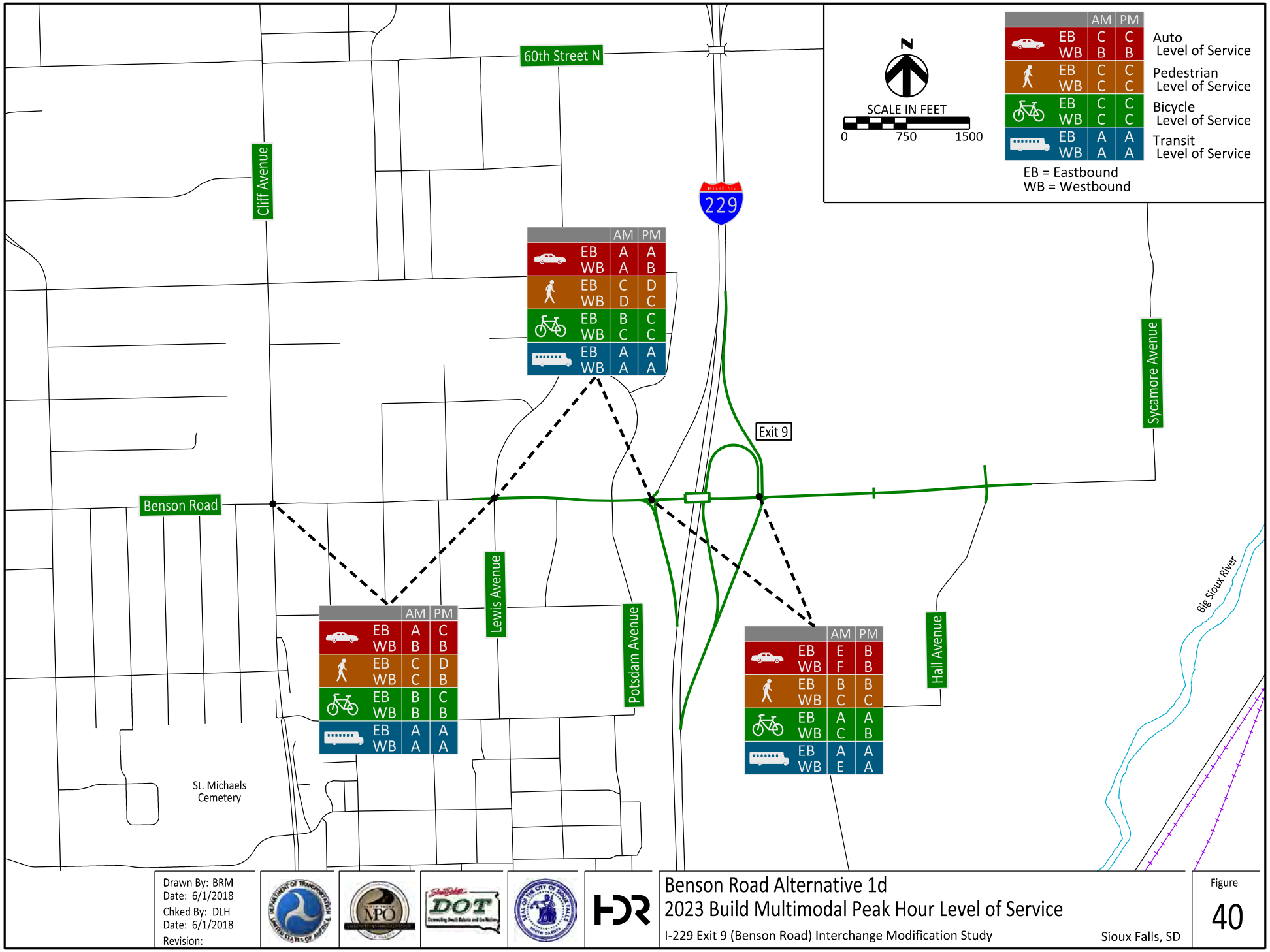
Benson Road Alternative 1c
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 39

FILE: ...\Figure 39 (MM 2023).dgn
PLOTTING DATE: 10-09-2018

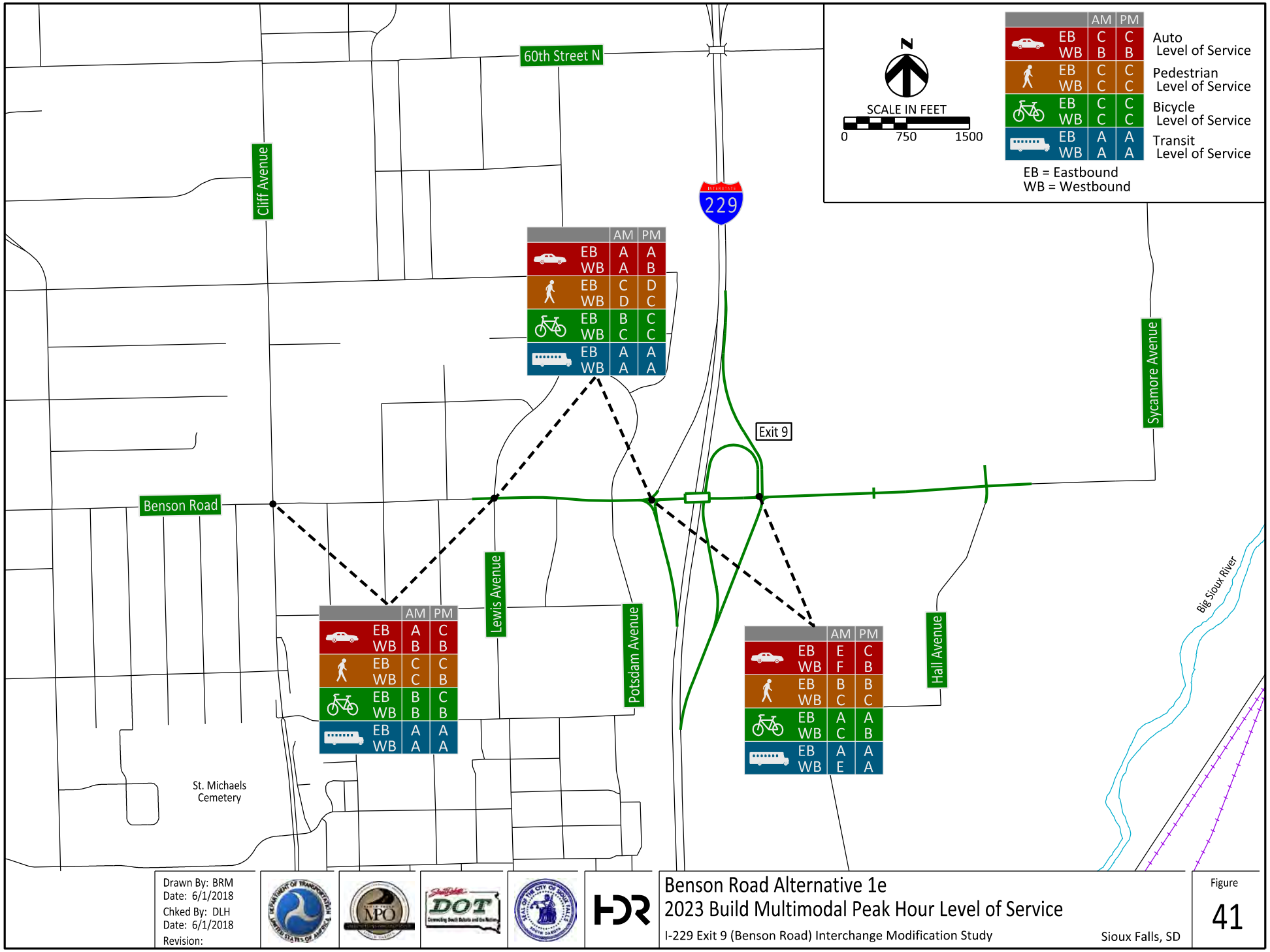


Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1d
2023 Build Multimodal Peak Hour Level of Service
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 40

FILE: ...\Figure 40 (MM 2023).dgn
PLOTTING DATE: 10-09-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

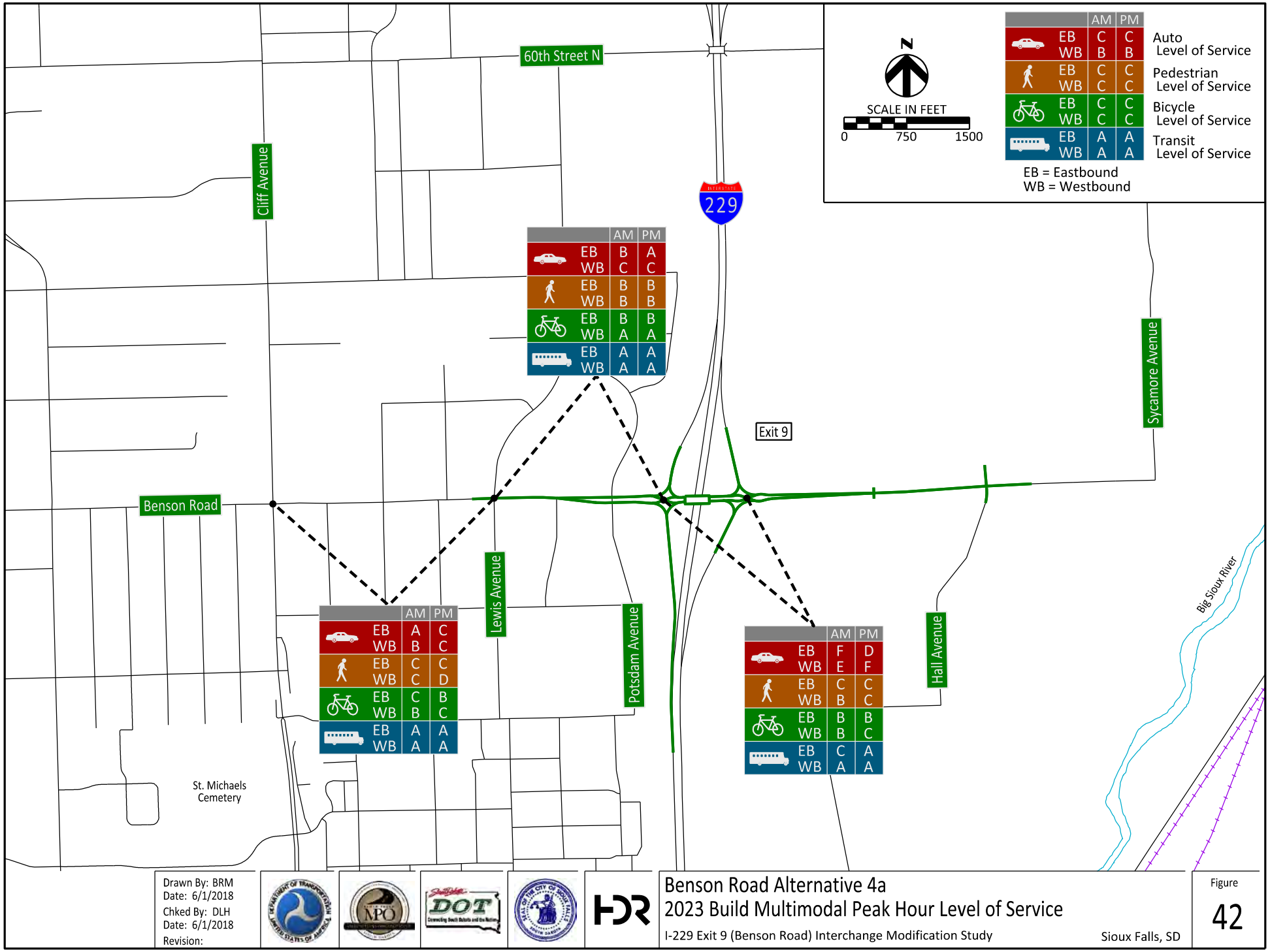
Benson Road Alternative 1e
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 41

FILE: ...\Figure 41 (MM 2023).dgn
PLOTTING DATE: 10-09-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

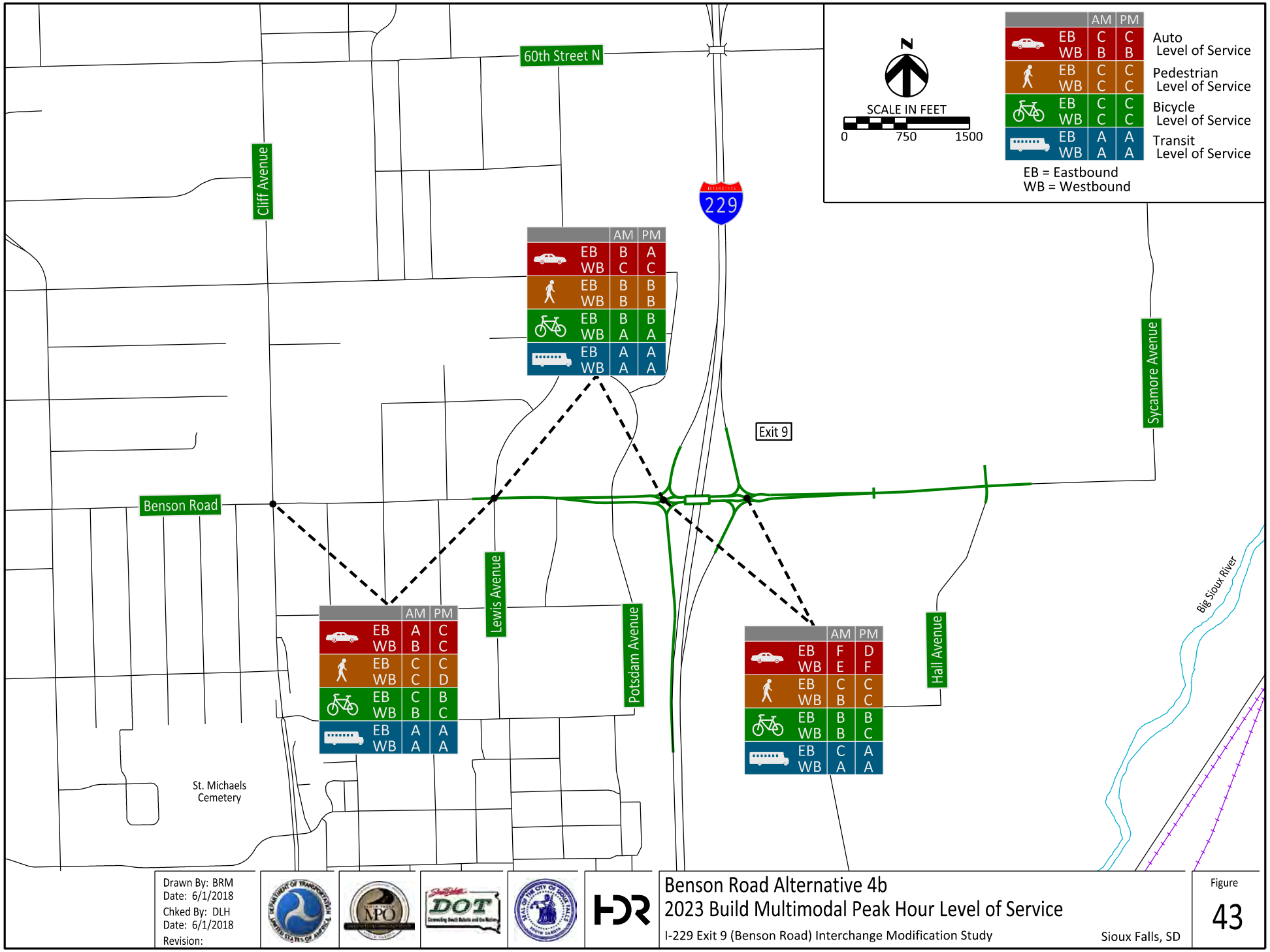
Benson Road Alternative 4a
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 42

FILE: ...\Figure 42 (MM 2023).dgn
PLOTTING DATE: 10-09-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

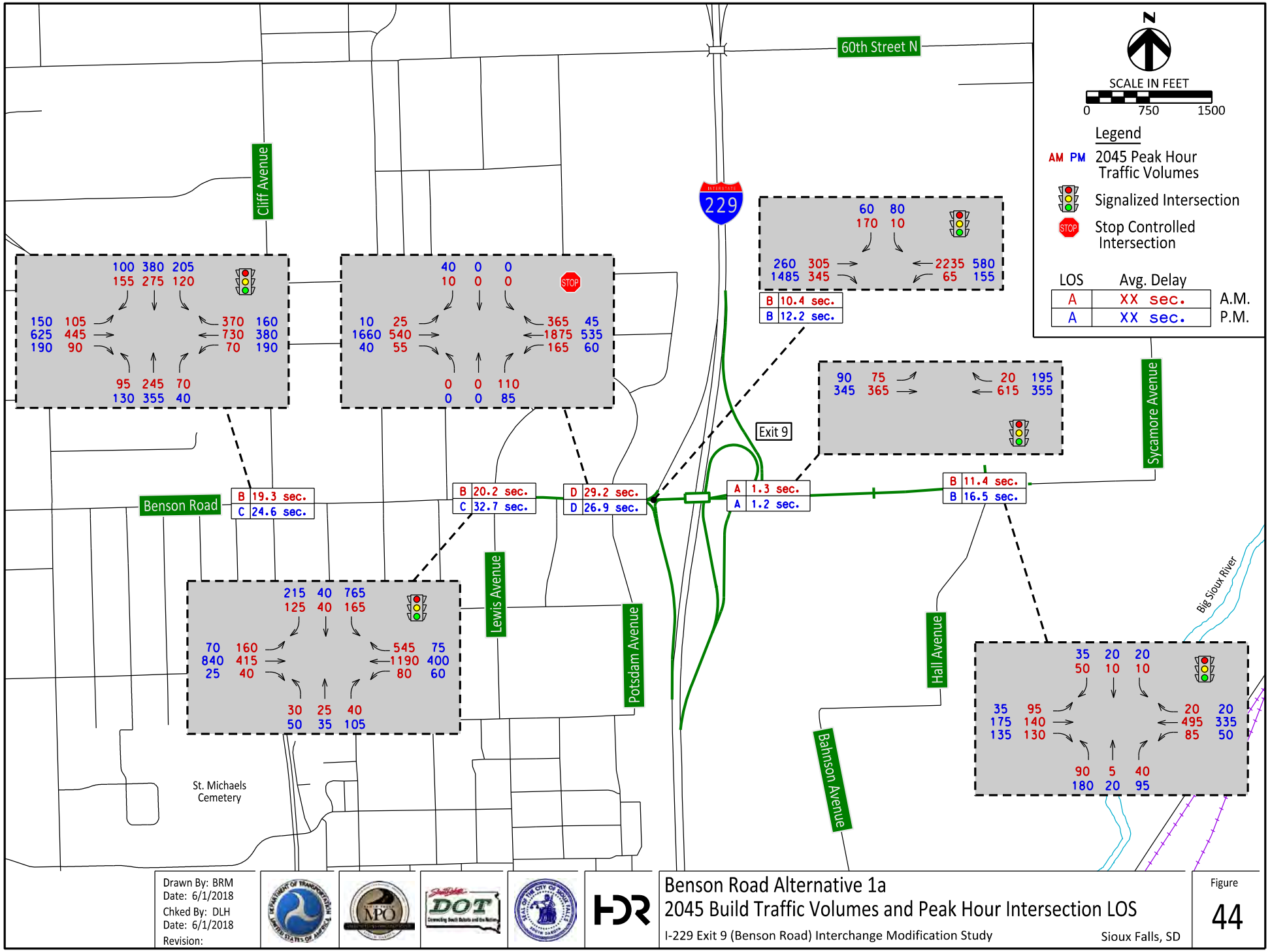
Benson Road Alternative 4b
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 43

FILE: ...\Figure 43 (MM 2023).dgn
PLOTTING DATE: 10-09-2018

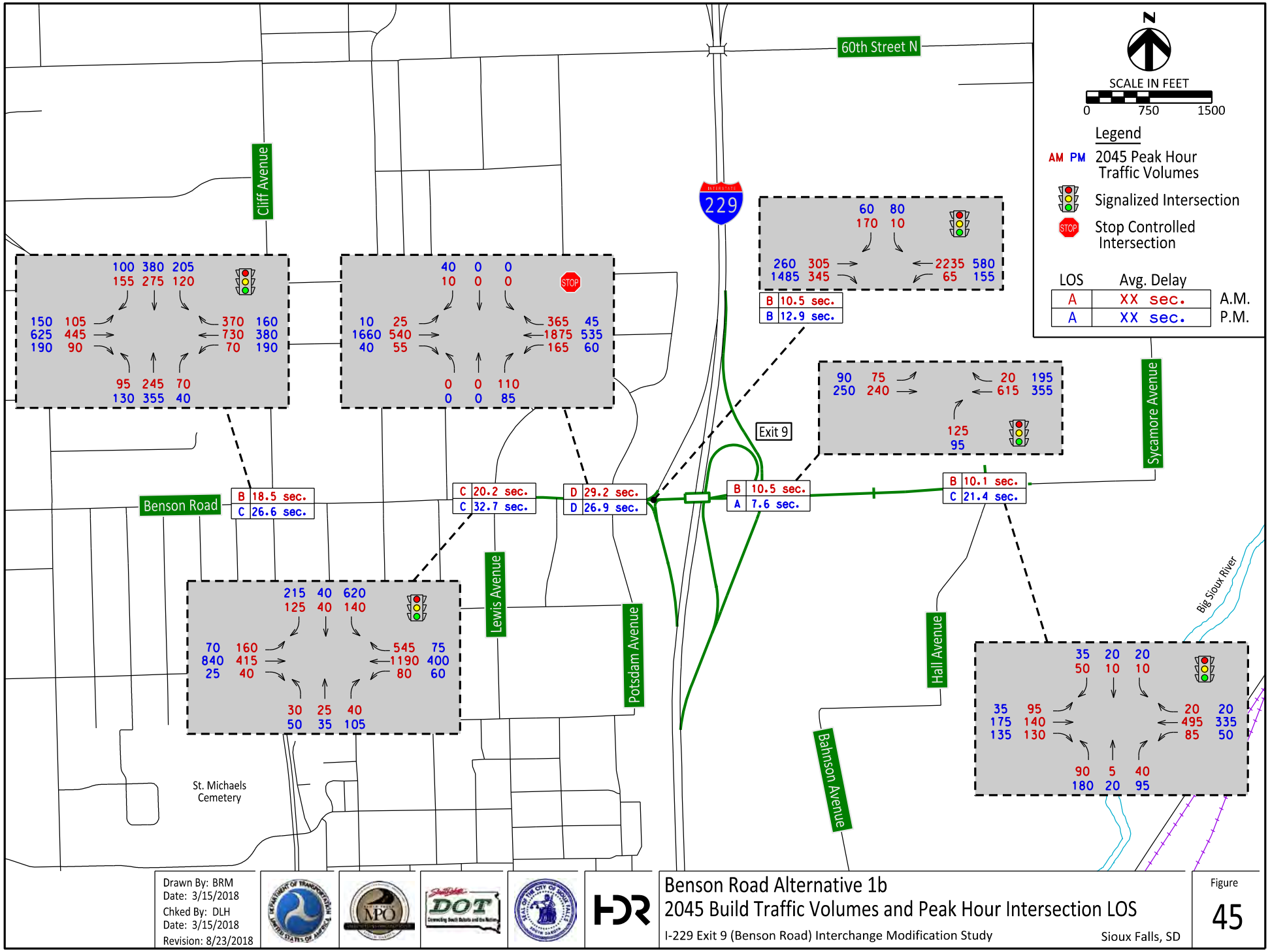


Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1a
2045 Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 44

FILE: ...\Figure 44 (2045).dgn
PLOTTING DATE: 10-09-2018

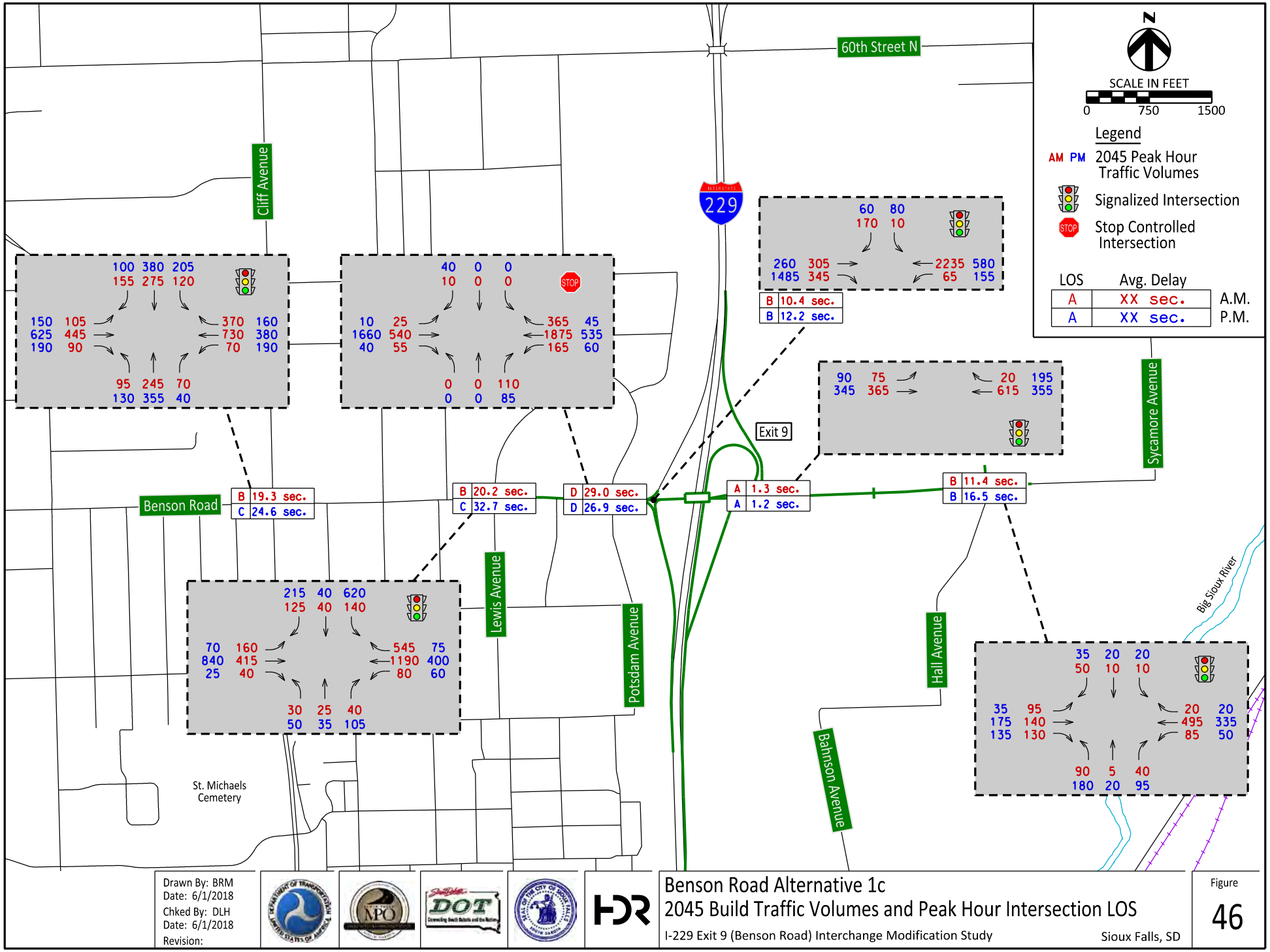


Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision: 8/23/2018

Benson Road Alternative 1b
2045 Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 45

FILE: ...\Figure 45 (2045).dgn
PLOTTING DATE: 10-09-2018



FILE: ...\Figure 46 (2045).dgn
PLOTTING DATE: 10-09-2018

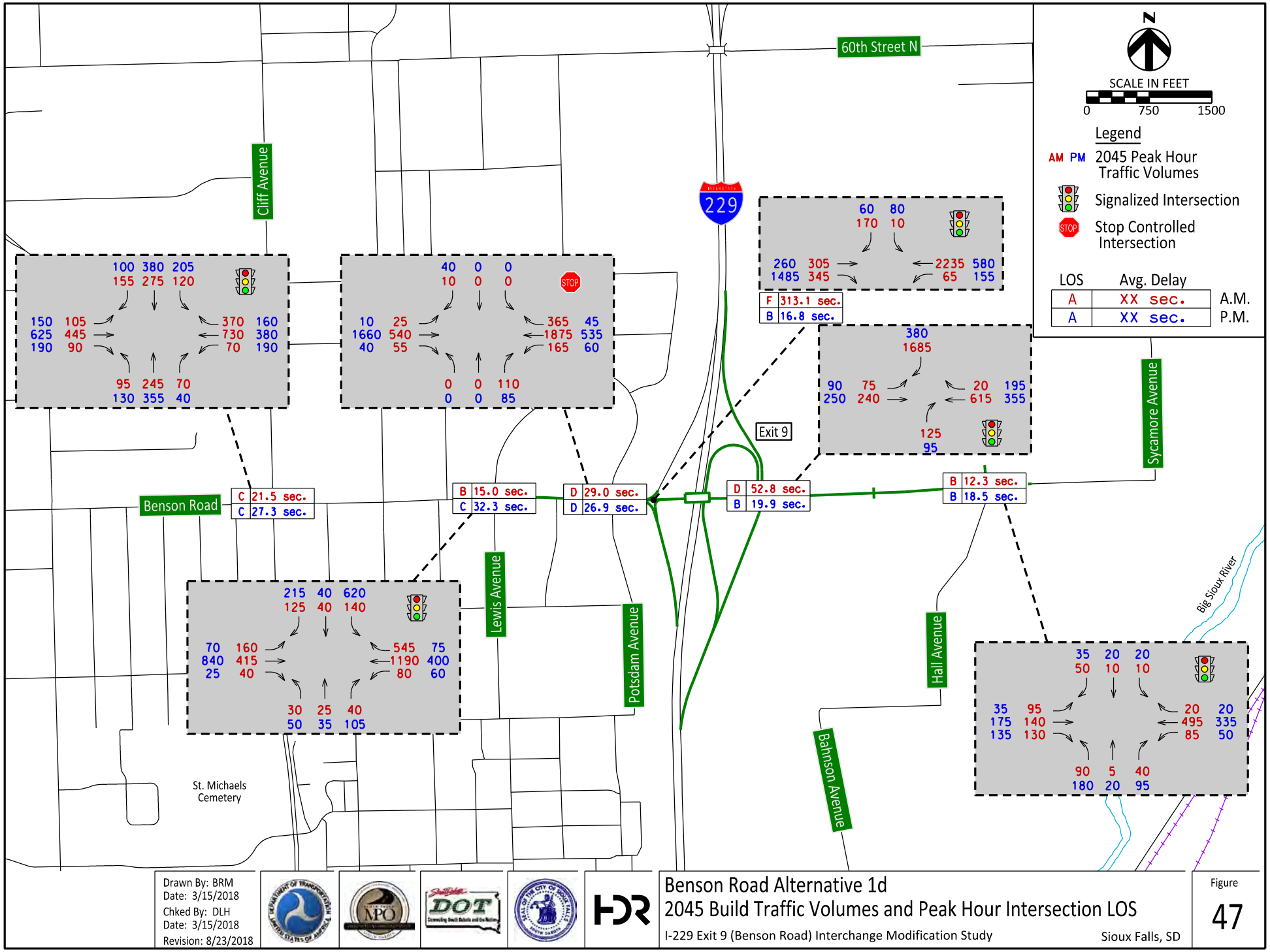
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1c
2045 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 46

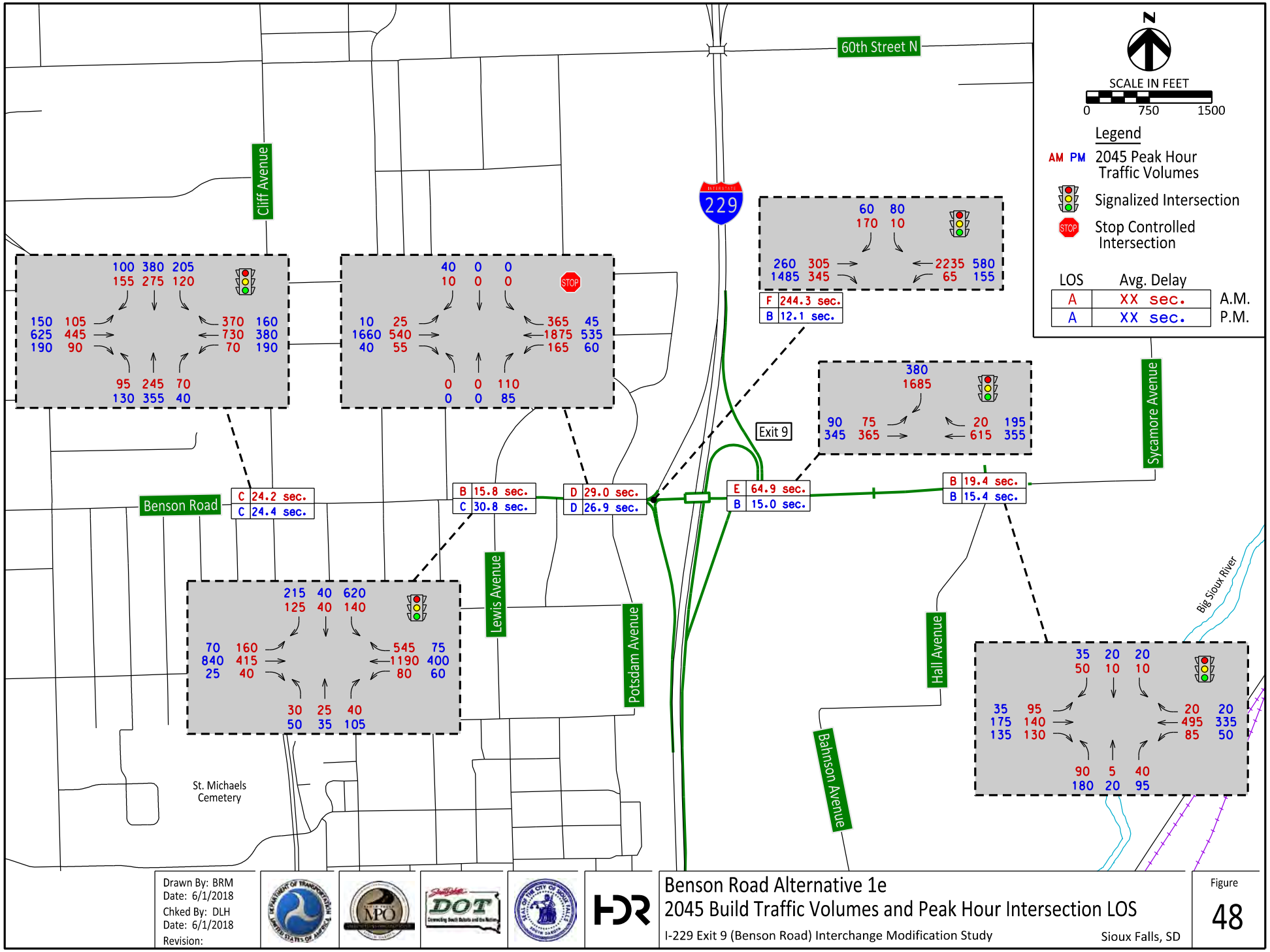


Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision: 8/23/2018

Benson Road Alternative 1d
2045 Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 47

FILE: ...\Figure 47 (2045).dgn
PLOTTING DATE: 10-09-2018



FILE: ...\Figure 48 (2045).dgn
PLOTTING DATE: 10-09-2018

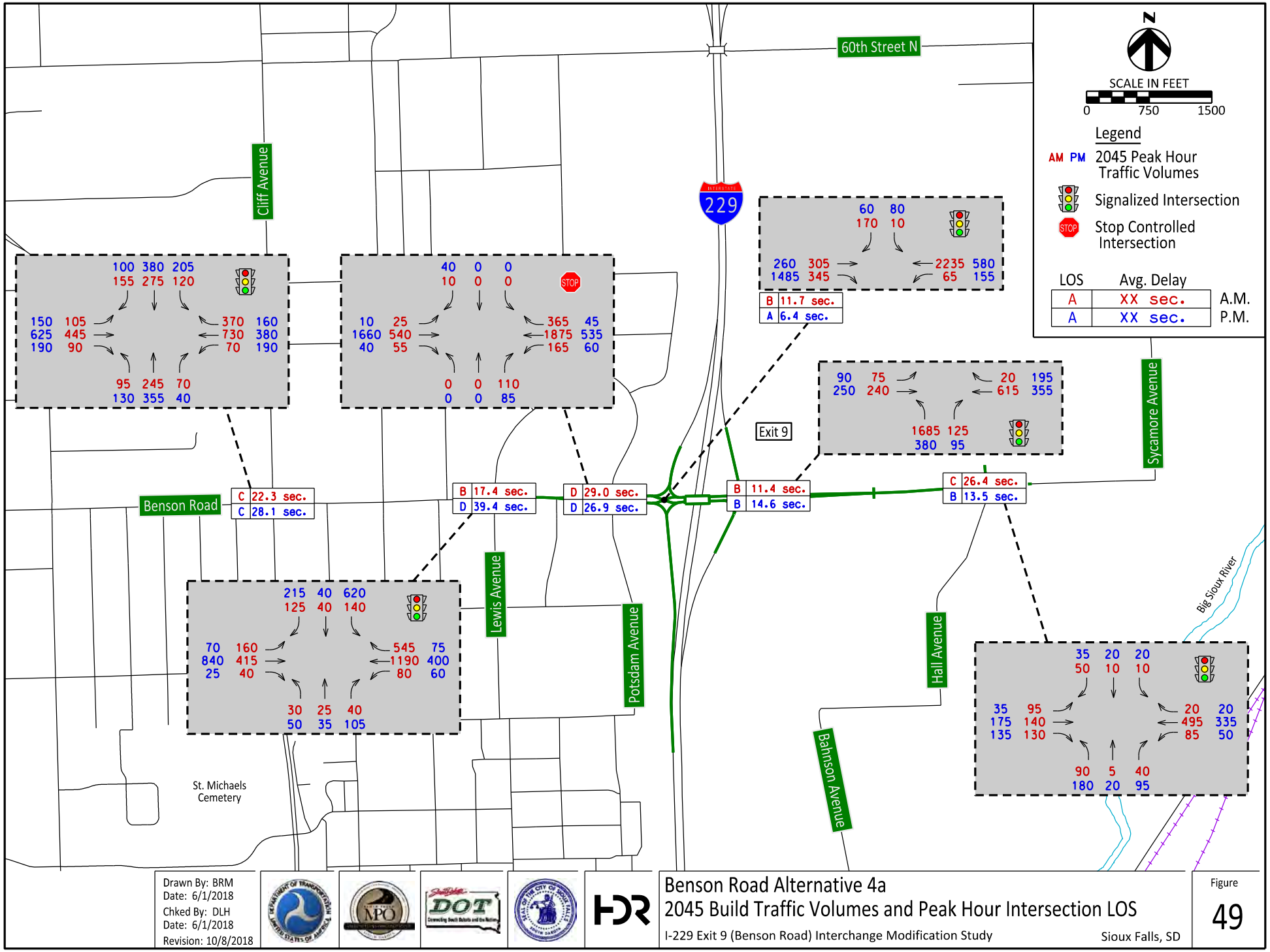
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1e
2045 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 48



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision: 10/8/2018

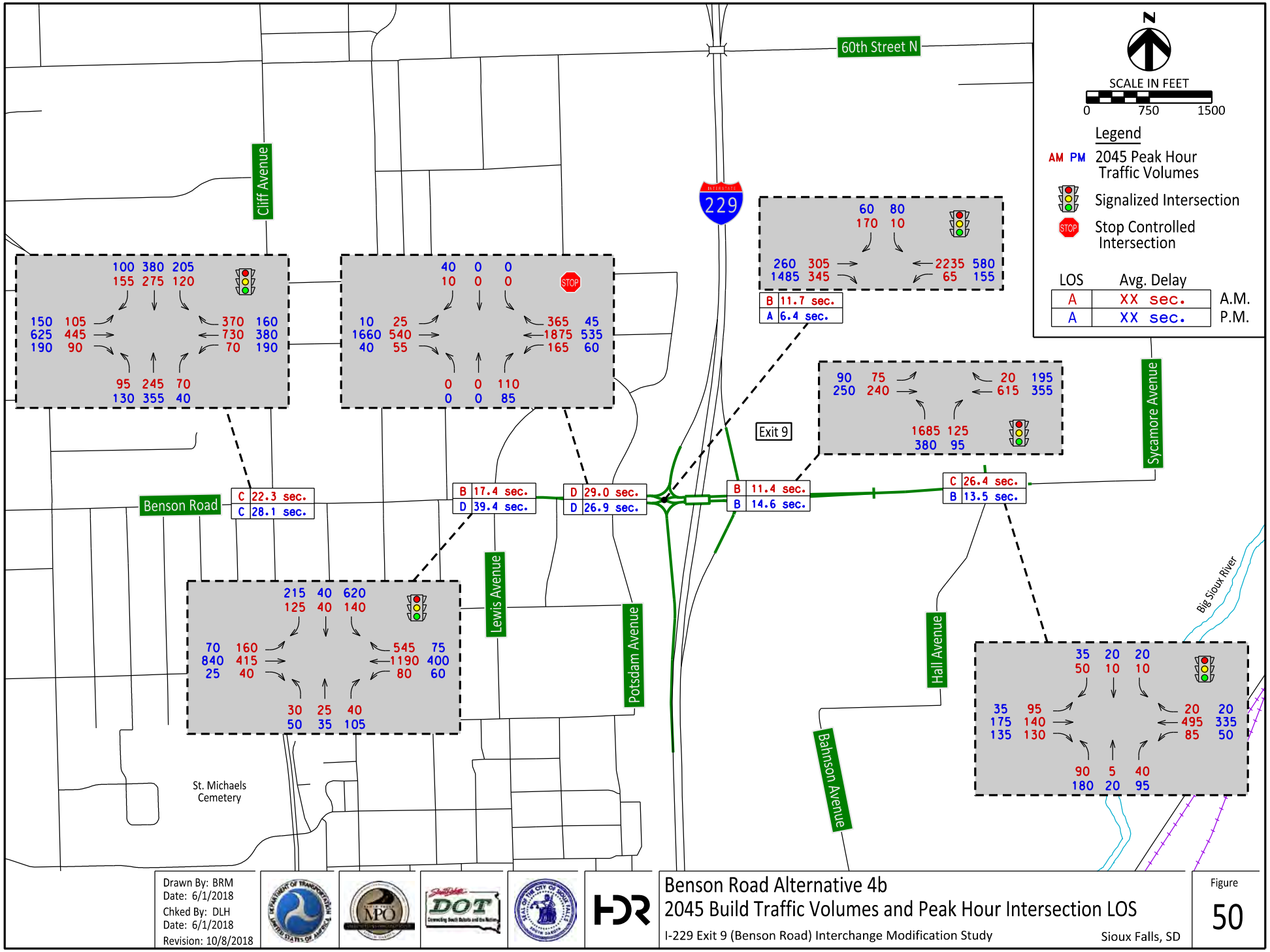
Benson Road Alternative 4a
2045 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 49

FILE: ...\Figure 49 (2045).dgn
PLOTTING DATE: 10-10-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision: 10/8/2018

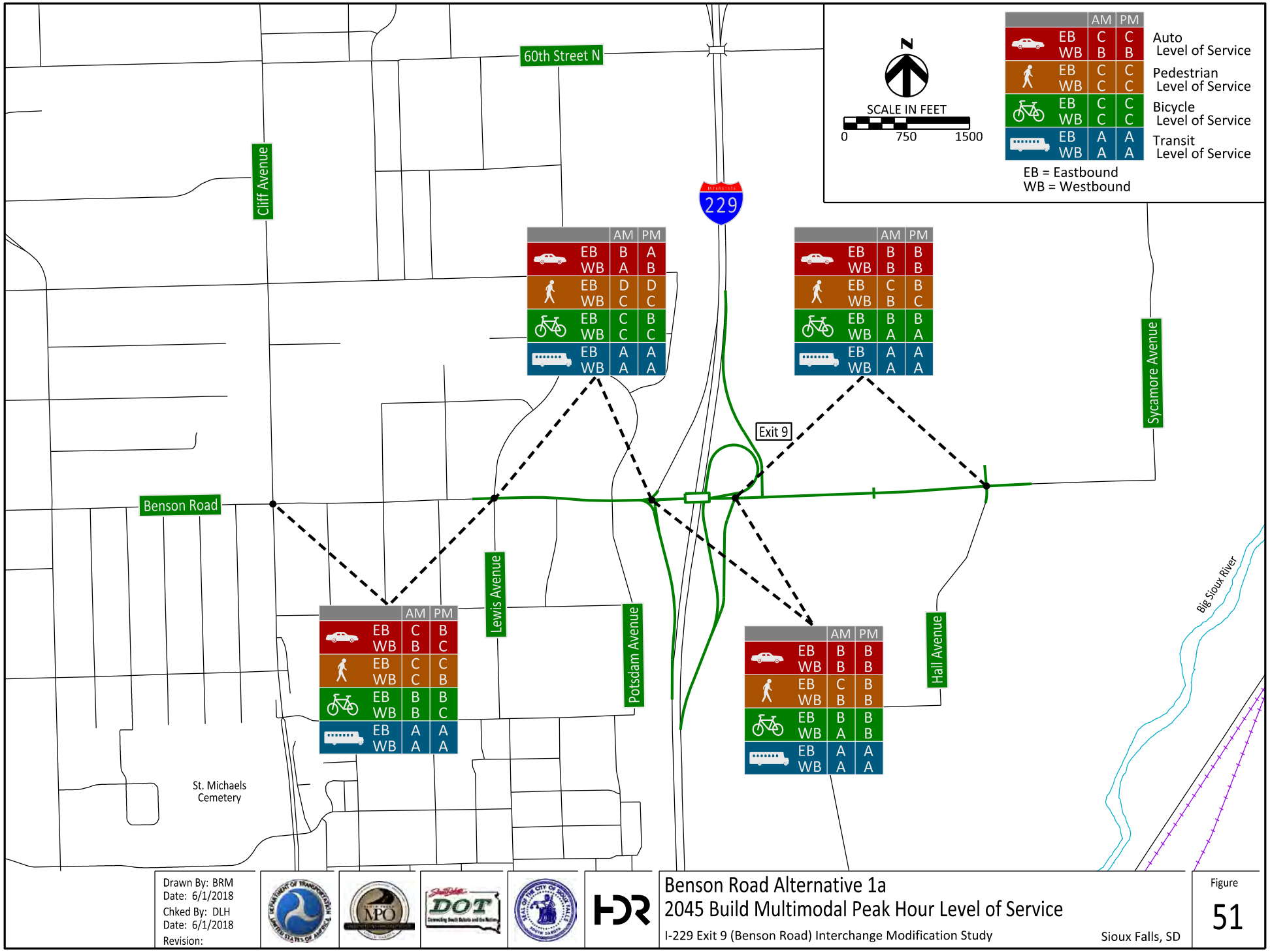
Benson Road Alternative 4b
2045 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 50

FILE: ...\Figure 50 (2045).dgn
PLOTTING DATE: 10-10-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1a
2045 Build Multimodal Peak Hour Level of Service
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 51

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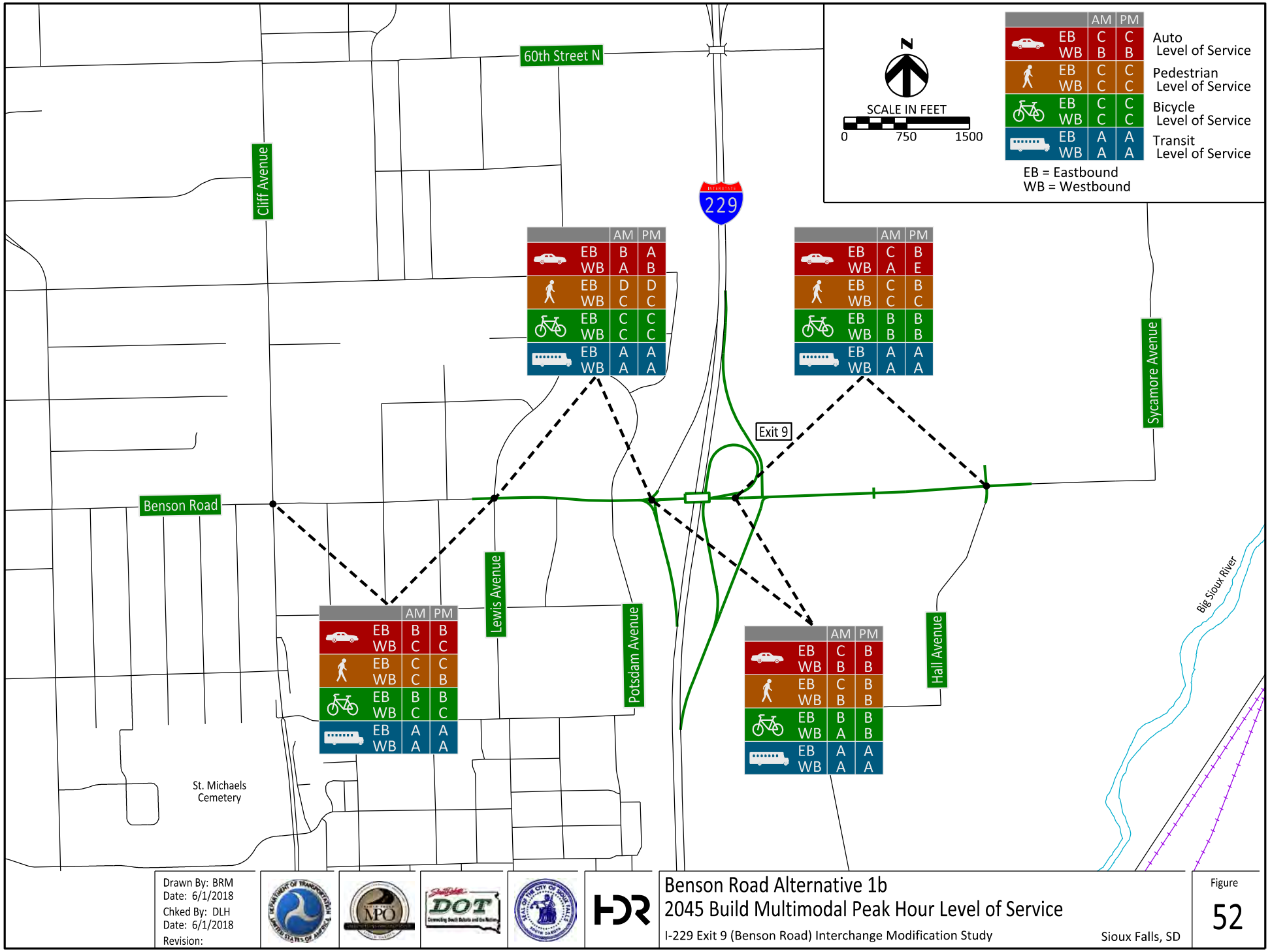

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Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1b
2045 Build Multimodal Peak Hour Level of Service
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 52

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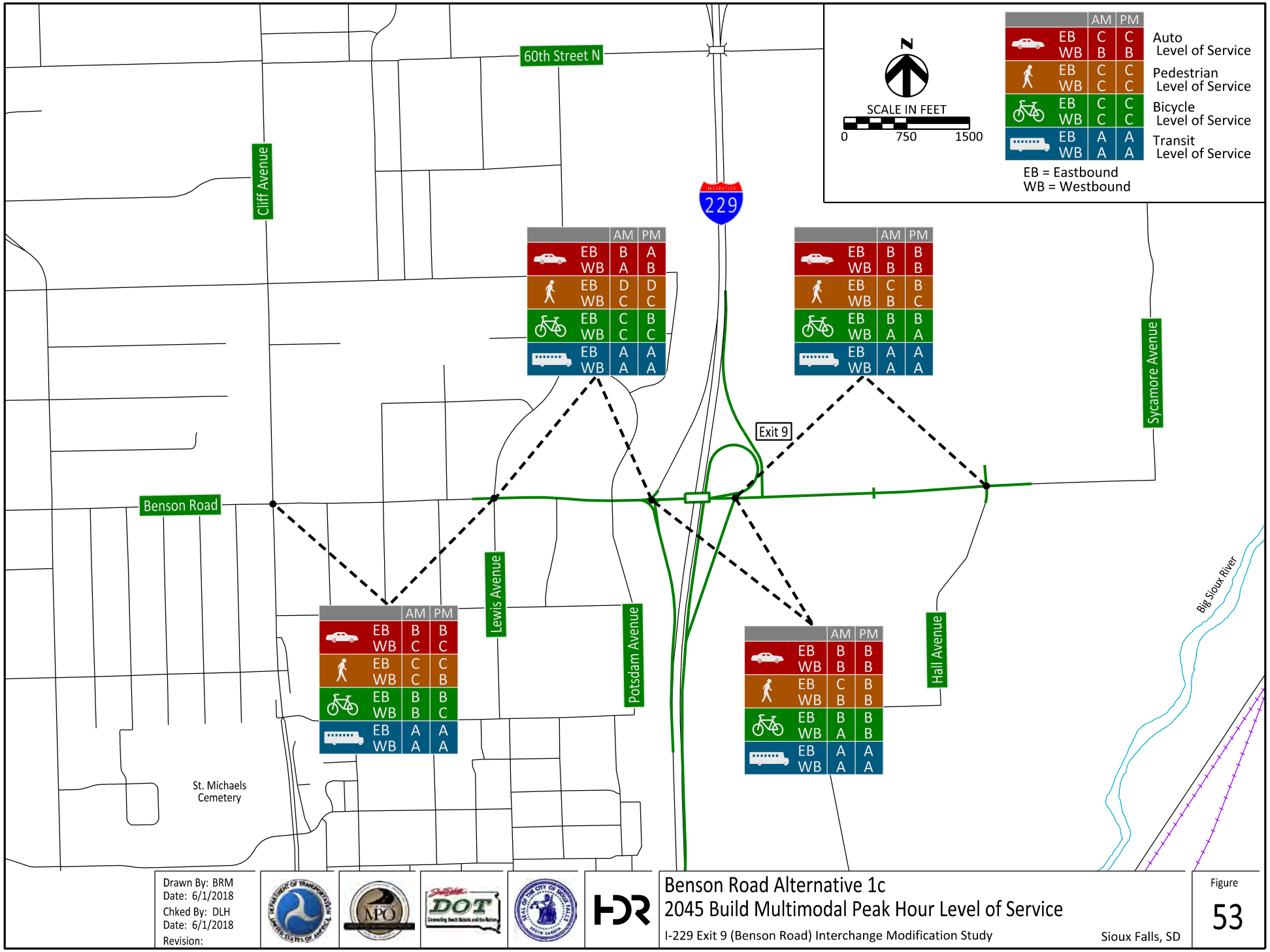

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Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1c
2045 Build Multimodal Peak Hour Level of Service
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 53

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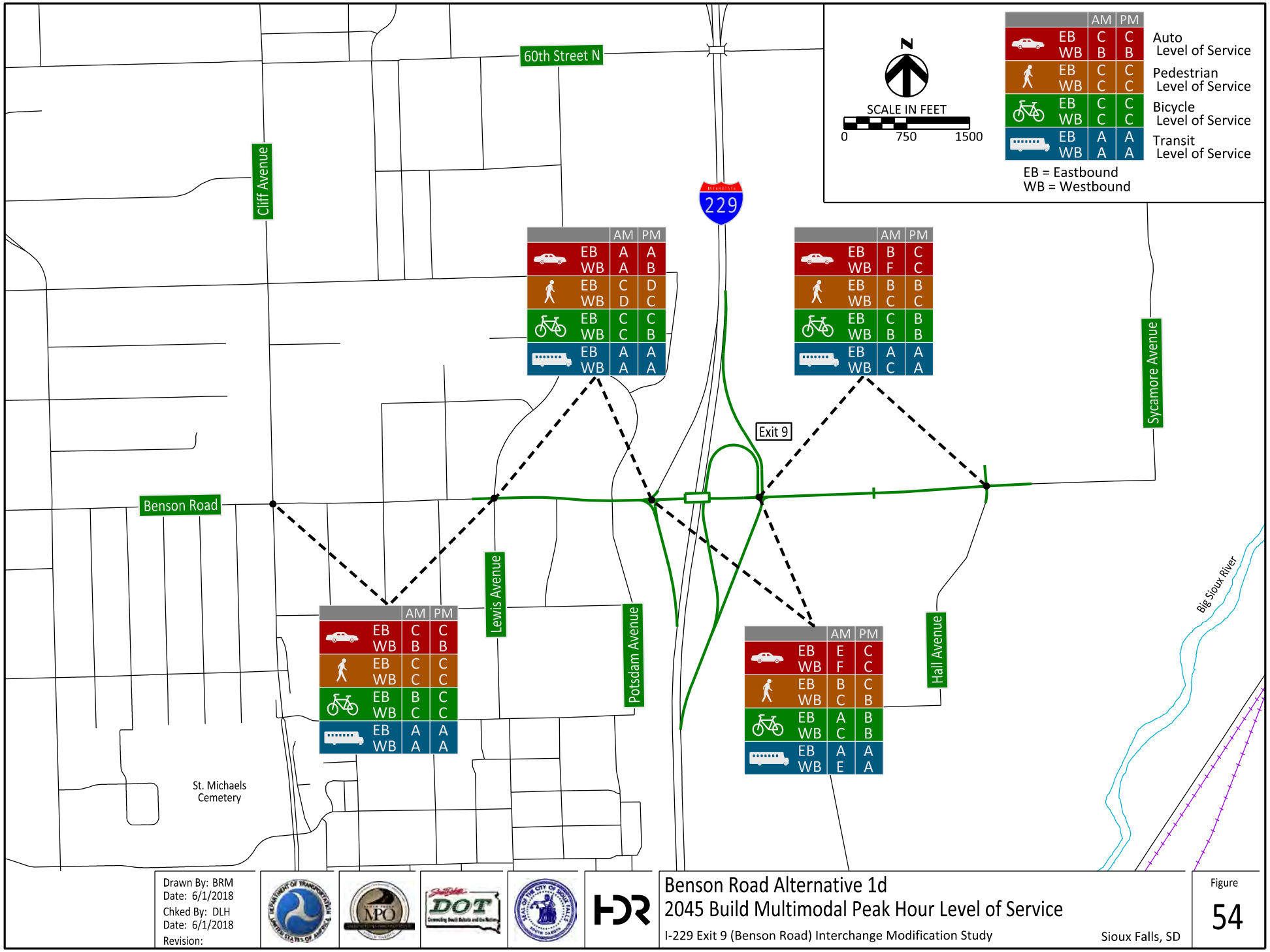

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Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1d
2045 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 54

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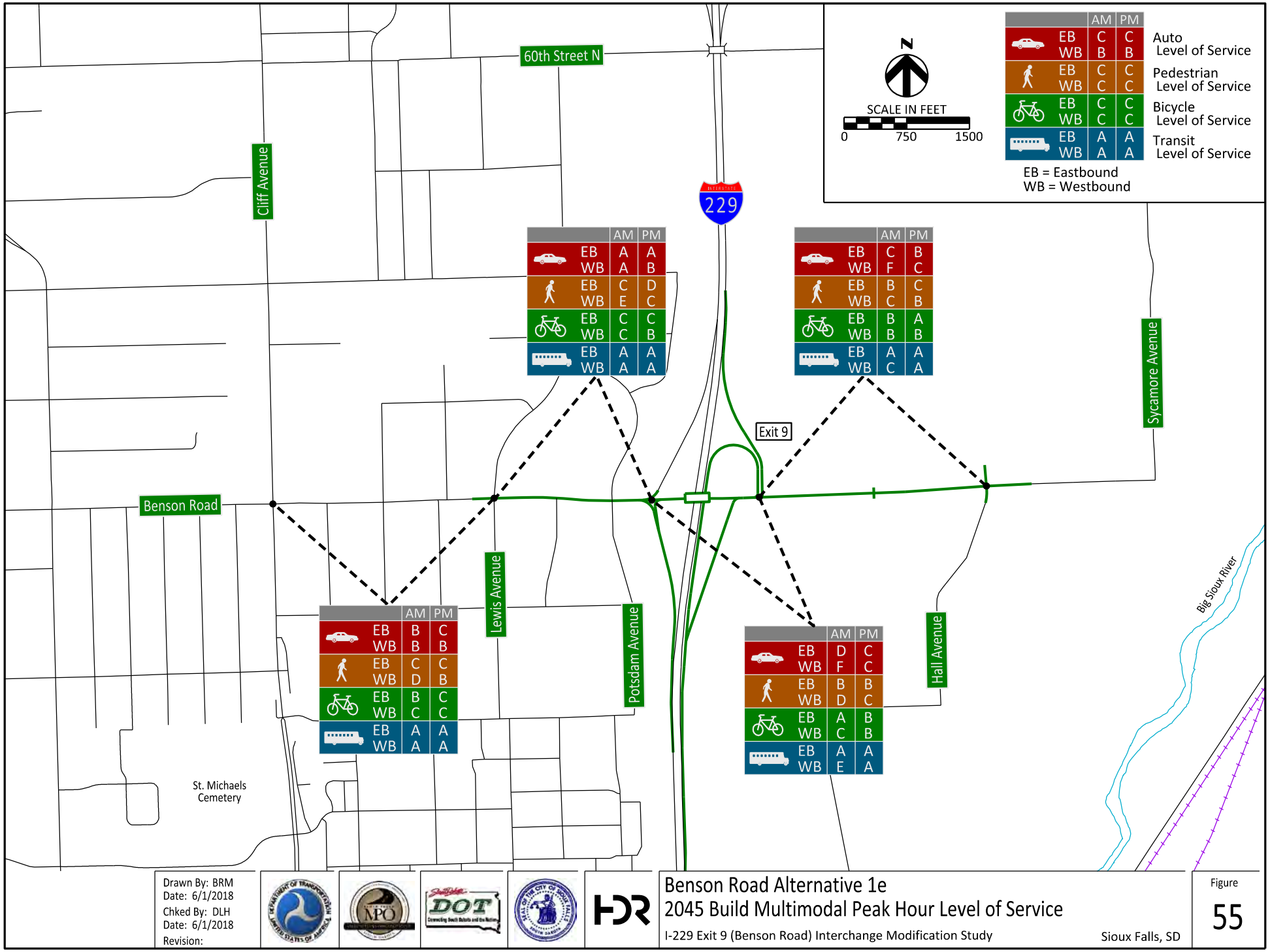

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PLOTTING DATE: 10-09-2018

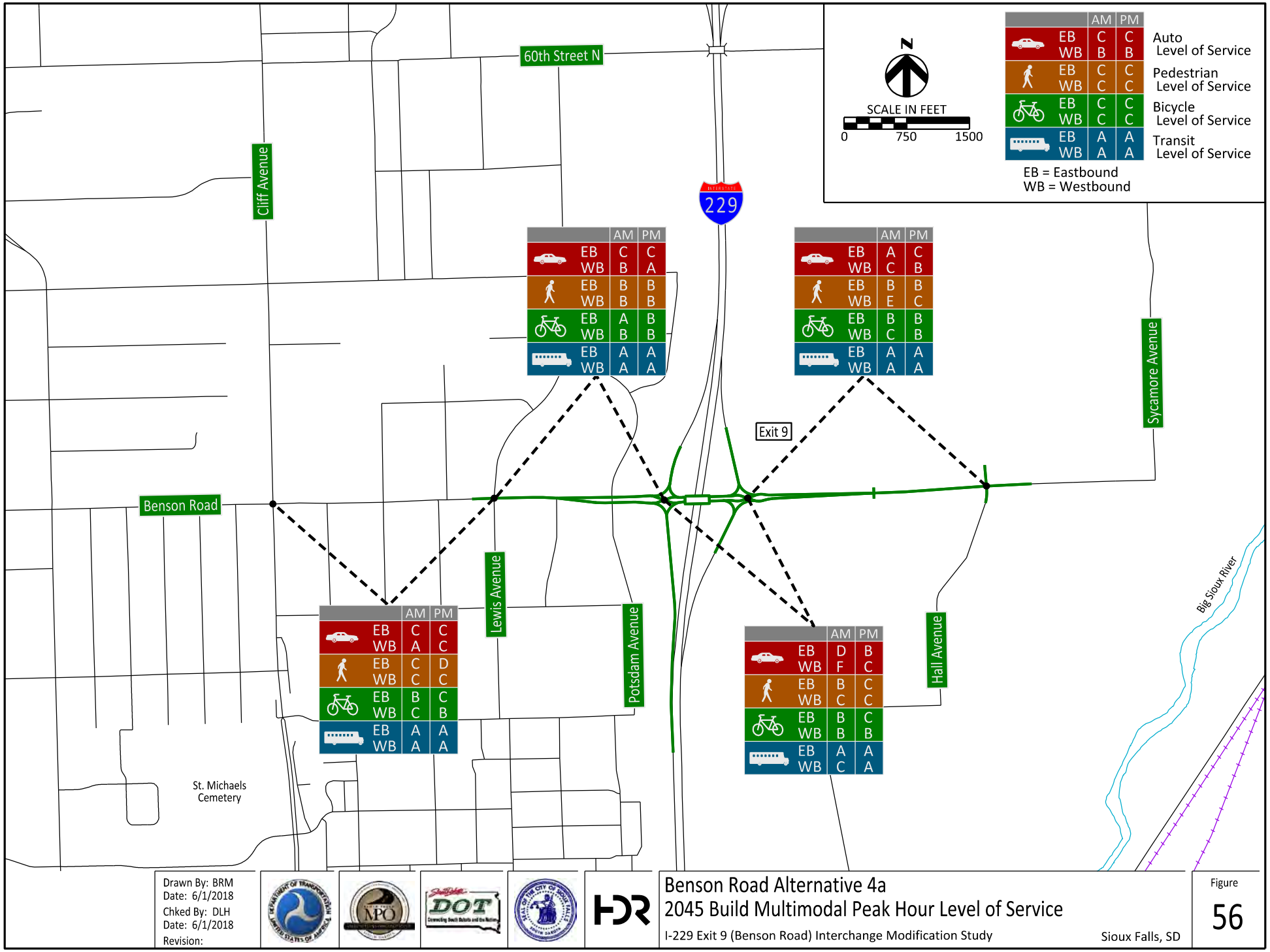
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1e
2045 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 55



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 4a
2045 Build Multimodal Peak Hour Level of Service
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 56

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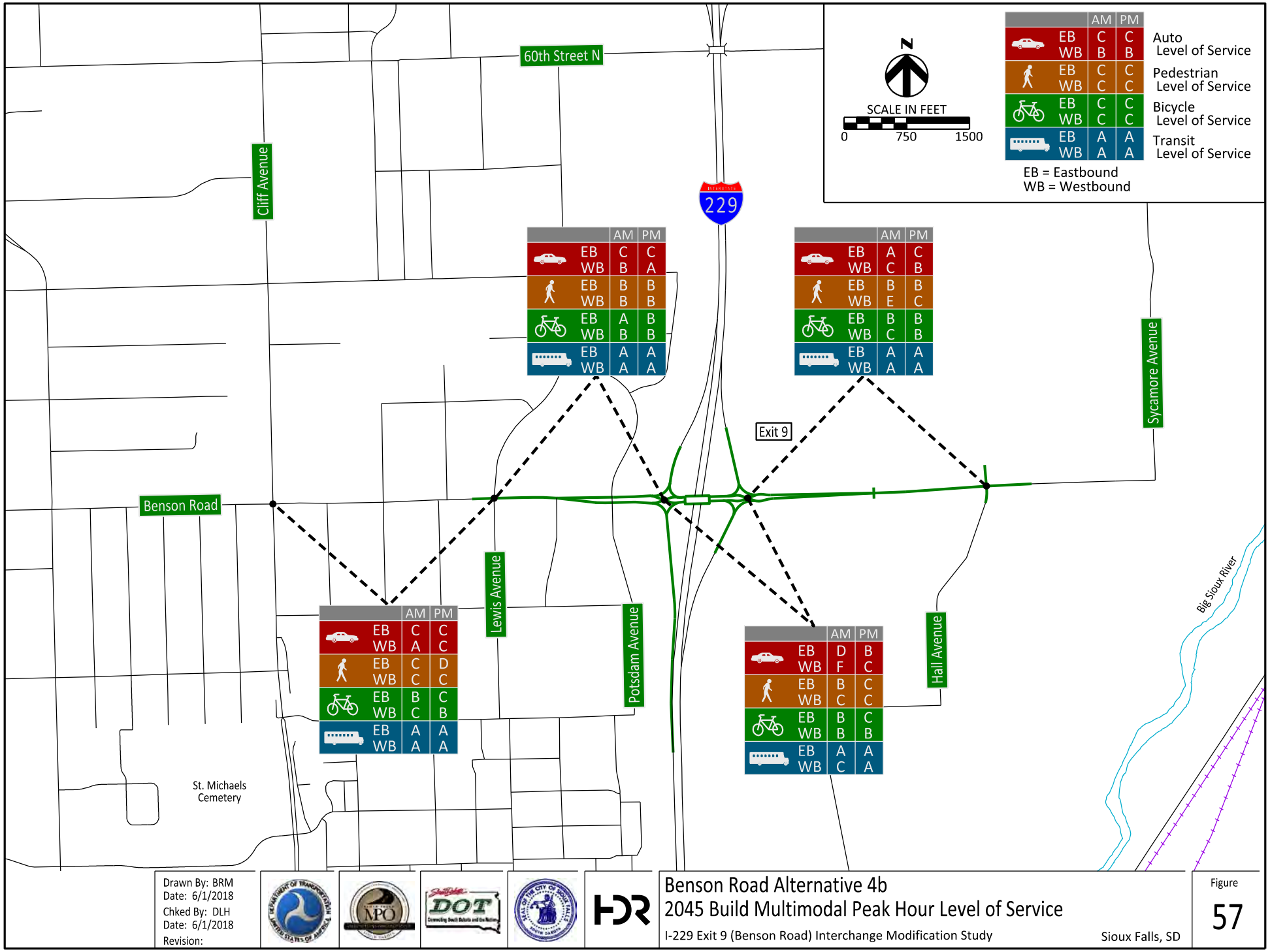
PLOTTING DATE: 10-09-2018



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Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 4b
2045 Build Multimodal Peak Hour Level of Service
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 57

FILE: ...\Figure 57 (MM 2045).dgn
PLOTTING DATE: 10-09-2018

Safety

The build alternatives are a modified diamond interchange containing a dual-lane loop ramp (DLLR) in the northeast quadrant and a Diverging Diamond Interchange (DDI), which would replace the existing diamond interchange.

The analysis limits for the predictive safety analysis are focused on the immediate interchange area as shown in **Figure 58**. On I-229, the limits extend from the interchange of I-229 / Rice Street to the interchange of I-229 / I-90, for a total distance of 2.3 miles. In addition to the freeway, the four interchange ramps and the two ramp terminals were analyzed.

Three alternatives were evaluated with this predictive safety analysis. The “No-Build” alternative maintains the existing diamond interchange layout. The second alternative adds a dual-lane loop ramp in the northeast quadrant to serve northbound I-229 traffic turning west onto Benson Road. This alternative would also reconfigure the alignments and lane layouts for other ramps, but they would still maintain the traditional diamond interchange layout. The third alternative would convert the interchange to a diverging diamond interchange. Within these general configurations, the IMJR includes review of several variations of the DLLR and DDI. However, the crash prediction analysis herein is based on the DLLR concept numbered 1a and the DDI concept denoted 4a.

The predictive crash analysis presented in this memorandum is based on the principles and methods of the Highway Safety Manual (HSM) 2010 edition with 2014 supplement published by AASHTO as discussed in detail below. It presents a comparative analysis of the predicted crashes anticipated within the interchange area for the “No-Build” future condition (maintain diamond interchange) and the planned build alternatives (DLLR and DDI). The results are intended to verify the assumption that the construction of a DLLR or DDI at this location will not result in a decrease in overall safety performance in the interchange area.

Figure 58 – IHSDM Analysis Limits

Source: Google Earth, April 2018

Safety Methodology

This predictive safety analysis was completed using the American Association of State Highway and Transportation Officials (AASHTO) HSM method, including the National Cooperative Highway Research Program (NCHRP) Report 17-45 method for evaluating freeways and interchanges, which is now part of the HSM as a supplemental volume published in 2014.

FHWA supports, and in many cases now requires, the use of the method for the evaluation of proposed freeway facility improvements, including new or modified Interstate access. According to the HSM preface: *"The focus of the HSM is to provide quantitative information for decision making. The HSM assembles currently available information and methodologies on measuring, estimating, and evaluating roadways in terms of crash frequency (number of crashes per year) and crash severity (level of injures due to crashes). The HSM presents tools and methodologies for consideration of 'safety' across the range of highway activities …"*

For this study, the HSM predictive method was used. *"The predictive method provides a quantitative measure of expected crash frequency under both existing conditions and conditions which have not yet occurred. This allows proposed roadway conditions to be quantitatively assessed …"* (HSM, 2010)

The HSM method crash prediction estimates are developed using safety performance functions (SPFs) for specific facility types. The SPFs take into account the daily traffic volume information, but they assume that other geometric and traffic control features match a theoretical base condition for that facility type. Therefore, crash modification factors (CMFs) are used to make adjustments to the initial SPF results, to account for differences between the actual analysis condition and the theoretical base condition. A CMF of 1 means the analysis condition and the theoretical base condition will predict the same number of crashes. Thus, if a CMF is greater than 1, that will increase the number of predicted crashes, while if it is less than 1, it will decrease the number of predicted crashes. For example, if a depressed freeway median is narrower than the assumed 60-foot base condition, then a CMF greater than 1 is applied to adjust the SPF results for the segment.

The HSM methodology has been in development for many years and is rapidly advancing; however, there are still many limitations where the available tools do not yet offer SPFs and/or CMFs for certain conditions. Where this is the case, recent research and crash data were also considered to refine the results as described later in this section.

Facilities, Segmentation and Data Inputs:

In keeping with the site based HSM analysis approach, each type of facility was examined separately. This involved segmenting the I-229 mainline and the I-229 ramps into functional elements. The Interactive Highway Safety Design Model (IHSDM) software automatically segments highways (including freeway segments, ramps and C-D roads) following HSM guidance. The ramp terminal intersections were also considered individually. IHSDM reports provided in **Appendix 6** list all freeway, ramp, and ramp terminal intersection sites that were reviewed.

The HSM method requires several geometric and operational inputs to accurately compute the SPFs and apply the correct CMFs. This includes information such as segment length, daily traffic volume, ramp locations, merge distances, and horizontal curvature. The geometric inputs were primarily obtained from the conceptual design files and aerial photography. The traffic volume data was based on data and design year volume forecasts from the 2040 Sioux Falls Travel Demand Model.

I-229 Mainline Segments

The I-229 mainline segments were evaluated using HSM methods implemented using the Interactive Highway Safety Design Model (IHSDM) version 13.1.0 software provided by FHWA.

I-229 Entrance and Exit Ramps

The I-229 entrance and exit ramps were also evaluated using HSM methods in the IHSDM software. Consistent with this method, each ramp was evaluated as one or more specific ramp segments, taking into account the ramp geometry. Some of the ramps were subdivided into multiple segments to account for changes in number of lanes or shoulder widths.

In the DLLR alternative, the I-229 Northbound exit ramp traverses a portion of two-lane ramp alignment with a tight curve radius before intersecting Benson Road. The condition is uncommon in practice and was very likely unobserved or under-sampled in the development of the HSM crash prediction models. Past research for SDDOT on this gap in the crash prediction methodology led to the "Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI) and Two-Lane Loop Ramp" memo dated November 4th, 2015. In the memo, it is recommended to analyze the two-lane loop ramp, now called DLLR, with standard HSM procedures with greater scrutiny unless the research results of NCHRP 03-105 should develop enhanced models / guidance. The referenced research project was published in 2017 as NCHRP Web-Only Document 227: Design of Interchange Loop Ramps and Pavement/Shoulder Cross-Slope Breaks. The report includes a chapter reviewing the HSM procedure for loop ramps against directional ramps, but does not make recommendations on the specific DLLR geometry. The report's most poignant comment on loop ramp crash prediction is that *"HSM prediction models for ramp crashes do a better job of predicting diamond ramp crashes than predicting loop ramp crashes",* which the researchers arrived at through advanced statistical analysis of geometry and crash data.

Benson Road Ramp Terminals

For the No-Build and Build options, the ramps connect to Benson Road at signalized and non-signalized intersections. Interchange ramp terminals are evaluated using the HSM ramp terminal procedure in IHSDM. The IHSDM ramp terminal method does not, however, address DDIs. It only predicts crashes for a variety of more typical diamond and partial cloverleaf interchange ramp terminals. Therefore, it was necessary to develop an estimate for an "operationally-similar" diamond interchange design and then use CMFs from HDR's "Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI) and Two-Lane Loop Ramp" memo dated November 4th, 2015 to modify the results to estimate the predictions for a DDI design. Based on research done in Missouri on safety evaluations of DDIs, the preliminary CMF for conversion of a traditional diamond interchange to a DDI is 0.37 for Fatal + Injury (F+I) crashes at ramp terminal intersections and 0.49 for Property Damage Only (PDO) crashes at ramp terminal intersections.

Benson Road Segments

Crash prediction for an interchange study area within a typical urban footprint can be almost entirely described by evaluating the crashes from the freeway, freeway ramps, and ramp terminal intersections due to how the HSM defines the influence area for those types of sites. For that reason, this analysis does not report urban arterial crashes outside of those estimated directly through ramp terminal analysis. Given the emerging nature of both the DLLR and DDI configurations in crash prediction practice, it is likely that the base HSM models would struggle

to replicate the crash patterns for the proposed Benson Road configuration between the interchange ramp terminals.

Calibration Factors:

According to the HSM, *"the predictive models were developed from the most complete and consistent data sets available."* However, the report also recommends that the equations be calibrated for each jurisdiction because *"the general level of crash frequencies may vary substantially from one jurisdiction to another."* However, SDDOT has not yet conducted the extensive analyses required to develop a complete set of HSM related calibration factors. Therefore, using the national HSM equations is proposed as the best approach for this current analysis.

Empirical Bayes Approach: Considering Historical Crash Data:

The HSM method includes an optional step called the Empirical Bayes (EB) approach, which combines "*the estimate from a predictive model with observed crash data to obtain a more reliable estimate of the expected average crash frequency."* (HSM, 2010) Essentially, the historical crash data is used to adjust the future crash prediction. Typically, the EB method is only used when it can be applied equally to all of the alternatives under consideration. Thus the improvements being considered must be moderate, so that the historical crash data is reasonable to consider for the No-Build and Build conditions. When major alignment or traffic control changes are proposed (such as the proposed DLLR or DDI), it is not used because *"there is typically a small difference in the results obtained from the predictive method when it is used with and without the EB Method."* Therefore, *"if the EB Method is not applied consistently, such differences will likely introduce a small bias in the comparison of expected crash frequency among alternatives."* (HSM Supplement, 2014) Therefore, the results are presented without the EB method adjustment.

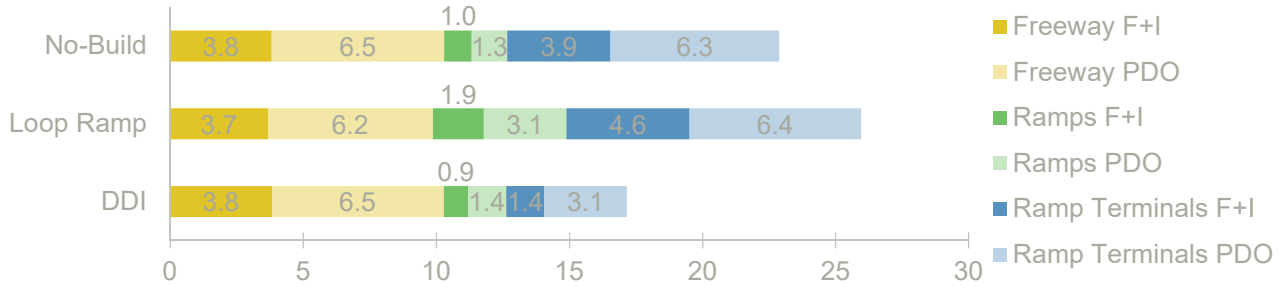
Safety Analysis Results

The No-Build and Build interchange alternatives were evaluated and the predicted number of crashes was compared for the 2023 to 2045 analysis period. As mentioned previously, the required inputs were derived from design plans, aerial photography, and traffic volume data from the 2040 Sioux Falls Travel Demand Model. The following sections present the details of the analyses.

Build and No-Build Crash Frequency Comparison:

The predicted annual crash frequencies for the No-Build and Build scenarios (2023 to 2045) are presented in **Table 7** including a breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes. The resulting total number of annual predicted crashes is 26.0 for the DLLR concept, 17.2 for the DDI concept, and 22.9 predicted crashes for the No-Build condition. The No-Build and Build detailed IHSDM results sheets are provided in **Appendix 6**.

Table 7: 2023 to 2045 Predicted Build and No-Build Annual Crash Frequencies



As shown, the majority of predicted crashes for all scenarios occur on the freeway and at the ramp terminal intersections. The freeway crashes for the Build scenarios introduce small changes in the predicted number of crashes versus the No-Build. The ramp crashes are expected to increase due to added lanes and additional length on some of the ramps.

Focusing on the ramp terminals, the DLLR ramp terminal crashes are expected to increase by 8% and the DDI ramp terminal crashes are expected to be reduced by 56%. The reduction for the DDI is consistent with what would be expected from eliminating left-turns with the DDI concept. The DLLR findings are more surprising given that the loop ramp re-aligns a significant amount of traffic from a left turn movement to a right turn movement at the northbound ramp terminal. A more in-depth review of this site does show that the DLLR reduces total crashes from 7 crashes per year to 2.5 crashes per year, consistent with the significant amount of traffic that has moved to the loop ramp and no longer would be in conflict with cross street traffic. This means the net increase in ramp terminal crashes is projected to happen entirely at the southbound ramp terminal. The primary consideration in this increase is the traffic control device at the intersection as the No-Build assumes a continuation of the stop-controlled condition where the DLLR alternative recommends a traffic signal to improve traffic operations. Since there is not a traffic signal planned for the southbound ramp terminal, it was not considered for the No-Build scenario, even though operations would degrade to a failing level of service condition if volumes increased to the 2045 forecasted levels.

Considering predicted crash severity, the DDI concept may decrease the number of F+I crashes at the ramp terminals by 63% while the DLLR concept may increase F+I crashes by 17%. In addition, the DDI concept may decrease the number of PDO crashes at the ramp terminals by 51% while the DLLR concept may increase by 2%. This result took into account the significant reduction in F+I crashes observed at DDIs compared to standard diamond interchanges in the Missouri research (63% reduction).

Safety Conclusions

Based on the preceding HSM analysis, it is concluded that the DDI interchange is likely to exhibit significantly less overall crash frequencies than the existing diamond interchange. The DLLR would likely result in an increase in crashes, but this is due to a longer northbound ramp, and the southbound terminal being signalized instead of stop-controlled. The northbound terminal, in this scenario, would be expected to have a decrease in crashes compared to the No-Build. The freeway crashes for the Build scenarios introduce small changes in the predicted number of crashes versus the No-Build. The ramp crashes are expected to increase due to added lanes and additional length on some of the ramps. The ramp terminal crashes are expected to be reduced by 56% for the DDI and increased by 8% for the DLLR. The DDI has an even better crash benefit when looking at F+I crashes. The DDI reduces F+I crashes at the ramp terminals by 63%, compared to an increase of 19% for the DLLR. The PDO crashes at the ramp terminals are reduced by 51% for the DDI and an increase of 2% for the DLLR. The DDI

alternative would be expected to provide significant safety benefits compared to the No-Build, but the DLLR alternative would likely result in an increase of crashes compared to the No-Build.

3.4 Alternatives Analysis

Option 1a: 2 Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp

Option 1a (Figure I-1) proposes a northbound off-ramp with separation of eastbound and westbound traffic on Benson Road. This separation reduces the amount of vehicles queued at the existing signal and the eastbound off ramp skew supports one-way eastbound turning movement. On Benson Road the additional proposed eastbound lane, increased to three total from Lewis Avenue to the east to I-229 and the three lane southbound on-ramp also reduces queuing significantly.

Benefits of Option 1a:

- Free flow northbound I-229 to westbound Benson Road due to loop and no signal.
- Traffic Level of Service (LOS) B is forecast at the interchange for year 2045 conditions.
- Pedestrian underpass reduces conflict with vehicles using the northbound on ramp and the larger volume of traffic on the loop ramp for the westbound Benson Road traffic.
- Free-flow dual rights on Benson Road eastbound to I-229 southbound reduces congestion/queuing on Benson Road between Lewis Avenue and I-229. Free-flow is only interrupted for pedestrian movement.
- Access management treatments considered with installation of raised median.

Drawbacks of Option 1a:

- The construction of the ramps requires substantial right of way acquisition and grading costs associated with constructing a new loop ramp and removal of the existing ramps.
- Option 1a could result in additional crashes compared to the no-build due to added lanes and additional length on some of the ramps.
- Although the pedestrian underpass in this option reduces conflict, the additional cost per pedestrian and bicycle user is high.
- Due to the increased right of way and grading impacts to environmental resources are higher with this option compared to non-loop ramp options.

It is recommended that Option 1a be eliminated from further evaluation for these reasons:

- *Total right of way necessary to be acquired.*
- *High construction cost*

Option 1b: 2 Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp

Option 1b (Figure I-2) is very similar to Option 1a. Proposes a northbound off-ramp with separation of eastbound and westbound traffic on Benson Road. This separation reduces the amount of vehicles queued at the existing signal and the eastbound off ramp skew supports one-way eastbound turning movement. The proposed Benson Road eastbound lanes and two

southbound on-ramp lanes from Lewis Avenue to the east to the southbound on-ramp also reduces queuing, however, not as efficient as Option 1a.

Benefits of Option 1b:

- Free flow northbound I-229 to westbound Benson Road due to loop and no signal.
- Traffic Level of Service (LOS) B is forecast at the interchange for year 2045 conditions.
- Pedestrian underpass reduces conflict with vehicles using the northbound on ramp and the larger volume of traffic on the loop ramp for the westbound Benson Road traffic.
- Single free-flow right turn lane on Benson Road eastbound to I-229 southbound reduces congestion/queuing on Benson between Lewis Avenue and I-229. Free-flow is only interrupted for pedestrian movement.
- Access management treatments considered with installation of raised median.

Drawbacks of Option 1b:

The construction of the ramps requires a substantial amount of right of way acquisition and grading costs associated with constructing a new loop ramp and removal of existing ramps.

- Option 1b is anticipated to create more crashes compared to the no-build due to added lanes and additional length on some of the ramps.
- Although the pedestrian underpass in this option reduces conflict, the additional cost per pedestrian and bicycle user is high.

It is recommended that Option 1b be eliminated from further evaluation for these reasons:

- *Total right of way necessary to be acquired.*
- *High construction cost.*

Option 1c: 2-Lane Collector – Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp

Option 1c (Figure I-3) proposes a northbound off-ramp with separation of eastbound and westbound traffic on Benson Road while reducing the grading and right of way necessary by implementing a Collector-Distributor lane. The separation of eastbound and westbound vehicles on Benson Road is similar to Options 1a and 1b. The additional proposed eastbound lanes, totaling three, on Benson Road from Lewis Avenue to the east to the southbound on-ramp also reduces queuing significantly.

Benefits of Option 1c:

- The CD lane reduces the amount of right of way acquisition and grading costs associated with the northbound off-ramp.
- Free flow northbound I-229 to westbound Benson Road due to loop and no signal.
- Traffic Level of Service (LOS) B is forecast at the interchange for year 2045 conditions.
- Pedestrian underpass reduces conflict with vehicles using the northbound on ramp and the larger volume of traffic on the loop ramp for the westbound Benson Road traffic.
- Dual rights on Benson Road for eastbound to I-229 southbound reduces congestion/queuing on Benson Road eastbound between Lewis Avenue and I-229.

- CD lane enhances safety by allowing more distance and separation for vehicles slowing to exit and remain adjacent to the high-speed mainline.

Drawbacks of Option 1c:

- Option 1c is anticipated to create more crashes compared to the no-build due to added lanes and additional length on some of the ramps.
- Although the pedestrian underpass in this option reduces conflict, the additional cost per pedestrian and bicycle user is high.

It is recommended that Option 1c be eliminated from further evaluation for this reason:

- *High construction cost.*

Option 1d: 2-Lane Partial Clover Leaf Northeast Quadrant Loop with 2-Lane SB On-Ramp

Option 1d (Figure I-4) proposes a signalized loop at the intersection of Benson Road. Right-turn on red would not be allowed.

Benefits of Option 1d

- Access Management treatments considered with installation of raised median

Drawbacks of Option 1d:

- Does not meet Purpose and Need. The Level of Service falls below the acceptable level C because the right turn on red movements would not be allowed to operate as a free-flow movement.
- The construction of the ramps requires substantial right of way acquisition and grading costs associated with constructing a new loop ramp and removal of the existing ramps.

It is recommended that Option 1d be eliminated from further evaluation for these reasons:

- *This option does not meet the acceptable Level of Service.*
- *Total right of way necessary to be acquired.*
- *High construction cost*

Option 1e: 2-Lane Partial Clover Leaf Northeast Quadrant Loop with CD Lane 2-Lane and 2-SB On-Ramp

Option 1e (Figure I-5) proposes is similar to Option 1d with the exception of the CD lane. Right turn on red will not be allowed at the off-ramp for westbound traffic on Benson Road.

Benefits of Option 1e:

- Access management treatments considered with installation of raised median.

Drawbacks of Option 1e:

- Does not meet Purpose and Need. The Level of Service falls below the acceptable level C because the right turn on red movements would not be allowed to operate as a free-flow movement.
- The construction of the ramps requires substantial right of way acquisition.

It is recommended that Option 1e be eliminated from further evaluation for these reasons:

- *This option does not meet the acceptable Level of Service.*
- *Total right of way necessary to be acquired.*

Option 4a: Diverging Diamond Interchange (DDI) with 3-Lane SB On-Ramp; Add 2 WB Lanes to Existing Overpass

Option 4a (Figure I-6) proposes a diverging diamond interchange with a three lane southbound on-ramp for eastbound traffic on Benson Road. This option proposes adding onto the existing structure and converting it to a DDI. The existing structure would be the four westbound lanes.

Benefits of Option 4a:

- Fewer crashes expected compared to the other build alternatives developed. The predicted annual traffic accidents reduces 25% from the no-build option.
- Traffic Level of Service (LOS) C is worst case forecast at the interchange in the morning for the northbound ramp for year 2045 conditions.
- Cost of construction reasonable due to limited amount of grading and reduced right of way acquisition.
- Requires no additional right of way on I-229.
- Fewer impacts to wildlife habitat, wetlands, and other environmental resources due to less grading and right of way.

Drawbacks of Option 4a:

- Adding onto the existing overpass to accommodate the DDI adds cost compared to a new structure over I-229. Cost of this structure is similar but slightly lower compared to other options.
- Out of the two DDI's the construction costs for this option are the higher of the two.

It is recommended that Option 4a be carried forward for further evaluation and refinement for these reasons:

- *Expected reduction in annual total crash numbers resulting in improved safety*
- *Lower construction cost than the other options*
- *Fewer environmental impacts*

Option 4b: Diverging Diamond Interchange (DDI) with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB Lanes.

Option 4b (Figure I-7) proposes a diverging diamond interchange with a three lane southbound on-ramp for eastbound traffic on Benson Road. This option proposes constructing a new and separate structure for the future two eastbound lanes of the DDI and converting the existing structure into the four lanes for the westbound traffic.

Benefits of Option 4b:

- Least amount of crashes expected compare to other build alternatives developed. The predicted annual traffic accidents reduces 25% from the no-build option.
- Traffic Level of Service (LOS) C is worst case forecast at the interchange in the morning for the northbound ramp for year 2045 conditions.
- This option has the lowest estimated construction cost due to limited amount of grading and reduced right of way lower structure costs.
- Requires no additional right of way on I-229.
- Fewer impacts to wildlife habitat, wetlands, and other environmental resources due to less grading and right of way.
- Out of the two DDI's, using the existing structure for maintenance of traffic creates the least amount of impact.

Drawbacks of Option 4b:

- Adding the proposed structure to the north of the existing structure may require additional coordination with private utilities.

It is recommended that Option 4b be carried forward for further evaluation and refinement for these reasons:

- *Reduced number of annual total crashes; increased safety*
- *Lower construction cost than the other options*
- *Fewer environmental impacts*

The Build Options Evaluation Memo and corresponding evaluation matrix is provided in **Appendix 7**. A summary of the build option recommendations are provided in **Table 8** and **Table 9**.

Table 8 - Build Options to Carry Forward

Options recommended to be carried forward for further refinement and evaluation

Option	Interchange Description	Main reason(s) for carrying forward
4a	Diverging Diamond Interchange (DDI) with 3-Lane SB On-Ramp. Add 2 WB Lanes to Existing Overpass	• Minimal cost and impacts compared to other options • Increase in safety compared to other options • Decrease in traffic accidents compared to no-build by 25% • Less impact to environmental resources
4b	Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB Lanes	• This option is the least expensive of all the options discussed • Increase in safety in compared to other options • Decrease in traffic accidents compared to no-build by 25% • Less impact to environmental resources

It is recommended that both options be justified within the Interchange Modification Study and final bridge option will be determined during preliminary and final design.

Table 9 - Build Options to Eliminate

Options recommended to be eliminated from further evaluation

Option	Interchange Description	Main reason(s) for not carrying forward
1a	2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp	• Additional right of way acquisition • High construction cost
1b	2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp	• Additional right of way acquisition • High construction cost
1c	2-Lane Collector – Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp	• High construction cost • Greater impact to environmental resources
1d	2-Lane Partial Clover Leaf Northeast Quadrant Loop with 2-Lane SB On-Ramp	• This option does not meet the acceptable Level of Service • Additional right of way acquisition • High construction cost • Greater impact to environmental resources
1e	2-Lane Partial Clover Leaf Northeast Quadrant Loop with CD Lane 2-Lane and 2-SB On-Ramp	• This option does not meet the acceptable Level of Service. • High construction cost • Greater impact to environmental resources

3.5 Conceptual Signing Plan

A conceptual signing plan for each design alternative is provided in **Appendix 8**.

4.0 Funding Plan

The Benson Road Interchange project PE is programmed in the Statewide Transportation Improvement Program (STIP) for 2022 with construction in the 2023-2025 timeframe. Current SDDOT Budget Estimates for the interchange improvements are shown below.

Table 10 - Anticipated Funding Allocation

Project Number	State Funding Category	Federal Funding Category	Federal Funds ($ million)	State Funds ($ million)	Other Funds ($ million)	Total Funds ($ million)
IM 2292(98)6 P, PCN 04XK	Interstate	National Highway Performance Program (NHPP)	15.036	2.464	0	17.5
P 1200 ( ) P, PCN 06MM	Local Urban Systems	Surface Transportation Block Grant (STBG)	9.691	2.809	0	12.5
Total			24.727	5.273	0	30.000

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

Inflated costs to year of implementation are calculated at $34.0 million.

5.0 Recommendation

The results of this technical analysis indicate that a modified interchange configuration on I-229 at Benson Road in Sioux Falls, SD will provide future operational and safety benefits. Further, the analysis indicates that a diverging diamond interchange configuration is the recommended option and will have fewer environmental impacts than the other build interchange alternatives. The recommended diverging diamond interchange alternatives are displayed in **Figure I-6** and **Figure I-7** following the considerations and requirements for Interstate access.

The two considerations and requirements for the Interstate access are addressed below:

1. **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, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should 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 (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should 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 (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

The operational and safety analysis contained in this study shows that the proposed Diverging Diamond build scenarios are not expected to adversely affect the safety or efficiency of the Interstate system, including the mainline lanes, modified ramps, ramp intersections with the crossroad, and local street network based upon the current and future traffic projections. The Build and No-build scenarios were evaluated for operational capacity using Highway Capacity Manual 2010 techniques via HCS 2010. All Build scenarios maintain a LOS "C" or better for all Interstate facilities for the build year (2023) and future year (2045) forecast traffic volumes. Additionally, a predictive safety analysis was completed for the Build and No-build scenarios using the AASHTO HSM method, including the NCHRP Report 17-45 method for evaluating freeways and interchanges via the IHSDM version 13.1.0 software. The recommended diverging diamond interchange configuration is likely to exhibit significantly less overall crash frequencies than the existing diamond interchange.

All recommended build alternatives are also expected to improve access management and satisfactorily accommodate design year traffic volumes on the crossroad in the vicinity of the interchange. The crossroad in the vicinity of the interchange (Benson Road) was also evaluated for operational capacity and maintains a minimum LOS "C" at the interchange ramp terminals and meets minimum LOS thresholds as established by the local jurisdiction for signalized intersections on arterial streets under 2045 forecast traffic volumes. Access management on the arterial corridor will be achieved with the installation of a median and limiting left turns to specific street intersections.

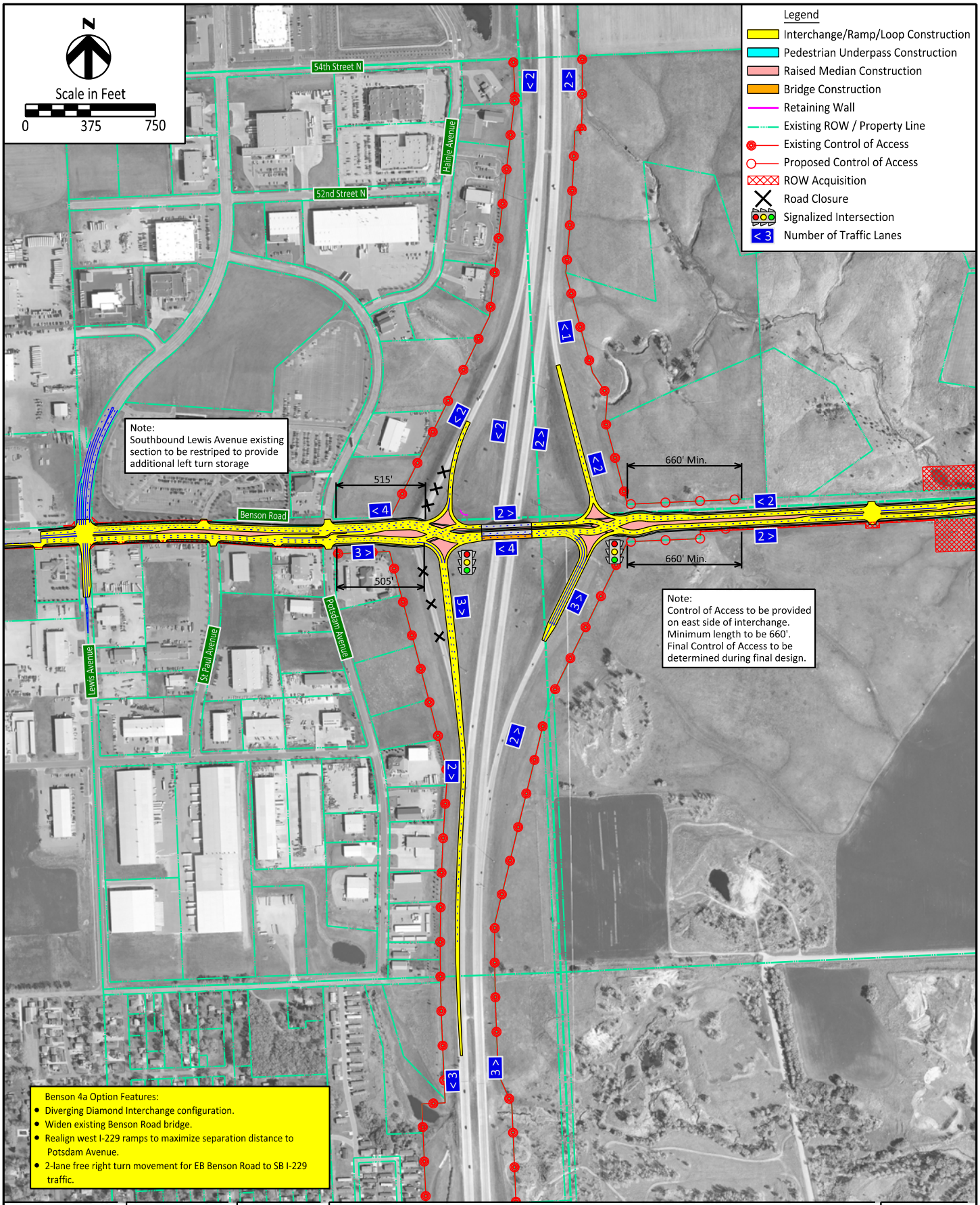
The study area included the interchanges north and south of the Benson Road interchange and extends from Exit 7(Rice Street) to Exit 10 (I-90) on I-229. The adjacent interchange ramps and Interstate segments were analyzed under 2023 and 2045 traffic forecast volumes and are expected to operate at LOS "C" or better.

The conceptual signing plan for the recommended Diverging Diamond alternative is displayed following the considerations and requirements for Interstate access section of this report. A conceptual signing plan has been developed and included in Section 8 of the Appendix for each additional design alternative.

2. **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, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The**

report should describe whether future provision of a full interchange is precluded by the proposed design.

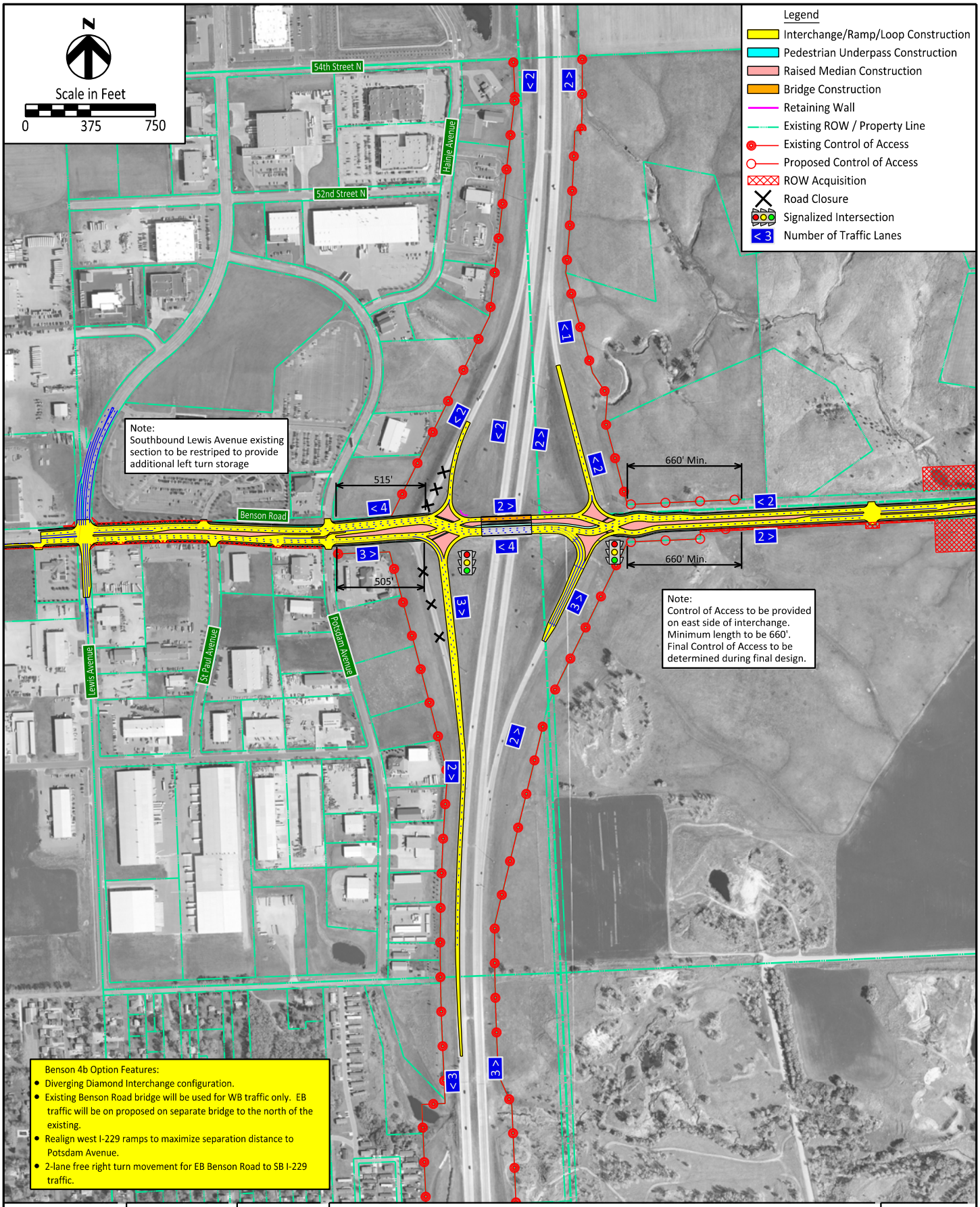
The proposed access is a reconfiguration of an existing interchange with full access to an arterial city street and includes all movements. The proposed change does not result in any new access points on the Interstate Highway System The conceptual drawings have been prepared using current standards and further design using current standards is anticipated. Additional refinement will take place during the environmental and design phases of the project.



Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 12/4/2018

Alternative Scenario 4a
Diverging Diamond Interchange with 3-Lane SB On-Ramp
Add 2 WB Lanes to Existing Overpass.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

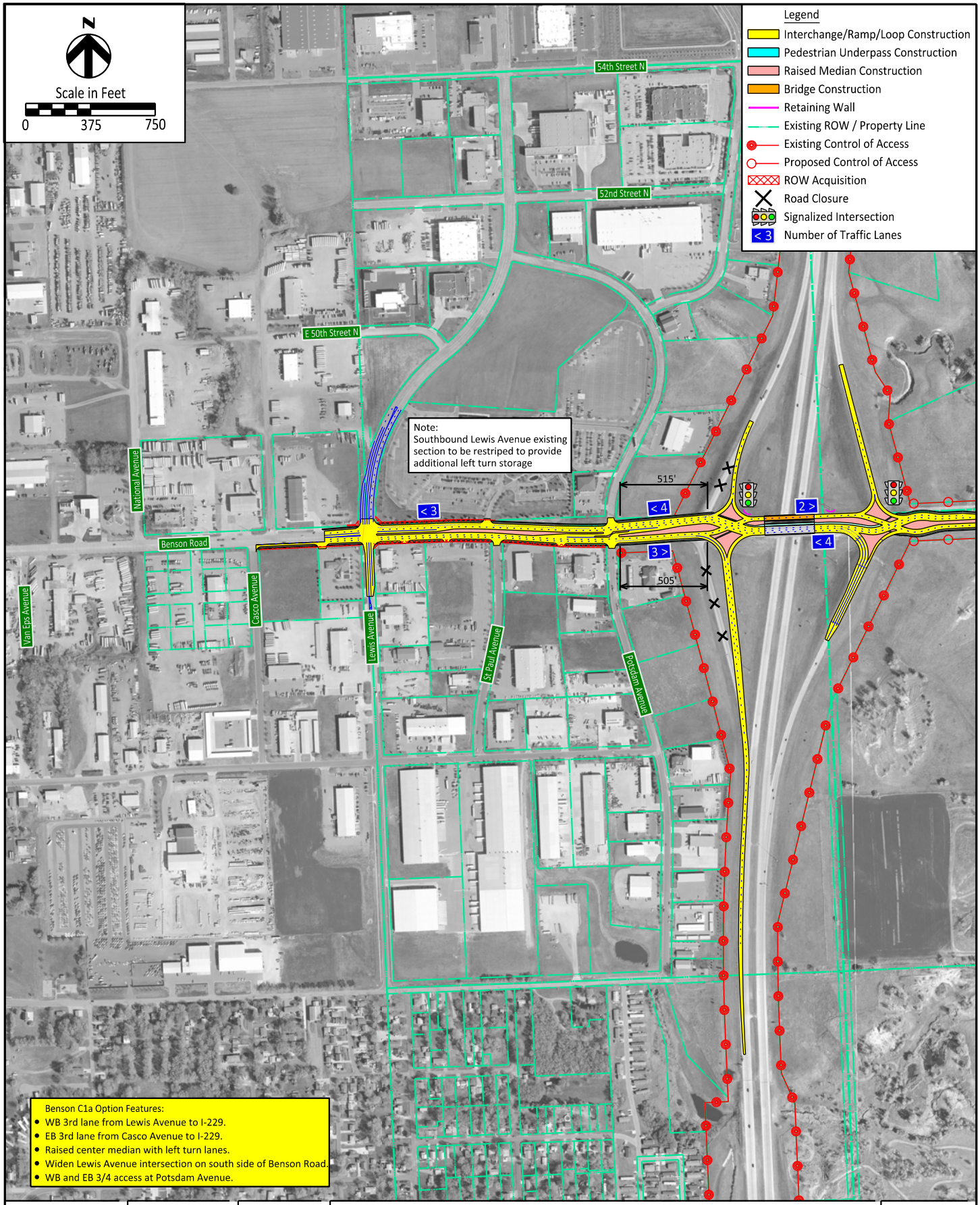
Figure
I-6



Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 12/4/2018

Alternative Scenario 4b
Diverging Diamond Interchange with 3-Lane SB On-Ramp
Add a Separate Structure for 2 EB Lanes
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
I-7



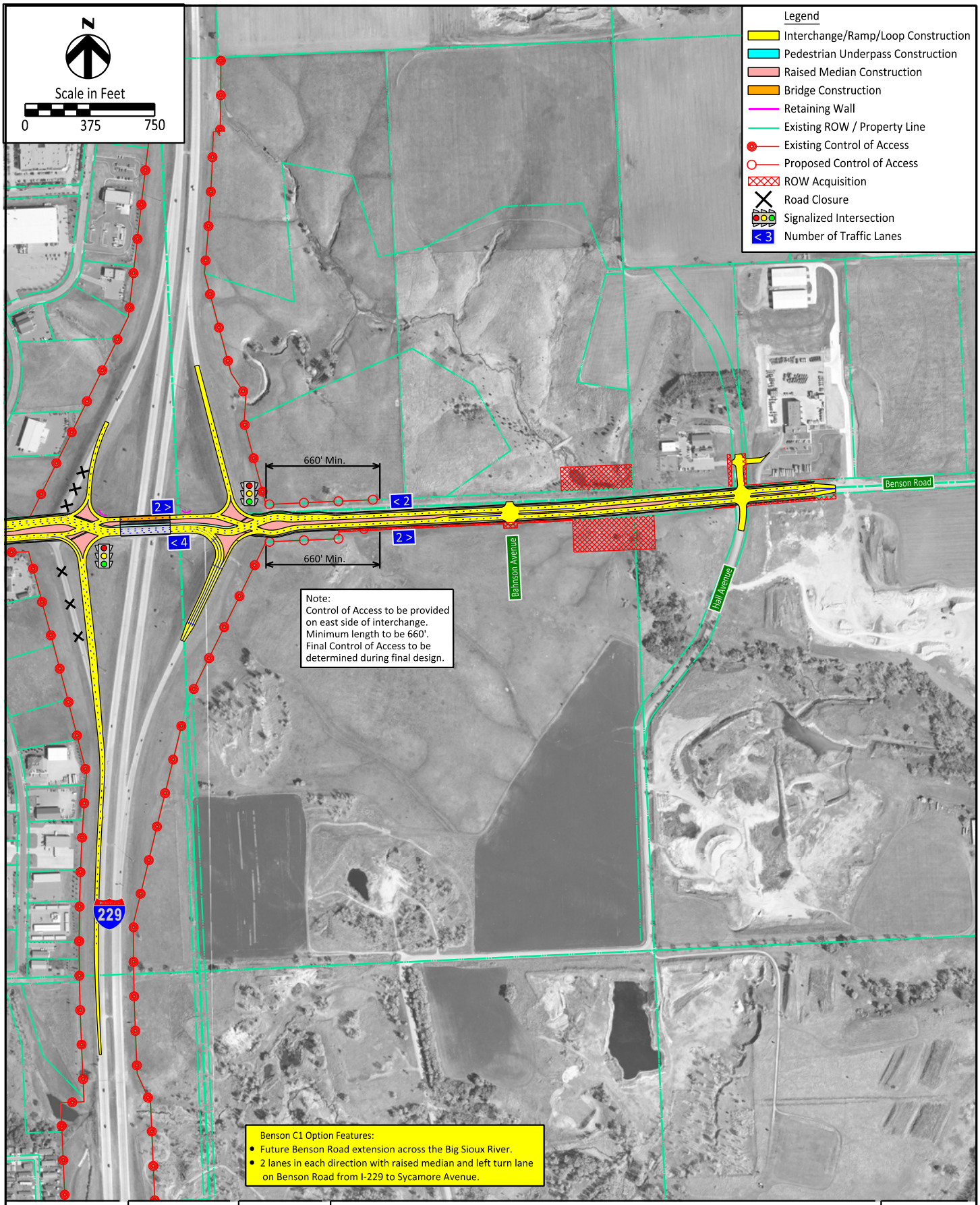
Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 10/8/2018

Alternative Scenario Benson Road
Westbound 3rd Lane from Lewis Avenue to I-229

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure
A-1



Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision: 12/4/2018

Alternative Scenario Benson Road
4-Lane Divided Section to Hall Avenue east of I-229

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure
A-2

Legend

- Interchange/Ramp/Loop Construction
- Pedestrian Underpass Construction
- Raised Median Construction
- Bridge Construction
- Road Closure
- Signalized Intersection

N

Scale in Feet

0 200 400

St Paul Avenue

Benson Road

Potsdam Avenue

52nd Street N

54th Street N

Hainje Avenue

RIGHT LANE MUST TURN RIGHT

RIGHT LANE MUST TURN RIGHT

ONLY

ONLY

ONLY

EXIT 9

EXIT 9

SOUTH

229

SOUTH

229

NORTH

229

NORTH

229

229

West Benson Road

North Lewis Ave

North Potsdam Ave

East Benson Road

The existing ½ mile and 1 mile advance guide signs for I-229 SB Exit 9 to remain.

Drawn By: B.Miller
Date: 7/27/2018
Chked By: P.Sanow
Date: 7/27/2018
Revision: 11/15/2018

Alternative Scenario 4a
Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add 2 WB Lanes to Existing Overpass.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
S-I-6

Legend

- Interchange/Ramp/Loop Construction
- Pedestrian Underpass Construction
- Raised Median Construction
- Bridge Construction
- Road Closure
- Signalized Intersection

N

Scale in Feet

0 200 400

St Paul Avenue

Benson Road

Potsdam Avenue

52nd Street N

54th Street N

Hainje Avenue

RIGHT LANE MUST TURN RIGHT

RIGHT LANE MUST TURN RIGHT

SOUTH 229

SOUTH INTERSTATE 229

ONLY

ONLY

ONLY

EXIT 9

EXIT 9

NORTH 229

NORTH INTERSTATE 229

INTERSTATE 229

West Benson Road

North Lewis Ave

North Potsdam Ave

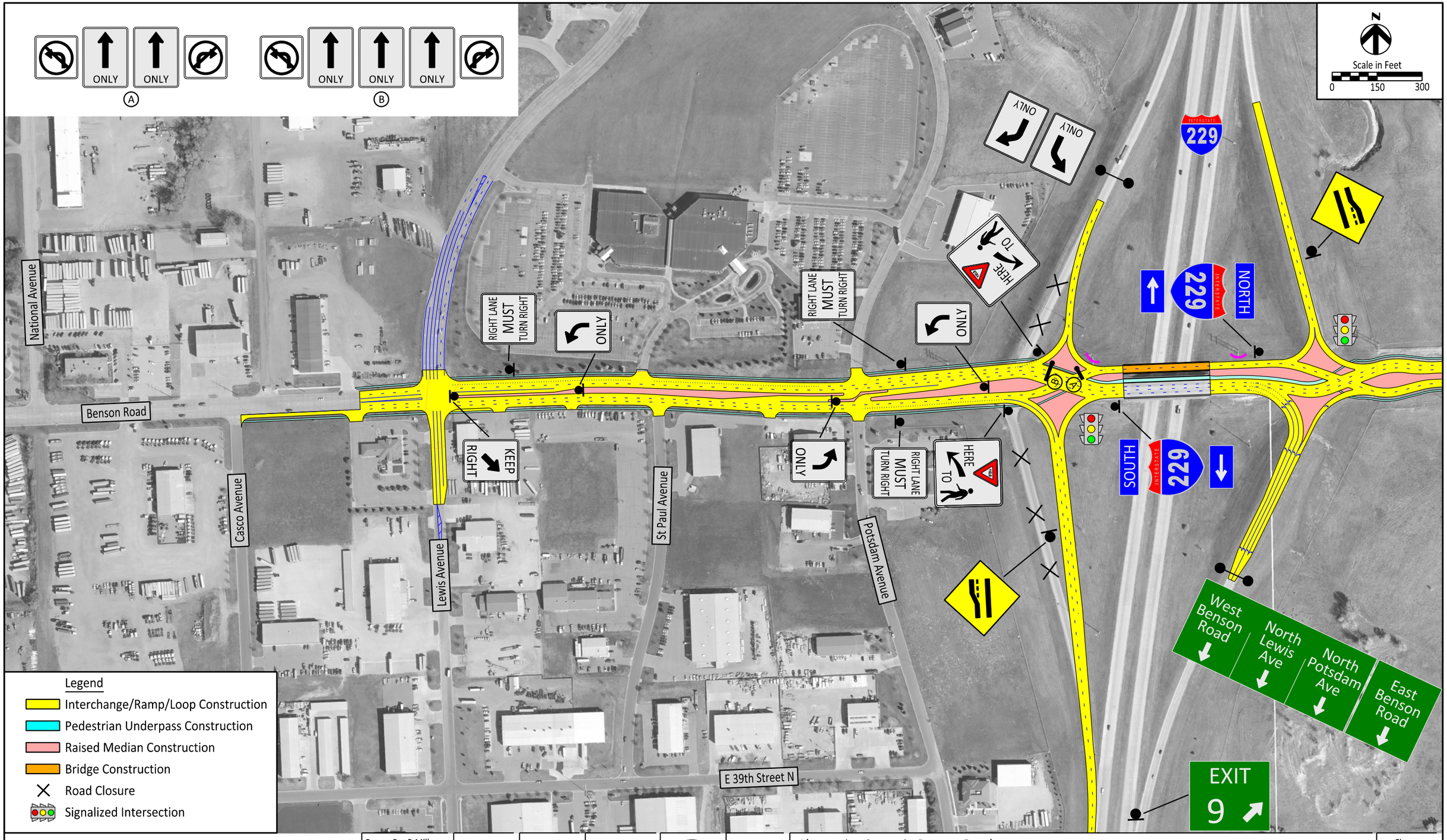
East Benson Road

The existing ½ mile and 1 mile advance guide signs for I-229 SB Exit 9 to remain.

Drawn By: B.Miller
Date: 7/30/2018
Chked By: P.Sanow
Date: 7/30/2018
Revision: 11/15/2018

Alternative Scenario 4b
Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB Lanes.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
S-I-7



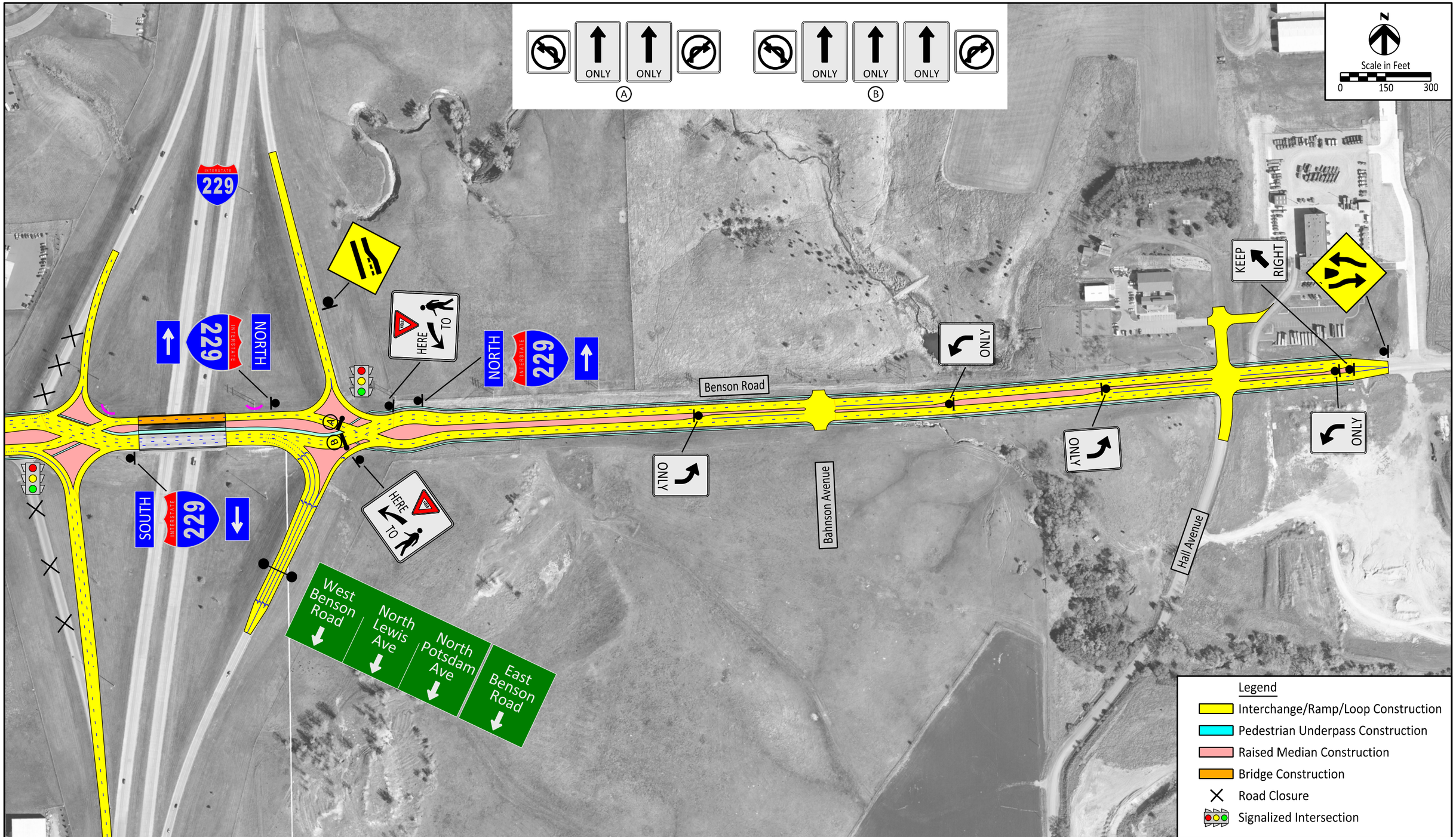
Drawn By: B.Miller
Date: 7/30/2018
Chked By: P.Sanow
Date: 7/30/2018
Revision: 11/15/2018

Alternative Scenario Benson Road
Westbound 3rd Lane from Lewis Avenue to I-229.

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure
S-A-1



Drawn By: B.Miller
Date: 7/30/2018
Chked By: P.Sanow
Date: 7/30/2018
Revision: 10/8/2018

Alternative Scenario Benson Road
4-Lane Divided Section to Hall Avenue east of I-229.

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure
S-A-2

APPENDIX

1 - Purpose and Need

2 - Methods and Assumptions Document

3 – Technical Memo - Existing Traffic Conditions

4 – Technical Memo - Existing Conditions Crash Analysis

5 – Technical Memo - Future Traffic Conditions

6 – Technical Memo - Predictive Crash Analysis

7 – Technical Memo - Interchange Options Evaluation

8 - Conceptual Signing Plans

SECTION 1

PURPOSE AND NEED MEMORANDUM

Draft Purpose and Need

I-229 Benson Road Interchange Modification Study

Project # IM2292(98)67N, PCN 04XK

Sioux Falls, South Dakota

March 21, 2018

City of Sioux Falls
SOUTH DAKOTA

SouthDakota DOT
Connecting South Dakota and the Nation

1.0 Introduction

The South Dakota Department of Transportation (SDDOT) and the city of Sioux Falls (the City) are studying alternatives to enhance traffic operations and travel conditions at the Interstate-229 (I-229) Exit 9 (Benson Road) interchange (Benson Road Interchange) and along a portion of Benson Road (Benson Road Corridor) in Sioux Falls, South Dakota (the Project). This memorandum contains the draft Purpose and Need statement for the project, and is intended for review and approval by the Study Advisory Team (SAT). Upon review and approval by the SAT, this statement will be presented to the public at the next Public Information Meeting. Public input will be incorporated into the Purpose and Need statement for inclusion in the environmental document, which would be prepared according to the provisions of the National Environmental Policy Act (NEPA), corresponding federal and state environmental regulations, and guidelines of Federal Highway Administration (FHWA), the lead federal agency, and the requirements of SDDOT, the joint lead agency. All alternatives evaluated for the Project must satisfy the issues identified in the Purpose and Need in order to advance for further evaluation.

1.1 Project Background

The Benson Road Interchange is located in northeast Sioux Falls, SD. The Project extends along Benson Road from west of Lewis Avenue to near Hall Avenue (Figure 1). Land use around the interchange and along Benson Road is a mix of agriculture, industrial, office, and commercial development. The area is in transition, in particular east of I-229 which has been designated a growth area. Several roads east of I-229 are unpaved but planned for future improvement consistent with the growth and transition in the area.

I-229 Exit 9 (Benson Road) Interchange

Several studies examined the traffic operations and safety conditions at the Benson Road Interchange. The *SDDOT 2010 Decennial Interstate Corridor Study* (2010 Interstate Study) identified operational issues. Following the 2010 Interstate Study, SDDOT and the city of Sioux Falls initiated the *I-229 Major Investment Corridor Study* (I-229 Corridor Study) to examine existing and future operations, safety and geometrics / design standards along the I-229 corridor. As a part of the overall study, the *I-229 Exit 9 (Benson Road) Crossroad Corridor Study* (2017 Benson Road Corridor Study) was completed to specifically examine the area around Benson Road.

The 2017 Benson Road Corridor Study concluded that improvements were necessary along Benson Road and at the Benson Road Interchange to address existing congestion issues and to accommodate planned growth which are expected to worsen traffic operations at the interchange and along Benson Road. The study considered potential improvements to address these issues and improve traffic efficiencies and safety within the project planning area. A recommendation was made to build sidewalks along Benson

meeting the Americans with Disability Act (ADA) standards to ensure safe pedestrian access and mobility.

SDDOT and Sioux Falls are moving forward with further project planning, NEPA compliance, and preliminary design for improvements associated with the Benson Road Interchange and the portions of Benson Road necessary to modify the interchange to accommodate future traffic demand. The Benson Road Interchange construction project is included in the 2018-2021 Statewide Transportation Improvement Program (STIP) as part of the 2022-2025 Developmental STIP; however, it is pending funding availability.

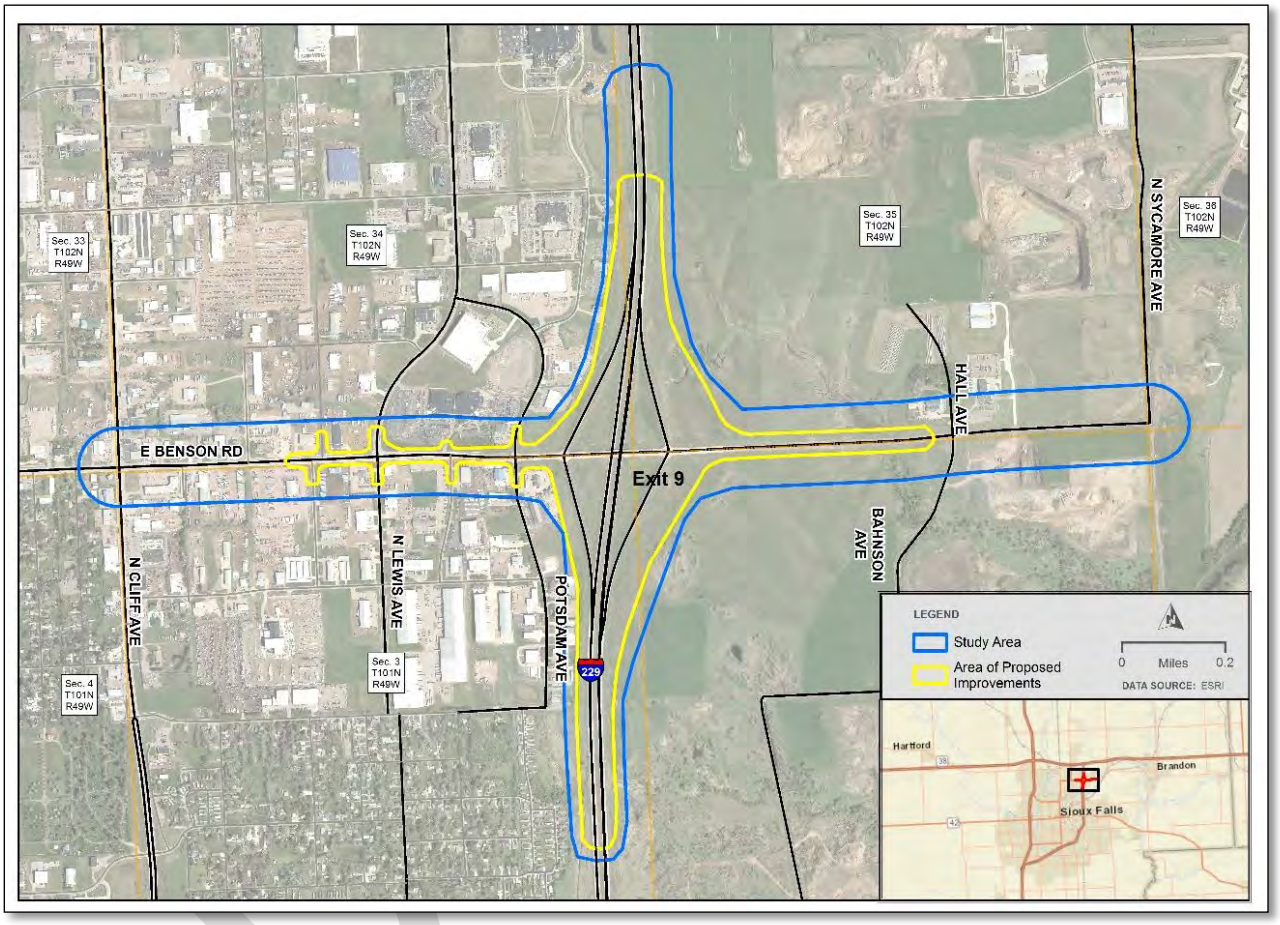


Figure 1. Study area

Project Limits

The environmental study area for this project extends from Cliff Avenue east to Sycamore Avenue along Benson Road including the area the interchange of Benson Road and I-229 (Figure 1).

The following intersections along Benson Road are included in the study (Figure 2):

- Cliff Avenue
- Lewis Avenue
- Potsdam Avenue
- I-229 Southbound Ramp Terminal
- I-229 Northbound Ramp Terminal
- Hall Avenue/Bahnson Avenue

This study area represents the area that could be potentially directly or indirectly impacted by the Project. The study area is smaller than the Interchange Modification Justification Report (IMJR) study area which is being concurrently prepared with the environmental study, but larger than proposed interchange improvements shown on Figure 1. The majority of impacts resulting from the Project would occur immediately adjacent to the proposed improvements, with some indirect or cumulative impacts extending beyond this area.

The logical termini for the study were established in conjunction with the SAT during a project scoping meeting on January 3, 2018 (Figure 2). Logical termini are defined by FHWA as (1) rational end points for a transportation improvement and (2) rational end points for a review of the environmental impacts. The environmental impact review frequently covers a broader geographic area than the strict limits of the transportation improvements (FHWA 1993). Construction of the proposed Project improvements would be begin along Benson Road west of Lewis Avenue to approximately 2,700 feet east of the I-229 Interchange and include interchange geometric improvements.

Other improvements were included as projects in the 2017 Benson Road Corridor Study west of Lewis Avenue along Benson Road including the intersection with Cliff Avenue and farther east of I-229 along Benson Road to Sycamore Road. These other projects have independent utility from this interchange improvement project meaning that the projects have stand-alone needs and can be evaluated and constructed as separate projects. The need for improvements at the Cliff Avenue and Benson Road intersection includes existing congestion and safety concerns, and the Sycamore Avenue and Benson Road intersection improvement is driven by growth in northeast Sioux Falls. While related to the larger congestion concerns with the Benson Road Corridor and Benson Road Interchange these projects will not be evaluated in this environmental study and will be evaluated and constructed separately.

Figure 2. Intersection locations along Benson Road studied as part of the Project

2.0 Project Purpose

The primary purpose of this project is to improve traffic operations and safety and to enhance mobility for other modes of transportation at the Benson Road Interchange and along the Benson Road Corridor.

3.0 Project Need

The 2010 Corridor Study and the 2017 Benson Road Corridor Study identified two primary needs to be addressed: existing and future capacity of the Benson Road Interchange and along the Benson Road Corridor due to congestion and the lack of accessibility for non-automobile transportation modes along Benson Road.

3.1 Poor Capacity

The Benson Road Interchange and Benson Road Corridor experience congestion resulting in long vehicle queues, traffic delays, and an overall increased travel time. Congestion has been

documented at the Benson Road Interchange with high peak volumes and heavy demand for the northbound I-229 to westbound Benson Road movement in the AM peak hour, and heavy demand for the eastbound Benson Road to southbound I-229 movement in the PM peak hour. Improvements were made to the Benson Road Interchange ramps to alleviate back up onto mainline I-229 (SDDOT 2010 and 2017).

Traffic congestion along Benson is generally a result of turning movements to and from adjacent businesses. A large office park north of Benson between Potsdam and Lewis Avenues creates heavy traffic during peak periods corresponding to work day start and end times. Traffic congestion is worsened by large vehicles turning onto Benson from the industrial and truck related businesses south of Benson Road. Several of the stop controlled accesses are at or nearing capacity.

An operational analysis was completed for I-229 mainline and for intersections along Benson Road. The results of the level of service (LOS) analysis are shown in Table 1 for the intersections show poor operations. The mainline interstate facilities operate at an acceptable level of service[1], except for the merge segment between Benson Road and Rice Street which operates at LOS F for the northbound direction in the AM peak hour and for the southbound direction in the PM peak hour (HDR 2018).

Table 3. Existing (2018) and future (2045) conditions based on operational analysis

Location	Existing		2045 No-Build	
	AM	PM	AM	PM
Benson Road and Cliff Avenue	LOS B	LOS B	LOS B	LOS C
Benson Road and Lewis Avenue	LOS B	LOS C	LOS B	LOS C
Benson Road and Potsdam Avenue	**LOS F**	**LOS F**	**LOS F**	**LOS F**
Benson Road and I-229 SB Ramp Terminal	**LOS D**	LOS A	**LOS F**	LOS B
Benson Road and I-229 NB Ramp Terminal	**LOS F**	LOS B	**LOS F**	LOS B
Benson Road and Hall Avenue	LOS A	LOS B	LOS D	LOS C

Note: An acceptable level of service threshold is LOS D for arterial intersections and LOS C for freeway, ramps and ramp terminal intersections. Hall Avenue is currently LOS D, and while it meets acceptable thresholds, it is noted as being deficient.

As shown in Figure 3, the existing I-229 northbound and southbound ramp terminals operate at levels of service below acceptable limits in urban areas during AM peak periods with conditions worsening by 2045. As growth continues along the Benson Road Corridor conditions will worsen. Geometric improvements at the Benson Road Interchange are needed to address inadequate capacity and vehicle queuing at the intersections and ramps.

The Benson Road and Potsdam Avenue intersection currently operates at an LOS of F during the AM peak hour and an LOS of F at the PM peak hour. At the stop controlled intersection it is difficult to turn left from Potsdam Avenue onto Benson Road. The close proximity of Potsdam Avenue to the Benson Road Interchange increases the congestion and worsens the overall traffic operations. Needed improvements to the Benson Road Interchange must be made in conjunction with improvements along Benson Road and at the Potsdam Avenue intersection. Access management for assorted traffic issues should be considered with geometric improvements to increase overall operational efficiencies and safety.

[1] SDDOT generally considers LOS C acceptable for mainline and ramps.

Crashes experienced along Benson Road and at the associated intersections within the study area, notably at the Cliff Avenue and Benson Road intersection which has a crash critical ratio greater than one, are consistent with congested road conditions. In particular, rear end or angle crashes were experienced. These types of accidents cause further delays and add to the congested conditions for the traveling public.

On the east side of I-229, Benson Road currently serves low traffic volumes and the stop controlled intersections at Hall and Sycamore Avenues currently operate under capacity. However, the future construction of the Bahnson Avenue and growth north of Benson Road and east of Sycamore Avenue are expected to result in increased traffic volumes.

Figure 3. Intersections with unacceptable levels of service (LOS)

3.2 Accessibility for Multimodal Movements

The Transportation Equity Act for the 21st Century (TEA-21) and its predecessor, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), call for mainstreaming transit, pedestrian, and bicycle projects into the planning, design, and operation of the national transportation system. These non-automotive modes are part of the overall transportation system and are often emphasized to achieve community goals such as “complete streets” (NRCHP 2008). The City and the Sioux Falls Metropolitan Planning Organization (MPO) have adopted several goals for integrating other transportation modes into the transportation system.

More specifically, the *Shape Sioux Falls 2040 Comprehensive Plan* notes that projects should be designed with connections to citywide pedestrian, transit, and bicycles infrastructure, allowing for additional modes of commuter transportation other than the typical single-occupancy vehicle (city of Sioux Falls 2016). Specific pedestrian and bicycle plans have also been prepared by the City that include goals for “complete streets” ordinances and safe accommodation for bicycle and pedestrian modes of transportation (city of Sioux Falls 2006 and 2015).

The *Sioux MPO Long Range Transportation Plan 2040* calls for providing “an integrated transportation network that encourages use of all modes by offering travel choices that are accessible to all segments of the region’s population” (Sioux Falls MPO 2015).

The Sioux Falls MPO 2040 Long Range Transportation Plan specifically calls for:

D.1 Provide comfortable, convenient, safe, economical, and use-friendly multimodal transportation options for all user groups, regardless of socioeconomic status or physical ability.

D.2 Support a fully integrated multimodal network to facilitate walking, bicycling, driving, and taking public transportation.

D.3 Expand and maintain a network of bicycle, pedestrian, and transit facilities that closes gaps, removes barriers, and connects homes, activity centers, and complementary amenities

D.4 Implement complete street policies where appropriate to ensure streets serve as a shared public resource for all users.

While none of the plans show dedicated bicycle improvements along Benson Road, the 2017 Benson Road Corridor Study proposed sidewalks on either one or both sides of Benson Road that would meet ADA standards at all crossings.

Multimodal level of service is a method to evaluate the transportation facility and compare the needs of various modes against existing and proposed design alternatives to allocate and balance the right-of-way needed to accommodate all modes (NRCHP 2008). A multimodal LOS analysis was completed to evaluate the transportation operations for pedestrian, bicycle and transit modes along Benson Road (Figure 4). Multimodal levels of service vary widely along the Benson Road Corridor (HDR 2018). Sidewalk facilities are present west of the interchange and LOS ranges from A to D for pedestrians. There are no facilities at the Benson Road Interchange, or on the east side of the interchange limiting mobility and safety for pedestrian and bicycle modes.

***Note: No sidewalks present through Benson Road interchange or east along Benson Road.*

Figure 4. Multimodal levels of service along Benson Road

4.0 Conclusion

The 2010 Interstate Study and the 2017 Benson Road Corridor Study, as well as 2018 analysis, identified congestion and unacceptable traffic operations at the Benson Road Interchange and along the Benson Road corridor. These issues are consistent with an overall observed east west congestion that has been observed in Sioux Falls. Additionally, commuting patterns resulting from a substantial percentage of individuals that live outside of the city but are employed within the city. There is a desire from adjacent landowners and businesses for convenient access to the regional road network, such as I-229 (Sioux Falls MPO 2015). These access expectations are anticipated to increase at the Benson Road Interchange and along the Corridor as the area continues to develop. Currently, both the City and the MPO have planned for increasing alternative modes of transportation within their respective transportation planning areas. The existing Benson Road Corridor does not include sufficient facilities to support this plan and cannot provide for these modes of transportation, in particular for pedestrians. The 2017 Benson Road Corridor Study recommended pedestrian facilities through the interchange and sidewalks east along Benson Road. The purpose of this Project is to address these issues, thereby improving the safety and operations of the Benson Road Interchange and Corridor.

5.0 References

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SECTION 2

METHODS AND ASSUMPTIONS DOCUMENT

Methods and Assumptions Document

Date: Monday, January 29, 2018

Project: I-229 Exit 9 (Benson Road) Interchange Modification Study

To: Steve Gramm

From: HDR

Subject: Methods and Assumptions Document

This Methods and Assumptions document was developed in preparation for the Methods and Assumptions Meeting held as part of the project start-up with representatives from the City of Sioux Falls, South Dakota Department of Transportation (SDDOT), the Federal Highway Administration (FHWA) 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 9 (Benson Road) Interchange Modification Study.**

1. Stakeholder Acceptance Page

The undersigned parties concur with the Methods and Assumptions for the **I-229 Exit 9 (Benson Road) Interchange Modification Study** as presented in this document.

SDDOT:	FHWA:
Signature	Signature
Planning Engineer Title	Planning/Civil Rights Specialist Title
Feb. 8, 2018 Date	2/13/18 Date

2. Introduction and Project Description

2.1 Project Background and Understanding

The South Dakota Department of Transportation (SDDOT) in conjunction with the City of Sioux Falls, the Sioux Falls Metropolitan Planning Organization (MPO) and the Federal Highway Administration (FHWA) has contracted with HDR Engineering, Inc. (HDR) to perform an interchange modification justification study for the I-229 Exit 9 interchange and conduct the associated environmental investigation and design.

As part of the *I-229 Major Investment Corridor Study* completed in 2017, it was determined that reconfiguring the I-229 Exit 9 (Benson Road) interchange would be the best alternative to handle current and future traffic levels. Two interchange configuration options were carried forward for further study: 1) a partial cloverleaf interchange with a loop ramp in the northeast quadrant for northbound traffic exiting to westbound Benson Road, and 2) a diverging diamond interchange. Two options for reconfiguration of Benson Road were also carried forward for further study: 1) a raised median on Benson Road with a single eastbound right turn lane at the I-229 SB ramp terminal, and 2) a raised median on Benson Road with a double eastbound right turn lane at the I-229 SB ramp terminal.

At present, pending funding availability, the SDDOT intends to let for construction a project to reconfigure the Exit 9 interchange and the City of Sioux Falls intends on reconstructing and widening Benson Road from a point west of Lewis Avenue to I-229 and reconstructing Benson Road from I-229 to Sycamore Avenue. These projects do not currently appear in State or Local construction programs.

The study will include performing a HCM (6th Edition) based traffic analysis comparison of the reconfigured interchange options versus the existing configuration. In addition to the interchange specific objective listed above, the study is expected to fulfill the following additional objectives:

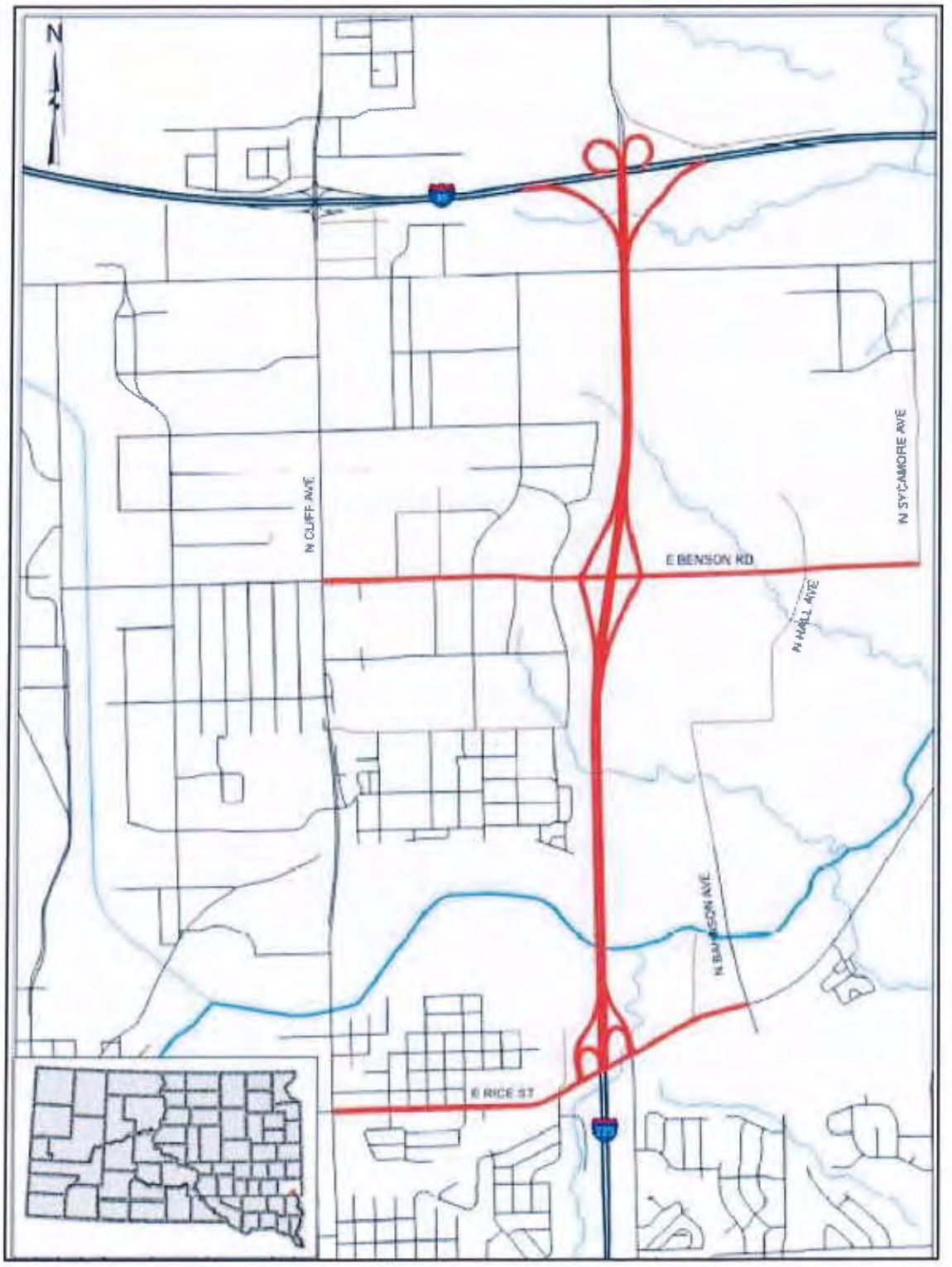
- Create an Interchange Modification Justification Report (IMJR) for the SDDOT to submit to FHWA.
- Prepare an environmental document for the I-229 Exit 9 interchange project and the associated reconstruction project of the Benson Road crossroad corridor and associated intersections.
- Create final products for use by the City of Sioux Falls, the Sioux Falls Area MPO and the SDDOT which will provide guidance to implement recommended improvements for future construction.

Location

The project area is shown in Map 1. It is located in northeast Sioux Falls and includes the Interstate 229 Exit 7, Exit 9 and Exit 10 interchanges and the mainline sections of Interstate 229 connecting those interchanges. The study area also includes the following sections of city streets:

- Benson Road from Cliff Avenue to Sycamore Avenue
- Rice Street from Cliff Avenue to Bahnson Avenue

The study area roadway sections are shown in red on Map 1.



Map 1 – Study Area Roadways

Intersection operations analysis will be conducted at the following locations (also shown in Map 2).

1. Benson Road/Cliff Avenue
2. Benson Road/Lewis Avenue
3. Benson Road/Potsdam Avenue
6. Benson Road/Hall Avenue-Bahnson Avenue
7. Rice Street/Cliff Avenue
8. Rice Street/Wayland Avenue
11. Rice Street/Bahnson Avenue

Interchange ramp terminal analysis will be conducted at the following locations (also shown on Map 2).

4. Benson Road/I-229 SB ramps
5. Benson Road/I-229 NB ramps
9. Rice Street/I-229 SB ramps
10. Rice Street/I-229 NB ramps

Map 2 – Analysis Intersections

Need for Study

Congestion has been documented at the I-229/Benson Road interchange for years, with high peak hour volumes and heavy demand for the northbound I-229 to westbound Benson Road movement in the AM peak hour and heavy demand for the eastbound Benson Road to southbound I-229 movement in the PM peak hour. Long queues have occurred on the northbound off-ramp, requiring the inclusion of a second exiting lane and double left turns at the ramp terminal.

Study Schedule

Date	Task/Event
November 2017	Notice to Proceed
January, 2018	Kick-off Meeting
January, 2018	Methods & Assumptions Documentation
March, 2018 to April, 2018	Public Involvement meetings
June, 2018	Draft IMJR
November, 2018	Draft Environmental Determination
April, 2019	Decision Document for Environmental Findings
October, 2021	Final Plan Submittal
April, 2022	Project Completion

Facilities Affected by the Study

The facilities affected by this project include the sections of the Interstate and local roadway systems identified in the previous "Location" section of this memorandum.

Previous Studies

Previous studies including the subject study area include:

- I-229 Major Investment Corridor Study
- Interstate 90/Interstate 229 Interstate Access Modification Request
- South Dakota Decennial Interstate Corridor Study
- Go Sioux Falls 2040 – Sioux Falls MPO Long Range Plan
- 60th Street North Planning and Feasibility Study
- Various other specialized planning documents prepared by the Sioux Falls Metropolitan Planning Organization.

Study Advisory Team Members

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

PARTICIPANT	AGENCY
Shannon Ausen	City of Sioux Falls
Jeff Brosz	SDDOT
Mark Hoines	FHWA
Travis Dressen	SDDOT
Stacy Duchene	SDDOT
Jim Feeney	Sioux Falls MPO
Steve Gramm	SDDOT
Heath Hoftiezer	City of Sioux Falls
Dave Huft	SDDOT
Paula Huizenga	SDDOT
Tom Lehmkuhl	SDDOT
Dave Madden	SDDOT
Brian Raecke	SDDOT
Brad Remmich	SDDOT
Craig Smith	SDDOT
Ryan Tobin	SDDOT

Additional team members may be added as the study progresses.

3. Analysis Years/Periods

Existing conditions will be analyzed for 2017 conditions. Future year forecasts will represent both 2023 (year of completion) and 2045 (planning horizon year) conditions.

4. Policy Standard

IMJR analysis will be conducted in compliance with the Policy on Access to the Interstate System issued by FHWA on May 22, 2017.

5. Data Collection

Turning movement counts have been collected for the analysis intersections listed in the Location section of this document. Turning movement data including the AM and PM peak hours were collected during the years 2015-2017. Vehicular 24-hour ramp and crossroad counts were also conducted in 2017.

Other vehicular volume, GIS, survey, plan and crash data is available from State and City resources and is being provided for review and use in this study.

6. Traffic Forecasting and Volume Development

Future-year traffic will be determined through use of the regional travel demand model maintained by the City of Sioux Falls. Forecasts will be post-processed to produce future-year turning movement volumes for analysis. The current future-year model represents 2040 land use. Model output will be used to produce 2023 and 2045 traffic assignments for this study.

Traffic volumes will be balanced to create coherent volume networks for the weekday AM and PM peak hours for the current year and 2023 and 2045 forecast years. The volume networks will represent average Fall or Spring conditions with school in session.

7. Traffic Operations Analysis

Analysis of existing and proposed intersection operations will be conducted using Highway Capacity Software (HCS) Release 7.40 (HCM 6th Edition Methodology) Streets Module. Interstate operations will be conducted using the appropriate HCS Release 7.40 procedures. Other software, such as Synchro may be used as an aid in developing new signal timings, but all analysis will be reported using HCS. Specific operational variables are listed below:

Variables

- Peak Hour Factor (PHF) – use peak hour factors developed from turning movement counts for existing conditions. Use a default PHF of .90 for future year conditions.
- Saturation Flow Rate - SDDOT Design Manual (Page 24, Chapter 15) requires the use of 1,600 vph, except in Rapid City and Sioux Falls where 1,800 vph is used. These values will be used within the study area.
- Right Turn on Red percentage – right turn on red percentage will be based on sampling of actual operations.
- Heaviest Lane Volume (Lane Utilization) - Default HCS Streets Values used for arterial intersections, except where uncommon lane utilization is documented during field review. The per-lane 24-hour counts will be used to review current lane utilization.
- Heavy Vehicle Percentage - Based on new turning movement counts.
- Phase Change Intervals - Vehicle clearance times will be based on existing timings for existing conditions analysis. Vehicle clearance times for future conditions will be calculated using MUTCD and ITE methods.
- Pedestrian clearance times will be based on existing timings for existing conditions analysis. Pedestrian clearance times for future conditions analysis will be calculated per ITE methods.
- Speeds – based on approach speed limits.

8. Safety Issues

Crash reports for the study area will be analyzed and safety problems within the study area will be identified. The procedures described in the memorandum *Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), and Two-Lane Loop Ramp,* (November, 2015) will be used to predict the safety impacts of the interchange design alternatives. Note that safety prediction analysis will be conducted for the interchange concepts only.

9. Selection of Measures of Effectiveness (MOE)

The effectiveness of traffic operations in the study area will be based on the appropriate level of service measurement, with the goal of achieving a vehicle level of service C or better on any freeway segment or ramp. Arterial street signalized intersections will have a desirable goal of level of service C or better, with a minimum individual movement level of service D on the State system. The City of Sioux Falls jurisdiction signalized intersection level of service goal will be D or better with individual movements at level of service E or better. Stop sign-controlled intersections may have a lower level of service.

10. Other Study Considerations

Scenarios

Interchange alternatives will include:

- No-build
- Build diverging diamond interchange
- Build parclo interchange with a loop in the northeast quadrant

Benson Road corridor alternatives will include:

- No Build
- Build with raised median on Benson Road and a single eastbound right turn lane at the I-229 southbound ramp terminal
- Build with raised median on Benson Road and a double eastbound right turn lane at the I-229 southbound ramp terminal
- Build with lane configurations needed to serve Project Viper trip generation

Refinement of Build Options

Build scenarios will be refined as follows:

- Preliminary profile of all ramps/crossroads affect by the build scenario. Entails refinement of horizontal alignments (as necessary) and vertical profiles as generated in previous studies
- Conceptual structure type, length & width
- Typical section of ramps and all roadways affect by the build scenarios
- Lane requirements on the crossroad and through interchange areas necessary to maintain the agreed upon level of services as identified under the MOE discussion above.
- Turn lane requirements at all ramp terminals and crossroad intersections affected by the build options. Horizontal alignment adjustments anticipated include turn lane and storage requirements provided by traffic analysis/engineering need
- Bicycle, pedestrian, and transit related improvements along the corridor and at the intersections will be reviewed for applicability and may or may not be incorporated, however pedestrian connectivity meeting the ADA requirements will be included in the design
- Right of way limits will be depicted on plan drawings and suggested right-of-way needs identified as part of the alignment refinement. This will include showing the existing and proposed control of access along the crossroad.
- Permanent signing, lane delineation and other permanent traffic control items as necessary through the interchange area for the recommended build options.

Conceptual signing plan will serve as "a conceptual plan of the type and location of the signs proposed to support" the build alternative.

- Local or other arterial connection modifications that may be needed as a result of implementing the build options. Additional need is not anticipated outside of the roadways previously listed. Should the operational analyses indicate improvements area required beyond the interchange limits, the design will be informed by traffic analysis findings
- Utility impact/needs
- Access locations that should be removed/consolidated/relocated with the project to enhance traffic flow through the interchange area
- Location of pedestrian and bicycle access and crossings. Local plans will be used to identify the location and type of such facilities.
- Planning-level project quantities and costs.

Traffic Variables for Design

The following traffic design variables will be provided for the selected build scenario:

- Average Annual Daily Traffic for the year of construction ($AADT_{2023}$)
- Average Annual Daily Traffic for the future year ($AADT_{2045}$)
- Design Hour Volume, 30th highest hour of the year (DHV)
- Direction Distribution in the predominant direction of travel (D)
- Truck Percentage of DHV (T DHV)
- Truck Percentage of AADT (T ADT)
- Design Speed (V)

Design variables will be determined for the following:

- I-229 mainline
- Exit 9 off-ramps
- Exit 9 on-ramps
- Benson Road (may need different values east and west of I-229)

Constructability Analysis of Build Scenarios

As traffic control during construction could be a major factor in the decision making process, the consultant will determine the most feasible construction detours and phasing options based upon researching similar installations, coordination with SDDOT staff, and generalized analyses of phasing timelines and costs for each build scenario. The consultant shall analyze each build option to determine the overall time duration of construction and ramp closure time anticipated necessary to construct. HDR will provide estimated construction durations and SDDOT will calculate costs for user delays during constructability reviews.

11. Data Provided

The following will be provided by the participating agencies to aid the consultant in performing the study:

- Existing vehicular traffic data, including crash data and turning movement counts
- Existing structure condition data
- SDDOT Road Design Manual
- Available construction plans
- Available land survey data (topography and original DTM file)
- Available GIS data, including aerial photography, parcel information, existing land use (rooftops and commercial square footage) and crash locations
- Available data and reports from previously completed and on-going studies

12. Deviations/Justifications

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

13. Conclusion

All sections contained in this document will guide the traffic data collection, traffic assessment, and environmental review for this study. Future alternatives may be screened for geometric and right-of-way feasibility prior to traffic analysis to eliminate infeasible alternatives.

14. Appendices

The appendix includes the following:

- Methods and Assumptions Study Team Meeting Minutes
- Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), and Two-Lane Loop Ramp (November 4, 2015)

APPENDIX

Meeting Minutes

Project: I-229 Exit 9 (Benson Rd) Interchange Modification Study and Environmental Document

Subject: Study Advisory Meeting #1 – Kick-off Meeting

Date: Wednesday, January 03, 2018

Location: SDDOT Conference Room A – Video Conference with Pierre Office

Attendees:

NAME	ORGANIZATION	TEL. NO. e-mail address
Gramm, Steve	SDDOT Proj Deve...	Steve.Gramm@state.sd.us
Amber Gibson	SECOG	Amber@secog.org
Ausen, Shannon	Sioux Falls PW	sausen@siouxfalls.org
Brosz, Jeff	SDDOT Data/Traffic	Jeff.Brosz@state.sd.us
~~Dressen, Travis~~	SDDOT Area Eng...	Travis.Dressen@state.sd.us
DuChene, Stacy	SDDOT RD	Stacy.DuChene@state.sd.us
Heath Hoftiezer	CSF Traffic	hhoftiezer@siouxfalls.org
Hoines, Mark	FHWA	Mark.Hoines@dot.gov
~~Huft, Dave~~	SDDOT	Dave.Huft@state.sd.us
Huizenga, Paula	SDDOT LGA...	Paula.Huizenga@state.sd.us
Lehmkuhl, Tom	SDDOT Environ...	Tom.Lehmkuhl@state.sd.us
Madden, Dave	SDDOT Bridge...	Dave.Madden@state.sd.us
~~Raecke, Brian~~	SDDOT Head of RD	Brian.Raecke@state.sd.us
Remmich, Bradley	SDDOT	Bradley.Remmich@state.sd.us
Smith, Craig	SDDOT Region...	Craig.Smith@state.sd.us
Tobin, Ryan	SDDOT	Ryan.Tobin@state.sd.us
Kjenstad, Jason (142550)	HDR Project Manager	Jason.Kjenstad@hdrinc.com
Laura Lutz-Zimmerman	HDR Environmental	Laura.Lutz-Zimmerman@hdrinc.com
Aaron Fagerness	HDR Design Lead	Aaron.Fagerness@hdrinc.com
Jill Rust	HDR Environmental	Jill.rust@hdrinc.com
Rick Laughlin	HDR Traffic	Rick.Laughlin@hdrinc.com

Introductions and Staff Overview

- Laura Lutz-Zimmerman will be environmental lead for HDR to replace Meg Thorton
- Mark Hoines will be FHWA project team member in lieu of Mark Clausen

Location Map and Project Limits

- In general there was not changes to the project scope in regards to limits, the one item clarified was that Benson Road in the traffic forecast model should still extend to Rice Street and terminate for the purposes of traffic distribution and assignment
- The limits of construction on the east side of Interstate 229 are to be determined as study progresses and as development warrants. The construction project is anticipated to go ¼ mile east at this time but the team will decide the final termini later in the project

Study Schedule Review (IMJR and Environmental)

- The study schedule for the traffic work is generally on schedule, model files have been setup and HDR is awaiting the new count data from the City of Sioux Falls. Shannon indicated that they would get that out in the near future.

- Rick is scheduling a meeting with Sam T. to discuss the model and the connections residing in the model for the 2040 volume scenario. The scenario should include a connection of Benson Road to Rice Street. Since the 2045 land use scenario in the travel demand model is subjective HDR will utilize the 2040 model files and project to 2045 based on a 2015 to 2040 multiplier.
- Other data is generally collected or has been provided, Heath Hoftiezer with the City indicated he would count the driveway to HSBC (or current owner) so we could determine a lane utilization for the interchange options for the NB to WB movements.
- Environmental staff is reviewing previous documents and was awaiting this meeting to start developing the Draft purpose and need
- Due to the change in staff HDR is behind schedule by a few weeks
- HDR intends to send out draft Purpose and Need memo in early to mid-February
- Notification Letters have been sent to adjacent property owners in regards to both the environmental survey and topo/utilities survey

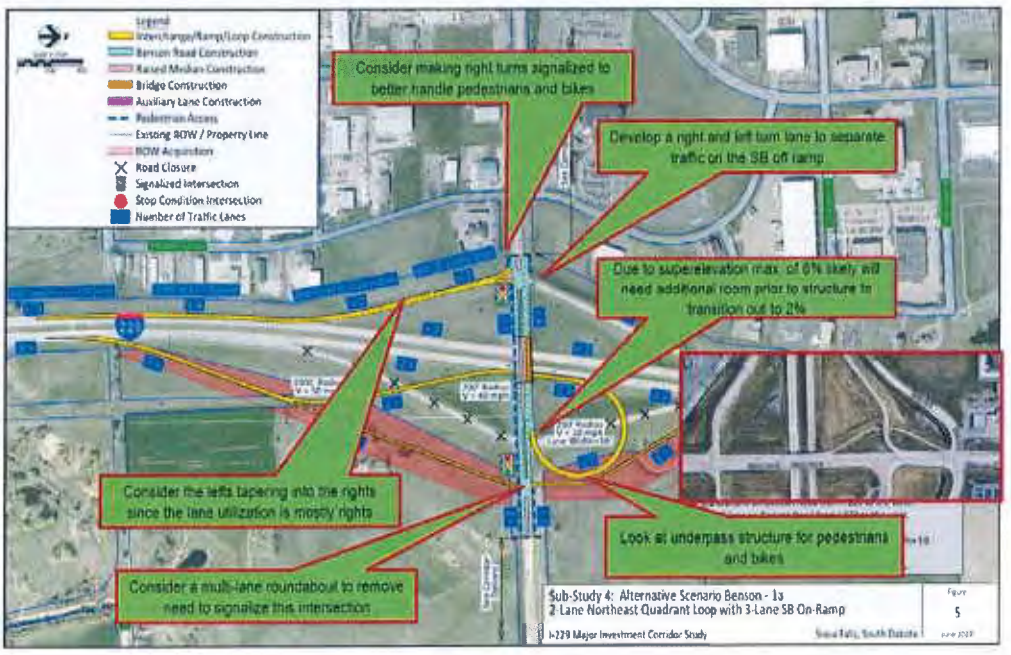
Survey & Utility locating schedule (Utility Locating by UMS, Inc.)

- HDR has established control for the purposes of the survey to begin by HDR on topographic features as well as for UMS to start on the utility survey
- UMS scheduled kickoff utility meeting for Jan 4th, 2018 with area utility companies at the SDDOT area office. HDR and UMS will provide a joint presentation and start the process of coordinating with the utilities.
- UMS is anticipating to be complete in February
- HDR anticipates to be mostly complete in early March

Review of Advanced Options from I229 MIS

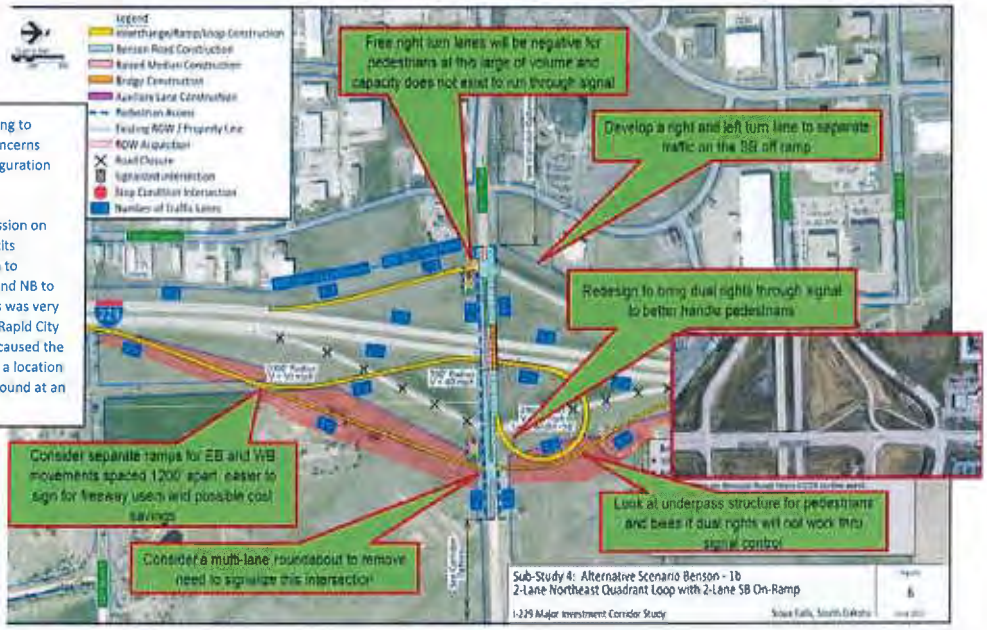
- Option 1a discussion items

Review "Advanced Options" for IMJR



- Option 1b discussion items

Review "Advanced Options" for IMJR

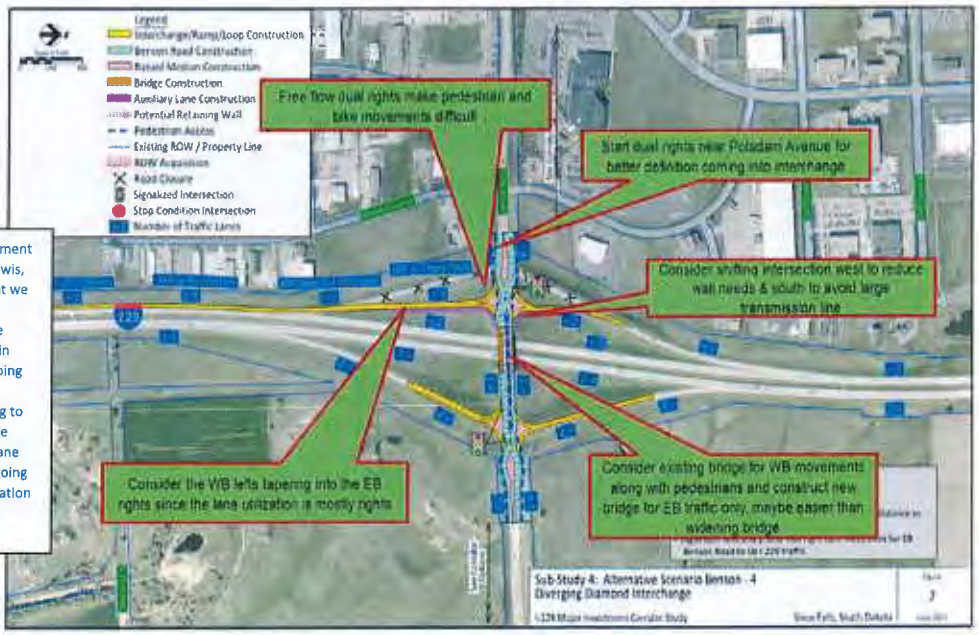


Craig Smith was going to check on signing concerns with NB ramp configuration shown here

Noted during discussion on having two ramp exits (revising this option to separate NB to EB and NB to WB ramps) that this was very confusing out near Rapid City (Exit 67) which has caused the SDDOT to construct a location for trucks to turn around at an interchange

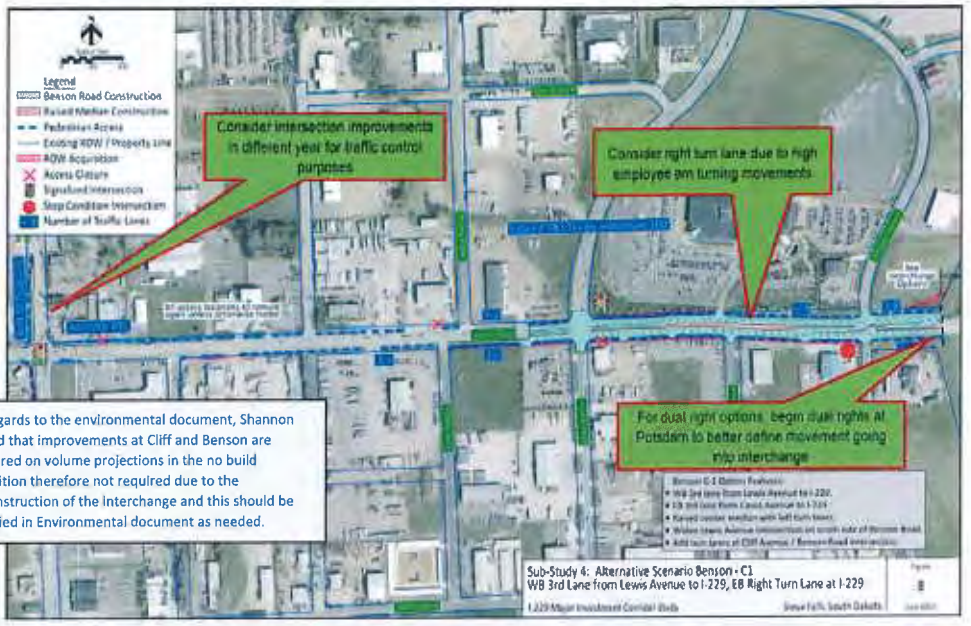
- Option 4 discussion items

Review "Advanced Options" for IMJR

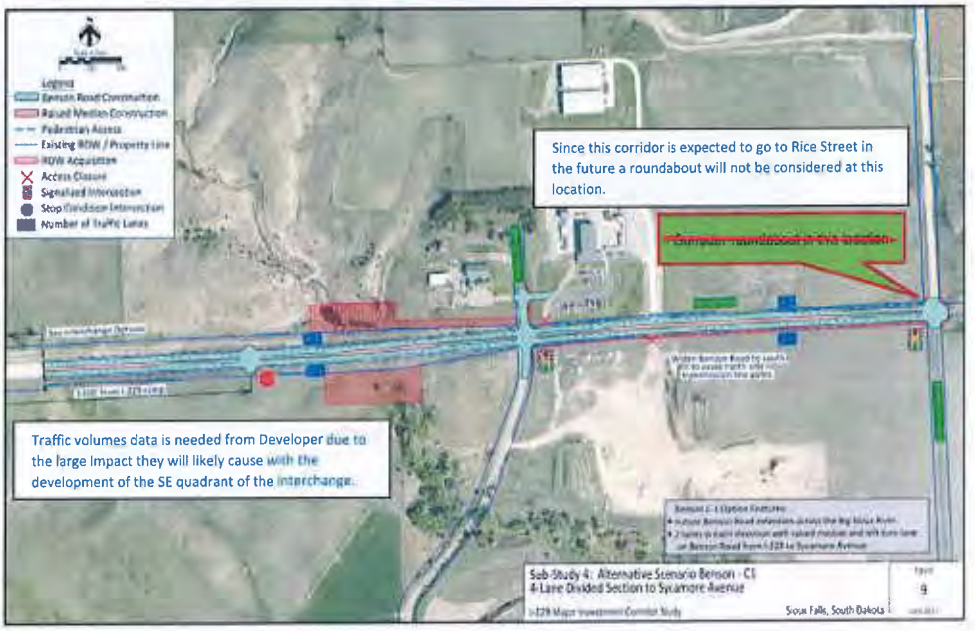


Discussed weaving movement from Potsdam west to Lewis, Heath recommended that we get counts at the HSBC building and for the triple lefts us a lane utilization in regards to the vehicles going to Potsdam (right lane of triple lefts), vehicles going to HSBC (center lane of triple lefts), and left lane (left lane of triple lefts) for traffic going to Lewis as the best utilization that each lane could get.

- Benson Road Corridor discussion items



In regards to the environmental document, Shannon noted that improvements at Cliff and Benson are required on volume projections in the no build condition therefore not required due to the reconstruction of the interchange and this should be clarified in Environmental document as needed.



Traffic volumes data is needed from Developer due to the large impact they will likely cause with the development of the SE quadrant of the interchange.

HDR tentative approach for IMJR and Environmental Review

- IMJR Existing Traffic Volume
  - 2015,2016,2017 Volumes Balanced for Existing conditions
  - 2045 Volumes need to account for possible "large employer" in SE quadrant of interchange (need to verify projected employees soon)
  - 2045 Volumes will not consider access from I-229 to 60th Street North
- Interchange Layout Updates
  - After verifying the 2045 volumes the layouts can be updated to meet the M&A requirements for the various LOS thresholds
- NEPA Discussion
  - Logical Termini (agreed it would be from Cliff to Sycamore along Benson Road and extent of ramp limits along I-229)

- Purpose & Need Focus Areas
  - Arterial and Interchange Capacity
  - ~~Ensure corridor is accessible to pedestrians~~

Accessibility for multi-modal movements planned

Table 8. Alternative Scenarios Evaluation Matrix
I-229/Benson Road Interchange/Corridor Consi

SDDOT indicated that if we use the issues map that was part of our proposal that we should remove the arrow pointing to the stone circle as we don't want to indicate to people the exact location in a public setting

Verify public involvement process and schedule

- Website: www.BensonRoadProject.com
- Public Meetings (3) & will live stream video
  - Need to allow questions to be asked during online video if possible and can we log in email addresses to make sure we know how many people use it?
- Considering March 8th at the Convention Center, other dates would be the 20th and 22nd of March for consideration
- MPO Meetings (3) – prepare information for briefing
- Stakeholder Meetings (2 Sets)
- Large Employee Company Meetings (2 minimum)

Methods and Assumptions Memo Discussion

- Page 3 - Update reference to 41st Street Exit 77 interchange to Benson Road Exit 9 interchange
- Page 3 - In second bullet use "conduct environmental document versus assessment".
- Page 7 - Study Schedule – change draft EA to draft Environmental Determination
  - FONSI should be Date April 2019
- Page 8 - Under SAT Members section update where it says City of Rapid City to Sioux Falls and add MPO
  - Remove Mark Clauson and only show Mark Hoines
- Page 9 – in the second paragraph remove the need for a Saturday afternoon peak hour and change year to 2023 from 2021
  - Under pedestrian clearance times indicate that for new options pedestrian clearance times will be calculated per ITE
- Page 10 – Correct the spelling of Scenarios at top of page
  - Under scenarios add one additional for "Project Viper" included volumes
- Page 11 – Indicate IMJR will be done per NEW INTERSTATE ACCESS POLICY, this fits better likely earlier in M&A Document
  - Under constructability Craig Smith indicated that if we provided durations that SDDOT staff would be able to calculate costs for user delays during the constructability review, this could include detours as well. This will allow them early on to recommend incentives or disincentives as well.

Verify items to be supplied by SDDOT or City of Sioux Falls.

- Traffic Counts (City and SDDOT)
  - Intersection Counts – City is pulling information together along with HSBC driveway counts
  - Ramps – SDDOT provided counts to 2016
  - Mainline – SDDOT provided counts to 2016
- Forecasts – need to coordinate with Sam T. on SE quadrant trips in the model and get 2040 model printouts
- Crash Database – provided by SDDOT on FTP
- Structure Plans (SDDOT) – provided by SDDOT during I-229 MIS
- Interchange Design Plans (SDDOT) – provided by SDDOT during I-229 MIS
- Control of Access Documentation – provided by SDDOT during I-229 MIS

Memo

Date: Wednesday, November 04, 2015

Project:

To: File

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

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

Introduction

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

Crash Prediction

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

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

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

Diverging Diamond Interchange (DDI)

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

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

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

Single-Point Urban Interchange (SPUI)

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

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

a. Analyze the SPUI ramp terminal intersection based on methods / equations from NCHRP Project 17-68.

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

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

Two-Lane Loop Ramp

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

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

SECTION 3

EXISTING CONDITIONS TRAFFIC MEMORANDUM

2018 Traffic Conditions Technical Memorandum

I-229 Benson Road Interchange Modification Study

Sioux Falls, South Dakota

May 16, 2018

City of Sioux Falls
SOUTH DAKOTA

South Dakota DOT
Connecting South Dakota and the Nation

This memorandum provides the results of operations analysis for the year 2018 traffic conditions in the project study area (Figure 1). The analysis was prepared using the procedures and inputs specified in the approved Methods and Assumptions document for this study. Analysis output documents are provided in the appendix to this memorandum.

1.0 Traffic Volume Development

Traffic counts on the Interstate roadway segments were gathered by SDDOT in 2017. Traffic counts on the arterial street system were available in City of Sioux Falls and HDR files. Count data were assembled and balanced to produce a representation of peak hour traffic flows through the study area. Peak hour traffic volumes are shown in Figures 2, 3 and 6.

2.0 Traffic Operations

Level of service on Interstate 229 was calculated for mainline, ramp merge-diverge, and weave areas for peak hours under 2018 conditions. The level of service results are shown in Figure 6. Note that several Interstate mainline segments were analyzed both as regular mainline segments and weaving segments. If it was determined that the segment satisfied the conditions for weaving, the weaving level of service was reported and indicated by an asterisk (*) next to the level of service result.

Intersection turning volumes and level of service for peak hours under 2018 conditions are shown in Figures 2 and 3. Multimodal levels of service for the Benson Road and Rice Street arterial corridors are shown in Figures 4 and 5.

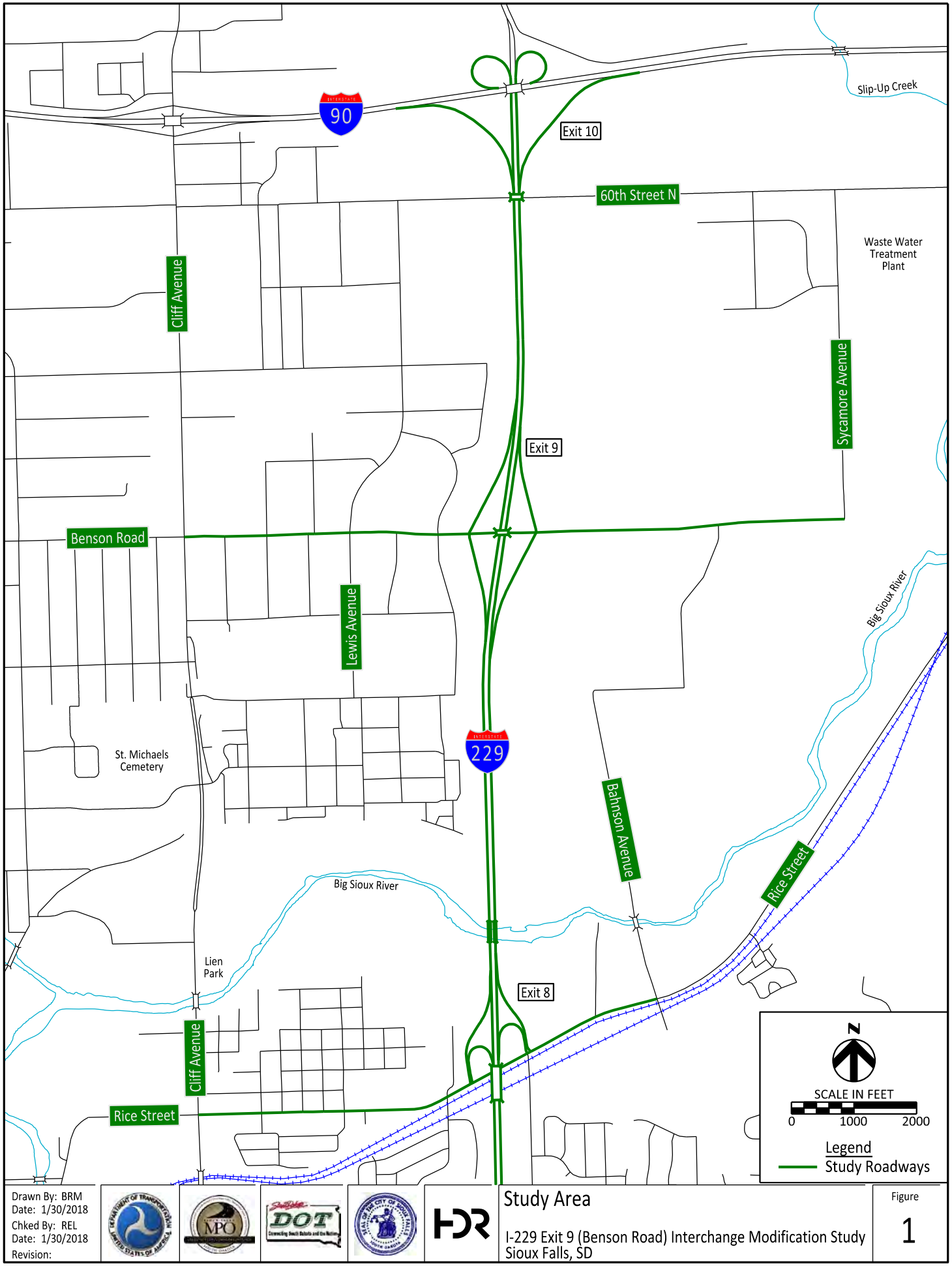
The 2018 conditions analysis shows that all Interstate facilities within the study area operate at an acceptable level of service (Figure 6).

The arterial street system experiences peak hour congestion at the following locations:

- Benson Road/Potsdam Avenue
- Benson Road/I-229 Southbound
- Benson Road/I-229 Northbound
- Rice Street/I-229 SB
- Rice Street/I-229 NB

Certain movements experienced low levels of service or queues that exceeded the length of the available storage during particular peak hours. The southbound left turn at Rice Street/Cliff Avenue is an example of this characteristic, with the left turn queue extending through the Bennett Street/Cliff Avenue intersection at times.

Multimodal level of service varies widely throughout the Benson Road and Rice Street corridors. The lowest levels of service are related to locations with the absence of specific facilities for pedestrians and bicyclists in these corridors.

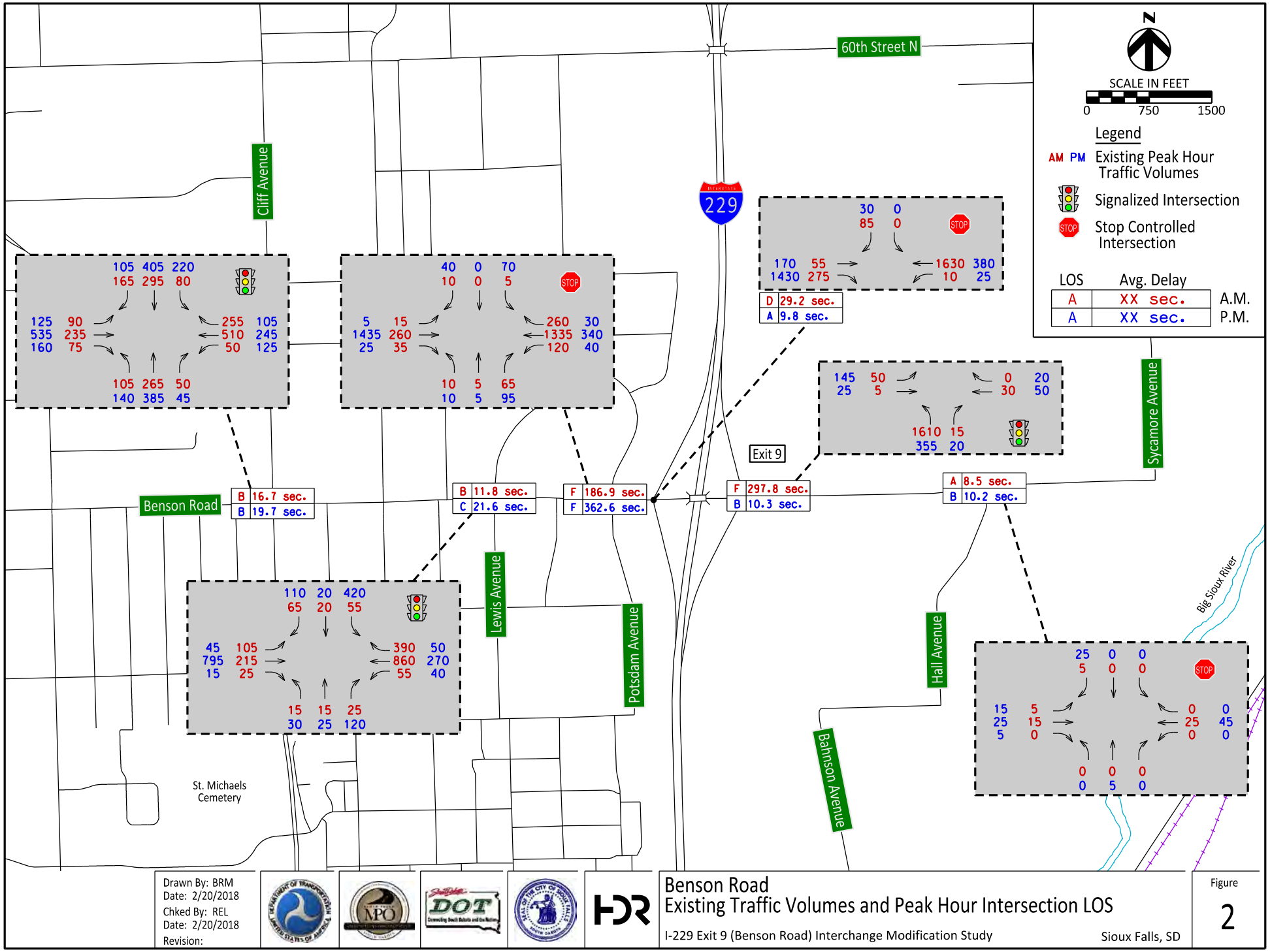


Drawn By: BRM
Date: 1/30/2018
Chked By: REL
Date: 1/30/2018
Revision:

Study Area

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 1



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PLOTTING DATE: 03-08-2018

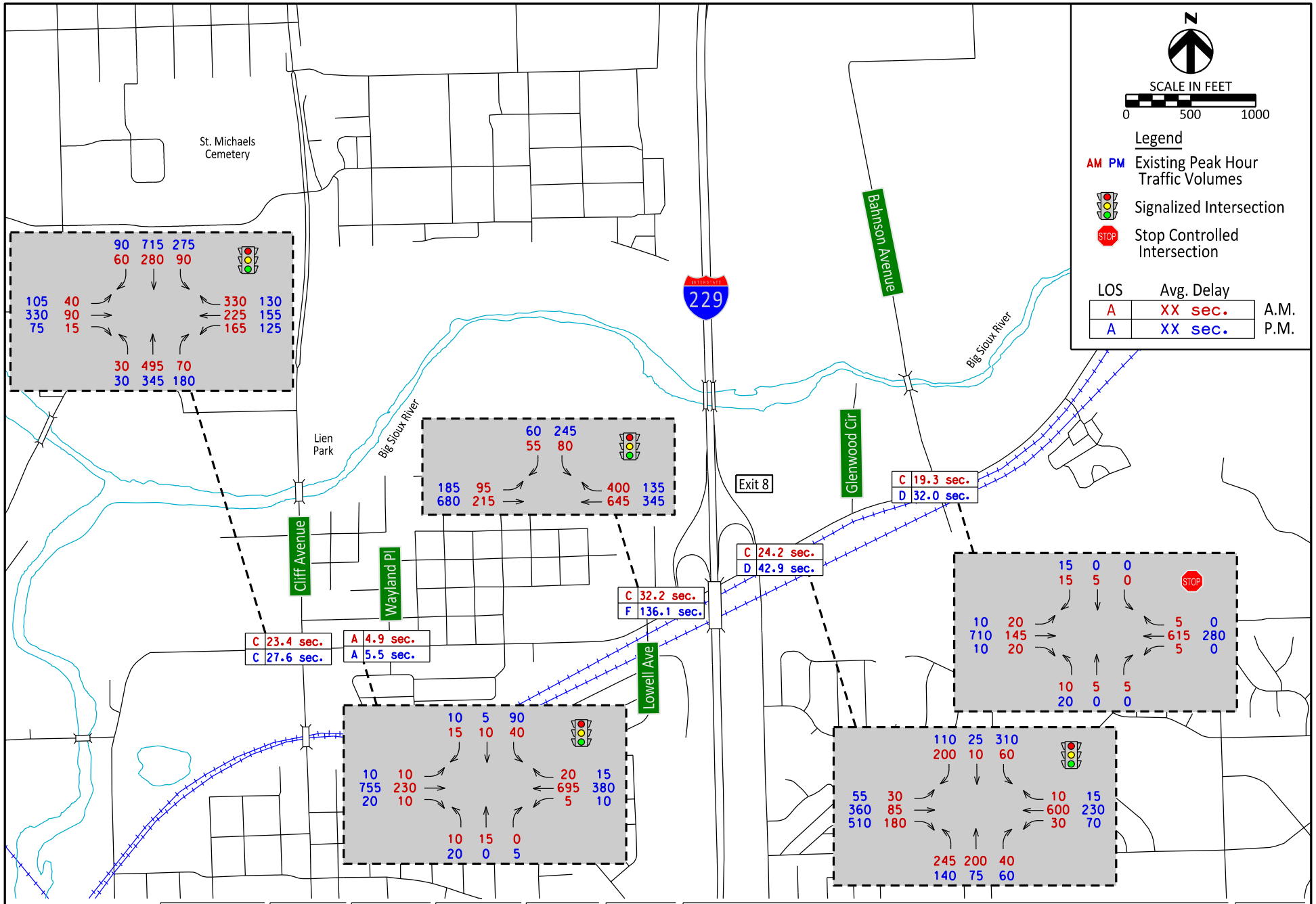
Drawn By: BRM
Date: 2/20/2018
Chked By: REL
Date: 2/20/2018
Revision:

Benson Road
Existing Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 2

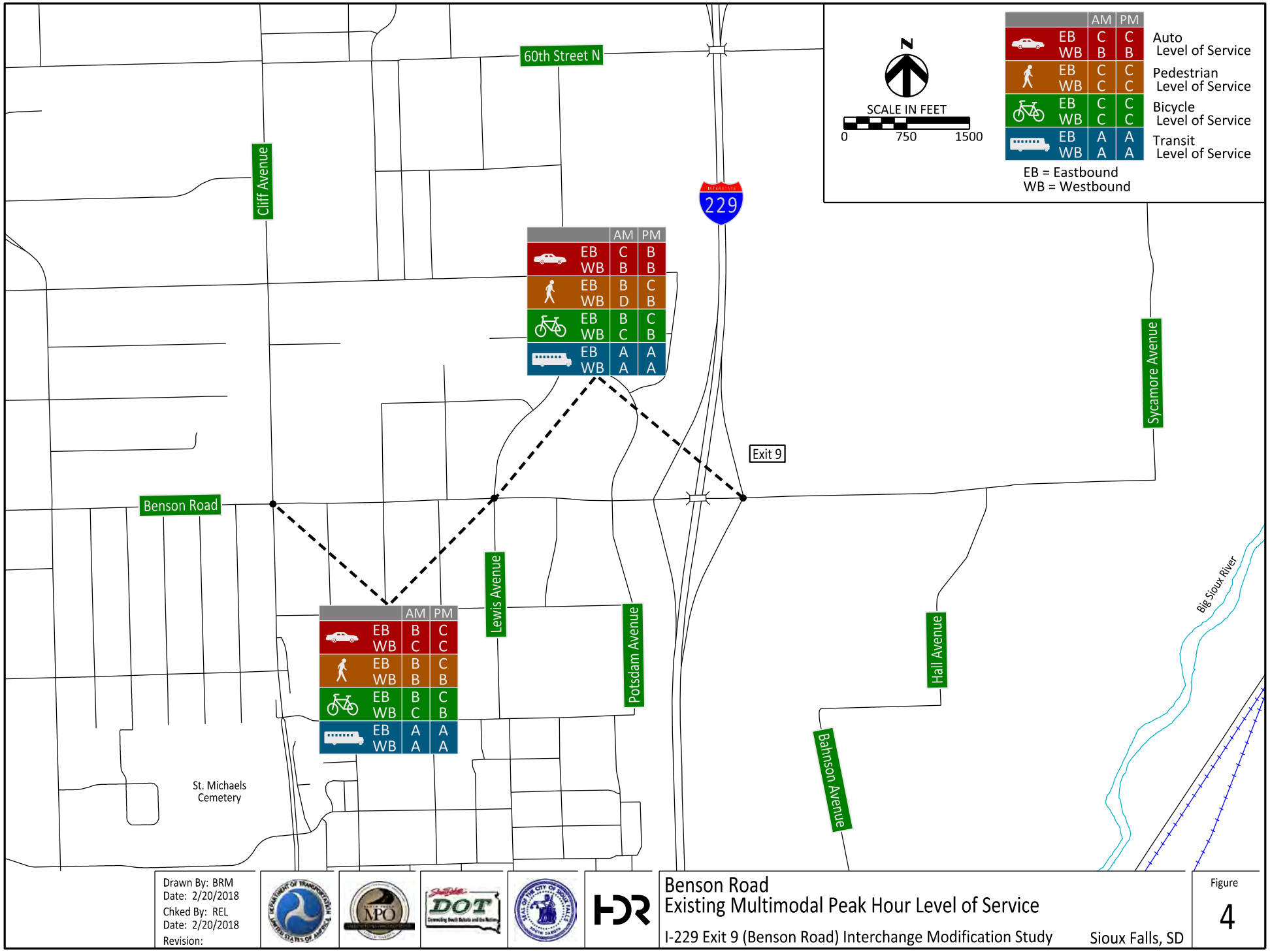


Drawn By: BRM
Date: 2/20/2018
Chked By: REL
Date: 2/20/2018
Revision:

Rice Street
Existing Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study Sioux Falls, SD

Figure 3



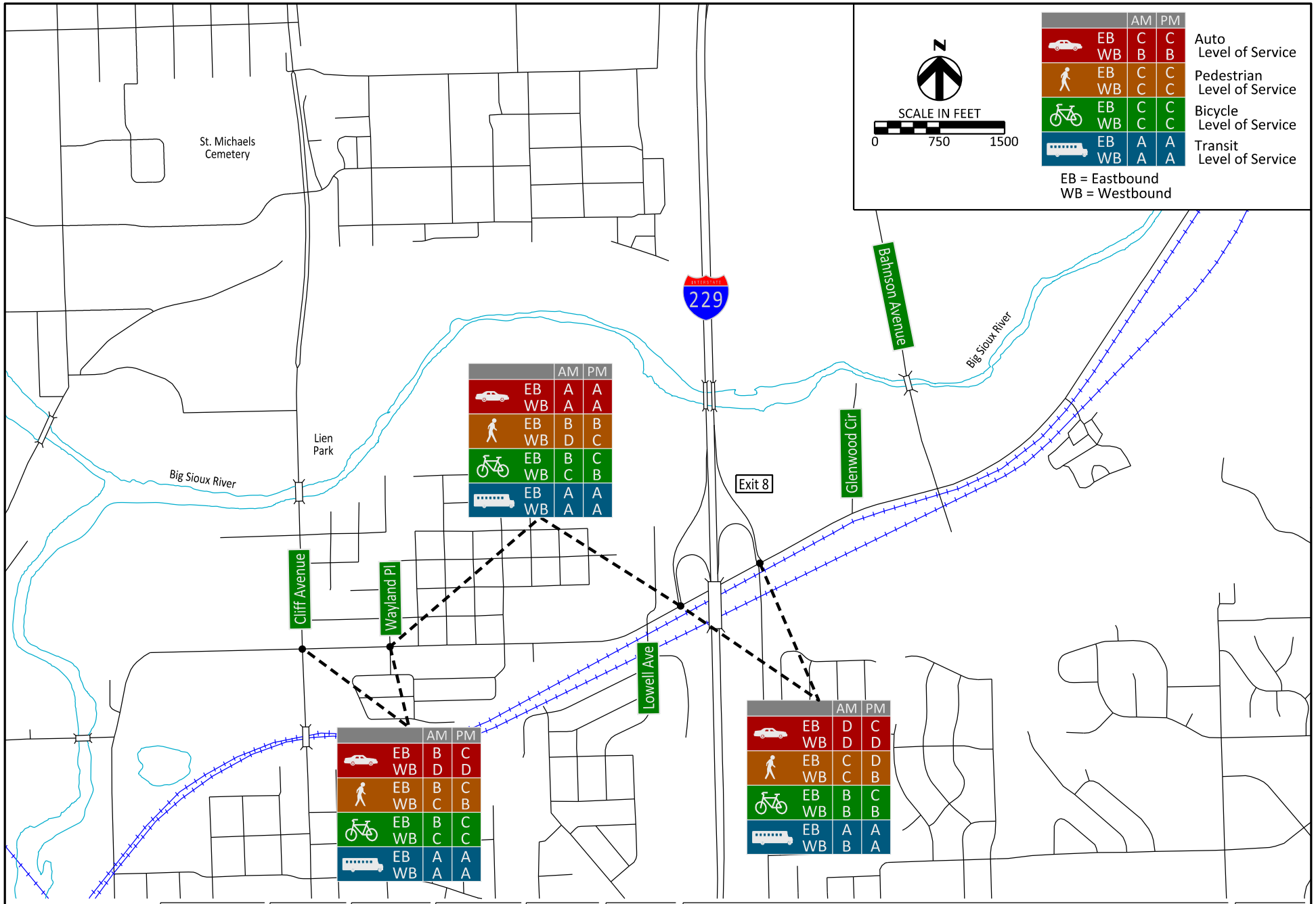
Drawn By: BRM
Date: 2/20/2018
Chked By: REL
Date: 2/20/2018
Revision:

Benson Road
Existing Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 4



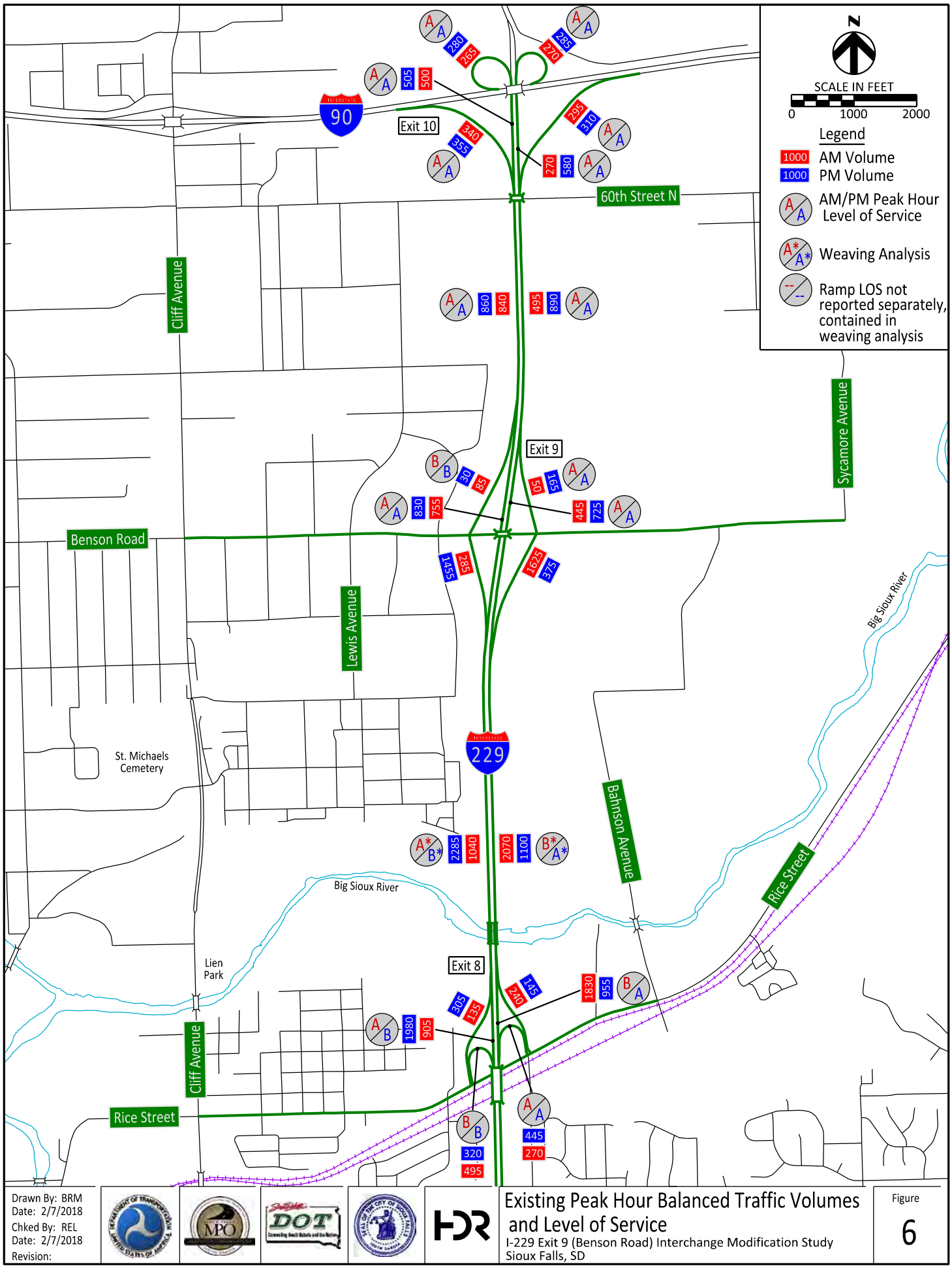
Drawn By: BRM
Date: 2/20/2018
Chked By: REL
Date: 2/20/2018
Revision:

Rice Street
Existing Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 5



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PLOTTING DATE: 05-16-2018

Drawn By: BRM
Date: 2/7/2018
Chked By: REL
Date: 2/7/2018
Revision:

Existing Peak Hour Balanced Traffic Volumes and Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 6

APPENDIX

I. Freeway Analysis – Mainline
II. Freeway Analysis – Ramps
III. Freeway Analysis – Weaving
IV. Arterial Analysis

I. Freeway Analysis – Mainline

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	500	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.82	Flow Rate (V_p), pc/h/ln	336
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.15
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	5.0
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	840	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.82	Flow Rate (V_p), pc/h/ln	564
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.25
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	8.4
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	755	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.82	Flow Rate (V_p), pc/h/ln	506
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.22
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	7.5
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1040	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.82	Flow Rate (V_p), pc/h/ln	452
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.20
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	6.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	905	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.82	Flow Rate (V_p), pc/h/ln	590
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.26
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	8.8
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1830	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.92	Flow Rate (V_p), pc/h/ln	1064
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.46
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	15.8
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	2070	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.92	Flow Rate (V_p), pc/h/ln	802
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.35
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	11.9
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	445	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.92	Flow Rate (V_p), pc/h/ln	266
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.12
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	4.0
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	495	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.92	Flow Rate (V_p), pc/h/ln	197
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.09
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	2.9
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	270	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.92	Flow Rate (V_p), pc/h/ln	162
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.07
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	2.4
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	505	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.88	Flow Rate (V_p), pc/h/ln	316
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.14
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	4.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	860	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.88	Flow Rate (V_p), pc/h/ln	538
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.23
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	8.0
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

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Project Information

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Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	830	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.88	Flow Rate (V_p), pc/h/ln	519
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.23
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	7.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

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Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	2285	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.88	Flow Rate (V_p), pc/h/ln	926
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.40
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	13.8
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

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Project Information

Analyst	RL	Date	2/26/2018
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Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1980	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.88	Flow Rate (V_p), pc/h/ln	1203
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.52
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	17.9
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

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Project Information

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Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	955	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.92	Flow Rate (V_p), pc/h/ln	555
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.24
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	8.2
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

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Project Information

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Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1100	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.92	Flow Rate (V_p), pc/h/ln	426
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.19
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	6.3
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

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Project Information

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Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	725	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.92	Flow Rate (V_p), pc/h/ln	434
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.19
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	6.4
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

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Project Information

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Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	890	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.92	Flow Rate (V_p), pc/h/ln	355
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.15
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	5.3
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

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Project Information

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Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	580	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.92	Flow Rate (V_p), pc/h/ln	347
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.15
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	5.2
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

II. Freeway Analysis – Ramps

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	500	340
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	671	456
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.25	0.22

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	4.7
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.201
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	62.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	671	Ramp Junction Speed (S), mi/h	62.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1127	Average Density (D), pc/mi/ln	9.1
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

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Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	840	85
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1127	114
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.25	0.06

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	11.4
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.323
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1127	Ramp Junction Speed (S), mi/h	59.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	9.5
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

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Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3655	1500
Terrain Type	Rolling	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	755	285
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	20.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.714	0.833
Flow Rate (v_i), pc/h	1290	417
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.38	0.21

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	9.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.211
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	62.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1290	Ramp Junction Speed (S), mi/h	62.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1707	Average Density (D), pc/mi/ln	13.8
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5705	1500
Terrain Type	Rolling	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1040	134
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.877	0.877
Flow Rate (v_i), pc/h	1446	186
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.21	0.09

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	0.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.329
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	359
Distance to Downstream Ramp (L_{DOWN}), ft	1080	Off-Ramp Influence Area Speed (S_R), mi/h	59.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.715	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	1087	Ramp Junction Speed (S), mi/h	62.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	7.8
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1080	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	905	495
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1180	688
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.41	0.36

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.4
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.244
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1180	Ramp Junction Speed (S), mi/h	61.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1868	Average Density (D), pc/mi/ln	15.3
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
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Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5500	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	2100	270
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	7.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.833
Flow Rate (v_i), pc/h	2739	395
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.40	0.19

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	7.7
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.348
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	766
Distance to Downstream Ramp (L_{DOWN}), ft	1000	Off-Ramp Influence Area Speed (S_R), mi/h	58.5
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.673	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	1973	Ramp Junction Speed (S), mi/h	62.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	14.7
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
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Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1000	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	1830	240
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	2387	334
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.60	0.16

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	17.2
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.249
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	2387	Ramp Junction Speed (S), mi/h	61.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	2721	Average Density (D), pc/mi/ln	22.3
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

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Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	2
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5195	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	2070	1625
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	2700	2260
Capacity (c), pc/h	6824	4066
Volume-to-Capacity Ratio (v/c)	0.40	0.56

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	11.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.516
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	242
Distance to Downstream Ramp (L_{DOWN}), ft	3445	Off-Ramp Influence Area Speed (S_R), mi/h	54.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.450	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	2458	Ramp Junction Speed (S), mi/h	55.5
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	16.2
Level of Service (LOS)	B		

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Project Information

Analyst	RL	Date	2/26/2018
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Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	445	50
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	597	67
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.15	0.03

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	4.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.236
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	597	Ramp Junction Speed (S), mi/h	61.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	664	Average Density (D), pc/mi/ln	5.4
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
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Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	4075	550
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	495	295
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	664	396
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.15	0.19

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	5.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.348
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.5
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	664	Ramp Junction Speed (S), mi/h	58.5
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	5.7
Level of Service (LOS)	A		

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Project Information

Analyst	RL	Date	2/26/2018
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Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Deceleration Length (L_D), ft	1885	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	270	270
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	362	362
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.08	0.19

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	0.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.472
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	55.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	362	Ramp Junction Speed (S), mi/h	55.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	3.3
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
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Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1750	250
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	235	265
Peak Hour Factor (PHF)	0.82	0.82
Total Trucks, %	2.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.980	0.909
Flow Rate (v_i), pc/h	292	356
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.14	0.18

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.311
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	59.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	292	Ramp Junction Speed (S), mi/h	59.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	648	Average Density (D), pc/mi/ln	5.5
Level of Service (LOS)	A		

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Project Information

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Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1750	250
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	225	280
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	2.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.980	0.909
Flow Rate (v_i), pc/h	250	335
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.13	0.17

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.4
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.311
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	59.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	250	Ramp Junction Speed (S), mi/h	59.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	585	Average Density (D), pc/mi/ln	4.9
Level of Service (LOS)	A		

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Project Information

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Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	505	355
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	604	424
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.23	0.21

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	4.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.200
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	62.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	604	Ramp Junction Speed (S), mi/h	62.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1028	Average Density (D), pc/mi/ln	8.3
Level of Service (LOS)	A		

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Project Information

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Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	860	30
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1028	36
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.23	0.02

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.316
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1028	Ramp Junction Speed (S), mi/h	59.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	8.7
Level of Service (LOS)	B		

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Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3655	1500
Terrain Type	Rolling	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	830	1455
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	20.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.714	0.833
Flow Rate (v_i), pc/h	1264	1899
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.70	0.93

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	19.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.282
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	60.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1264	Ramp Junction Speed (S), mi/h	60.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	3163	Average Density (D), pc/mi/ln	26.3
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5705	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	2285	305
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	7.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.833
Flow Rate (v_i), pc/h	2656	398
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.39	0.20

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	7.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.348
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	734
Distance to Downstream Ramp (L_{DOWN}), ft	1080	Off-Ramp Influence Area Speed (S_R), mi/h	58.5
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.675	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	1922	Ramp Junction Speed (S), mi/h	62.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	14.3
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1080	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	1980	320
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	2302	397
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.59	0.21

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	17.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.277
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	60.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	2302	Ramp Junction Speed (S), mi/h	60.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	2699	Average Density (D), pc/mi/ln	22.4
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5500	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	1400	445
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	7.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.833
Flow Rate (v_i), pc/h	1628	581
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.24	0.29

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	2.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.365
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	321
Distance to Downstream Ramp (L_{DOWN}), ft	1000	Off-Ramp Influence Area Speed (S_R), mi/h	58.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.693	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	1307	Ramp Junction Speed (S), mi/h	60.6
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	9.0
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1000	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	955	145
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1110	180
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.09

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	6.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.203
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	62.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1110	Ramp Junction Speed (S), mi/h	62.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1290	Average Density (D), pc/mi/ln	10.4
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	2
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5195	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1100	375
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1279	465
Capacity (c), pc/h	6824	4066
Volume-to-Capacity Ratio (v/c)	0.19	0.11

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	0.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.354
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	448
Distance to Downstream Ramp (L_{DOWN}), ft	3445	Off-Ramp Influence Area Speed (S_R), mi/h	58.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.450	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	831	Ramp Junction Speed (S), mi/h	62.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	6.8
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	725	165
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	867	197
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.23	0.10

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	7.2
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.240
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	867	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1064	Average Density (D), pc/mi/ln	8.7
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	4075	550
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	890	310
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1064	371
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.23	0.18

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.5
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.346
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.5
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1064	Ramp Junction Speed (S), mi/h	58.5
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	9.1
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Deceleration Length (L_D), ft	1885	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	580	285
Peak Hour Factor (PHF)	0.92	0.92
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	694	341
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.15	0.18

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	0.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.470
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	55.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	694	Ramp Junction Speed (S), mi/h	55.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	6.3
Level of Service (LOS)	A		

III. Freeway Analysis – Weaving

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	5705	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	630	275	10	125
Peak Hour Factor (PHF)	0.82	0.82	0.82	0.82
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	822	382	14	174

Weaving Flow Rate (v_w), pc/h	556	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	836	Density-Based Capacity (c_{IWL}), pc/h/ln	2299
Total Flow Rate (v), pc/h	1392	Demand Flow-Based Capacity (c_{IW}), pc/h	6015
Volume Ratio (VR)	0.399	Weaving Segment Capacity (c_W), veh/h	5624
Minimum Lane Change Rate (LC_{MIN}), lc/h	556	Adjusted Weaving Area Capacity, pc/h	5975
Maximum Weaving Length (L_{MAX}), ft	6670	Volume-to-Capacity Ratio (v/c)	0.23

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	315	Average Weaving Speed (S_W), mi/h	61.3
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1875	Average Non-Weaving Speed (S_{NW}), mi/h	61.1
Weaving Lane Change Rate (LC_W), lc/h	943	Average Speed (S), mi/h	61.2
Total Lane Change Rate (LC_{All}), lc/h	2818	Density (D), pc/mi/ln	7.6
Weaving Intensity Factor (W)	0.130	Level of Service (LOS)	A

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Highway/CD Roadway
Short Length (L_S), ft	5195	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	305	140	100	1525
Peak Hour Factor (PHF)	0.92	0.92	0.92	0.92
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	355	174	124	1890

Weaving Flow Rate (v_w), pc/h	2064	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	479	Density-Based Capacity (c_{IWL}), pc/h/ln	1876
Total Flow Rate (v), pc/h	2543	Demand Flow-Based Capacity (c_{IW}), pc/h	2956
Volume Ratio (VR)	0.812	Weaving Segment Capacity (c_W), veh/h	2764
Minimum Lane Change Rate (LC_{MIN}), lc/h	2064	Adjusted Weaving Area Capacity, pc/h	3024
Maximum Weaving Length (L_{MAX}), ft	11695	Volume-to-Capacity Ratio (v/c)	0.84

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	164	Average Weaving Speed (S_W), mi/h	58.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1796	Average Non-Weaving Speed (S_{NW}), mi/h	48.4
Weaving Lane Change Rate (LC_W), lc/h	2432	Average Speed (S), mi/h	56.6
Total Lane Change Rate (LC_{All}), lc/h	4228	Density (D), pc/mi/ln	15.0
Weaving Intensity Factor (W)	0.192	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	5705	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	555	1425	30	275
Peak Hour Factor (PHF)	0.92	0.92	0.92	0.92
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	645	1766	37	341

Weaving Flow Rate (v_w), pc/h	2107	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	682	Density-Based Capacity (c_{IWL}), pc/h/ln	1971
Total Flow Rate (v), pc/h	2789	Demand Flow-Based Capacity (c_{IW}), pc/h	3179
Volume Ratio (VR)	0.755	Weaving Segment Capacity (c_W), veh/h	2972
Minimum Lane Change Rate (LC_{MIN}), lc/h	2107	Adjusted Weaving Area Capacity, pc/h	3231
Maximum Weaving Length (L_{MAX}), ft	10956	Volume-to-Capacity Ratio (v/c)	0.86

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	257	Average Weaving Speed (S_W), mi/h	59.2
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1841	Average Non-Weaving Speed (S_{NW}), mi/h	47.7
Weaving Lane Change Rate (LC_W), lc/h	2494	Average Speed (S), mi/h	55.9
Total Lane Change Rate (LC_{All}), lc/h	4335	Density (D), pc/mi/ln	16.6
Weaving Intensity Factor (W)	0.182	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	5195	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Unfamiliar	Final Speed Adjustment Factor (SAF)	0.913
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.898
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	640	85	60	315
Peak Hour Factor (PHF)	0.92	0.92	0.92	0.92
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	744	105	74	390

Weaving Flow Rate (v_w), pc/h	495	Freeway Max Capacity (c_{IFL}), pc/h/ln	2330
Non-Weaving Flow Rate (v_{NW}), pc/h	818	Density-Based Capacity (c_{IWL}), pc/h/ln	2236
Total Flow Rate (v), pc/h	1313	Demand Flow-Based Capacity (c_{IW}), pc/h	6366
Volume Ratio (VR)	0.377	Weaving Segment Capacity (c_W), veh/h	5952
Minimum Lane Change Rate (LC_{MIN}), lc/h	495	Adjusted Weaving Area Capacity, pc/h	5870
Maximum Weaving Length (L_{MAX}), ft	6424	Volume-to-Capacity Ratio (v/c)	0.22

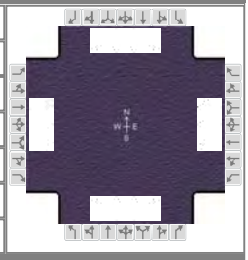
Speed and Density

Non-Weaving Vehicle Index (I_{NW})	280	Average Weaving Speed (S_W), mi/h	57.3
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1871	Average Non-Weaving Speed (S_{NW}), mi/h	57.3
Weaving Lane Change Rate (LC_W), lc/h	863	Average Speed (S), mi/h	57.3
Total Lane Change Rate (LC_{All}), lc/h	2734	Density (D), pc/mi/ln	7.6
Weaving Intensity Factor (W)	0.136	Level of Service (LOS)	A

IV. Arterial Analysis

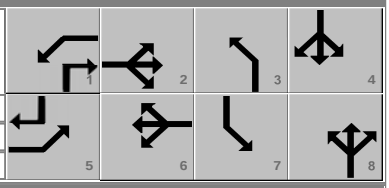
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 23, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.80
Urban Street	BENSON ROAD	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	90	235	75	50	510	255	105	265	50	80	295	165

Signal Information												
Cycle, s	57.9	Reference Phase	2									
Offset, s	0	Reference Point	Begin									
Uncoordinated	Yes	Simult. Gap E/W	On	Green	1.7	2.4	15.0	3.7	1.1	15.0		
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.0	0.0	3.5	3.0	0.0	3.5		
				Red	1.0	0.0	2.0	1.0	0.0	2.0		



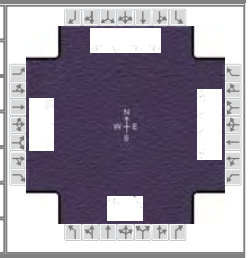
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	8.1	22.9	5.7	20.5	8.8	21.6	7.7	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	1.0	5.1	1.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	4.8	6.8	2.9	8.8	5.3	6.7	4.5	7.4
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Phase Call Probability	0.84	1.00	0.42	1.00	0.88	1.00	0.80	1.00
Max Out Probability	1.00	0.00	0.93	0.00	1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	113	178	172	34	232	218	131	331	38	100	369	125
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1634	1647	1730	1592	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	2.8	4.6	4.8	0.9	6.6	6.8	3.3	4.7	1.1	2.5	5.4	3.6
Cycle Queue Clearance Time (g_c), s	2.8	4.6	4.8	0.9	6.6	6.8	3.3	4.7	1.1	2.5	5.4	3.6
Green Ratio (*g/C*)	0.34	0.30	0.30	0.29	0.26	0.26	0.34	0.28	0.31	0.32	0.26	0.33
Capacity (*c*), veh/h	372	521	492	358	448	413	424	914	449	396	853	484
Volume-to-Capacity Ratio (*X*)	0.303	0.341	0.349	0.094	0.517	0.529	0.309	0.363	0.083	0.253	0.432	0.258
Back of Queue (*Q*), ft/ln (95 th percentile)	44.2	74.3	69.3	13.7	108.8	99.3	51.3	72	14.2	39.7	83.9	47.9
Back of Queue (*Q*), veh/ln (95 th percentile)	1.7	2.9	2.8	0.5	4.2	4.0	2.0	2.8	0.5	1.5	3.2	1.8
Queue Storage Ratio (*RQ*) (95 th percentile)	0.23	0.00	0.00	0.10	0.00	0.00	0.17	0.00	0.06	0.11	0.00	0.15
Uniform Delay (d_1), s/veh	14.1	15.8	15.8	15.1	18.3	18.4	13.9	16.8	14.3	14.4	17.9	14.2
Incremental Delay (d_2), s/veh	0.6	0.1	0.2	0.1	0.3	0.3	0.6	0.1	0.0	0.5	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	0.0	0.0
Control Delay (*d*), s/veh	14.8	15.9	16.0	15.3	18.6	18.7	14.5	16.9	14.3	14.9	18.0	14.3
Level of Service (LOS)	B	B	B	B	B	B	B	B	B	B	B	B
Approach Delay, s/veh / LOS	15.6	B		18.4	B		16.1	B		16.7	B	
Intersection Delay, s/veh / LOS	16.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.71	C	2.86	C	2.83	C	2.73	C
Bicycle LOS Score / LOS	2.64	C	3.00	C	2.80	C	2.88	C

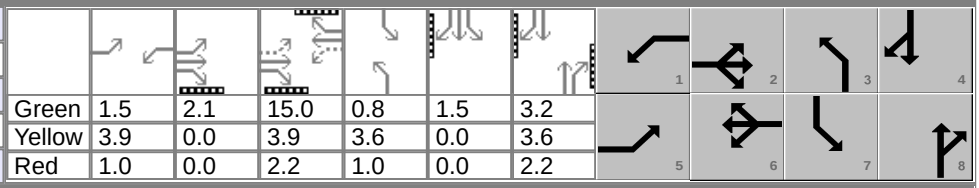
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 23, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.80
Urban Street	BENSON ROAD	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	105	215	25	55	860	390	15	15	25	55	20	65

Signal Information			
Cycle, s	45.7	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.5	2.1	15.0	0.8	1.5	3.2
Yellow	3.9	0.0	3.9	3.6	0.0	3.6
Red	1.0	0.0	2.2	1.0	0.0	2.2

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	8.6	23.2	6.4	21.1	5.4	9.0	6.9	10.5
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.8	4.6	5.8
Max Allow Headway (*MAH*), s	5.1	1.0	5.1	1.0	5.1	1.2	5.1	1.2
Queue Clearance Time (g_s), s	4.3	4.6	2.7	8.9	2.5	3.0	3.0	3.4
Green Extension Time (g_e), s	0.2	0.1	0.0	0.1	0.0	0.0	0.1	0.0
Phase Call Probability	0.81	1.00	0.39	1.00	0.21	0.81	0.58	0.90
Max Out Probability	1.00	0.00	0.27	0.00	0.18	0.00	0.43	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	131	145	143	38	602	164	19	38		69	25	50
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1690	1647	1647		1647	1587		1600	1730	1466
Queue Service Time (g_s), s	2.3	2.6	2.6	0.7	6.9		0.5	1.0		1.0	0.6	1.4
Cycle Queue Clearance Time (g_c), s	2.3	2.6	2.6	0.7	6.9		0.5	1.0		1.0	0.6	1.4
Green Ratio (*g/C*)	0.41	0.38	0.38	0.36	0.33		0.02	0.07		0.05	0.10	0.10
Capacity (*c*), veh/h	433	649	634	506	1082		31	113		163	179	152
Volume-to-Capacity Ratio (*X*)	0.303	0.223	0.225	0.076	0.556		0.613	0.332		0.421	0.140	0.329
Back of Queue (*Q*), ft/ln (95 th percentile)	30.3	34.5	32.8	8.8	67.2		18.3	16.5		17.3	10.1	20.9
Back of Queue (*Q*), veh/ln (95 th percentile)	1.2	1.3	1.3	0.3	2.6		0.7	0.6		0.7	0.4	0.8
Queue Storage Ratio (*RQ*) (95 th percentile)	0.15	0.00	0.00	0.13	0.00		0.46	0.00		0.06	0.00	0.00
Uniform Delay (d_1), s/veh	9.3	9.7	9.7	9.6	12.6		22.2	20.2		21.0	18.6	19.0
Incremental Delay (d_2), s/veh	0.5	0.1	0.1	0.0	0.0		25.0	0.6		2.4	0.1	0.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	9.8	9.8	9.8	9.6	12.6	0.0	47.3	20.8		23.5	18.7	19.5
Level of Service (LOS)	A	A	A	A	B	A	D	C		C	B	B
Approach Delay, s/veh / LOS	9.8	A		9.9	A		29.6	C		21.3	C	
Intersection Delay, s/veh / LOS	11.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.99	B	2.58	C	3.09	C	2.71	C
Bicycle LOS Score / LOS	2.61	C	3.45	C	2.02	B	2.32	B

HCS7 Two-Way Stop-Control Report

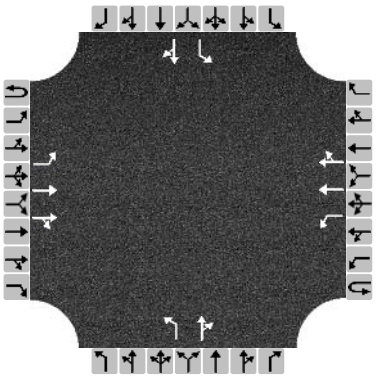
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	1/23/2018
Analysis Year	2018
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.81
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume, V (veh/h)		15	260	35		120	1335	260		10	5	65		5	0	10
Percent Heavy Vehicles (%)		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.20				4.20				7.60	6.60	7.00		7.60	6.60	7.00
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.25				2.25				3.55	4.05	3.35		3.55	4.05	3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		19				148				12		86		6		12
Capacity, c (veh/h)		280				1170				67		195		11		242
v/c Ratio		0.07				0.13				0.19		0.44		0.55		0.05
95% Queue Length, Q_{95} (veh)		0.2				0.4				0.6		2.1		1.2		0.2
Control Delay (s/veh)		18.8				8.5				70.8		37.5		519.3		20.7
Level of Service, LOS		C				A				F		E		F		C
Approach Delay (s/veh)		0.9				0.6				41.7				186.9		
Approach LOS										E				F		

HCS7 Two-Way Stop-Control Report

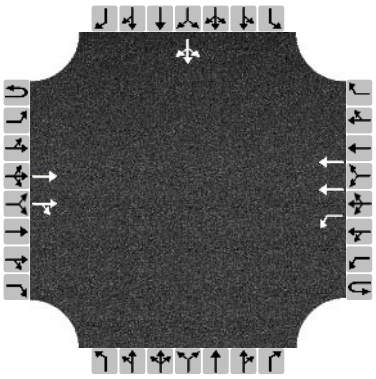
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	1/23/2018
Analysis Year	2018
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/I-229 SB
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	I-229 SB
Peak Hour Factor	0.84
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	1	2	0		0	0	0		0	1	0
Configuration			T	TR		L	T								LTR	
Volume, V (veh/h)			55	275		10	1630							0	0	85
Percent Heavy Vehicles (%)						5								5	5	5
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

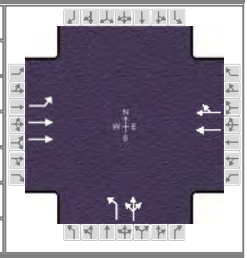
Base Critical Headway (sec)						4.1								7.5	6.5	6.9
Critical Headway (sec)						4.20								6.90	6.60	7.00
Base Follow-Up Headway (sec)						2.2								3.5	4.0	3.3
Follow-Up Headway (sec)						2.25								3.55	4.05	3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						12									101	
Capacity, c (veh/h)						1141									248	
v/c Ratio						0.01									0.41	
95% Queue Length, Q_{95} (veh)						0.0									1.9	
Control Delay (s/veh)						8.2									29.2	
Level of Service, LOS						A									D	
Approach Delay (s/veh)					0.0								29.2			
Approach LOS													D			

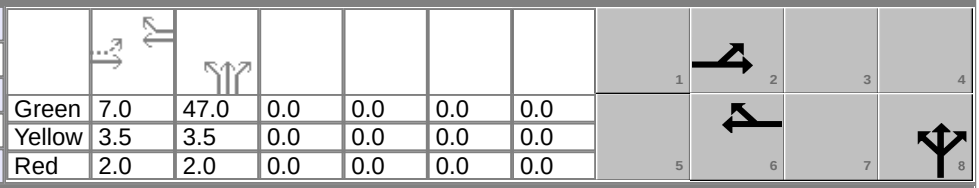
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 23, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.81
Urban Street	BENSON ROAD	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	50	5			30	0	1610	0	15			

Signal Information			
Cycle, s	65.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.0	47.0	0.0	0.0	0.0	0.0						
Yellow	3.5	3.5	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		8.0		10.0		
Phase Duration, s		12.5		12.5		52.5		
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		
Max Allow Headway (*MAH*), s		5.1		5.1		5.0		
Queue Clearance Time (g_s), s		5.4		2.7		49.0		
Green Extension Time (g_e), s		0.2		0.3		0.0		
Phase Call Probability		1.00		1.00		1.00		
Max Out Probability		0.15		0.02		1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	59	6			37	0	1988	12				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1338	1539			1619	0	1647	1371				
Queue Service Time (g_s), s	2.7	0.1			0.7	0.0	47.0	0.2				
Cycle Queue Clearance Time (g_c), s	3.4	0.1			0.7	0.0	47.0	0.2				
Green Ratio (*g/C*)	0.11	0.11			0.11		0.72	0.72				
Capacity (*c*), veh/h	241	332			349		1191	992				
Volume-to-Capacity Ratio (*X*)	0.246	0.018			0.106	0.000	1.669	0.012				
Back of Queue (*Q*), ft/ln (95 th percentile)	39.9	1.8			11.6	0	4471.5	0.9				
Back of Queue (*Q*), veh/ln (95 th percentile)	1.5	0.1			0.4	0.0	172.0	0.0				
Queue Storage Ratio (*RQ*) (95 th percentile)	0.40	0.00			0.00	0.00	0.00	0.00				
Uniform Delay (d_1), s/veh	27.7	25.9			26.2		9.0	2.5				
Incremental Delay (d_2), s/veh	0.7	0.0			0.2	0.0	304.6	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	28.4	26.0			26.4		313.6	2.5				
Level of Service (LOS)	C	C			C		F	A				
Approach Delay, s/veh / LOS	28.2	C		26.4	C		311.7	F		0.0		
Intersection Delay, s/veh / LOS	297.8						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.18	C	1.43	A	2.16	B	2.88	C
Bicycle LOS Score / LOS	2.53	C	2.51	C	5.47	E		

HCS7 Two-Way Stop-Control Report

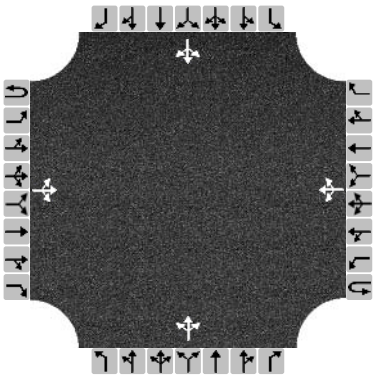
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	1/23/2018
Analysis Year	2018
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/HALL
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	HALL AVENUE
Peak Hour Factor	0.66
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		5	15	0		0	25	0		0	0	0		0	0	5
Percent Heavy Vehicles (%)		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.15				4.15				7.15	6.55	6.25		7.15	6.55	6.25
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.24				2.24				3.54	4.04	3.34		3.54	4.04	3.34

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		8				0					0				8	
Capacity, c (veh/h)		1557				1576					0				1027	
v/c Ratio		0.00				0.00									0.01	
95% Queue Length, Q_{95} (veh)		0.0				0.0									0.0	
Control Delay (s/veh)		7.3				7.3					5.0				8.5	
Level of Service, LOS		A				A					A				A	
Approach Delay (s/veh)	1.9				0.0				5.0				8.5			
Approach LOS									A				A			

HCS7 Streets Text Report

File Name:	BENSON AM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Jan 23, 2018
Time Period:	AM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2018
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	3
Number of Segments	2
Analysis period duration, h	0.25
System cycle length, s	65
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	2955	2955	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	345	20	0	815	125	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	295	0	0	1305	50	0	0	0	15	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	260	35	120	1335	260	10	5	65	5	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	55	275	10	1630	0	0	0	0	0	0	85
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43			43.31	
1	Running Speed, mph		41.94			41.64	
1	Through Delay, s/veh		9.79			18.66	
1	Travel Speed, mph		34.16			29.1	
1	Stop Rate, stops/veh		0.51			0.65	
1	Spatial Stop Rate, stops/mi		1.01			1.31	
1	Through vol/cap ratio		0.22			0.52	
1	Percent of Base FFS		77.52			66.03	
1	Level of Service		B			C	
1	Automobile Perception Score		2.29			2.34	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		47.59			48.82	
2	Running Speed, mph		42.34			41.27	
2	Through Delay, s/veh		25.96			12.61	
2	Travel Speed, mph		27.4			32.8	
2	Stop Rate, stops/veh		0.73			0.61	
2	Spatial Stop Rate, stops/mi		1.31			1.08	
2	Through vol/cap ratio		0.02			0.56	
2	Percent of Base FFS		62.16			74.42	
2	Level of Service		C			B	
2	Automobile Perception Score		2.39			2.41	

Facility Travel Time, s	126.33	123.4
Facility Travel Speed, mph	30.22	30.94
Facility Spatial Stop Rate, stops/mi	1.17	1.19
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	68.58	70.21
Facility Level of Service	B	B
Facility Automobile Perception Score	2.34	2.37
Facility Pedestrian Space	Infinity	Infinity
Facility Pedestrian Travel Speed	4.29	4.28
Facility Pedestrian LOS Score	2.57	3.18
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	13.76	13.13
Facility Bicycle LOS Score	2.55	2.9
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	34.17	29.12
Facility Transit LOS Score	0.86	0.92
Facility Transit LOS	A	A

SPILLBACK TIME, h 999

Multimodal Results

1	Average Pedestrian Space, ft2/p	Infinity	Infinity
1	Pedestrian Travel Speed, ft/s	4.22	4.22
1	Ped LOS Score for Intersection	1.99	2.86
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.52	0.8
1	Speed Adjustment Factor	0.7	0.69
1	Ped LOS Score for Link	2.53	2.8
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	0.93	0.84
1	Ped LOS Score for Segment	2.63	2.65
1	Ped Segment LOS	B	B
1	Bicycle Travel Speed	13.42	13.82
1	Bicycle LOS Score for Intersection	2.61	3
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.05	2.27
1	Speed Adjustment Factor	0.85	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	2.96	3.17
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.59	2.76
1	Bicycle Segment LOS	B	C
1	Transit Running Speed, mi/h	41.94	41.64
1	g/C Ratio	0.38	0.26
1	Transit Running Time, s	43	43.31
1	Delay at Intersection, s/veh	9.78	18.63
1	Transit Travel Speed, mi/h	34.17	29.12
1	Transit Wait-Ride Score	3.83	3.62
1	Ped LOS Score for Link	2.53	2.8
1	Transit LOS Score for Segment	0.64	1
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	Infinity	Infinity
2	Pedestrian Travel Speed, ft/s	4.34	4.33
2	Ped LOS Score for Intersection	3.18	2.58
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.42	1.4
2	Speed Adjustment Factor	0.72	0.68
2	Ped LOS Score for Link	2.44	3.39
2	Ped Link LOS	B	C
2	Roadway Crossing Difficulty Factor	0.89	1.1
2	Ped LOS Score for Segment	2.51	3.66
2	Ped Segment LOS	B	D
2	Bicycle Travel Speed	14.07	12.58
2	Bicycle LOS Score for Intersection	2.53	3.45
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	1.94	2.55
2	Speed Adjustment Factor	0.85	0.84
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	2.85	3.45
2	Bicycle Link LOS	C	C
2	Number of access point approaches	0	0
2	Segment Length, ft	2955	2955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.51	3.03
2	Bicycle Segment LOS	B	C
2	Transit Running Speed, mi/h	42.34	41.27
2	g/C Ratio	0.11	0.33
2	Transit Running Time, s	47.59	48.82
2	Delay at Intersection, s/veh	25.96	12.61
2	Transit Travel Speed, mi/h	27.4	32.8
2	Transit Wait-Ride Score	3.54	3.77
2	Ped LOS Score for Link	2.44	3.39
2	Transit LOS Score for Segment	1.06	0.85
2	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	431	25	0	608	93.3	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked												
1: Thru veh delay		0.02			0.05							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

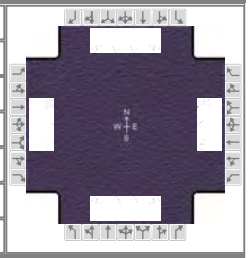
SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	369	0	0	997	38.2	0	0	0	15	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked												
1: Thru veh delay		0			0.03							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	18.6	322	43.3	91.3	1016	198	10	5	65	5	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked												
2: Thru veh delay		0.03			0.1							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											
3: Volume, veh/h	0	65.3	327	7.48	1220	0	0	0	0	0	0	85
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked												
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

This Urban Streets text report was created in HCS7 Streets Version 7.4 on January 29, 2018 at 02:08:07

HCS7 Signalized Intersection Results Summary

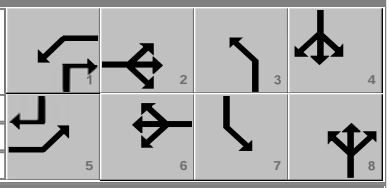
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 29, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.93
Urban Street	BENSON ROAD	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	125	535	160	125	245	105	140	385	45	220	405	105

Signal Information			
Cycle, s	62.3	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	4.6	0.7	15.0	5.8	2.2	15.0						
Yellow	3.0	0.0	3.5	3.0	0.0	3.5						
Red	1.0	0.0	2.0	1.0	0.0	2.0						



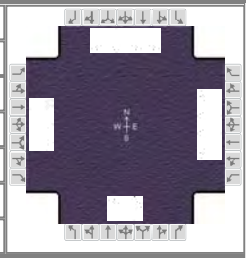
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	9.3	21.2	8.6	20.5	9.8	20.5	12.0	22.7
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	1.0	5.1	1.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	5.7	13.8	5.2	6.5	6.2	8.8	8.6	8.9
Green Extension Time (g_e), s	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.1
Phase Call Probability	0.90	1.00	0.86	1.00	0.93	1.00	0.98	1.00
Max Out Probability	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	134	347	330	114	144	139	151	414	27	237	435	70
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1639	1647	1730	1606	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	3.7	11.7	11.8	3.2	4.3	4.5	4.2	6.8	0.8	6.6	6.9	2.0
Cycle Queue Clearance Time (g_c), s	3.7	11.7	11.8	3.2	4.3	4.5	4.2	6.8	0.8	6.6	6.9	2.0
Green Ratio (*g/C*)	0.33	0.25	0.25	0.31	0.24	0.24	0.33	0.24	0.31	0.37	0.28	0.36
Capacity (*c*), veh/h	436	436	413	260	417	387	394	793	460	452	909	529
Volume-to-Capacity Ratio (*X*)	0.308	0.795	0.799	0.440	0.347	0.359	0.382	0.522	0.058	0.523	0.479	0.132
Back of Queue (*Q*), ft/ln (95 th percentile)	60	200.8	186.1	54	73.1	68	67.5	109.4	11	105.5	108.6	26.7
Back of Queue (*Q*), veh/ln (95 th percentile)	2.3	7.7	7.4	2.1	2.8	2.7	2.6	4.2	0.4	4.1	4.2	1.0
Queue Storage Ratio (*RQ*) (95 th percentile)	0.31	0.00	0.00	0.39	0.00	0.00	0.22	0.00	0.05	0.29	0.00	0.08
Uniform Delay (d_1), s/veh	15.6	21.8	21.8	17.3	19.6	19.6	15.6	20.5	14.9	14.8	18.8	13.4
Incremental Delay (d_2), s/veh	0.6	1.3	1.4	1.6	0.2	0.2	0.9	0.2	0.0	1.5	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	0.0	0.0
Control Delay (*d*), s/veh	16.2	23.0	23.2	18.9	19.7	19.8	16.5	20.7	14.9	16.3	19.0	13.4
Level of Service (LOS)	B	C	C	B	B	B	B	C	B	B	B	B
Approach Delay, s/veh / LOS	22.0	C		19.5	B		19.4	B		17.6	B	
Intersection Delay, s/veh / LOS	19.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.81	C	2.85	C	2.78	C	2.80	C
Bicycle LOS Score / LOS	2.93	C	2.65	C	2.87	C	3.00	C

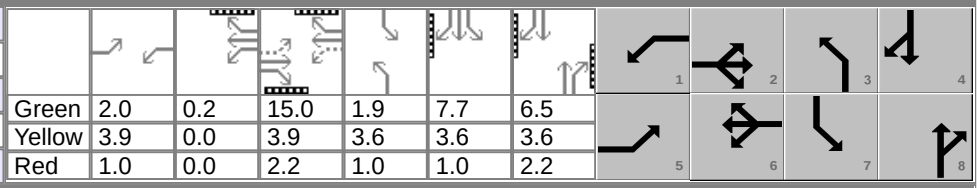
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 29, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.79
Urban Street	BENSON ROAD	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	45	795	15	40	270	50	30	25	120	420	20	110

Signal Information			
Cycle, s	59.3	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.0	0.2	15.0	1.9	7.7	6.5
Yellow	3.9	0.0	3.9	3.6	3.6	3.6
Red	1.0	0.0	2.2	1.0	1.0	2.2

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	6.9	21.1	7.1	21.3	6.5	12.3	18.7	24.6
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.8	4.6	5.8
Max Allow Headway (*MAH*), s	5.1	1.0	5.1	1.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	3.1	14.6	3.3	6.9	3.4	6.5	11.0	4.4
Green Extension Time (g_e), s	0.1	0.1	0.1	0.1	0.1	0.0	3.1	0.0
Phase Call Probability	0.51	1.00	0.55	1.00	0.47	0.99	1.00	1.00
Max Out Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	43	383	381	49	331	37	38	120		532	25	82
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1722	1647	1647		1647	1527		1600	1730	1466
Queue Service Time (g_s), s	1.1	12.6	12.6	1.3	4.9		1.4	4.5		9.0	0.6	2.4
Cycle Queue Clearance Time (g_c), s	1.1	12.6	12.6	1.3	4.9		1.4	4.5		9.0	0.6	2.4
Green Ratio (*g/C*)	0.29	0.25	0.25	0.29	0.26		0.03	0.11		0.24	0.32	0.32
Capacity (*c*), veh/h	322	438	436	211	845		52	168		764	548	464
Volume-to-Capacity Ratio (*X*)	0.133	0.874	0.874	0.232	0.392		0.729	0.718		0.696	0.046	0.177
Back of Queue (*Q*), ft/ln (95 th percentile)	17.9	193.3	185.3	21.3	77.1		39.6	75.3		148.8	9.9	33.5
Back of Queue (*Q*), veh/ln (95 th percentile)	0.7	7.4	7.4	0.8	3.0		1.5	2.9		5.7	0.4	1.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.09	0.00	0.00	0.30	0.00		0.99	0.00		0.55	0.00	0.00
Uniform Delay (d_1), s/veh	15.9	21.2	21.2	16.8	18.2		28.5	25.5		20.6	14.1	14.7
Incremental Delay (d_2), s/veh	0.2	1.5	1.5	0.6	0.1		24.0	2.1		1.6	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	16.0	22.7	22.7	17.4	18.3	0.0	52.4	27.7		22.3	14.1	14.7
Level of Service (LOS)	B	C	C	B	B	A	D	C		C	B	B
Approach Delay, s/veh / LOS	22.4	C		16.6	B		33.6	C		21.0	C	
Intersection Delay, s/veh / LOS	21.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.11	B	2.62	C	3.05	C	2.69	C
Bicycle LOS Score / LOS	3.15	C	2.62	C	2.19	B	3.13	C

HCS7 Two-Way Stop-Control Report

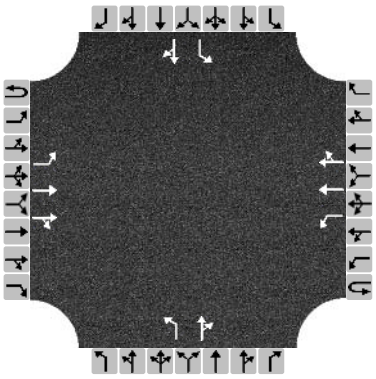
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	1/29/2018
Analysis Year	2018
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.84
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume, V (veh/h)		5	1435	25		40	340	30		10	5	95		70	0	40
Percent Heavy Vehicles (%)		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.20				4.20				7.60	6.60	7.00		7.60	6.60	7.00
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.25				2.25				3.55	4.05	3.35		3.55	4.05	3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		6				48				12		119		83		48
Capacity, c (veh/h)		1095				345				27		208		47		775
v/c Ratio		0.01				0.14				0.44		0.57		1.79		0.06
95% Queue Length, Q_{95} (veh)		0.0				0.5				1.4		3.1		8.3		0.2
Control Delay (s/veh)		8.3				17.1				219.5		43.2		564.1		9.9
Level of Service, LOS		A				C				F		E		F		A
Approach Delay (s/veh)		0.0				1.7				59.2				362.6		
Approach LOS										F				F		

HCS7 Two-Way Stop-Control Report

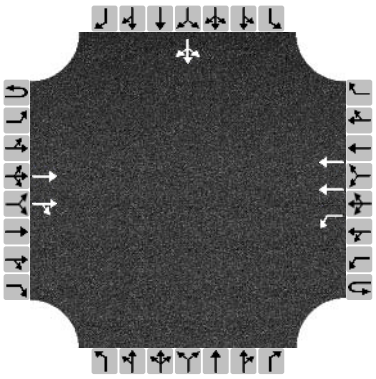
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	1/29/2018
Analysis Year	2018
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/I-229 SB
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	I-229 SB
Peak Hour Factor	0.88
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	1	2	0		0	0	0		0	1	0
Configuration			T	TR		L	T								LTR	
Volume, V (veh/h)			170	1430		25	380							0	0	30
Percent Heavy Vehicles (%)						5								5	5	5
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

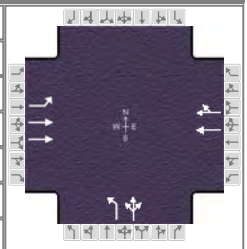
Base Critical Headway (sec)						4.1								7.5	6.5	6.9
Critical Headway (sec)						4.20								6.90	6.60	7.00
Base Follow-Up Headway (sec)						2.2								3.5	4.0	3.3
Follow-Up Headway (sec)						2.25								3.55	4.05	3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						28									34	
Capacity, c (veh/h)						321									780	
v/c Ratio						0.09									0.04	
95% Queue Length, Q_{95} (veh)						0.3									0.1	
Control Delay (s/veh)						17.3									9.8	
Level of Service, LOS						C									A	
Approach Delay (s/veh)					1.1								9.8			
Approach LOS													A			

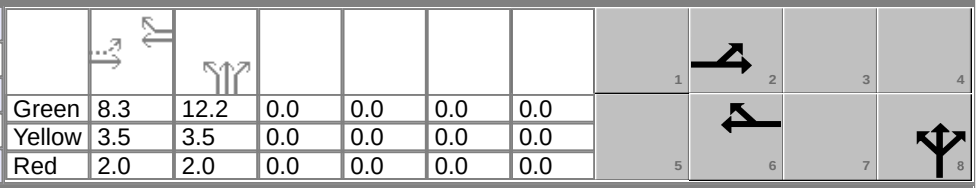
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 29, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.78
Urban Street	BENSON ROAD	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	145	25			50	20	355	0	20			

Signal Information			
Cycle, s	31.5	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.3	12.2	0.0	0.0	0.0	0.0						
Yellow	3.5	3.5	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		8.0		10.0		
Phase Duration, s		13.8		13.8		17.7		
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		
Max Allow Headway (*MAH*), s		5.2		5.2		5.0		
Queue Clearance Time (g_s), s		7.5		4.0		9.4		
Green Extension Time (g_e), s		0.8		1.0		3.1		
Phase Call Probability		1.00		1.00		0.98		
Max Out Probability		0.22		0.05		0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	154	27			39	38	455	13				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1291	1540			1619	1527	1647	1371				
Queue Service Time (g_s), s	3.4	0.2			2.0	0.6	7.4	0.2				
Cycle Queue Clearance Time (g_c), s	5.5	0.2			2.0	0.6	7.4	0.2				
Green Ratio (*g/C*)	0.26	0.26			0.26	0.26	0.39	0.39				
Capacity (*c*), veh/h	486	813			428	403	637	530				
Volume-to-Capacity Ratio (*X*)	0.317	0.033			0.090	0.095	0.714	0.024				
Back of Queue (*Q*), ft/ln (95 th percentile)	31.8	2			6.4	6.1	71	1.3				
Back of Queue (*Q*), veh/ln (95 th percentile)	1.2	0.1			0.2	0.2	2.7	0.0				
Queue Storage Ratio (*RQ*) (95 th percentile)	0.32	0.00			0.00	0.00	0.00	0.00				
Uniform Delay (d_1), s/veh	11.5	8.6			8.7	8.8	8.2	6.0				
Incremental Delay (d_2), s/veh	0.3	0.0			0.1	0.1	2.1	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	11.7	8.6			8.9	8.9	10.3	6.0				
Level of Service (LOS)	B	A			A	A	B	A				
Approach Delay, s/veh / LOS	11.3	B		8.9	A		10.2	B		0.0		
Intersection Delay, s/veh / LOS	10.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.02	B	1.42	A	2.17	B	2.54	C
Bicycle LOS Score / LOS	2.66	C	2.54	C	2.94	C		

HCS7 Two-Way Stop-Control Report

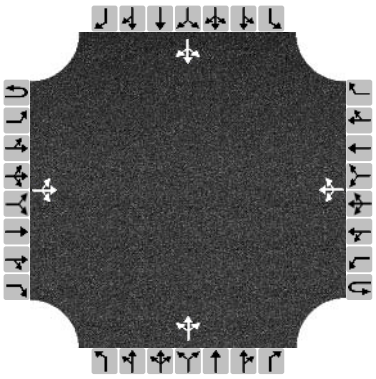
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	1/29/2018
Analysis Year	2018
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/HALL
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	HALL AVENUE
Peak Hour Factor	0.60
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		15	25	5		0	45	0		0	5	0		0	0	25
Percent Heavy Vehicles (%)		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.15				4.15				7.15	6.55	6.25		7.15	6.55	6.25
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.24				2.24				3.54	4.04	3.34		3.54	4.04	3.34

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		25				0					8				42	
Capacity, c (veh/h)		1509				1541					705				980	
v/c Ratio		0.02				0.00					0.01				0.04	
95% Queue Length, Q_{95} (veh)		0.1				0.0					0.0				0.1	
Control Delay (s/veh)		7.4				7.3					10.2				8.8	
Level of Service, LOS		A				A					B				A	
Approach Delay (s/veh)	2.6				0.0				10.2				8.8			
Approach LOS									B				A			

HCS7 Streets Text Report

File Name:	BENSON PM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Jan 29, 2018
Time Period:	PM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2018
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	3
Number of Segments	2
Analysis period duration, h	0.25
System cycle length, s	65
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	95
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	0.51
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

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	40	40	2	2	2610	2610	50	50	0	0	70	70	0	0
2	40	40	2	2	2990	2990	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	345	20	0	815	125	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1335	0	0	360	30	0	0	0	130	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	5	1435	25	40	340	30	10	5	95	70	0	40
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1410											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	170	1430	25	380	0	0	0	0	0	0	30
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1920											
3: Peak Hour Factor	1											

Number of access points: 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		42.94			42.55	
1	Running Speed, mph		41.44			41.82	
1	Through Delay, s/veh		22.71			19.78	
1	Travel Speed, mph		27.11			28.55	
1	Stop Rate, stops/veh		0.75			0.64	
1	Spatial Stop Rate, stops/mi		1.51			1.29	
1	Through vol/cap ratio		0.87			0.35	
1	Percent of Base FFS		61.5			64.78	
1	Level of Service		C			C	
1	Automobile Perception Score		2.37			2.33	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		49.57			48.32	
2	Running Speed, mph		41.13			42.19	
2	Through Delay, s/veh		8.62			18.31	
2	Travel Speed, mph		35.04			30.6	
2	Stop Rate, stops/veh		0.59			0.63	
2	Spatial Stop Rate, stops/mi		1.04			1.11	
2	Through vol/cap ratio		0.03			0.39	
2	Percent of Base FFS		79.5			69.42	
2	Level of Service		B			B	
2	Automobile Perception Score		2.35			2.41	

Facility Travel Time, s	123.84	128.96
Facility Travel Speed, mph	30.83	29.61
Facility Spatial Stop Rate, stops/mi	1.26	1.19
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	69.96	67.18
Facility Level of Service	B	B
Facility Automobile Perception Score	2.36	2.37
Facility Pedestrian Space	Infinity	Infinity
Facility Pedestrian Travel Speed	4.25	4.25
Facility Pedestrian LOS Score	3.11	2.57
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	13.24	13.66
Facility Bicycle LOS Score	2.93	2.63
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	27.11	28.57
Facility Transit LOS Score	0.94	0.93
Facility Transit LOS	A	A

SPILLBACK TIME, h 999

Multimodal Results

1	Average Pedestrian Space, ft2/p	Infinity	Infinity
1	Pedestrian Travel Speed, ft/s	4.21	4.21
1	Ped LOS Score for Intersection	2.11	2.85
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.98	0.58
1	Speed Adjustment Factor	0.69	0.7
1	Ped LOS Score for Link	2.97	2.59
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	0.94	0.8
1	Ped LOS Score for Segment	2.95	2.46
1	Ped Segment LOS	C	B
1	Bicycle Travel Speed	13.08	13.18
1	Bicycle LOS Score for Intersection	3.15	2.65
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.37	2.1
1	Speed Adjustment Factor	0.84	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.27	3.01
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2610	2610
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.86	2.64
1	Bicycle Segment LOS	C	B
1	Transit Running Speed, mi/h	41.44	41.82
1	g/C Ratio	0.25	0.24
1	Transit Running Time, s	42.94	42.55
1	Delay at Intersection, s/veh	22.7	19.75
1	Transit Travel Speed, mi/h	27.11	28.57
1	Transit Wait-Ride Score	3.52	3.59
1	Ped LOS Score for Link	2.97	2.59
1	Transit LOS Score for Segment	1.16	1
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	Infinity	Infinity
2	Pedestrian Travel Speed, ft/s	4.3	4.3
2	Ped LOS Score for Intersection	2.02	2.62
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	1.64	0.59
2	Speed Adjustment Factor	0.68	0.71
2	Ped LOS Score for Link	3.62	2.61
2	Ped Link LOS	D	C
2	Roadway Crossing Difficulty Factor	0.88	0.92
2	Ped LOS Score for Segment	3.25	2.67
2	Ped Segment LOS	C	B
2	Bicycle Travel Speed	13.37	14.11
2	Bicycle LOS Score for Intersection	2.66	2.62
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.63	2.12
2	Speed Adjustment Factor	0.84	0.85
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.53	3.02
2	Bicycle Link LOS	D	C
2	Number of access point approaches	0	0
2	Segment Length, ft	2990	2990
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.98	2.63
2	Bicycle Segment LOS	C	B
2	Transit Running Speed, mi/h	41.13	42.19
2	g/C Ratio	0.26	0.26
2	Transit Running Time, s	49.57	48.32
2	Delay at Intersection, s/veh	8.62	18.31
2	Transit Travel Speed, mi/h	35.04	30.6
2	Transit Wait-Ride Score	3.86	3.68
2	Ped LOS Score for Link	3.62	2.61
2	Transit LOS Score for Segment	0.75	0.87
2	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	813	47.1	0	441	67.6	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked												
1: Thru veh delay		0.04			0.04							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

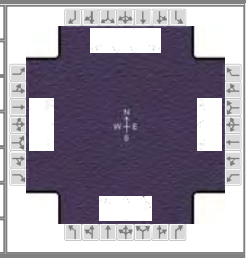
SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1438	0	0	441	36.8	0	0	0	130	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked												
1: Thru veh delay		0			0.03							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	5.35	1536	26.8	50.4	428	37.8	10	5	95	70	0	40
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked												
2: Thru veh delay		0.03			0.03							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1410											
3: Volume, veh/h	0	181	1520	32	486	0	0	0	0	0	0	30
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked												
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1920											

This Urban Streets text report was created in HCS7 Streets Version 7.4 on January 29, 2018 at 02:16:54

HCS7 Signalized Intersection Results Summary

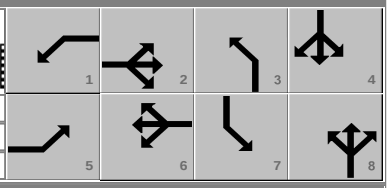
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 29, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.91
Urban Street	RICE STREET	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	90	15	165	225	330	30	495	70	90	280	60

Signal Information			
Cycle, s	87.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.6	2.3	36.0	2.2	1.8	19.2						
Yellow	3.5	3.5	3.5	3.5	0.0	3.5						
Red	0.5	0.5	2.0	0.5	0.0	2.0						



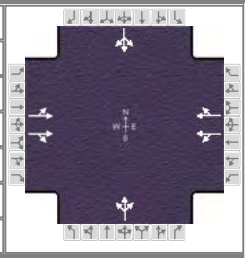
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	3.0
Phase Duration, s	6.6	41.5	12.9	47.7	6.2	24.7	8.0	26.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.1
Queue Clearance Time (g_s), s	3.4		8.6		3.3	16.1	6.0	8.8
Green Extension Time (g_e), s	0.0	0.0	0.3	0.0	0.0	3.0	0.0	3.6
Phase Call Probability	0.65		1.00		0.55	1.00	0.91	1.00
Max Out Probability	0.00		0.67		1.00	0.15	1.00	0.02

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	44	55	55	225	307	273	33	297	291	99	308	38
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1594	1674	1615	1594	1674	1418	1647	1730	1684	1647	1647	
Queue Service Time (g_s), s	1.4	1.7	1.8	6.6	10.0	10.7	1.3	14.1	14.1	4.0	6.8	
Cycle Queue Clearance Time (g_c), s	1.4	1.7	1.8	6.6	10.0	10.7	1.3	14.1	14.1	4.0	6.8	
Green Ratio (*g/C*)	0.44	0.41	0.41	0.54	0.49	0.49	0.25	0.22	0.22	0.27	0.24	
Capacity (*c*), veh/h	482	692	668	722	812	688	271	381	371	205	794	
Volume-to-Capacity Ratio (*X*)	0.091	0.080	0.082	0.312	0.378	0.396	0.122	0.780	0.784	0.482	0.388	
Back of Queue (*Q*), ft/ln (95 th percentile)	23	32.5	30.2	103.2	178	164.6	24.5	263.3	249.7	76.4	122.6	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.9	1.2	1.2	3.9	6.6	6.1	0.9	10.1	10.0	2.9	4.7	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.23	0.00	0.00	0.65	0.00	0.00	0.22	0.00	0.00	0.51	0.00	
Uniform Delay (d_1), s/veh	14.1	15.5	15.5	10.9	14.1	14.3	25.6	31.9	32.0	26.5	27.6	
Incremental Delay (d_2), s/veh	0.1	0.2	0.2	0.2	1.1	1.4	0.2	4.1	4.3	1.8	0.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	14.1	15.7	15.7	11.1	15.2	15.7	25.8	36.0	36.3	28.2	28.0	0.0
Level of Service (LOS)	B	B	B	B	B	B	C	D	D	C	C	A
Approach Delay, s/veh / LOS	15.3	B		14.2	B		35.6	D		25.6	C	
Intersection Delay, s/veh / LOS	23.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.62	C	2.77	C	2.75	C	2.35	B
Bicycle LOS Score / LOS	2.08	B	3.33	C	2.78	C	2.63	C

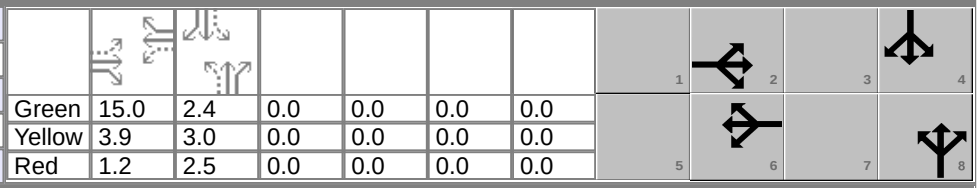
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 29, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.70
Urban Street	RICE STREET	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	WAYLAND AVE	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	10	230	10	5	695	20	10	15	0	40	10	15

Signal Information			
Cycle, s	28.0	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	15.0	2.4	0.0	0.0	0.0	0.0						
Yellow	3.9	3.0	0.0	0.0	0.0	0.0						
Red	1.2	2.5	0.0	0.0	0.0	0.0						

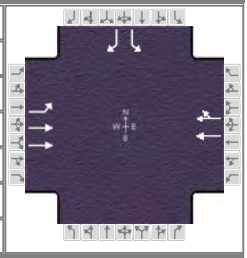
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		20.1		20.1		7.9		7.9
Change Period, ($Y+R_c$), s		5.1		5.1		5.5		5.5
Max Allow Headway (*MAH*), s		1.3		1.3		4.2		4.2
Queue Clearance Time (g_s), s		3.2		7.4		2.6		3.6
Green Extension Time (g_e), s		0.1		0.1		0.3		0.3
Phase Call Probability		1.00		1.00		0.61		0.61
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	140		128	489		442		36			86	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1612		1511	1671		1515		1592			1470	
Queue Service Time (g_s), s	0.0		1.2	0.0		5.4		0.0			1.0	
Cycle Queue Clearance Time (g_c), s	1.2		1.2	5.4		5.4		0.6			1.6	
Green Ratio (*g/C*)	0.53		0.53	0.53		0.53		0.09			0.09	
Capacity (*c*), veh/h	1000		808	1024		810		319			342	
Volume-to-Capacity Ratio (*X*)	0.140		0.158	0.478		0.546		0.112			0.250	
Back of Queue (*Q*), ft/ln (95 th percentile)	3.8		3.5	17.1		16		8.1			20.2	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.2		0.1	0.7		0.6		0.3			0.8	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00		0.00	0.00		0.00		0.00			0.00	
Uniform Delay (d_1), s/veh	3.3		3.3	4.3		4.3		12.0			12.4	
Incremental Delay (d_2), s/veh	0.0		0.0	0.1		0.2		0.2			0.4	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (*d*), s/veh	3.3		3.3	4.4		4.4		12.1			12.8	
Level of Service (LOS)	A		A	A		A		B			B	
Approach Delay, s/veh / LOS	3.3	A		4.4	A		12.1	B		12.8	B	
Intersection Delay, s/veh / LOS	4.9						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.69	B	1.73	B	2.50	C	2.48	B
Bicycle LOS Score / LOS	2.46	B	3.01	C	2.72	C	2.80	C

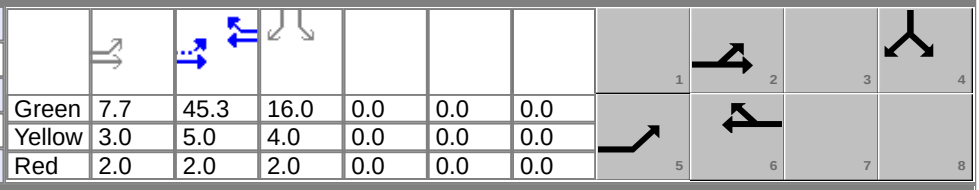
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 29, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.86
Urban Street	RICE STREET	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	95	215			645	400				80		55

Signal Information			
Cycle, s	87.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.7	45.3	16.0	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0

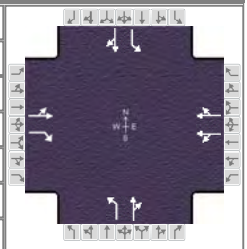
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				9.0
Phase Duration, s	12.7	65.0		52.3				22.0
Change Period, ($Y+R_c$), s	5.0	7.0		7.0				6.0
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.2
Queue Clearance Time (g_s), s	8.3							18.0
Green Extension Time (g_e), s	0.0	0.0		0.0				0.0
Phase Call Probability	0.92							0.98
Max Out Probability	1.00							1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	106	240			622	567				93		64
Adjusted Saturation Flow Rate (*s*), veh/h/ln	645	1623			1806	1627				377		1436
Queue Service Time (g_s), s	6.3	2.3			18.3	24.6				16.0		3.3
Cycle Queue Clearance Time (g_c), s	6.3	2.3			18.3	24.6				16.0		3.3
Green Ratio (*g/C*)	0.63	0.67			0.52	0.52				0.18		0.18
Capacity (*c*), veh/h	183	2164			940	847				69		264
Volume-to-Capacity Ratio (*X*)	0.581	0.111			0.662	0.669				1.341		0.242
Back of Queue (*Q*), ft/ln (95 th percentile)	91.8	30.2			351.3	364.3				463.2		51.5
Back of Queue (*Q*), veh/ln (95 th percentile)	2.2	1.2			14.1	14.6				10.3		2.1
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00	0.00				0.00		0.00
Uniform Delay (d_1), s/veh	15.7	5.2			16.7	19.6				35.5		30.3
Incremental Delay (d_2), s/veh	3.5	0.1			2.8	3.3				223.6		0.5
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	19.3	5.3			19.6	22.8				259.1		30.8
Level of Service (LOS)	B	A			B	C				F		C
Approach Delay, s/veh / LOS	9.6	A		21.1	C		0.0			166.1	F	
Intersection Delay, s/veh / LOS	32.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.66	A	1.89	B	2.37	B	2.31	B
Bicycle LOS Score / LOS	0.78	A	1.34	A				F

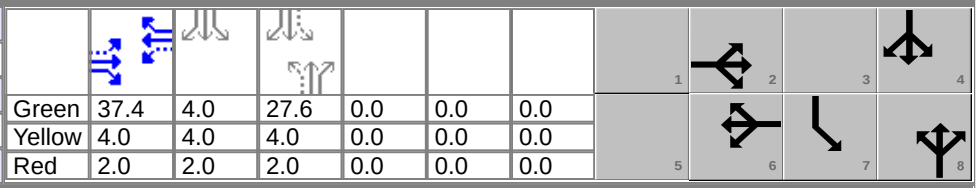
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 29, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.76
Urban Street	RICE STREET	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	30	85	180	30	600	10	245	200	40	60	10	200

Signal Information			
Cycle, s	87.0	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	37.4	4.0	27.6	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8	7	4
Case Number		7.0		8.0		6.3	1.0	4.0
Phase Duration, s		43.4		43.4		33.6	10.0	43.6
Change Period, ($Y+R_c$), s		6.0		6.0		6.0	6.0	6.0
Max Allow Headway (*MAH*), s		0.0		0.0		6.4	6.0	6.4
Queue Clearance Time (g_s), s						24.2	4.8	9.1
Green Extension Time (g_e), s		0.0		0.0		3.4	0.0	8.2
Phase Call Probability						1.00	0.85	1.00
Max Out Probability						0.95	1.00	0.07

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		111	106	435		400	322	296		79	171	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		839	1341	1641		1484	1185	1638		1594	1367	
Queue Service Time (g_s), s		1.0	4.7	0.0		18.3	22.2	13.1		2.8	7.1	
Cycle Queue Clearance Time (g_c), s		19.3	4.7	17.6		18.3	22.2	13.1		2.8	7.1	
Green Ratio (*g/C*)		0.43	0.43	0.43		0.43	0.32	0.32		0.39	0.43	
Capacity (*c*), veh/h		413	576	751		638	459	520		327	591	
Volume-to-Capacity Ratio (*X*)		0.269	0.184	0.580		0.627	0.703	0.570		0.242	0.290	
Back of Queue (*Q*), ft/ln (95 th percentile)		81.9	71.9	282.3		273	285.3	233.3		48.6	100.3	
Back of Queue (*Q*), veh/ln (95 th percentile)		3.1	2.7	11.3		10.9	11.0	9.0		1.8	3.7	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.00		0.00	1.90	0.00		0.49	0.00	
Uniform Delay (d_1), s/veh		19.0	17.3	19.1		19.2	27.9	24.7		18.7	16.0	
Incremental Delay (d_2), s/veh		1.4	0.6	3.3		4.6	5.4	2.1		0.8	0.6	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		20.4	17.9	22.4		23.8	33.3	26.9		19.5	16.6	
Level of Service (LOS)		C	B	C		C	C	C		B	B	
Approach Delay, s/veh / LOS	19.2	B		23.1	C		30.2	C		17.5	B	
Intersection Delay, s/veh / LOS	24.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.26	B	2.37	B	2.36	B	3.03	C
Bicycle LOS Score / LOS	2.81	C	1.30	A	3.16	C	2.58	C

HCS7 Two-Way Stop-Control Report

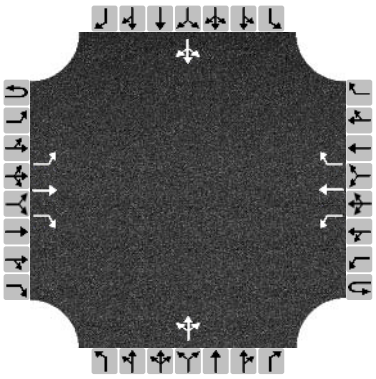
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	1/29/2018
Analysis Year	2018
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BAHNSON AVENUE
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	RICE STREET
North/South Street	BAHNSON AVENUE
Peak Hour Factor	0.85
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	1	0	1	1	1		0	1	0		0	1	0
Configuration		L	T	R		L	T	R			LTR				LTR	
Volume, V (veh/h)		20	145	20		5	615	5		10	5	5		0	5	15
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.13				4.13				7.13	6.53	6.23		7.13	6.53	6.23
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23				2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		24				6					24				24	
Capacity, c (veh/h)		869				1372					275				357	
v/c Ratio		0.03				0.00					0.09				0.07	
95% Queue Length, Q_{95} (veh)		0.1				0.0					0.3				0.2	
Control Delay (s/veh)		9.3				7.6					19.3				15.8	
Level of Service, LOS		A				A					C				C	
Approach Delay (s/veh)		1.0				0.1					19.3				15.8	
Approach LOS											C				C	

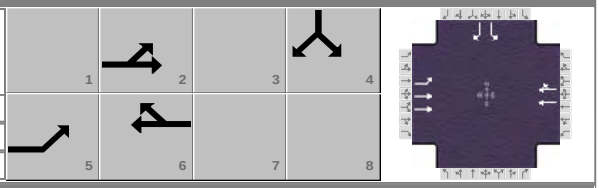
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Parclo AB-2Q
Analyst	RL	Analysis Date	Jan 29, 2018	Segment Distance, ft	1020
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 SB	PHF	0.86	Arterial Direction	East-West
File Name	RICE AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	95	215			645	400				80		55
Intersection Two Demand (*v*), veh/h	30	85	180	30	600	10	245	200	40	60	10	200

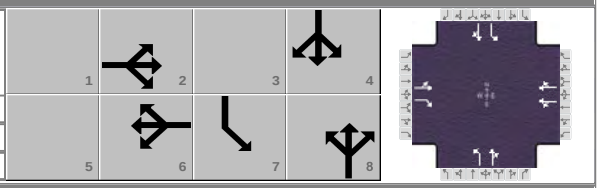
Signal One Information	
Cycle, s	87.0
Offset, s	75
Uncoordinated	No
Force Mode	Fixed

Green	7.7	45.3	16.0	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



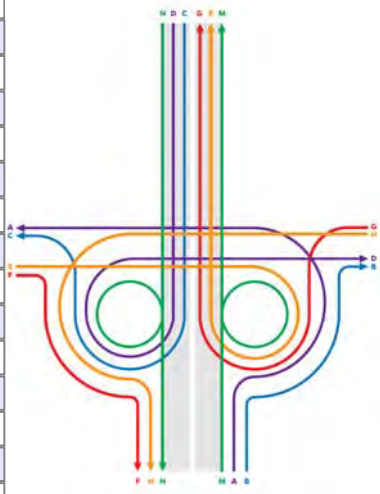
Signal Two Information	
Cycle, s	87.0
Offset, s	75
Uncoordinated	No
Force Mode	Fixed

Green	37.4	4.0	27.6	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Interchange Results

O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	122	52.9	0.0	52.9	No	Yes	F
B	33	26.9	0.0	26.9	No	No	B
C	0	0.0	5.0	5.0	No	No	A
D	0	0.0	5.0	5.0	No	No	A
E	106	23.2	5.0	28.2	No	No	B
F	0	5.3	0.0	5.3	No	No	A
G	39	22.4	5.0	27.4	No	No	B
H	0	0.0	0.0	0.0	No	No	A
I	282	5.3	0.0	5.3	No	No	A
J	544	19.6	0.0	19.6	No	No	B
K	-	-	0.0	-	-	-	-
L	-	-	0.0	-	-	-	-
M	200	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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	19.3	5.3			19.6	22.8				259.1		30.8
Level of Service (LOS)	B	A			B	C				F		C
Approach Delay, s/veh / LOS	9.6	A		21.1	C		0.0			166.1	F	
Intersection Delay, s/veh / LOS	32.2						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		20.4	17.9	22.4		23.8	33.3	26.9		19.5	16.6	
Level of Service (LOS)		C	B	C		C	C	C		B	B	
Approach Delay, s/veh / LOS	19.2	B		23.1	C		30.2	C		17.5	B	
Intersection Delay, s/veh / LOS	24.2						C					

HCS7 Streets Text Report

File Name:	RICE AM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Jan 29, 2018
Time Period:	AM
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2018
Project Description:	I-229/BENSON IMJR
Urban Street:	RICE STREET
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	87
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	95
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	0.51
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

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	35	35	2	1	1020	1020	50	50	0	0	70	70	0	0
2	35	35	2	2	3460	3460	50	50	0	0	70	70	0	0
3	35	35	1	2	1020	1020	50	50	0	0	70	70	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

	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB

Movement	LT 1	TH 2	RT 3	LT 4	TH 5	RT 6	LT 7	TH 8	RT 9	LT 10	TH 11	RT 12
1: Volume, veh/h	0	255	15	15	685	0	35	0	55	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Location, ft	3030											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 3

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				999		
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		19.87			20.94	
1	Running Speed, mph		35			33.21	
1	Through Delay, s/veh		3.34			15.22	
1	Travel Speed, mph		29.96			19.23	
1	Stop Rate, stops/veh		0.41			0.51	
1	Spatial Stop Rate, stops/mi		2.14			2.62	
1	Through vol/cap ratio		0.15			0.38	
1	Percent of Base FFS		71.82			46.1	
1	Level of Service		B			D	
1	Automobile Perception Score		2.7			2.78	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h						
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		58.04			59.03	
2	Running Speed, mph		40.65			39.97	
2	Through Delay, s/veh		5.32			4.41	
2	Travel Speed, mph		37.23			37.19	
2	Stop Rate, stops/veh		0.23			0.42	
2	Spatial Stop Rate, stops/mi		0.35			0.65	
2	Through vol/cap ratio		0.11			0.51	
2	Percent of Base FFS		89.24			89.13	
2	Level of Service		A			A	
2	Automobile Perception Score		2.29			2.34	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h						
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		20.05			20.53	
3	Running Speed, mph		34.68			33.88	
3	Through Delay, s/veh		20.43			20.5	
3	Travel Speed, mph		17.18			16.95	
3	Stop Rate, stops/veh		0.65			0.66	
3	Spatial Stop Rate, stops/mi		3.35			3.44	
3	Through vol/cap ratio		0.27			0.66	
3	Percent of Base FFS		41.17			40.63	
3	Level of Service		D			D	
3	Automobile Perception Score		2.91			2.93	

Facility Travel Time, s	127.05	140.62
Facility Travel Speed, mph	29.51	26.67
Facility Spatial Stop Rate, stops/mi	1.24	1.53
Facility Base Free Flow Speed, mph	41.72	41.72
Facility Percent Base Free Flow Speed	70.74	63.92
Facility Level of Service	B	C
Facility Automobile Perception Score	2.46	2.51
Facility Pedestrian Space	Infinity	Infinity
Facility Pedestrian Travel Speed	4.24	4.22
Facility Pedestrian LOS Score	2.46	3.36
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	13.74	13.53
Facility Bicycle LOS Score	2.45	2.86
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	35	19.23

Facility Transit LOS Score		0.48	0.99
Facility Transit LOS		A	A
SPILLBACK TIME, h		999	

Multimodal Results

1	Average Pedestrian Space, ft2/p	Infinity	Infinity
1	Pedestrian Travel Speed, ft/s	3.85	3.85
1	Ped LOS Score for Intersection	1.69	2.77
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.31	2.16
1	Speed Adjustment Factor	0.49	0.44
1	Ped LOS Score for Link	2.11	3.9
1	Ped Link LOS	B	D
1	Roadway Crossing Difficulty Factor	1.06	0.8
1	Ped LOS Score for Segment	2.51	3.18
1	Ped Segment LOS	B	C
1	Bicycle Travel Speed	11.34	14.08
1	Bicycle LOS Score for Intersection	2.46	3.33
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	1.79	2.77
1	Speed Adjustment Factor	0.76	0.74
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	2.61	3.57
1	Bicycle Link LOS	C	D
1	Number of access point approaches	0	0
1	Segment Length, ft	1020	1020
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.42	3.04
1	Bicycle Segment LOS	B	C
1	Transit Running Speed, mi/h	35	33.21
1	g/C Ratio	0.53	0.49
1	Transit Running Time, s	19.87	20.94
1	Delay at Intersection, s/veh	0	15.22
1	Transit Travel Speed, mi/h	35	19.23
1	Transit Wait-Ride Score	3.86	3.09
1	Ped LOS Score for Link	2.11	3.9
1	Transit LOS Score for Segment	0.53	1.96
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	Infinity	Infinity
2	Pedestrian Travel Speed, ft/s	4.34	4.34
2	Ped LOS Score for Intersection	0.66	1.73
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.35	1.06
2	Speed Adjustment Factor	0.66	0.64
2	Ped LOS Score for Link	2.32	3
2	Ped Link LOS	B	C
2	Roadway Crossing Difficulty Factor	0.8	1.2
2	Ped LOS Score for Segment	2.26	3.56
2	Ped Segment LOS	B	D
2	Bicycle Travel Speed	14.72	14.1
2	Bicycle LOS Score for Intersection	0.78	3.01
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	1.85	2.41
2	Speed Adjustment Factor	0.84	0.83
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	2.74	3.3
2	Bicycle Link LOS	C	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3460	3460
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.39	2.84
2	Bicycle Segment LOS	B	C
2	Transit Running Speed, mi/h	40.65	39.97
2	g/C Ratio	0.67	0.53
2	Transit Running Time, s	58.04	59.03
2	Delay at Intersection, s/veh	5.32	0
2	Transit Travel Speed, mi/h	37.23	39.97
2	Transit Wait-Ride Score	3.94	4.04
2	Ped LOS Score for Link	2.32	3
2	Transit LOS Score for Segment	0.43	0.4
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	Infinity	Infinity

3	Pedestrian Travel Speed, ft/s	4.31	4.22
3	Ped LOS Score for Intersection	2.26	1.89
3	Cross-section Adjustment Factor	-4.74	-4.74
3	Volume Adjustment Factor	0.7	1.56
3	Speed Adjustment Factor	0.48	0.46
3	Ped LOS Score for Link	2.49	3.33
3	Ped Link LOS	B	C
3	Roadway Crossing Difficulty Factor	1.2	0.8
3	Ped LOS Score for Segment	3.1	2.85
3	Ped Segment LOS	C	C
3	Bicycle Travel Speed	13.58	11.49
3	Bicycle LOS Score for Intersection	2.81	1.34
3	Cross-section Adjustment Factor	-1.28	-1.28
3	Volume Adjustment Factor	2.2	2.61
3	Speed Adjustment Factor	0.76	0.75
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	3.02	3.41
3	Bicycle Link LOS	C	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1020	1020
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	2.65	2.73
3	Bicycle Segment LOS	B	B
3	Transit Running Speed, mi/h	34.68	33.88
3	g/C Ratio	0.43	0.52
3	Transit Running Time, s	20.05	20.53
3	Delay at Intersection, s/veh	0	19.59
3	Transit Travel Speed, mi/h	34.68	17.34
3	Transit Wait-Ride Score	3.85	2.96
3	Ped LOS Score for Link	2.49	3.33
3	Transit LOS Score for Segment	0.6	2.06
3	Transit Segment LOS	A	B

ACCESS POINT DATA

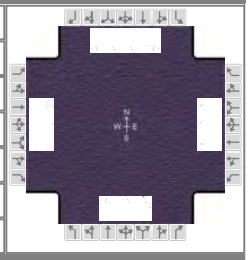
SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	291	17.1	19.9	911	0	35	0	55	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Prop blocked												
1: Thru veh delay		0.01			0							
1: Prob inside blk		0			0							
1: Dist to upstream signal	3030											

This Urban Streets text report was created in HCS7 Streets Version 7.4 on January 29, 2018 at 02:28:27

HCS7 Signalized Intersection Results Summary

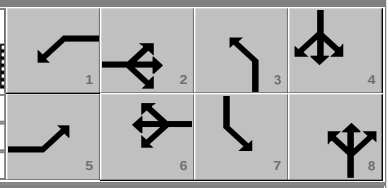
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 29, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.91
Urban Street	RICE STREET	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	105	330	75	125	155	130	30	345	180	275	715	90

Signal Information			
Cycle, s	76.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.2	1.1	25.5	2.0	2.0	21.2
Yellow	3.5	0.0	3.5	3.5	0.0	3.5
Red	0.5	0.0	2.0	0.5	0.0	2.0



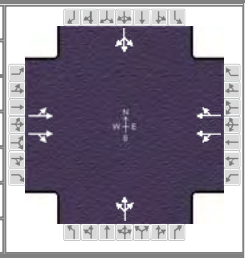
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	3.0
Phase Duration, s	9.2	31.0	10.3	32.1	6.0	26.7	8.0	28.7
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.1
Queue Clearance Time (g_s), s	5.5		6.5		3.1	11.8	6.0	18.5
Green Extension Time (g_e), s	0.1	0.0	0.2	0.0	0.0	5.4	0.0	4.7
Phase Call Probability	0.91		0.95		0.50	1.00	1.00	1.00
Max Out Probability	0.23		0.56		1.00	0.17	1.00	0.33

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	115	209	203	146	181	93	33	258	242	302	786	71
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1594	1674	1603	1594	1674	1418	1647	1730	1587	1647	1647	
Queue Service Time (g_s), s	3.5	7.2	7.3	4.5	6.0	3.5	1.1	9.6	9.8	4.0	16.5	
Cycle Queue Clearance Time (g_c), s	3.5	7.2	7.3	4.5	6.0	3.5	1.1	9.6	9.8	4.0	16.5	
Green Ratio (*g/C*)	0.40	0.34	0.34	0.42	0.35	0.35	0.31	0.28	0.28	0.33	0.31	
Capacity (*c*), veh/h	482	561	538	447	586	497	179	483	443	313	1005	
Volume-to-Capacity Ratio (*X*)	0.239	0.373	0.378	0.326	0.308	0.188	0.184	0.535	0.546	0.967	0.781	
Back of Queue (*Q*), ft/ln (95 th percentile)	58.4	140.3	128	73.2	114.1	56.3	19.2	177.7	161.1	303.4	270	
Back of Queue (*Q*), veh/ln (95 th percentile)	2.2	5.2	5.1	2.7	4.3	2.1	0.7	6.8	6.4	11.7	10.4	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.58	0.00	0.00	0.46	0.00	0.00	0.17	0.00	0.00	2.02	0.00	
Uniform Delay (d_1), s/veh	14.9	19.2	19.2	14.6	18.0	17.2	20.6	23.2	23.3	28.9	24.1	
Incremental Delay (d_2), s/veh	0.3	1.9	2.0	0.4	1.3	0.8	0.5	0.9	1.0	41.9	2.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	15.2	21.1	21.2	15.0	19.3	18.0	21.1	24.1	24.4	70.7	26.4	0.0
Level of Service (LOS)	B	C	C	B	B	B	C	C	C	E	C	A
Approach Delay, s/veh / LOS	19.9	B		17.5	B		24.0	C		36.3	D	
Intersection Delay, s/veh / LOS	27.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.75	C	2.86	C	2.76	C	2.40	B
Bicycle LOS Score / LOS	2.39	B	2.92	C	2.70	C	3.22	C

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 29, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.76
Urban Street	RICE STREET	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	WAYLAND AVE	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	10	755	20	10	380	15	20	0	5	90	5	10

Signal Information			
Cycle, s	29.3	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4
Green	15.0	3.7	0.0	0.0	0.0	0.0	5	6	7	8
Yellow	3.9	3.0	0.0	0.0	0.0	0.0				
Red	1.2	2.5	0.0	0.0	0.0	0.0				

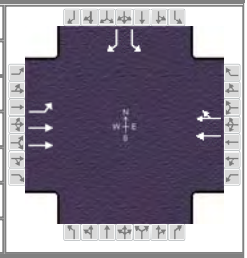
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		20.1		20.1		9.2		9.2
Change Period, ($Y+R_c$), s		5.1		5.1		5.5		5.5
Max Allow Headway (*MAH*), s		1.3		1.3		4.2		4.2
Queue Clearance Time (g_s), s		7.2		4.4		2.5		4.6
Green Extension Time (g_e), s		0.2		0.2		0.4		0.4
Phase Call Probability		1.00		1.00		0.74		0.74
Max Out Probability		0.00		0.00		0.00		0.01

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	445		404	240		219		33			132	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1664		1516	1638		1509		1482			1430	
Queue Service Time (g_s), s	0.0		5.2	0.0		2.4		0.0			2.1	
Cycle Queue Clearance Time (g_c), s	5.2		5.2	2.4		2.4		0.5			2.6	
Green Ratio (*g/C*)	0.51		0.51	0.51		0.51		0.12			0.12	
Capacity (*c*), veh/h	979		777	969		774		407			412	
Volume-to-Capacity Ratio (*X*)	0.455		0.520	0.247		0.283		0.081			0.319	
Back of Queue (*Q*), ft/ln (95 th percentile)	24.5		22.7	11.3		10.5		7.3			31.9	
Back of Queue (*Q*), veh/ln (95 th percentile)	1.0		0.9	0.5		0.4		0.3			1.3	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00		0.00	0.00		0.00		0.00			0.00	
Uniform Delay (d_1), s/veh	4.7		4.7	4.1		4.1		11.4			12.3	
Incremental Delay (d_2), s/veh	0.1		0.1	0.0		0.1		0.1			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	4.8		4.9	4.1		4.1		11.5			12.8	
Level of Service (LOS)	A		A	A		A		B			B	
Approach Delay, s/veh / LOS	4.9		A	4.1		A	11.5		B	12.8		B
Intersection Delay, s/veh / LOS	5.5						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.67	B	1.72	B	2.57	C	2.53	C
Bicycle LOS Score / LOS	3.01	C	2.61	C	2.72	C	2.88	C

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 29, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.91
Urban Street	RICE STREET	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	185	680			345	135				245		60

Signal Information			
Cycle, s	76.0	Reference Phase	2
Offset, s	65	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4
Green	15.0	23.0	20.0	0.0	0.0	0.0	5	6	7	8
Yellow	3.0	5.0	4.0	0.0	0.0	0.0				
Red	2.0	2.0	2.0	0.0	0.0	0.0				

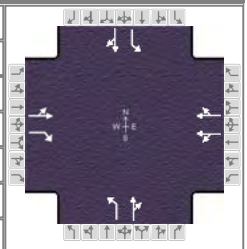
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				9.0
Phase Duration, s	20.0	50.0		30.0				26.0
Change Period, ($Y+R_c$), s	5.0	7.0		7.0				6.0
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.2
Queue Clearance Time (g_s), s	17.0							22.0
Green Extension Time (g_e), s	0.0	0.0		0.0				0.0
Phase Call Probability	0.99							1.00
Max Out Probability	1.00							1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	207	759			259	246				269		66
Adjusted Saturation Flow Rate (*s*), veh/h/ln	645	1662			1725	1611				377		1435
Queue Service Time (g_s), s	15.0	9.8			8.1	7.8				20.0		2.7
Cycle Queue Clearance Time (g_c), s	15.0	9.8			8.1	7.8				20.0		2.7
Green Ratio (*g/C*)	0.53	0.57			0.30	0.30				0.26		0.26
Capacity (*c*), veh/h	289	1881			522	487				99		378
Volume-to-Capacity Ratio (*X*)	0.715	0.404			0.496	0.504				2.713		0.175
Back of Queue (*Q*), ft/ln (95 th percentile)	195.8	140.4			136.8	125.9				1873.7		39.7
Back of Queue (*Q*), veh/ln (95 th percentile)	4.8	5.6			5.5	5.0				41.6		1.6
Queue Storage Ratio (*RQ*) (95 th percentile)	2.45	0.00			0.00	0.00				18.74		0.00
Uniform Delay (d_1), s/veh	15.6	9.3			16.2	15.4				28.0		21.6
Incremental Delay (d_2), s/veh	7.1	0.6			3.2	3.5				798.4		0.2
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	22.7	9.8			19.4	18.9				826.4		21.8
Level of Service (LOS)	C	A			B	B				F		C
Approach Delay, s/veh / LOS	12.6	B		19.1	B		0.0			668.2	F	
Intersection Delay, s/veh / LOS	136.1						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.68	A	1.91	B	2.22	B	2.31	B
Bicycle LOS Score / LOS	1.27	A	0.87	A				F

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 29, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.85
Urban Street	RICE STREET	Analysis Year	2018	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	55	360	510	70	230	15	140	75	60	310	25	110

Signal Information			
Cycle, s	76.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4	
Green	40.6	4.0	13.4	0.0	0.0	0.0	5	6	7	8	
Yellow	4.0	4.0	4.0	0.0	0.0	0.0					
Red	2.0	2.0	2.0	0.0	0.0	0.0					

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8	7	4
Case Number		7.0		8.0		6.3	1.0	4.0
Phase Duration, s		46.6		46.6		19.4	10.0	29.4
Change Period, ($Y+R_c$), s		6.0		6.0		6.0	6.0	6.0
Max Allow Headway (*MAH*), s		0.0		0.0		6.3	6.0	6.3
Queue Clearance Time (g_s), s						11.4	6.0	6.3
Green Extension Time (g_e), s		0.0		0.0		2.0	0.0	3.3
Phase Call Probability						1.00	1.00	1.00
Max Out Probability						0.60	1.00	0.02

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		356	261	181		184	165	129		365	106	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1569	1360	1290		1432	1257	1548		1594	1398	
Queue Service Time (g_s), s		0.0	3.9	0.0		5.2	9.4	5.7		4.0	4.3	
Cycle Queue Clearance Time (g_c), s		5.5	3.9	5.0		5.2	9.4	5.7		4.0	4.3	
Green Ratio (*g/C*)		0.53	0.53	0.53		0.53	0.18	0.18		0.26	0.31	
Capacity (*c*), veh/h		892	726	758		765	317	273		299	431	
Volume-to-Capacity Ratio (*X*)		0.399	0.360	0.239		0.240	0.520	0.474		1.219	0.246	
Back of Queue (*Q*), ft/ln (95 th percentile)		53.2	32.9	69.5		70.9	140.1	105.4		569	64.6	
Back of Queue (*Q*), veh/ln (95 th percentile)		2.0	1.2	2.8		2.8	5.4	4.1		21.2	2.4	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.00		0.00	0.93	0.00		5.69	0.00	
Uniform Delay (d_1), s/veh		4.9	3.7	9.4		9.4	29.7	28.1		31.6	19.7	
Incremental Delay (d_2), s/veh		0.1	0.1	0.7		0.7	2.8	2.7		124.8	0.6	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		5.0	3.8	10.1		10.1	32.5	30.8		156.4	20.3	
Level of Service (LOS)		A	A	B		B	C	C		F	C	
Approach Delay, s/veh / LOS	4.5	A		10.1	B		31.8	C		125.8	F	
Intersection Delay, s/veh / LOS	42.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.28	B	2.32	B	2.42	B	3.20	C
Bicycle LOS Score / LOS	3.72	D	0.91	A	2.63	C	2.95	C

HCS7 Two-Way Stop-Control Report

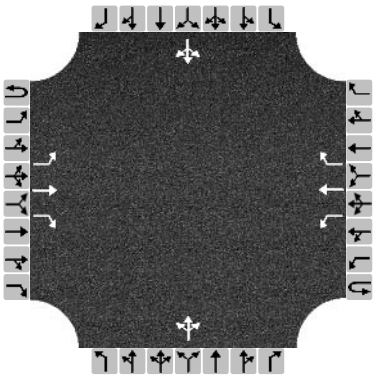
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	1/29/2018
Analysis Year	2018
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BAHNSON AVENUE
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	RICE STREET
North/South Street	BAHNSON AVENUE
Peak Hour Factor	0.85
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	1	0	1	1	1		0	1	0		0	1	0
Configuration		L	T	R		L	T	R			LTR				LTR	
Volume, V (veh/h)		10	710	10		0	280	0		20	0	0		0	0	15
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.13				4.13				7.13	6.53	6.23		7.13	6.53	6.23
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23				2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		12				0					24				18	
Capacity, c (veh/h)		1224				785					157				710	
v/c Ratio		0.01				0.00					0.15				0.02	
95% Queue Length, Q_{95} (veh)		0.0				0.0					0.5				0.1	
Control Delay (s/veh)		8.0				9.6					32.0				10.2	
Level of Service, LOS		A				A					D				B	
Approach Delay (s/veh)		0.1				0.0				32.0				10.2		
Approach LOS										D				B		

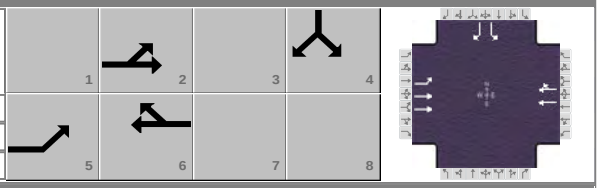
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Parclo AB-2Q
Analyst	RL	Analysis Date	Jan 29, 2018	Segment Distance, ft	1020
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 SB	PHF	0.91	Arterial Direction	East-West
File Name	RICE PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	185	680			345	135				245		60
Intersection Two Demand (*v*), veh/h	55	360	510	70	230	15	140	75	60	310	25	110

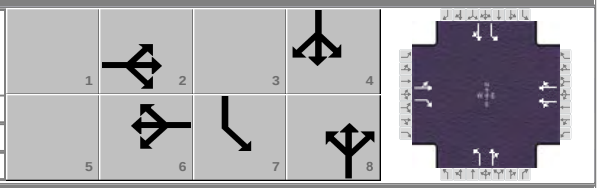
Signal One Information	
Cycle, s	76.0
Offset, s	65
Uncoordinated	No
Force Mode	Fixed

Green	15.0	23.0	20.0	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



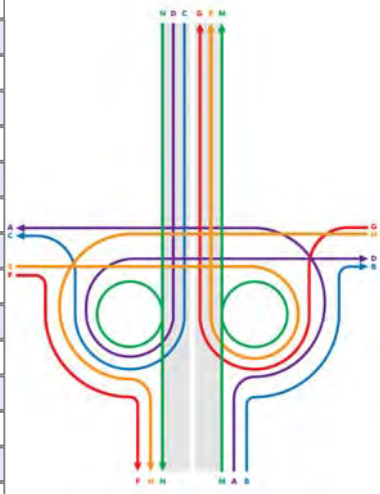
Signal Two Information	
Cycle, s	76.0
Offset, s	65
Uncoordinated	No
Force Mode	Fixed

Green	40.6	4.0	13.4	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Interchange Results

O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	90	51.8	0.0	51.8	No	No	C
B	41	30.8	0.0	30.8	No	No	C
C	0	0.0	5.0	5.0	No	No	A
D	0	0.0	5.0	5.0	No	No	A
E	261	13.6	5.0	18.6	No	No	A
F	0	9.8	0.0	9.8	No	No	A
G	82	10.1	5.0	15.1	No	No	A
H	0	0.0	0.0	0.0	No	No	A
I	384	9.8	0.0	9.8	No	No	A
J	245	19.4	0.0	19.4	No	No	B
K	-	-	0.0	-	-	-	-
L	-	-	0.0	-	-	-	-
M	75	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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	22.7	9.8			19.4	18.9				826.4		21.8
Level of Service (LOS)	C	A			B	B				F		C
Approach Delay, s/veh / LOS	12.6	B		19.1	B		0.0			668.2	F	
Intersection Delay, s/veh / LOS	136.1						F					

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		5.0	3.8	10.1		10.1	32.5	30.8		156.4	20.3	
Level of Service (LOS)		A	A	B		B	C	C		F	C	
Approach Delay, s/veh / LOS	4.5	A		10.1	B		31.8	C		125.8	F	
Intersection Delay, s/veh / LOS	42.9						D					

HCS7 Streets Text Report

File Name:	RICE PM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Jan 29, 2018
Time Period:	PM
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2018
Project Description:	I-229/BENSON IMJR
Urban Street:	RICE STREET
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	76
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	95
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	0.51
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

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	35	35	2	1	1020	1020	50	50	0	0	70	70	0	0
2	35	35	2	2	3460	3460	50	50	0	0	70	70	0	0
3	35	35	1	2	1020	1020	50	50	0	0	70	70	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

	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB

Movement	LT 1	TH 2	RT 3	LT 4	TH 5	RT 6	LT 7	TH 8	RT 9	LT 10	TH 11	RT 12
1: Volume, veh/h	0	835	15	60	345	0	60	0	30	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Location, ft	3030											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 3

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				999		
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		20.19			20.25	
1	Running Speed, mph		34.44			34.35	
1	Through Delay, s/veh		4.85			19.32	
1	Travel Speed, mph		27.77			17.58	
1	Stop Rate, stops/veh		0.44			0.62	
1	Spatial Stop Rate, stops/mi		2.26			3.21	
1	Through vol/cap ratio		0.49			0.31	
1	Percent of Base FFS		66.56			42.14	
1	Level of Service		C			D	
1	Automobile Perception Score		2.72			2.89	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999					
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		59.08			58.28	
2	Running Speed, mph		39.93			40.48	
2	Through Delay, s/veh		9.85			4.11	
2	Travel Speed, mph		34.23			37.81	
2	Stop Rate, stops/veh		0.39			0.43	
2	Spatial Stop Rate, stops/mi		0.59			0.66	
2	Through vol/cap ratio		0.4			0.26	
2	Percent of Base FFS		82.04			90.63	
2	Level of Service		A			A	
2	Automobile Perception Score		2.33			2.34	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h						
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		20.79			20.02	
3	Running Speed, mph		33.45			34.74	
3	Through Delay, s/veh		4.98			19.19	
3	Travel Speed, mph		26.99			17.74	
3	Stop Rate, stops/veh		0.19			0.55	
3	Spatial Stop Rate, stops/mi		0.97			2.85	
3	Through vol/cap ratio		0.4			0.5	
3	Percent of Base FFS		64.69			42.52	
3	Level of Service		C			D	
3	Automobile Perception Score		2.5			2.82	

Facility Travel Time, s	119.74	141.16
Facility Travel Speed, mph	31.32	26.57
Facility Spatial Stop Rate, stops/mi	0.97	1.54
Facility Base Free Flow Speed, mph	41.72	41.72
Facility Percent Base Free Flow Speed	75.07	63.67
Facility Level of Service	B	C
Facility Automobile Perception Score	2.43	2.51
Facility Pedestrian Space	Infinity	Infinity
Facility Pedestrian Travel Speed	4.26	4.22
Facility Pedestrian LOS Score	2.97	2.9
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	13.52	13.38
Facility Bicycle LOS Score	2.87	2.61
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	34.44	17.58

Facility Transit LOS Score		0.73	0.9
Facility Transit LOS		A	A
SPILLBACK TIME, h		999	

Multimodal Results

1	Average Pedestrian Space, ft2/p	Infinity	Infinity
1	Pedestrian Travel Speed, ft/s	3.93	3.93
1	Ped LOS Score for Intersection	1.67	2.86
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.98	1.08
1	Speed Adjustment Factor	0.47	0.47
1	Ped LOS Score for Link	2.76	2.86
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	0.96	0.8
1	Ped LOS Score for Segment	2.8	2.64
1	Ped Segment LOS	C	B
1	Bicycle Travel Speed	11.01	13.95
1	Bicycle LOS Score for Intersection	3.01	2.92
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.37	2.42
1	Speed Adjustment Factor	0.76	0.75
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.19	3.23
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	1020	1020
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.85	2.79
1	Bicycle Segment LOS	C	C
1	Transit Running Speed, mi/h	34.44	34.35
1	g/C Ratio	0.51	0.35
1	Transit Running Time, s	20.19	20.25
1	Delay at Intersection, s/veh	0	19.32
1	Transit Travel Speed, mi/h	34.44	17.58
1	Transit Wait-Ride Score	3.84	2.98
1	Ped LOS Score for Link	2.76	2.86
1	Transit LOS Score for Segment	0.66	1.96
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	Infinity	Infinity
2	Pedestrian Travel Speed, ft/s	4.37	4.37
2	Ped LOS Score for Intersection	0.68	1.72
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	1.08	0.54
2	Speed Adjustment Factor	0.64	0.66
2	Ped LOS Score for Link	3.03	2.5
2	Ped Link LOS	C	C
2	Roadway Crossing Difficulty Factor	0.8	1.2
2	Ped LOS Score for Segment	2.68	3.12
2	Ped Segment LOS	B	C
2	Bicycle Travel Speed	14.68	13.42
2	Bicycle LOS Score for Intersection	1.27	2.61
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.42	2.07
2	Speed Adjustment Factor	0.83	0.83
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.31	2.96
2	Bicycle Link LOS	C	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3460	3460
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.81	2.6
2	Bicycle Segment LOS	C	B
2	Transit Running Speed, mi/h	39.93	40.48
2	g/C Ratio	0.57	0.51
2	Transit Running Time, s	59.08	58.28
2	Delay at Intersection, s/veh	9.85	0
2	Transit Travel Speed, mi/h	34.23	40.48
2	Transit Wait-Ride Score	3.83	4.05
2	Ped LOS Score for Link	3.03	2.5
2	Transit LOS Score for Segment	0.71	0.3
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	Infinity	Infinity

3	Pedestrian Travel Speed, ft/s	4.27	4.08
3	Ped LOS Score for Intersection	2.28	1.91
3	Cross-section Adjustment Factor	-4.74	-4.74
3	Volume Adjustment Factor	1.95	0.64
3	Speed Adjustment Factor	0.45	0.48
3	Ped LOS Score for Link	3.71	2.43
3	Ped Link LOS	D	B
3	Roadway Crossing Difficulty Factor	1.18	0.86
3	Ped LOS Score for Segment	4.13	2.43
3	Ped Segment LOS	D	B
3	Bicycle Travel Speed	12.99	12.73
3	Bicycle LOS Score for Intersection	3.72	0.87
3	Cross-section Adjustment Factor	-1.28	-1.28
3	Volume Adjustment Factor	2.72	2.16
3	Speed Adjustment Factor	0.74	0.76
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	3.52	2.98
3	Bicycle Link LOS	D	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1020	1020
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	3.09	2.47
3	Bicycle Segment LOS	C	B
3	Transit Running Speed, mi/h	33.45	34.74
3	g/C Ratio	0.53	0.3
3	Transit Running Time, s	20.79	20.02
3	Delay at Intersection, s/veh	0	19.36
3	Transit Travel Speed, mi/h	33.45	17.66
3	Transit Wait-Ride Score	3.8	2.98
3	Ped LOS Score for Link	3.71	2.43
3	Transit LOS Score for Segment	0.86	1.89
3	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	936	16.8	70.4	405	0	60	0	30	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Prop blocked												
1: Thru veh delay		0.01			0							
1: Prob inside blk		0			0							
1: Dist to upstream signal	3030											

SECTION 4

EXISTING CONDITIONS SAFETY MEMORANDUM

2018 Crash Analysis Technical Memorandum

I-229 Benson Road Interchange Modification Study

Sioux Falls, South Dakota

February 28, 2018

City of Sioux Falls
SOUTH DAKOTA

DOT

This memorandum documents the safety analysis conducted for the study area surrounding the I-229 Exit 9 interchange in northeast Sioux Falls, SD. The safety analysis was conducted to help determine if any safety-related improvements could be incorporated into future construction.

1.0 Methodology

Crash data for the years 2013 through 2017 were provided by SDDOT and reviewed to identify any existing crash concentrations/crash trends and develop potential crash mitigation measures. Analyses were conducted for the following roadway facilities:

- Arterial street intersections
- Arterial street segments
- Interstate mainline segments
- Interstate ramp segments

Critical crash rates were calculated for each segment, ramp, or intersection and used to identify portions of the study area that displayed crash rates higher than the critical rate. Each of the above-critical locations is discussed in subsequent sections of this memorandum.

2.0 Segment, Ramp and Intersection Crash Rates

The study area was divided into segments representing:

- Interstate mainline segments (Figure 7, Table 1)
- Interstate ramp segments (Figure 8, Table 2)
- Arterial street intersections (Figures 9 &10, Table 3)
- Arterial street segments (Figures 11 & 12, Table 4)

Mainline and ramp sections were each analyzed separately to allow calculation of representative crash rates and critical rates for each type of Interstate feature.

The arterial street intersections named in the M&A document and the intervening arterial street segments were each grouped for calculation of crash rates and critical rates.

Details of the crash records for each segment and intersection are contained in the Appendix.

3.0 Segment and Intersection Critical Crash Rates

Critical crash rates were calculated based on the statistical populations in each spreadsheet, using the methods shown in the Highway Safety Manual (American Association of State Highway and Transportation Officials (AASHTO), 2010). Those segments and intersections that lay outside the critical rates are shown in red coloration in the last column of each spreadsheet. All the segments and intersections that lay within the critical limits are shown in green. The locations of non-critical or critical crash rates are also illustrated on the figures.

4.0 Crash Trends

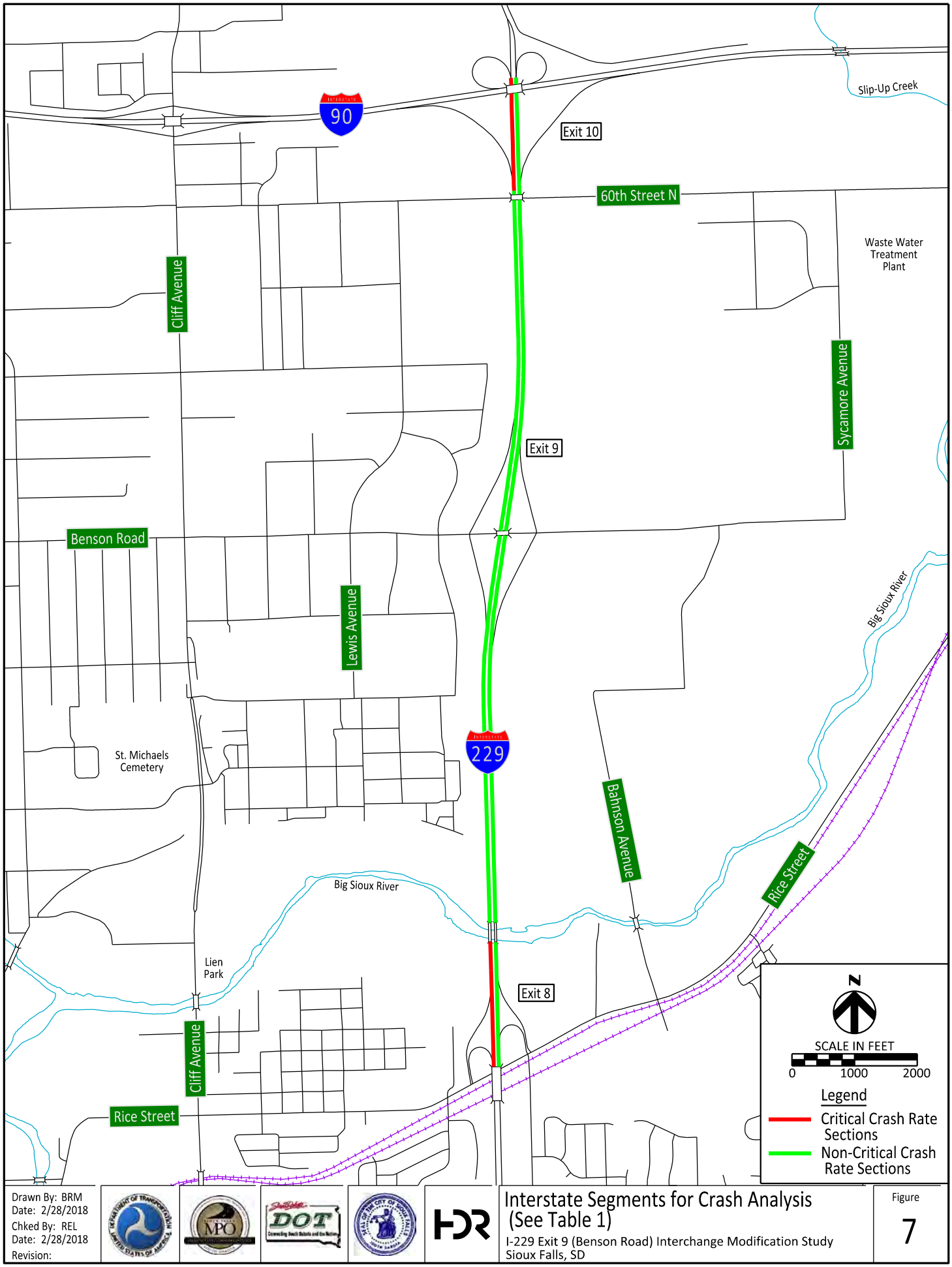
Review of the crash summaries for each Interstate and arterial street section revealed a few crash trends:

- Slightly elevated incidence of single vehicle crashes on southbound I-229 at I-90 during inclement weather events.
- A short-term concentration of crashes on southbound I-229 at Rice Street, likely during construction activities.
- Single-vehicle run-off crashes on the northbound Rice Street off-ramp during inclement weather (only 5 in the 5-year period, but enough to appear outside the critical rate boundary).
- Concentrations of angle crashes at the Benson/Cliff and Rice/Cliff intersections.
- A concentration of crashes involving parked cars on Rice between Wayland and I-229 SB.

5.0 Potential Mitigation Measures

The general crash trends identified above suggest several potential strategies for reducing crash rates with the study area:

- Consider ITS-related means of communicating slippery roadway conditions to drivers and continue aggressive winter maintenance.
- Addition of high-friction surface courses on bridges, curves and weaving areas may help reduce crashes that occur during inclement weather.
- Consider work zone traffic control that doesn't require drivers to enter high speed traffic from a dead stop.
- Conduct road safety audits of the Benson/Cliff and Rice/Cliff intersections to consider ways to reduce angle crashes.
- Consider a wider edge line to delineate the parking lane along Rice Street.



FILE: ...\Figure 07 (Interstate Crash).dgn
PLOTTING DATE: 02-28-2018

Drawn By: BRM
Date: 2/28/2018
Chked By: REL
Date: 2/28/2018
Revision:

Interstate Segments for Crash Analysis (See Table 1)

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 7

TABLE 1 - INTERSTATE SEGMENT CRASH RATES (2013-2017)

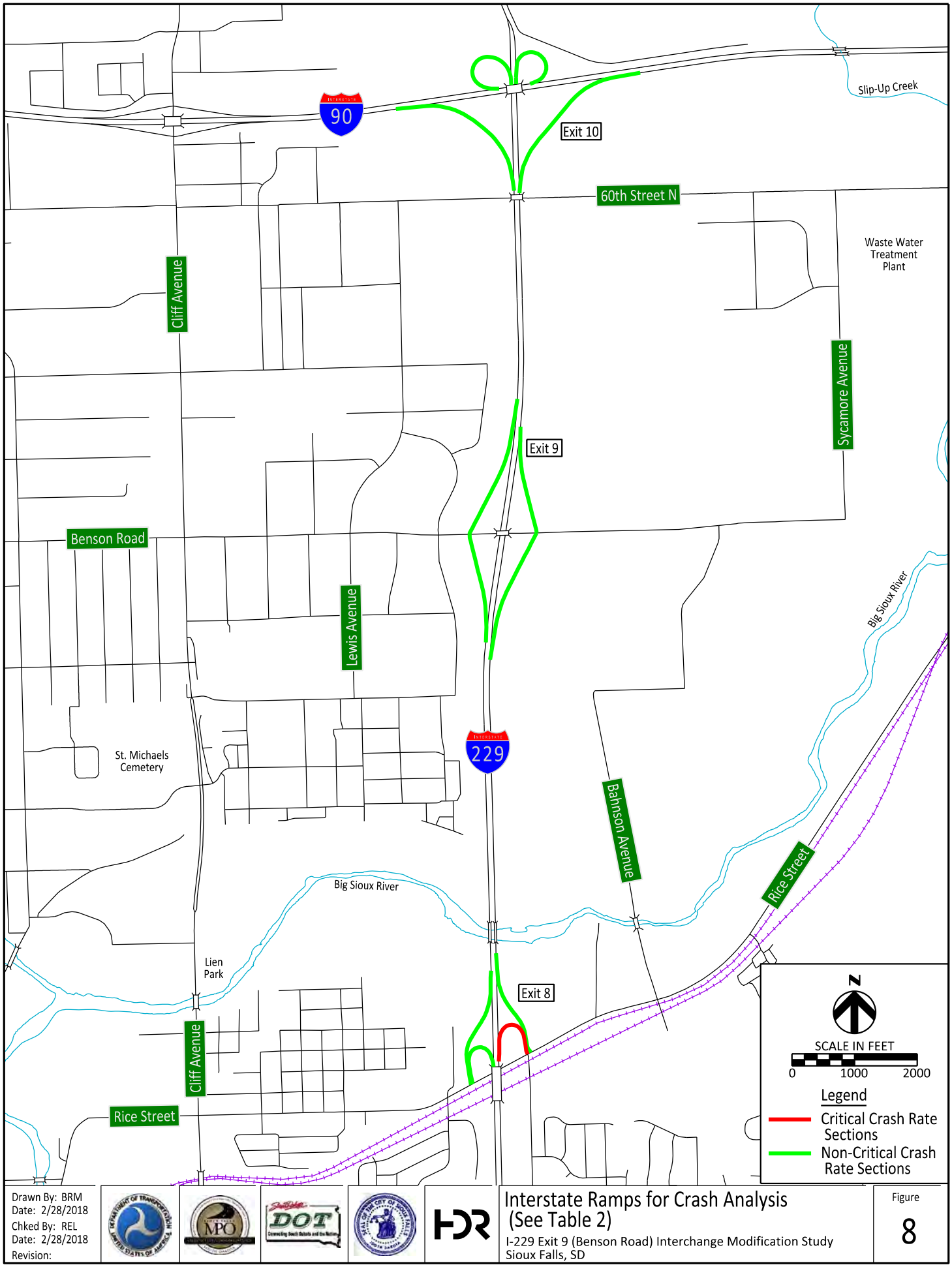
I-229/BENSON INTERSTATE ACCESS STUDY

TRAVEL DIRECTION	SEGMENT	NUMBER CRASHES	SEGMENT LENGTH	DAILY VOLUME	MVMT[1]	CRASH RATE	*TEV*R*[2]	CRITICAL RATE	CRASH/CRITICAL RATIO
SB	I-90 INTERCHANGE AREA	11	0.331	4265	2.58	4.27	18209.66	2.89	1.48
SB	I-90 TO BENSON	16	0.686	7900	9.89	1.62	12780.06	2.14	0.76
SB	BENSON INTERCHANGE AREA	2	0.692	7170	9.05	0.22	1583.66	2.18	0.10
SB	BENSON TO RICE	22	1.080	13775	27.15	0.81	11161.85	1.86	0.44
SB	RICE INTERCHANGE AREA	16	0.205	12270	4.59	3.49	42766.46	2.50	1.40
NB	RICE INTERCHANGE AREA	5	0.189	12190	4.20	1.19	14495.90	2.55	0.47
NB	RICE TO BENSON	35	0.974	13775	24.49	1.43	19690.02	1.88	0.76
NB	BENSON INTERCHANGE AREA	3	0.652	8740	10.40	0.29	2521.22	2.12	0.14
NB	BENSON TO I-90	2	0.771	7900	11.12	0.18	1421.39	2.10	0.09
NB	I-90 INTERCHANGE AREA	7	0.357	4745	3.09	2.26	10744.02	2.75	0.82
	COLUMN TOTAL			92730			135374.24		
	WEIGHTED AVERAGE RATE					1.46			

[1]MVMT = MILLION VEHICLE MILES TRAVELED

[2]TEV*R = TOTAL ENTERING VEHICLES PER DAY, TIMES OBSERVED CRASH RATE

SOURCE: HIGHWAY SAFETY MANUAL, FIRST EDITION, 2010, AASHTO



Drawn By: BRM
Date: 2/28/2018
Chked By: REL
Date: 2/28/2018
Revision:

FILE: ...\Figure 08 (Interstate Ramp Crash).dgn
PLOTTING DATE: 02-28-2018

Interstate Ramps for Crash Analysis (See Table 2)

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 8

TABLE 2 - INTERSTATE RAMP CRASH RATES (2013-2017)

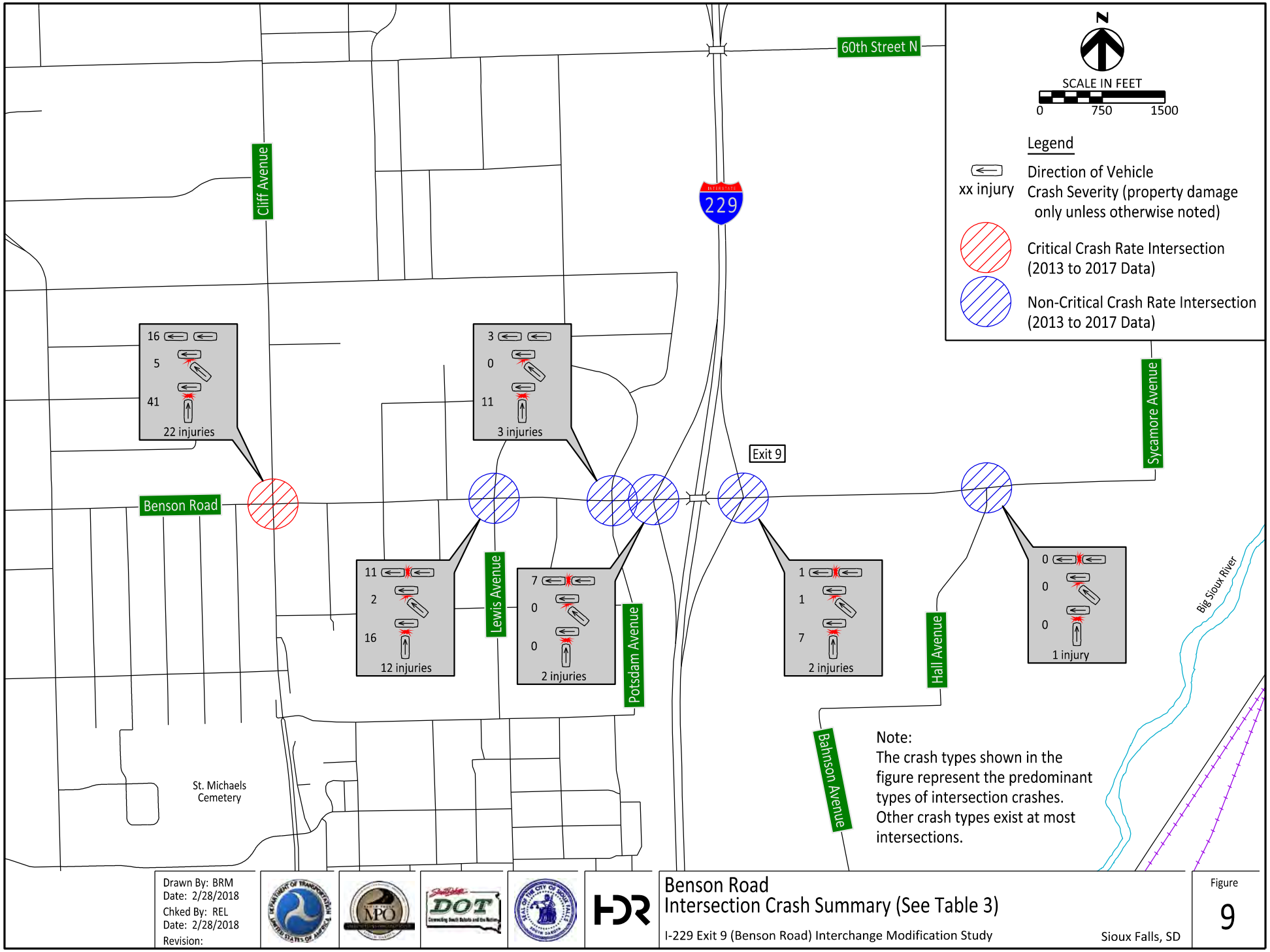
I-229/BENSON INTERSTATE ACCESS STUDY

TRAVEL DIRECTION	SEGMENT	NUMBER CRASHES	SEGMENT LENGTH	DAILY VOLUME	MVMT[1]	CRASH RATE	*TEV*R*[2]	CRITICAL RATE	CRASH/CRITICAL RATIO
SB	I-90 WB ON RAMP	4	0.234	2840	1.21	3.30	9366.58	4.91	0.67
SB	I-90 EB ON RAMP	0	0.367	3635	2.43	0.00	0.00	4.04	0.00
SB	BENSON OFF RAMP	2	0.371	730	0.49	4.05	2953.88	6.78	0.60
SB	BENSON ON RAMP	4	0.283	5140	2.65	1.51	7744.81	3.96	0.38
SB	RICE OFF RAMP	1	0.270	1505	0.74	1.35	2029.43	5.79	0.23
SB	RICE ON RAMP	1	0.173	2735	0.86	1.16	3167.31	5.49	0.21
NB	RICE OFF RAMP	5	0.152	2835	0.79	6.36	18024.51	5.67	1.12
NB	RICE ON RAMP	4	0.235	1585	0.68	5.88	9326.73	5.98	0.98
NB	BENSON OFF RAMP	8	0.360	5035	3.31	2.42	12176.56	3.76	0.64
NB	BENSON ON RAMP	0	0.264	970	0.47	0.00	0.00	6.93	0.00
NB	I-90 EB OFF RAMP	3	0.425	3155	2.45	1.23	3867.85	4.03	0.30
NB	I-90 WB OFF RAMP	2	0.189	2895	1.00	2.00	5798.36	5.22	0.38
	COLUMN TOTAL			33060			74456.03		
	WEIGHTED AVERAGE RATE					2.25			

[1]MVMT = MILLION VEHICLE MILES TRAVELED

[2]TEV*R = TOTAL ENTERING VEHICLES TIMES CRASH RATE

SOURCE: HIGHWAY SAFETY MANUAL, FIRST EDITION, 2010, AASHTO



FILE: ...\Figure 09 (Benson Crash).dgn
PLOTTING DATE: 03-05-2018

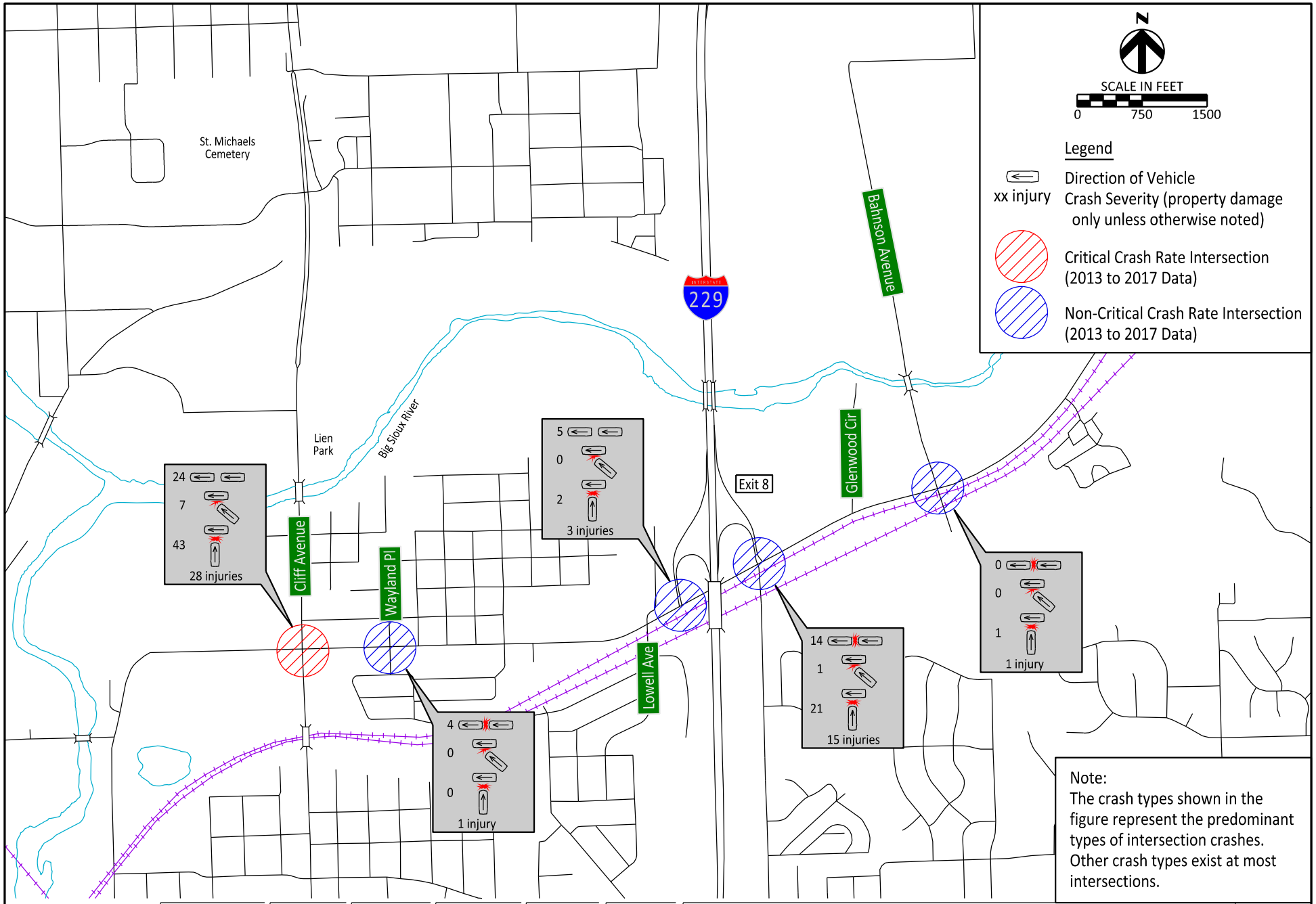
Drawn By: BRM
Date: 2/28/2018
Chked By: REL
Date: 2/28/2018
Revision:

Benson Road
Intersection Crash Summary (See Table 3)

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 9



Drawn By: BRM
Date: 2/28/2018
Chked By: REL
Date: 2/28/2018
Revision:

Rice Street
Intersection Crash Summary (See Table 3)

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 10

FILE: ...\Figure 10 (Rice Crash).dgn
PLOTTING DATE: 03-05-2018

TABLE 3 - INTERSECTION CRASH RATES (2013-2017)

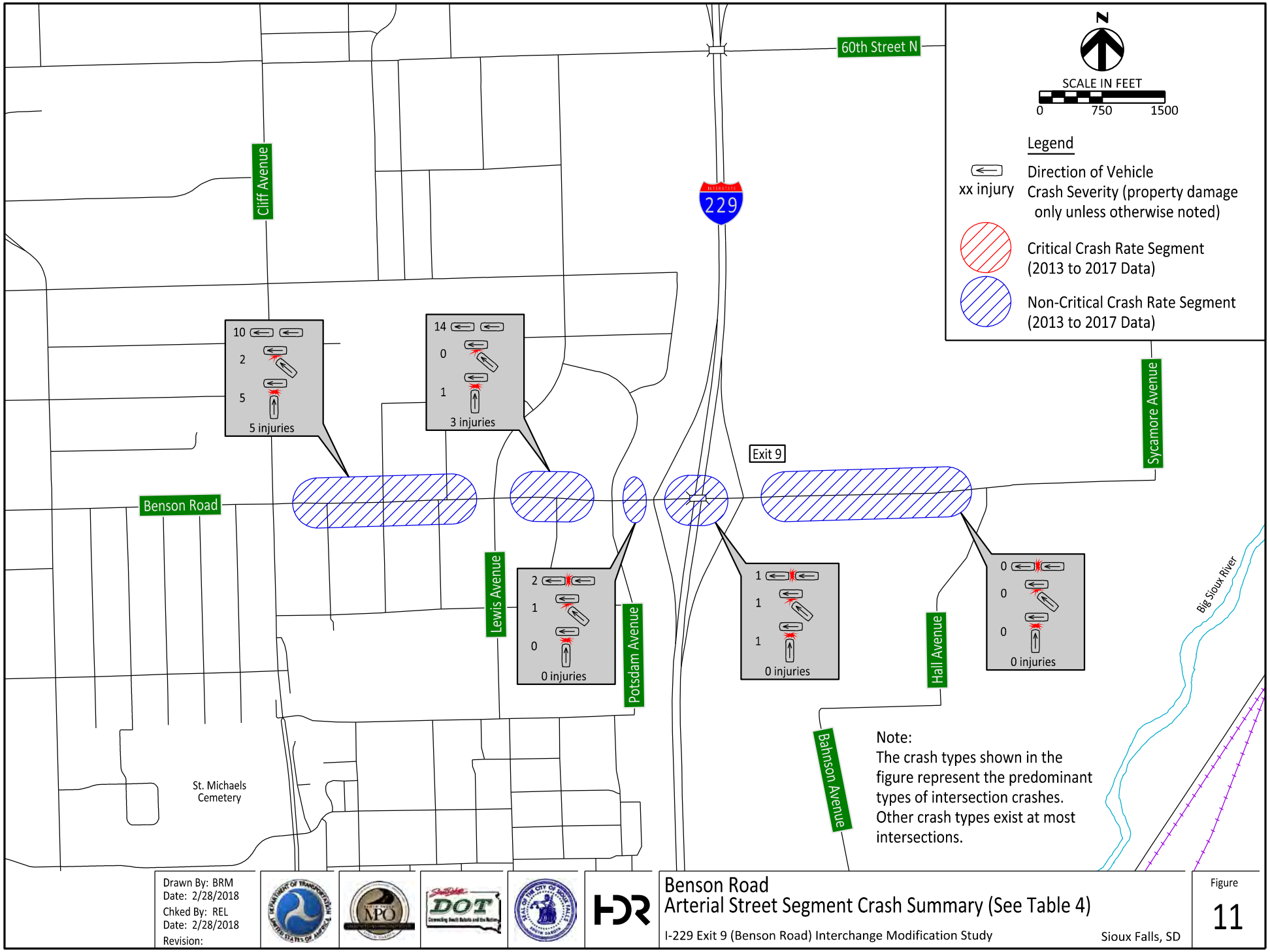
I-229/BENSON INTERSTATE ACCESS STUDY

INTERSECTION	NUMBER CRASHES	DAILY VOLUME	MEV[1]	CRASH RATE	*TEV*R* [2]	CRITICAL RATE	CRASH/CRITICAL RATIO
BENSON/CLIFF	64	25700	46.90	1.36	35068.49	1.10	1.24
BENSON/LEWIS	39	19600	35.77	1.09	21369.86	1.13	0.96
BENSON/POTSDAM	15	16000	29.20	0.51	8219.18	1.16	0.44
BENSON/I-229 SB	9	15600	28.47	0.32	4931.51	1.17	0.27
BENSON/I-229 NB	10	6000	10.95	0.91	5479.45	1.37	0.67
BENSON/HALL	2	1000	1.83	1.10	1095.89	2.27	0.48
RICE/CLIFF	77	27000	49.28	1.56	42191.78	1.09	1.43
RICE/WAYLAND	5	13700	25.00	0.20	2739.73	1.19	0.17
RICE/I-229 SB	7	15400	28.11	0.25	3835.62	1.17	0.21
RICE/I-229 NB	42	21700	39.60	1.06	23013.70	1.12	0.95
RICE/BAHNSON	2	11000	20.08	0.10	1095.89	1.23	0.08
COLUMN TOTAL		172700			149041.10		
WEIGHTED AVERAGE RATE				0.86			

[1]MEV = MILLION ENTERING VEHICLES

[2]TEV*R = TOTAL ENTERING VEHICLES TIMES CRASH RATE

SOURCE: HIGHWAY SAFETY MANUAL, FIRST EDITION, 2010, AASHTO



FILE: ...\Figure 11 (Benson Crash).dgn
PLOTTING DATE: 03-05-2018

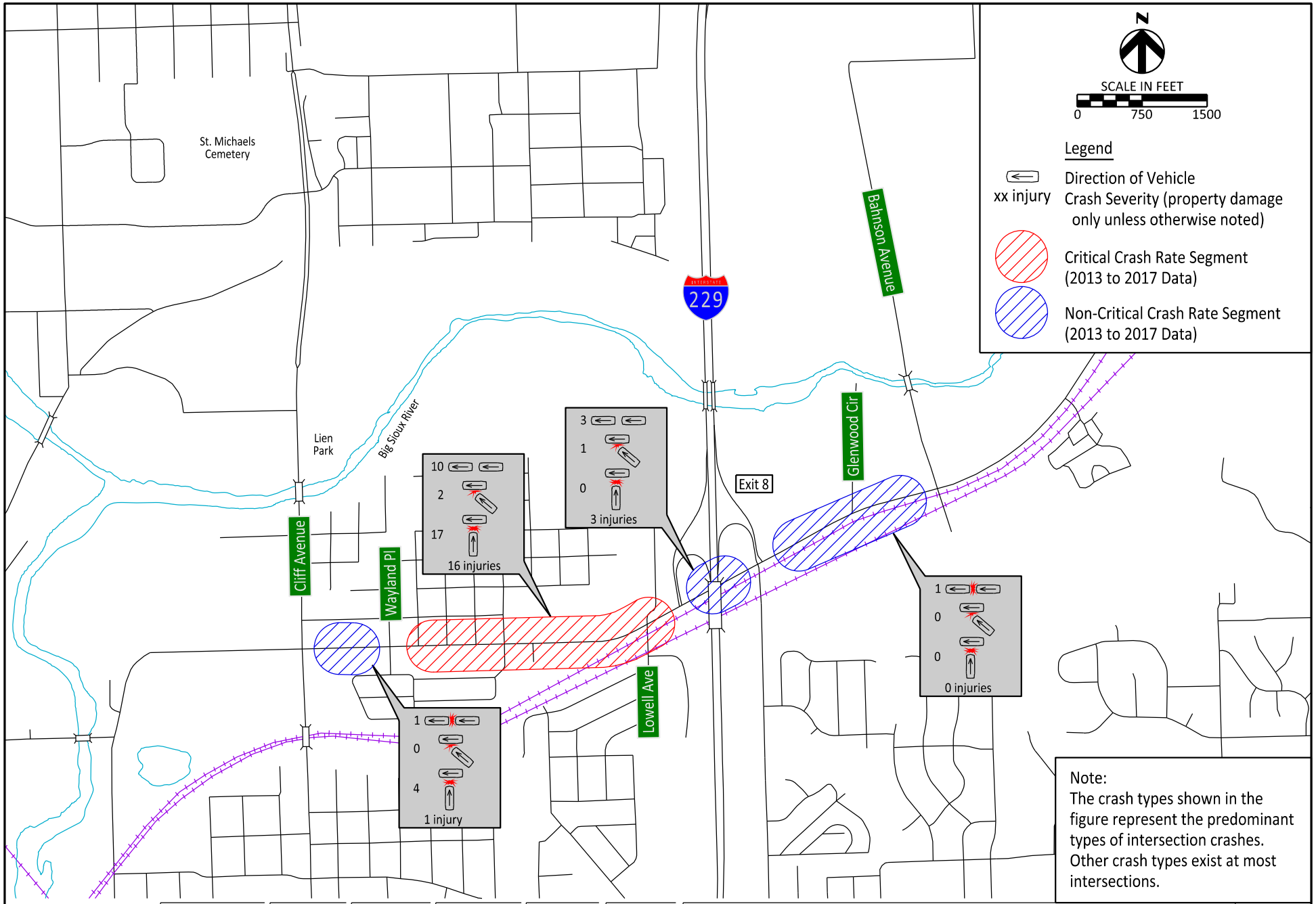
Drawn By: BRM
Date: 2/28/2018
Chked By: REL
Date: 2/28/2018
Revision:

Benson Road
Arterial Street Segment Crash Summary (See Table 4)

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 11



Drawn By: BRM
Date: 2/28/2018
Chked By: REL
Date: 2/28/2018
Revision:

Rice Street
Arterial Street Segment Crash Summary (See Table 4)

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 12

FILE: ...\Figure 12 (Rice Crash).dgn
PLOTTING DATE: 03-05-2018

TABLE 4 - ARTERIAL SEGMENT CRASH RATES (2013-2017)

I-229/BENSON RD IMJR

SEGMENT	NUMBER CRASHES	SEGMENT LENGTH	DAILY VOLUME	MVMT[1]	CRASH RATE	*TEV*R* [2]	CRITICAL RATE	CRASH/CRITICAL RATIO
BENSON: CLIFF TO LEWIS	19	0.501	12,200	11.15	1.70	20780.36	2.23	0.76
BENSON: LEWIS TO POTSDAM	15	0.267	14,900	7.26	2.07	30783.44	2.40	0.86
BENSON: POTSDAM TO I-229 SB	3	0.093	14,900	2.53	1.19	17675.65	3.07	0.39
BENSON: I-229 SB TO I-229 NB	3	0.200	14,900	5.44	0.55	8219.18	2.55	0.22
BENSON: I-229 NB TO HALL	1	0.551	1,000	1.01	0.99	994.46	4.12	0.24
RICE: CLIFF TO WAYLAND	5	0.193	12,700	4.47	1.12	14195.47	2.66	0.42
RICE: WAYLAND TO I-229 SB	46	0.655	11,600	13.87	3.32	38481.65	2.16	1.54
RICE: I-229 SB TO I-229 NB	12	0.192	13,900	4.87	2.46	34246.58	2.61	0.94
RICE: I-229 NB TO BAHNSON	2	0.429	10,800	8.46	0.24	2554.52	2.34	0.10
COLUMN TOTALS			106900			167931.30		
WEIGHTED AVERAGE RATE					1.57			

[1]MVMT=MILLION VEHICLE MILES TRAVELED

[2]TEV*R = TOTAL ENTERING VEHICLES PER DAY, TIMES OBSERVED CRASH RATE

APPENDIX

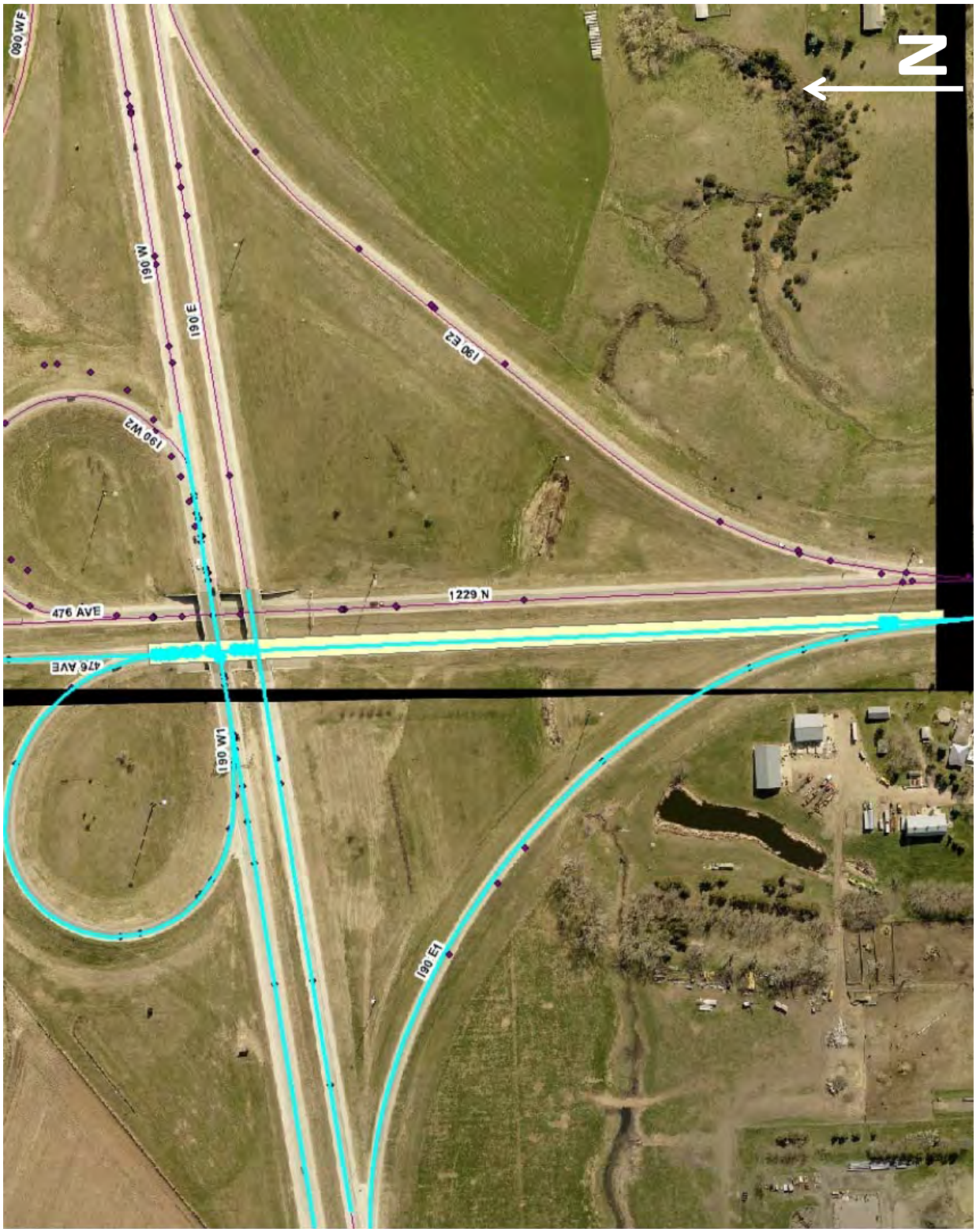
Interstate Segment Crash Maps

Interstate Ramp Crash Maps

Arterial Intersection Crash Diagrams

Arterial Segment Crash Maps

INTERSTATE SEGMENT CRASH MAPS



Segment Crash Map – I-229 SB from I-90 WB to I-90 EB

Segment Crash Map – I-229 SB from I-90 EB to Benson Rd.

Segment Crash Map – I-229 SB from Benson off to Benson on

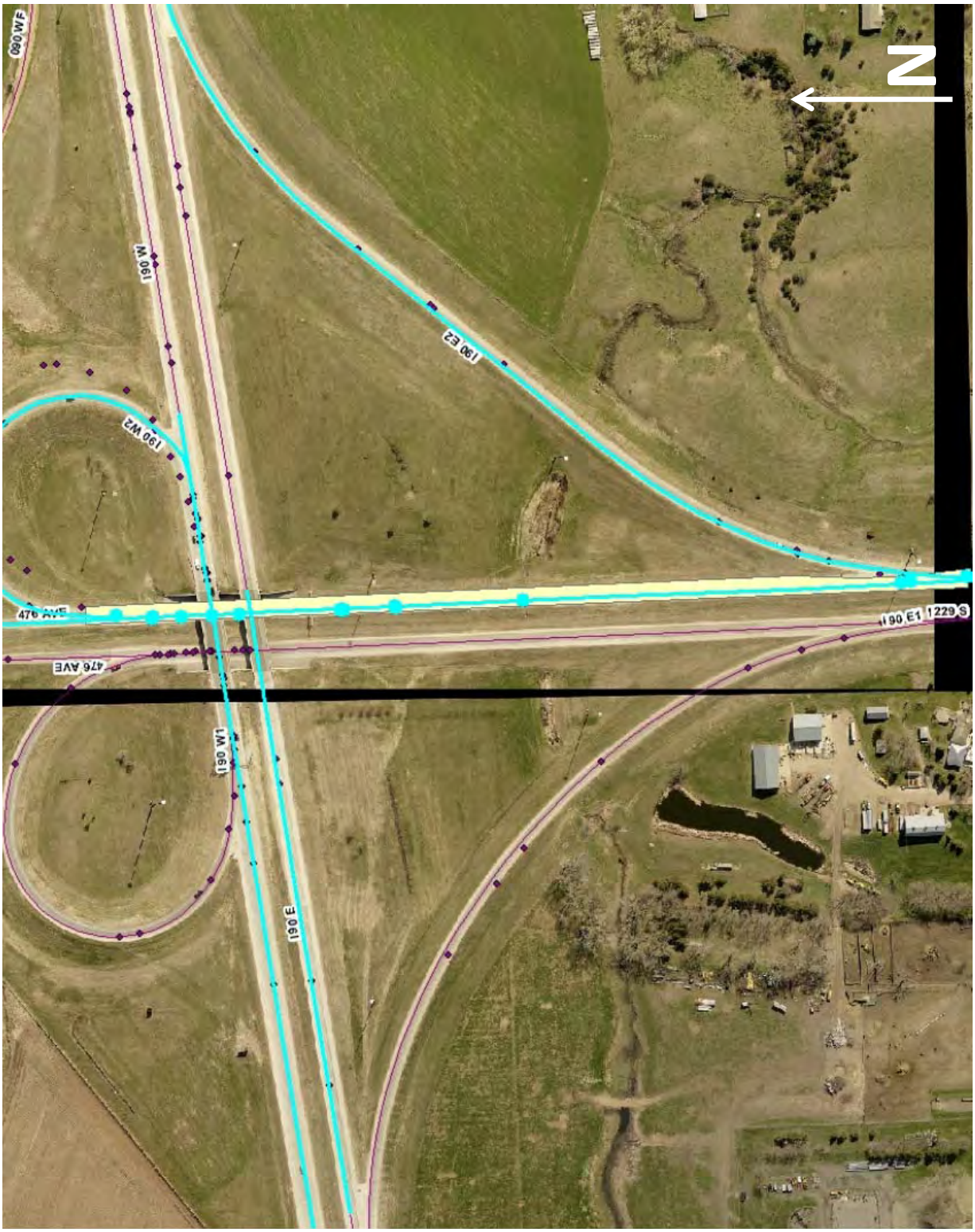
Segment Crash Map – I-229 SB from Benson to Rice

Segment Crash Map – I-229 NB from Rice off to Rice on

Segment Crash Map – I-229 NB from Rice to Benson

Segment Crash Map – I-229 NB from Benson off to Benson on

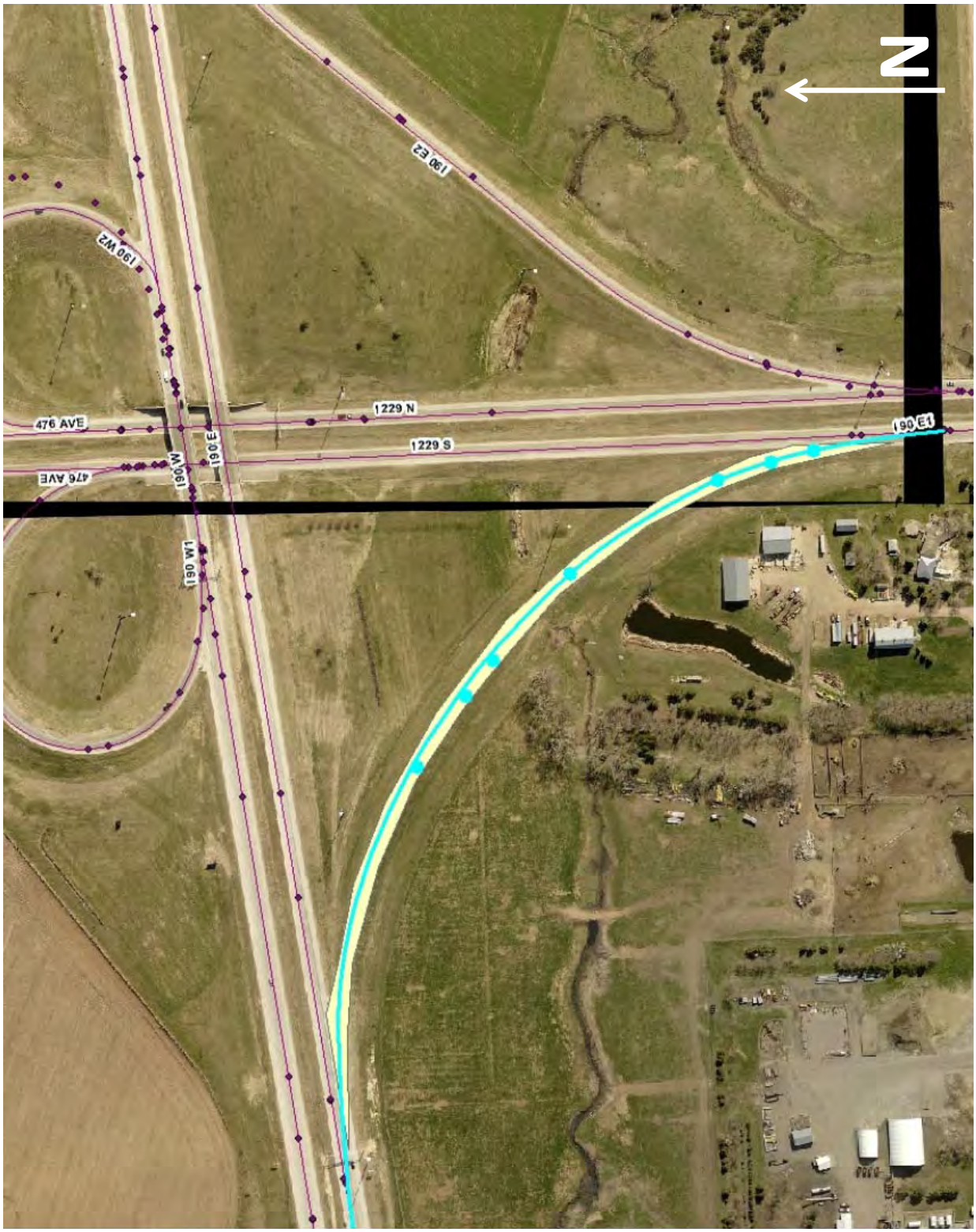
Segment Crash Map – I-229 NB from Benson to I-90 EB



Segment Crash Map – I-229 NB from I-90 EB to I-90 WB

INTERSTATE RAMP CRASH MAPS

Ramp Crash Map – I-90 WB to I-229 SB



Ramp Crash Map – I-90 EB to I-229 SB

Ramp Crash Map – I-229 SB/Benson off

Ramp Crash Map – I-229 SB/Benson on

Ramp Crash Map – I-229 SB/Rice off

Ramp Crash Map – I-229 SB/Rice on

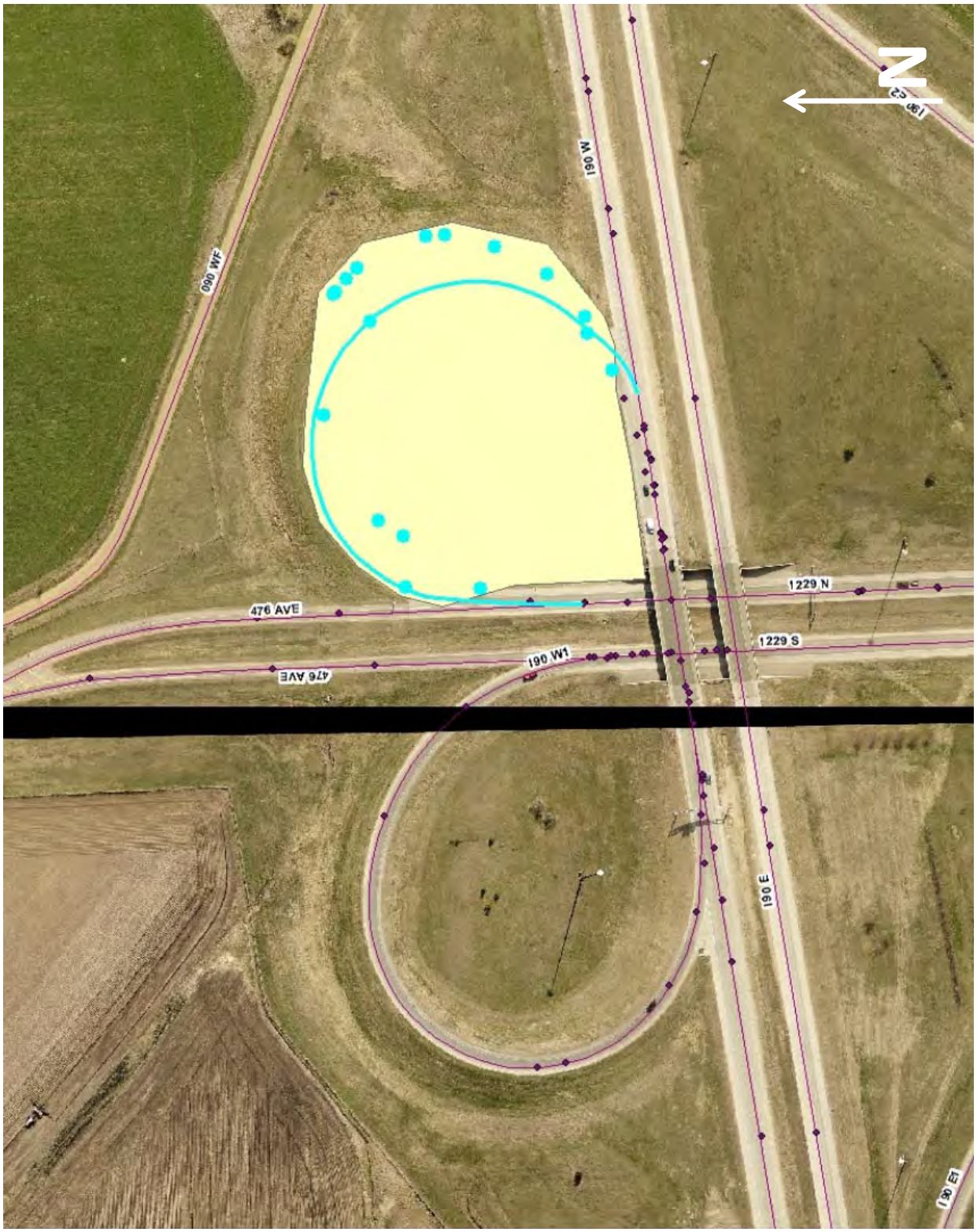
Ramp Crash Map – I-229 NB/Rice off

Ramp Crash Map – I-229 NB/Rice on

Ramp Crash Map – I-229 NB/Benson off

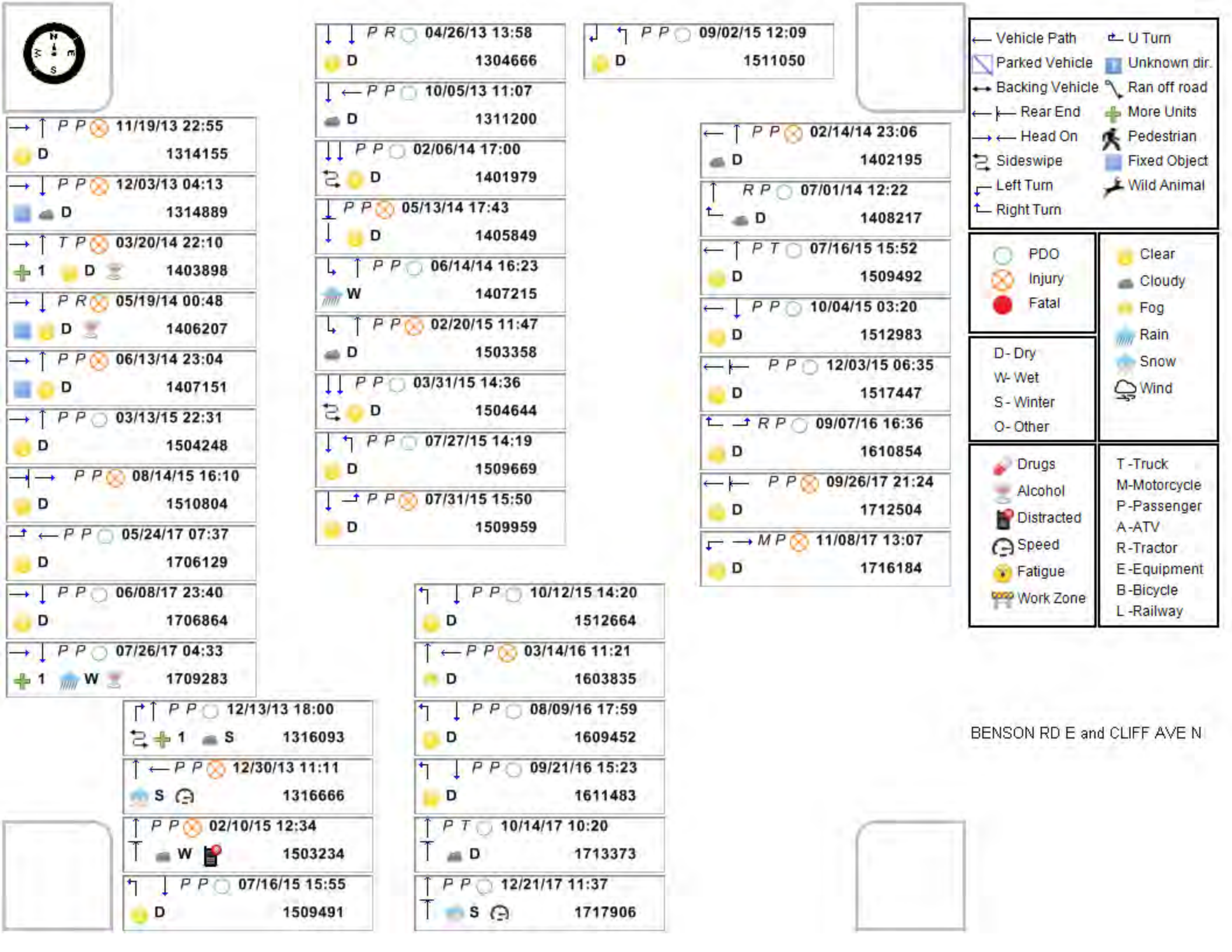
Ramp Crash Map – I-229 NB/Benson on

Ramp Crash Map – I-229 NB to I-90 EB



Ramp Crash Map – I-229 NB to I-90 EB

ARTERIAL INTERSECTION CRASH DIAGRAMS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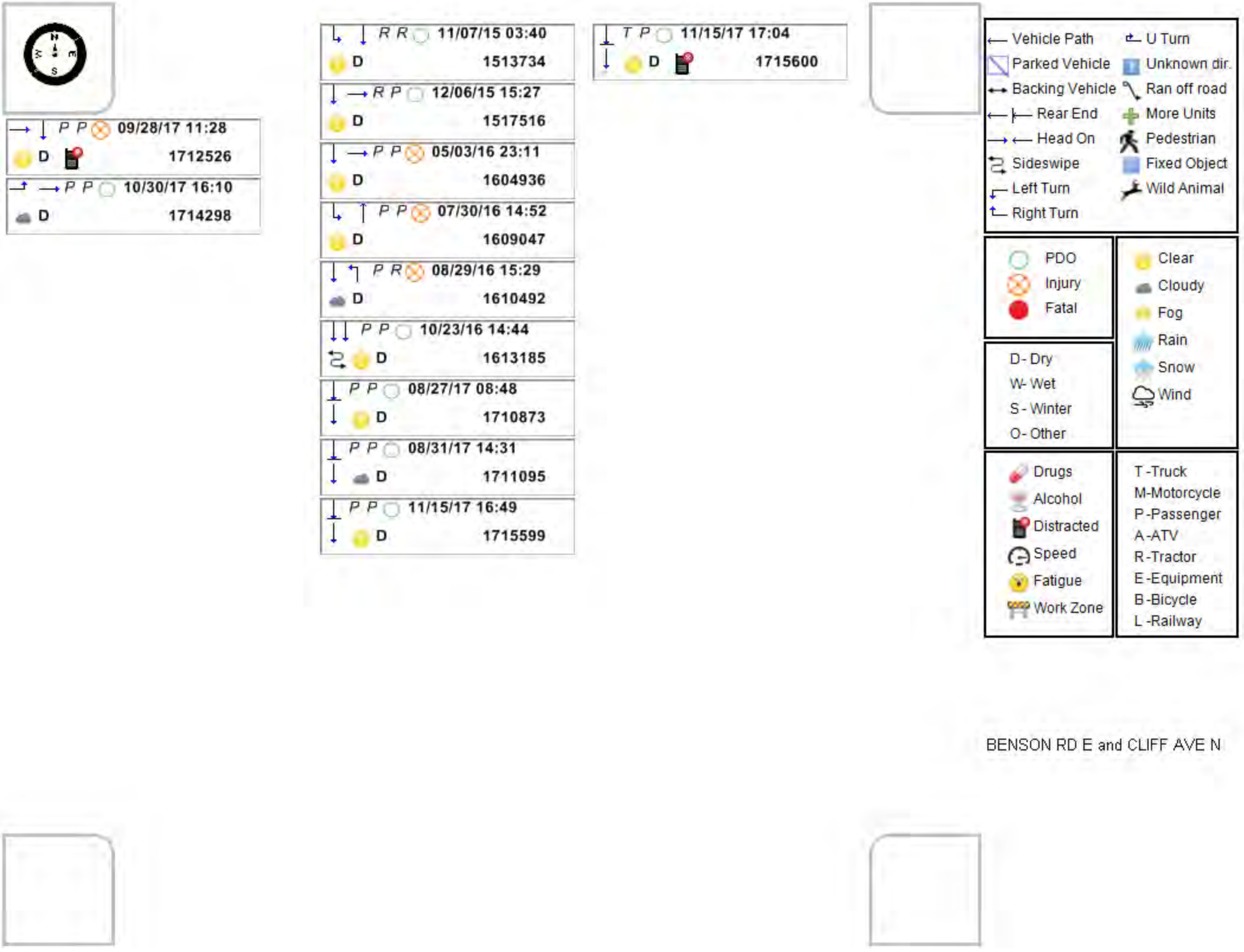
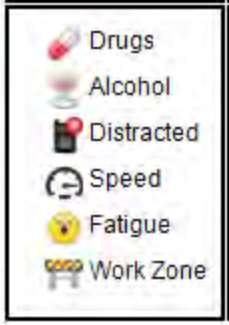
D 1314155
P P 12/03/13 04:13
D 1314889
T P 03/20/14 22:10
1 D 1403898
P R 05/19/14 00:48
D 1406207
P P 06/13/14 23:04
D 1407151
P P 03/13/15 22:31
D 1504248
P P 08/14/15 16:10
D 1510804
P P 05/24/17 07:37
D 1706129
P P 06/08/17 23:40
D 1706864
P P 07/26/17 04:33
1 W 1709283
P R 04/26/13 13:58
D 1304666
P P 10/05/13 11:07
D 1311200
P P 02/06/14 17:00
D 1401979
P P 05/13/14 17:43
D 1405849
P P 06/14/14 16:23
W 1407215
P P 02/20/15 11:47
D 1503358
P P 03/31/15 14:36
D 1504644
P P 07/27/15 14:19
D 1509669
P P 07/31/15 15:50
D 1509959
P P 09/02/15 12:09
D 1511050
P P 02/14/14 23:06
D 1402195
R P 07/01/14 12:22
D 1408217
P T 07/16/15 15:52
D 1509492
P P 10/04/15 03:20
D 1512983
P P 12/03/15 06:35
D 1517447
R P 09/07/16 16:36
D 1610854
P P 09/26/17 21:24
D 1712504
M P 11/08/17 13:07
D 1716184
P P 10/12/15 14:20
D 1512664
P P 03/14/16 11:21
D 1603835
P P 08/09/16 17:59
D 1609452
P P 09/21/16 15:23
D 1611483
P T 10/14/17 10:20
D 1713373
P P 12/21/17 11:37
S 1717906
P P 12/13/13 18:00
1 S 1316093
P P 12/30/13 11:11
S 1316666
P P 02/10/15 12:34
W 1503234
P P 07/16/15 15:55
D 1509491
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
D- Dry
W- Wet
S - Winter
O- Other
Clear
Cloudy
Fog
Rain
Snow
Wind
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
BENSON RD E and CLIFF AVE N


09/28/17 11:28
D
1712526
10/30/17 16:10
D
1714298
11/07/15 03:40
D
1513734
12/06/15 15:27
D
1517516
05/03/16 23:11
D
1604936
07/30/16 14:52
D
1609047
08/29/16 15:29
D
1610492
10/23/16 14:44
D
1613185
08/27/17 08:48
D
1710873
08/31/17 14:31
D
1711095
11/15/17 16:49
D
1715599
11/15/17 17:04
D
1715600
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
S - Winter
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
BENSON RD E and CLIFF AVE N



BENSON RD E and CLIFF AVE N

P 07/25/15 23:59 W 1509847	P P 02/06/15 10:47 W 1503175	P P 03/06/15 07:19 D 1504460	P P 06/03/16 12:24 D 1606477
P P 06/01/17 14:04 D 1706511	P P 12/11/17 15:38 D 1717310	P P 05/12/14 16:33 W 1406018	P P 12/03/15 12:09 D 1517452
P P 07/07/17 20:12 D 1708317	P P 04/24/14 08:04 W 1405242	P P 11/11/16 18:18 D 1614537	P P 02/16/17 12:11 D 1704569
P R 05/01/17 05:25 S 1705122			

Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal

PDO
Injury
Fatal

D - Dry
W - Wet
S - Winter
O - Other

Clear
Cloudy
Fog
Rain
Snow
Wind

Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone

T - Truck
M - Motorcycle
P - Passenger
A - ATV
R - Tractor
E - Equipment
B -Bicycle
L -Railway

R 02/16/15 09:21
D 1502855

P T 08/07/13 07:43
D 1308892

P P 05/22/14 17:16
D 1406469

P P 11/14/14 05:59
D 1416443

P P 12/19/14 08:03
W 1417542

P P 04/07/15 10:07
W 1504839

P P 08/24/15 16:55
D 1510966

P P 02/11/16 07:51
D 1602574

P P 12/02/16 19:17
D 1615943

P P 01/10/17 06:52
S 1700533

P P 10/24/13 15:38
D 1312276

P P 02/05/14 17:13
D 1401955

R P 12/23/15 09:05
W 1517705

P 01/17/14 18:13
W 1402794

P 02/29/16 17:59
S 1603124

P 12/14/16 23:10
D 1616663

P P 02/25/13 12:33
D 1302218

P P 04/14/14 06:38
D 1404769

T T 06/22/16 16:34
D 1607184

P P 12/12/16 15:39
D 1616524

T T 01/30/17 15:03
D 1705194

P P 01/22/13 07:40
S 1301377

P T 05/22/14 16:20
D 1406273

P P 08/24/17 05:53
D 1710647

P P 09/20/17 18:22
D 1712168

P P 11/20/17 17:52
D 1716013

- Vehicle Path
- Parked Vehicle
- Backing Vehicle
- Rear End
- Head On
- Sideswipe
- Left Turn
- Right Turn
- U Turn
- Unknown dir.
- Ran off road
- More Units
- Pedestrian
- Fixed Object
- Wild Animal

- PDO
- Injury
- Fatal

- Clear
- Cloudy
- Fog
- Rain
- Snow
- Wind

D- Dry
W- Wet
S - Winter
O- Other

- Drugs
- Alcohol
- Distracted
- Speed
- Fatigue
- Work Zone

T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway

BENSON RD E and LEWIS AVE N

P P	06/07/17 17:12		
1	D		1709379
P P	10/05/17 07:31		
D			1712896
P P	11/22/17 07:02		
D			1716028
P P	12/27/17 07:14		
D			1718269

- Vehicle Path
- Parked Vehicle
- Backing Vehicle
- Rear End
- Head On
- Sideswipe
- Left Turn
- Right Turn
- U Turn
- Unknown dir.
- Ran off road
- More Units
- Pedestrian
- Fixed Object
- Wild Animal

- PDO
- Injury
- Fatal

- Clear
- Cloudy
- Fog
- Rain
- Snow
- Wind

- D- Dry
- W- Wet
- S - Winter
- O- Other

- Drugs
- Alcohol
- Distracted
- Speed
- Fatigue
- Work Zone

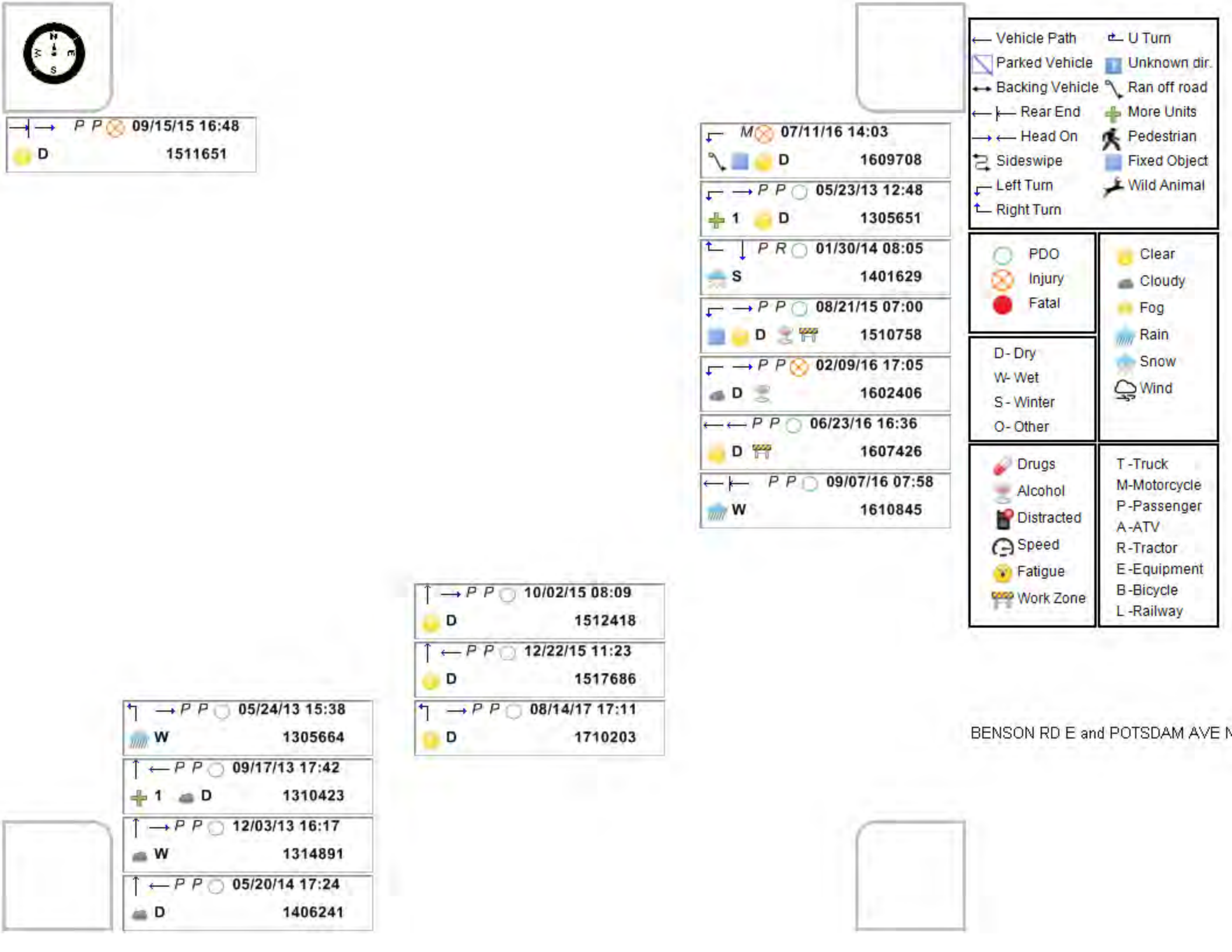
- T -Truck
- M-Motorcycle
- P -Passenger
- A -ATV
- R -Tractor
- E -Equipment
- B -Bicycle
- L -Railway

BENSON RD E and LEWIS AVE N

T 03/03/14 10:48 D 1403118	P 04/01/17 06:47 D 1703917	P P 06/08/16 07:55 D 1606511	P P 01/06/16 17:27 W 1601287
B P 09/25/17 06:25 W 1712409			

P P 08/06/13 16:53 1 D 1308885	P P 10/24/13 17:18 D 1312278	P P 11/03/13 17:46 D 1313731	P P 05/31/16 16:47 D 1606127

Vehicle Path Parked Vehicle Backing Vehicle Rear End Head On Sideswipe Left Turn Right Turn	U Turn Unknown dir. Ran off road More Units Pedestrian Fixed Object Wild Animal	PDO Injury Fatal D - Dry W - Wet S - Winter O - Other	Clear Cloudy Fog Rain Snow Wind	Drugs Alcohol Distracted Speed Fatigue Work Zone	T - Truck M - Motorcycle P - Passenger A - ATV R - Tractor E - Equipment B -Bicycle L -Railway


09/15/15 16:48
D
1511651
07/11/16 14:03
D
1609708
05/23/13 12:48
1
D
1305651
01/30/14 08:05
S
1401629
08/21/15 07:00
D
1510758
02/09/16 17:05
D
1602406
06/23/16 16:36
D
1607426
09/07/16 07:58
W
1610845
10/02/15 08:09
D
1512418
12/22/15 11:23
D
1517686
08/14/17 17:11
D
1710203
05/24/13 15:38
W
1305664
09/17/13 17:42
1
D
1310423
12/03/13 16:17
W
1314891
05/20/14 17:24
D
1406241
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
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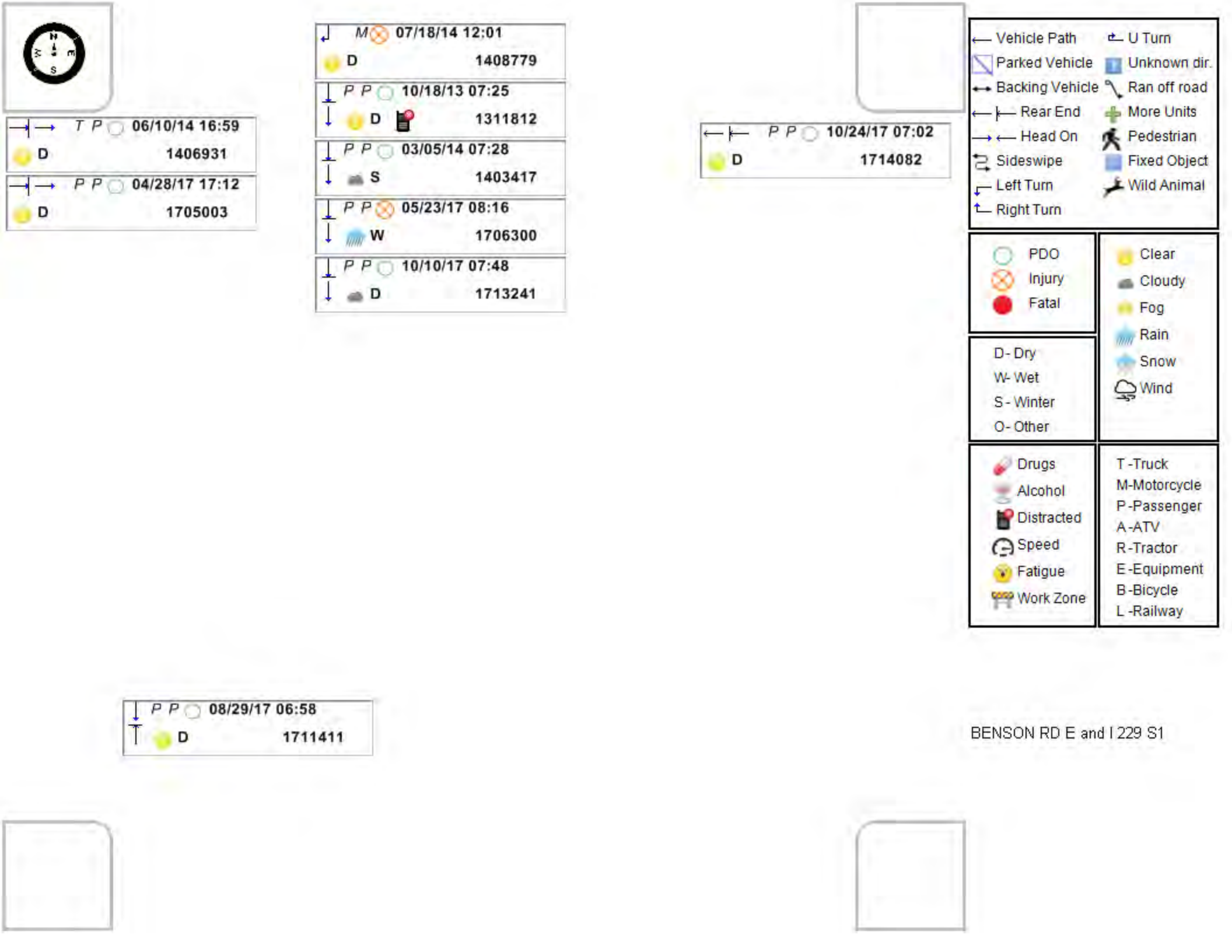
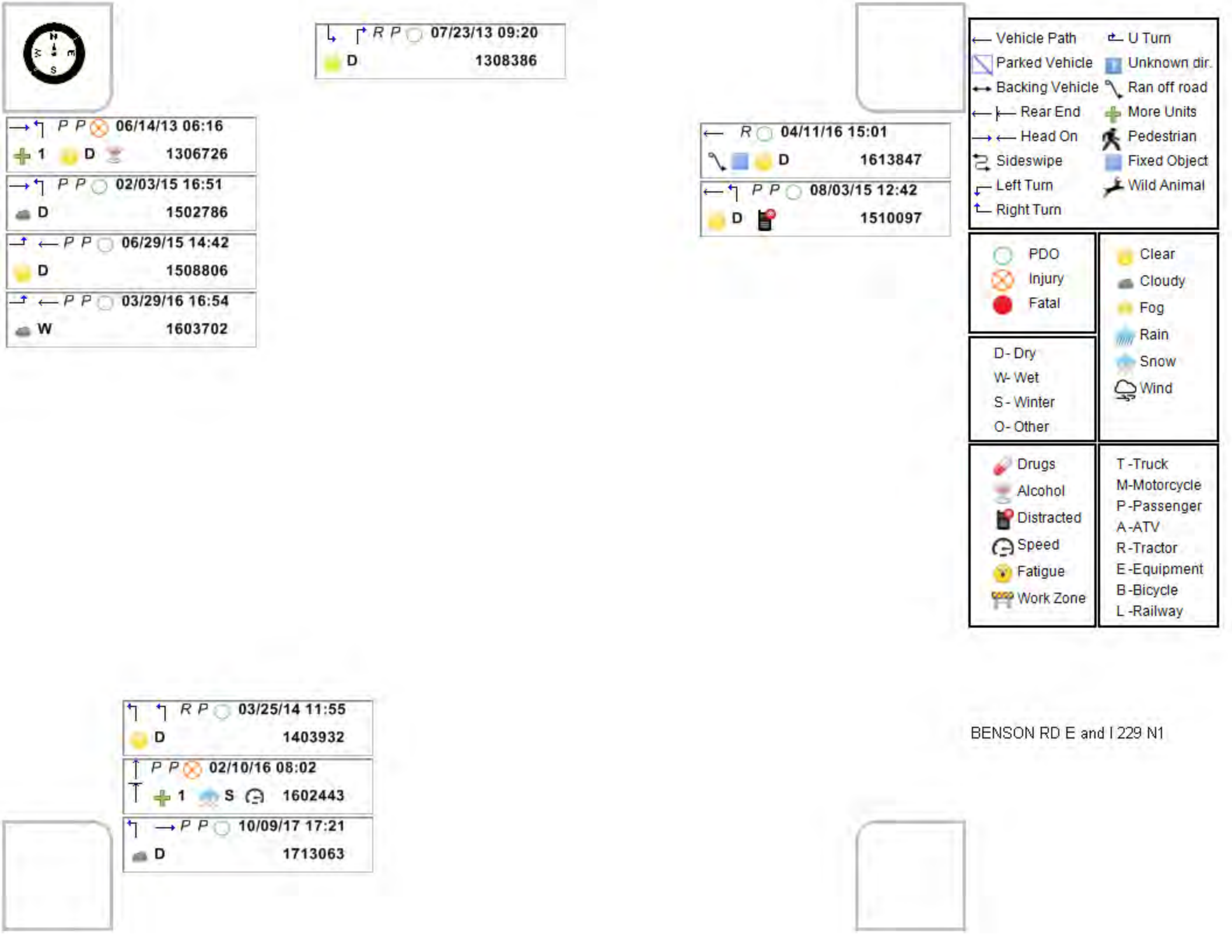
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
BENSON RD E and POTSDAM AVE N


M 07/18/14 12:01
D 1408779
P P 10/18/13 07:25
D 1311812
P P 03/05/14 07:28
S 1403417
P P 05/23/17 08:16
W 1706300
P P 10/10/17 07:48
D 1713241
T P 06/10/14 16:59
D 1406931
P P 04/28/17 17:12
D 1705003
P P 10/24/17 07:02
D 1714082
P P 08/29/17 06:58
D 1711411
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
S - Winter
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
BENSON RD E and I 229 S1


R P 07/23/13 09:20
D 1308386
P P 06/14/13 06:16
1 D 1306726
P P 02/03/15 16:51
D 1502786
P P 06/29/15 14:42
D 1508806
P P 03/29/16 16:54
W 1603702
R 04/11/16 15:01
D 1613847
P P 08/03/15 12:42
D 1510097
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
S - Winter
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
R P 03/25/14 11:55
D 1403932
P P 02/10/16 08:02
1 S 1602443
P P 10/09/17 17:21
D 1713063
BENSON RD E and I 229 N1

P 01/26/13 12:51
D 1301241

P 04/01/16 08:51
O 1604054

Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal

PDO
Injury
Fatal

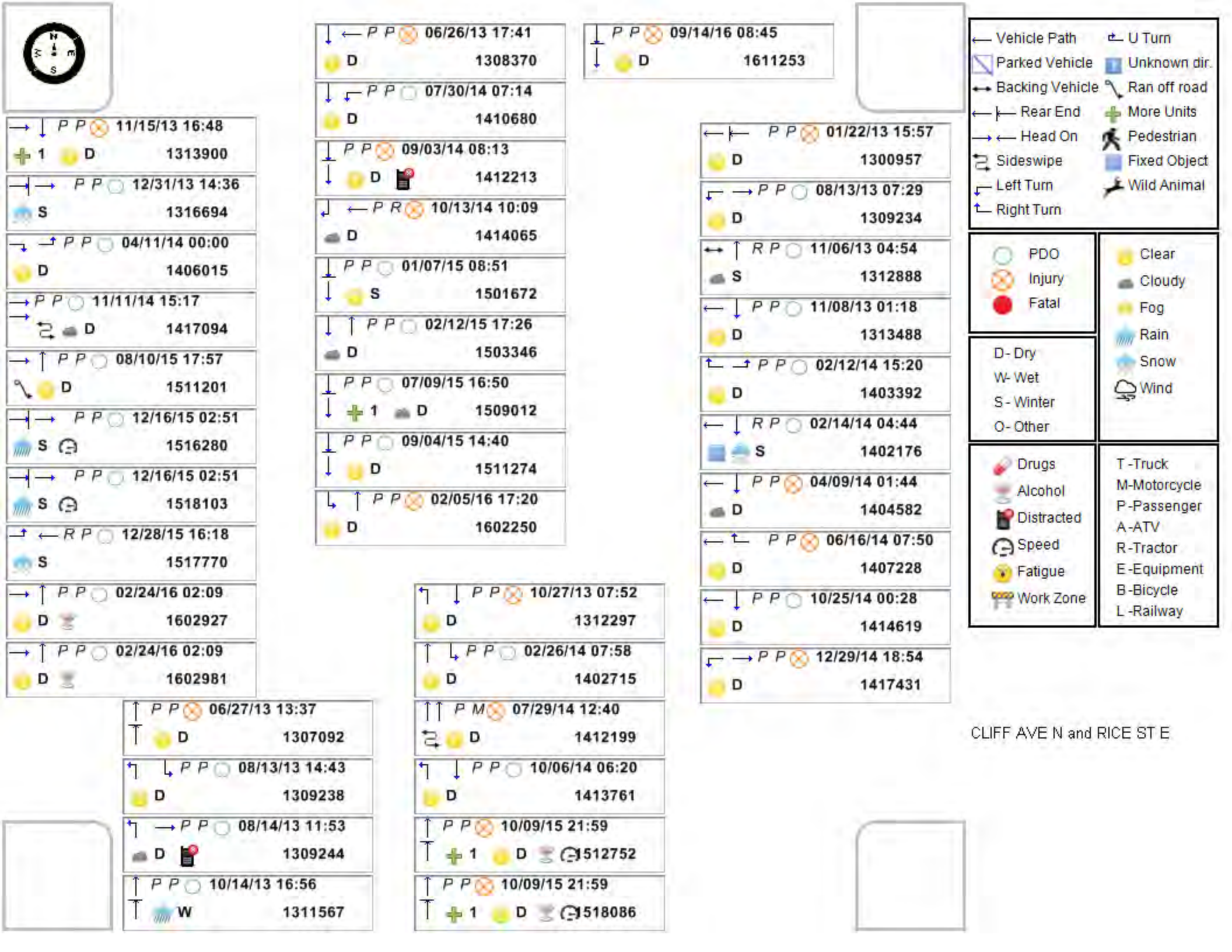
Clear
Cloudy
Fog
Rain
Snow
Wind

D- Dry
W- Wet
S - Winter
O- Other

Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone

T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway

BENSON RD E and HALL AVE N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P P 04/11/14 00:00
D 1406015
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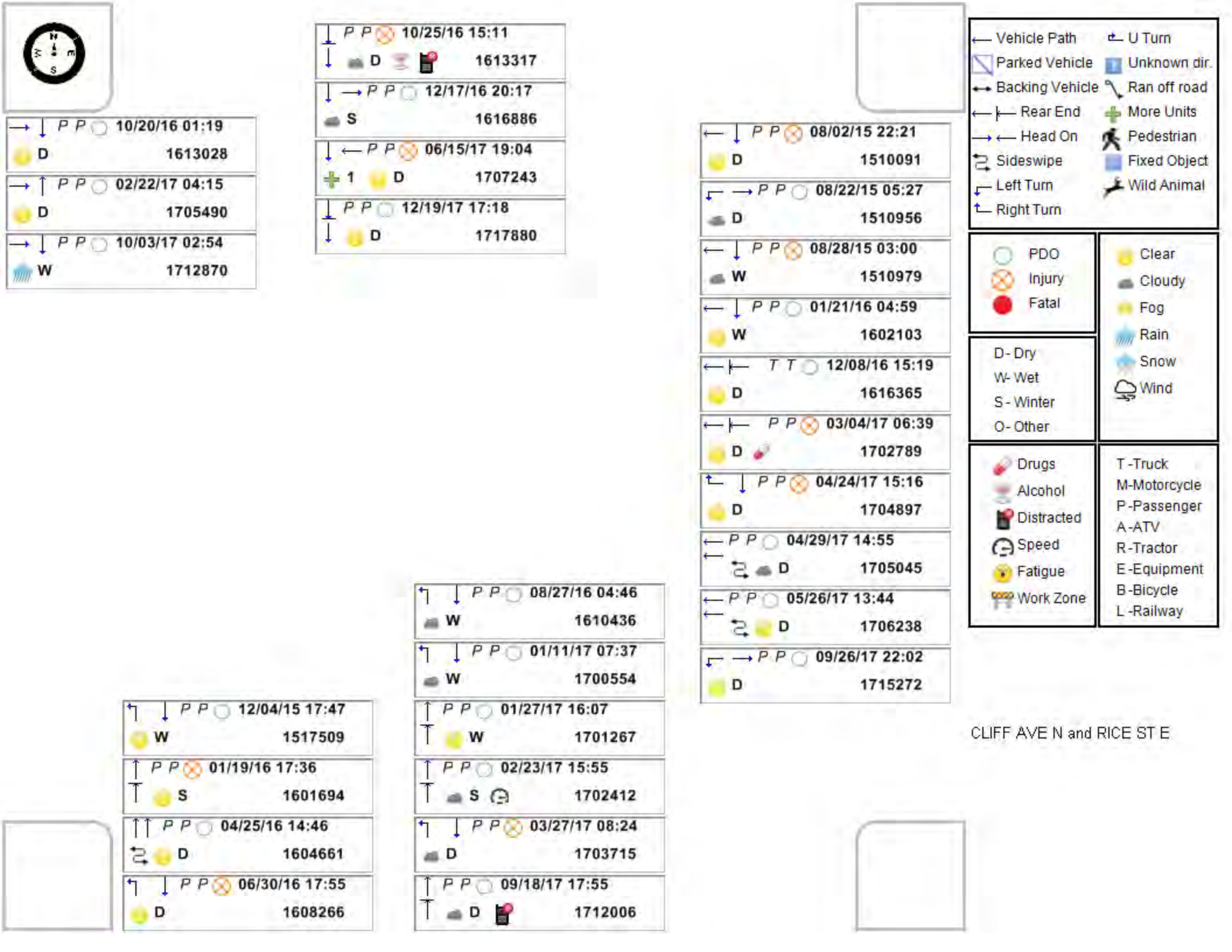
D 1417094
P P 08/10/15 17:57
D 1511201
P P 12/16/15 02:51
S 1516280
P P 12/16/15 02:51
S 1518103
R P 12/28/15 16:18
S 1517770
P P 02/24/16 02:09
D 1602927
P P 02/24/16 02:09
D 1602981
P P 06/27/13 13:37
D 1307092
P P 08/13/13 14:43
D 1309238
P P 08/14/13 11:53
D 1309244
P P 10/14/13 16:56
W 1311567
P P 06/26/13 17:41
D 1308370
P P 07/30/14 07:14
D 1410680
P P 09/03/14 08:13
D 1412213
P R 10/13/14 10:09
D 1414065
P P 01/07/15 08:51
S 1501672
P P 02/12/15 17:26
D 1503346
P P 07/09/15 16:50
1 D 1509012
P P 09/04/15 14:40
D 1511274
P P 02/05/16 17:20
D 1602250
P P 10/27/13 07:52
D 1312297
P P 02/26/14 07:58
D 1402715
P M 07/29/14 12:40
D 1412199
P P 10/06/14 06:20
D 1413761
P P 10/09/15 21:59
1 D 1512752
P P 10/09/15 21:59
1 D 1518086
P P 09/14/16 08:45
D 1611253
P P 01/22/13 15:57
D 1300957
P P 08/13/13 07:29
D 1309234
R P 11/06/13 04:54
S 1312888
P P 11/08/13 01:18
D 1313488
P P 02/12/14 15:20
D 1403392
R P 02/14/14 04:44
S 1402176
P P 04/09/14 01:44
D 1404582
P P 06/16/14 07:50
D 1407228
P P 10/25/14 00:28
D 1414619
P P 12/29/14 18:54
D 1417431
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
S - Winter
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
CLIFF AVE N and RICE ST E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P P 02/22/17 04:15
D 1705490
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W 1712870
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D 1613317
P P 12/17/16 20:17
S 1616886
P P 06/15/17 19:04
1 D 1707243
P P 12/19/17 17:18
D 1717880
P P 08/02/15 22:21
D 1510091
P P 08/22/15 05:27
D 1510956
P P 08/28/15 03:00
W 1510979
P P 01/21/16 04:59
W 1602103
T T 12/08/16 15:19
D 1616365
P P 03/04/17 06:39
D 1702789
P P 04/24/17 15:16
D 1704897
P P 04/29/17 14:55
D 1705045
P P 05/26/17 13:44
D 1706238
P P 09/26/17 22:02
D 1715272
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
S - Winter
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
P P 08/27/16 04:46
W 1610436
P P 01/11/17 07:37
W 1700554
P P 01/27/17 16:07
W 1701267
P P 02/23/17 15:55
S 1702412
P P 03/27/17 08:24
D 1703715
P P 09/18/17 17:55
D 1712006
P P 12/04/15 17:47
W 1517509
P P 01/19/16 17:36
S 1601694
P P 04/25/16 14:46
D 1604661
P P 06/30/16 17:55
D 1608266
CLIFF AVE N and RICE ST E

- Vehicle Path
- Parked Vehicle
- Backing Vehicle
- Rear End
- Head On
- Sideswipe
- Left Turn
- Right Turn
- U Turn
- Unknown dir.
- Ran off road
- More Units
- Pedestrian
- Fixed Object
- Wild Animal

- PDO
- Injury
- Fatal

- Clear
- Cloudy
- Fog
- Rain
- Snow
- Wind

D- Dry
W- Wet
S - Winter
O- Other

- Drugs
- Alcohol
- Distracted
- Speed
- Fatigue
- Work Zone

T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway

P P 10/10/17 15:34
D 1713246

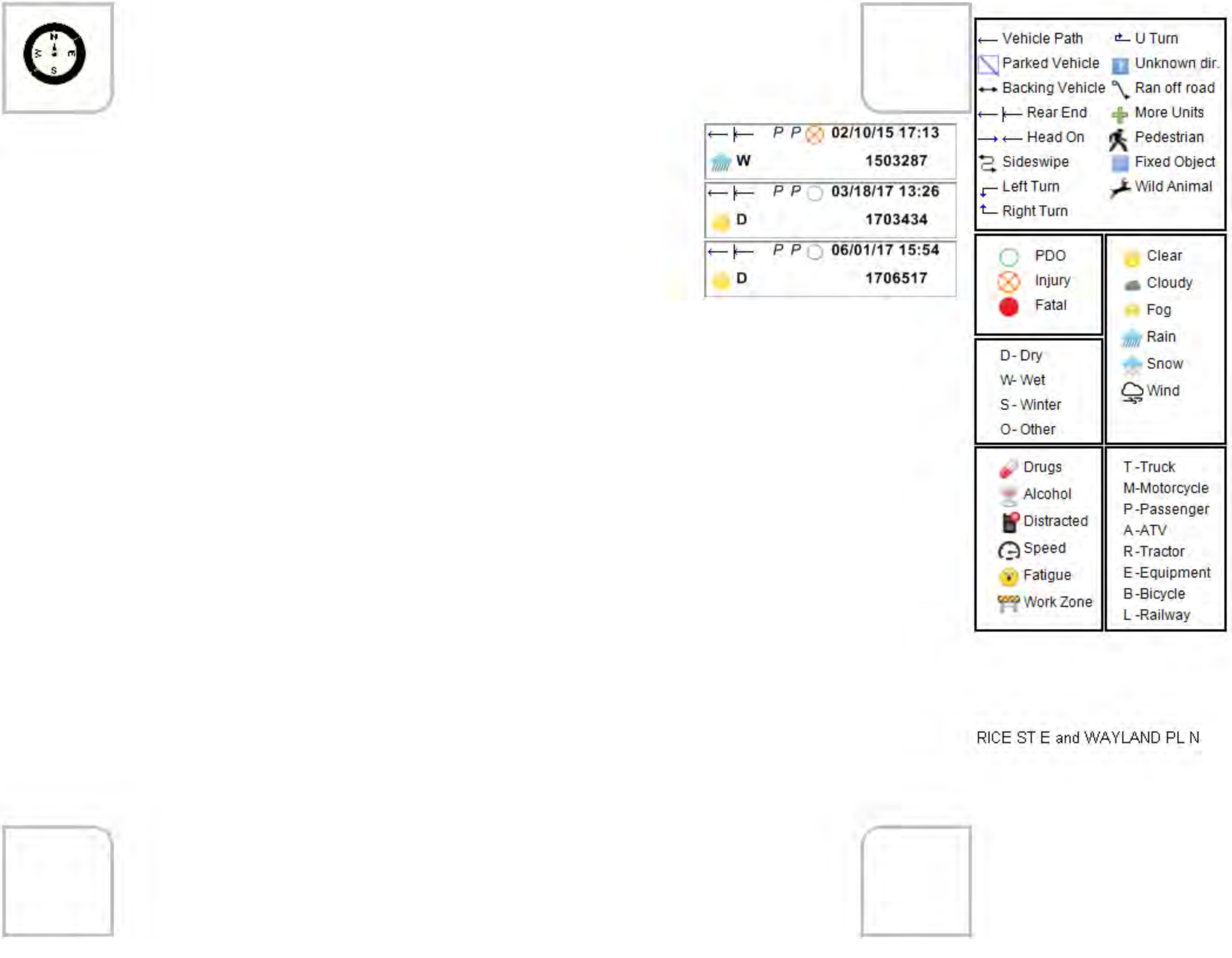
CLIFF AVE N and RICE ST E

P P 10/21/13 15:58 1 D 1311912	M P 09/25/15 19:46 D 1512226	P R 02/09/17 15:03 D 1701907	P P 10/30/13 17:10 W 1312538	P P 06/02/16 13:56 D 1613699
P P 12/22/17 12:04 W 1717950				

P P 06/10/15 14:32 D 1507854	P P 11/13/15 16:46 D 1515866	P P 04/22/17 17:42 D 1704740	P P 04/24/13 16:45 D 1304539	P P 05/10/16 15:37 D 1605201
P P 10/10/17 15:30 D 1713245				

Vehicle Path Parked Vehicle Backing Vehicle Rear End Head On Sideswipe Left Turn Right Turn	U Turn Unknown dir. Ran off road More Units Pedestrian Fixed Object Wild Animal	PDO Injury Fatal D - Dry W - Wet S - Winter O - Other	Clear Cloudy Fog Rain Snow Wind	Drugs Alcohol Distracted Speed Fatigue Work Zone

T - Truck
M - Motorcycle
P - Passenger
A - ATV
R - Tractor
E - Equipment
B -Bicycle
L -Railway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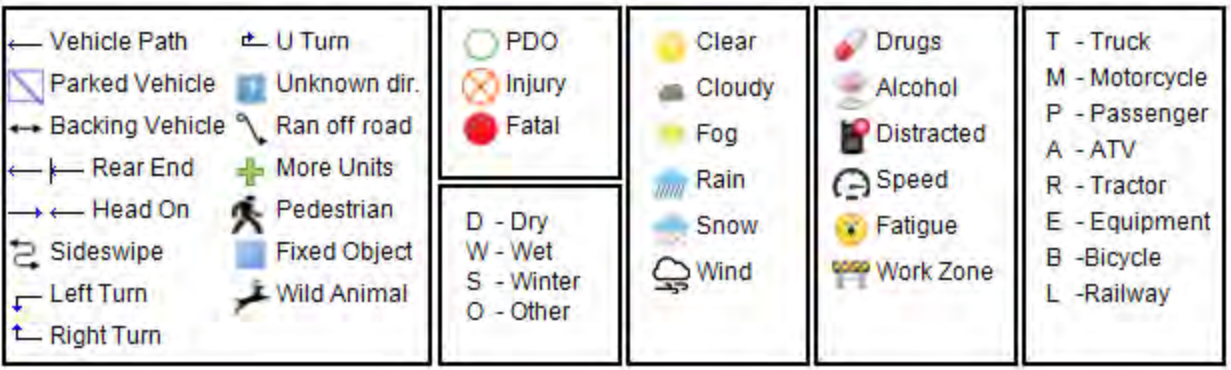
W 1503287
P P 03/18/17 13:26
D 1703434
P P 06/01/17 15:54
D 1706517
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
S - Winter
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
RICE ST E and WAYLAND PL N

P P 04/09/13 06:19

W 1305897

P P 02/10/15 17:26

W 1503291



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D 1305390

P P 08/08/14 07:55
D 1410775

T P 03/28/16 08:28
D 1603692

R P 07/08/14 07:30
D 1407753

P P 02/17/15 06:01
S 1503421

P P 05/28/13 15:54
D 1305687

M P 04/06/17 13:10
D 1704297

- Vehicle Path
- Parked Vehicle
- Backing Vehicle
- Rear End
- Head On
- Sideswipe
- Left Turn
- Right Turn
- U Turn
- Unknown dir.
- Ran off road
- More Units
- Pedestrian
- Fixed Object
- Wild Animal

- PDO
- Injury
- Fatal

- Clear
- Cloudy
- Fog
- Rain
- Snow
- Wind

D- Dry
W- Wet
S - Winter
O- Other

- Drugs
- Alcohol
- Distracted
- Speed
- Fatigue
- Work Zone

T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway

RICE ST E and I 229 S1

P P 05/17/13 22:05
D 1305390

P P 08/08/14 07:55
D 1410775

T P 03/28/16 08:28
D 1603692

R P 07/08/14 07:30
D 1407753

P P 02/17/15 06:01
S 1503421

P P 05/28/13 15:54
D 1305687

M P 04/06/17 13:10
D 1704297

- Vehicle Path
- Parked Vehicle
- Backing Vehicle
- Rear End
- Head On
- Sideswipe
- Left Turn
- Right Turn
- U Turn
- Unknown dir.
- Ran off road
- More Units
- Pedestrian
- Fixed Object
- Wild Animal

- PDO
- Injury
- Fatal

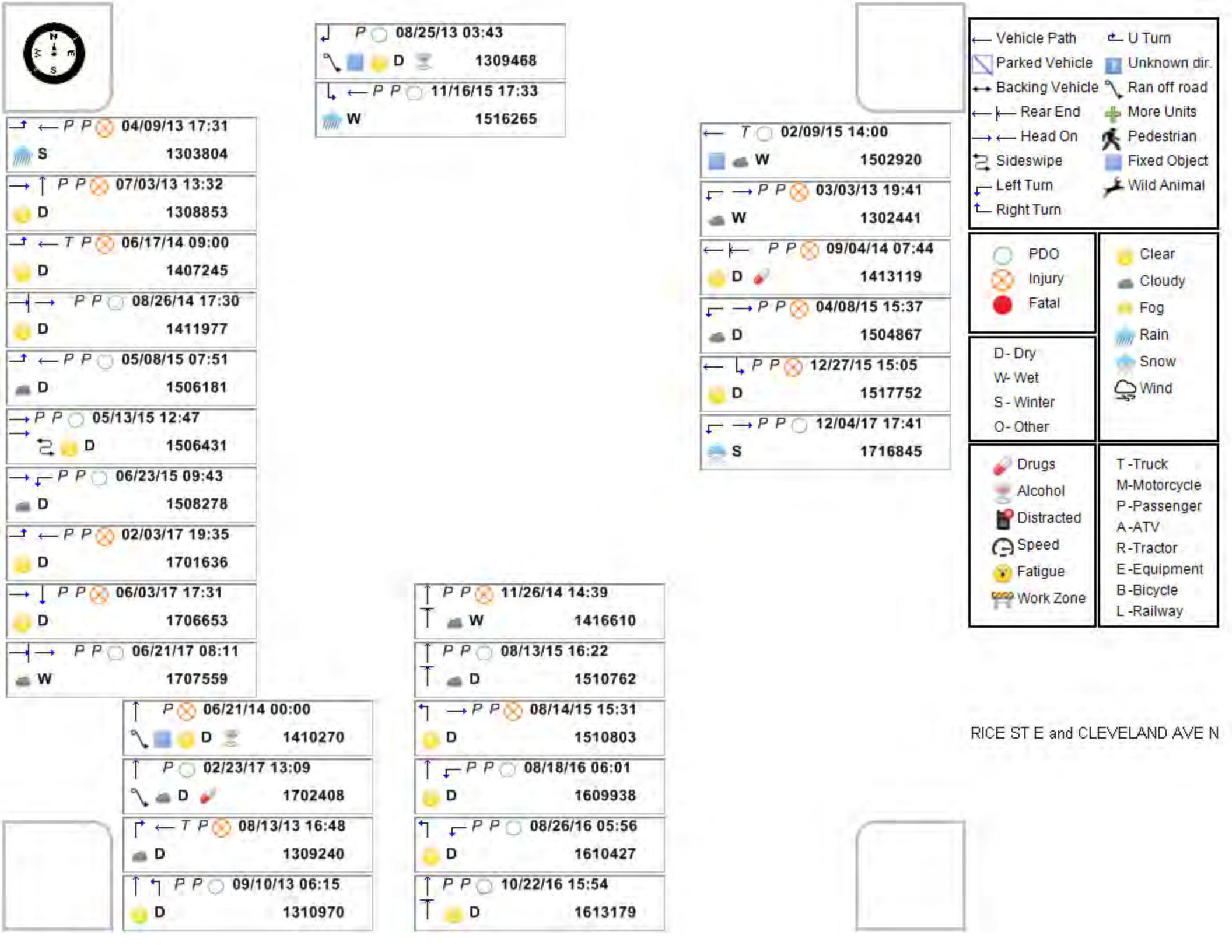
- Clear
- Cloudy
- Fog
- Rain
- Snow
- Wind

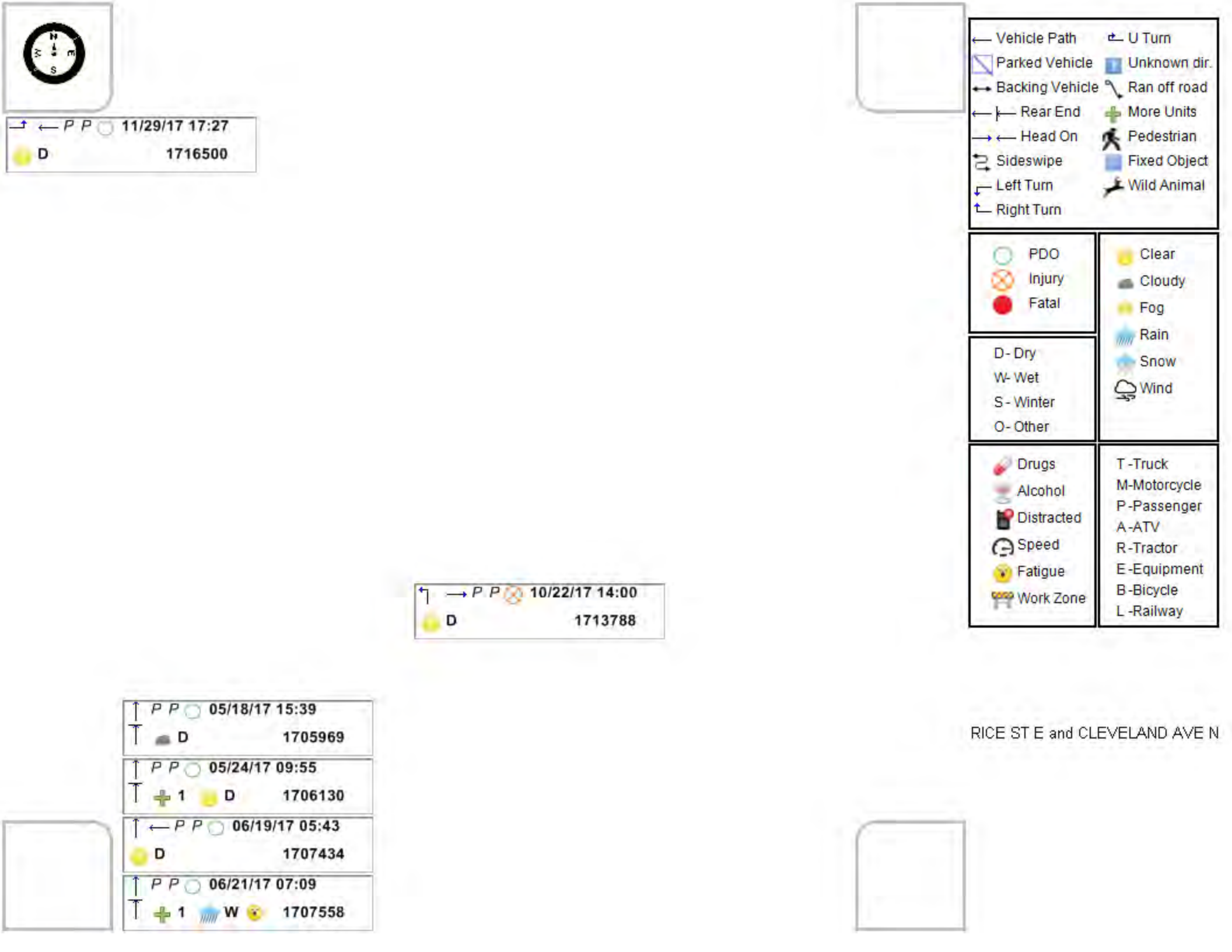
D- Dry
W- Wet
S - Winter
O- Other

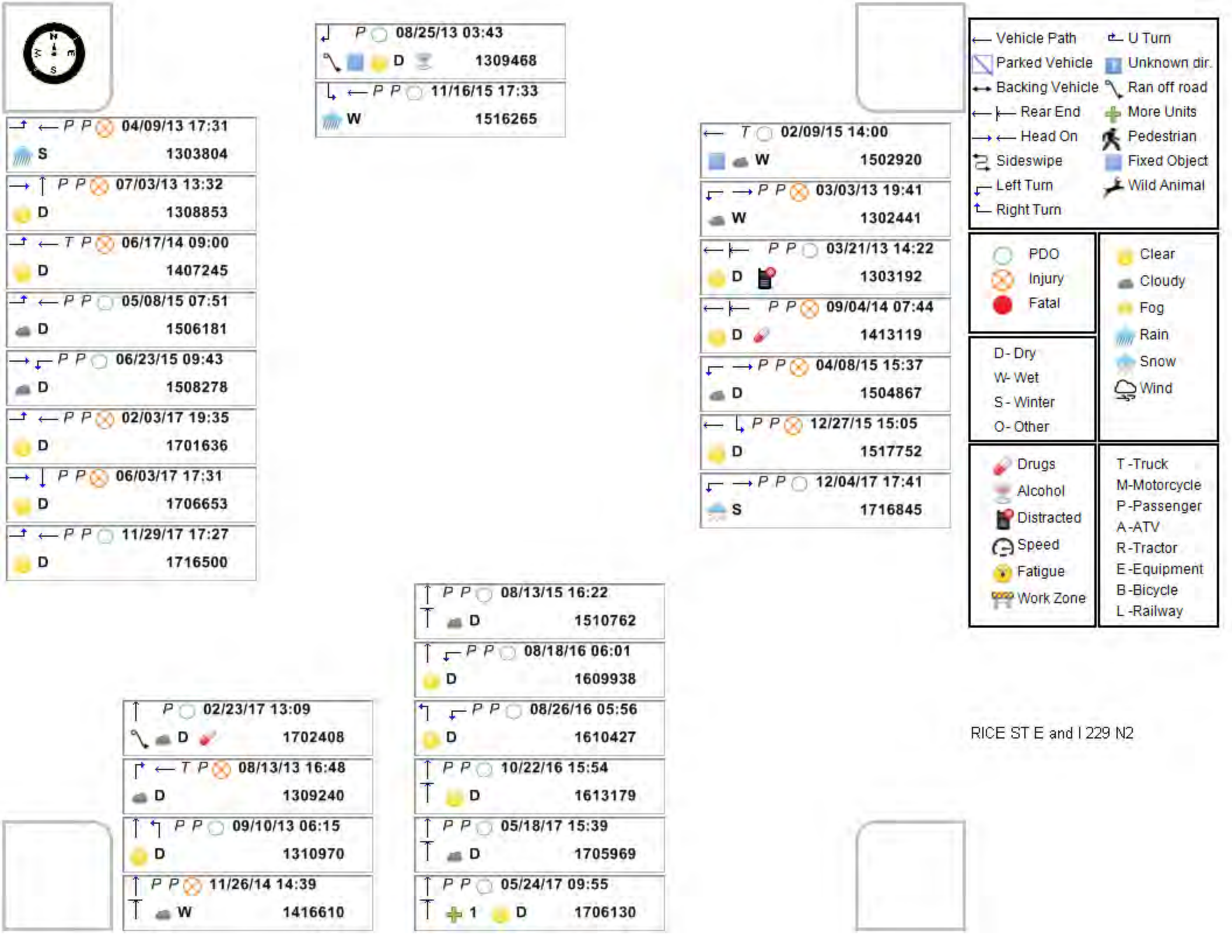
- Drugs
- Alcohol
- Distracted
- Speed
- Fatigue
- Work Zone

T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway

RICE ST E and I 229 S2


08/25/13 03:43
D
1309468
11/16/15 17:33
W
1516265
04/09/13 17:31
S
1303804
07/03/13 13:32
D
1308853
06/17/14 09:00
D
1407245
08/26/14 17:30
D
1411977
05/08/15 07:51
D
1506181
05/13/15 12:47
D
1506431
06/23/15 09:43
D
1508278
02/03/17 19:35
D
1701636
06/03/17 17:31
D
1706653
06/21/17 08:11
W
1707559
06/21/14 00:00
D
1410270
02/23/17 13:09
D
1702408
08/13/13 16:48
D
1309240
09/10/13 06:15
D
1310970
11/26/14 14:39
W
1416610
08/13/15 16:22
D
1510762
08/14/15 15:31
D
1510803
08/18/16 06:01
D
1609938
08/26/16 05:56
D
1610427
10/22/16 15:54
D
1613179
02/09/15 14:00
W
1502920
03/03/13 19:41
W
1302441
09/04/14 07:44
D
1413119
04/08/15 15:37
D
1504867
12/27/15 15:05
D
1517752
12/04/17 17:41
S
1716845
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
S - Winter
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
RICE ST E and CLEVELAND AVE N


11/29/17 17:27
D
1716500
10/22/17 14:00
D
1713788
05/18/17 15:39
D
1705969
05/24/17 09:55
1
D
1706130
06/19/17 05:43
D
1707434
06/21/17 07:09
1
W
1707558
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
S - Winter
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
RICE ST E and CLEVELAND AVE N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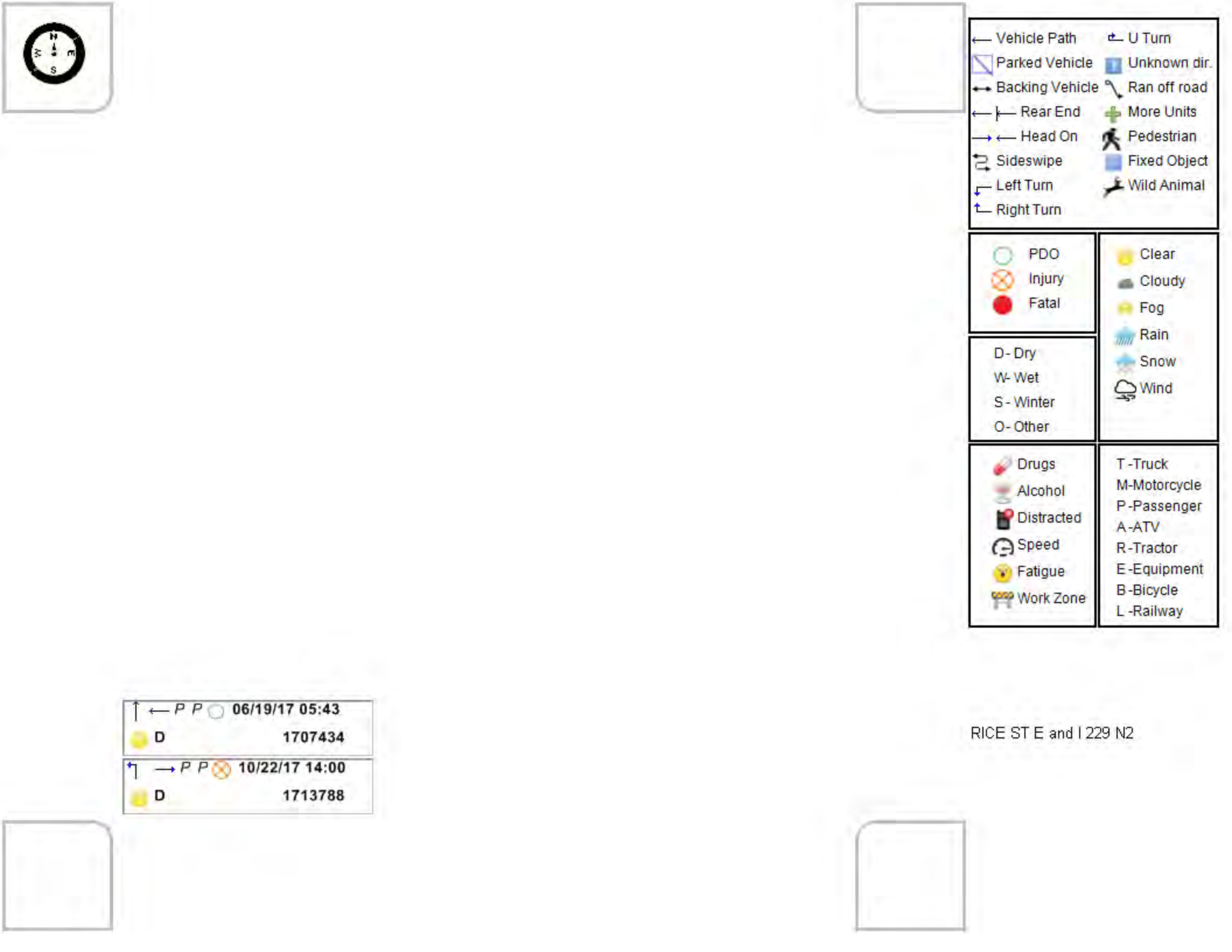
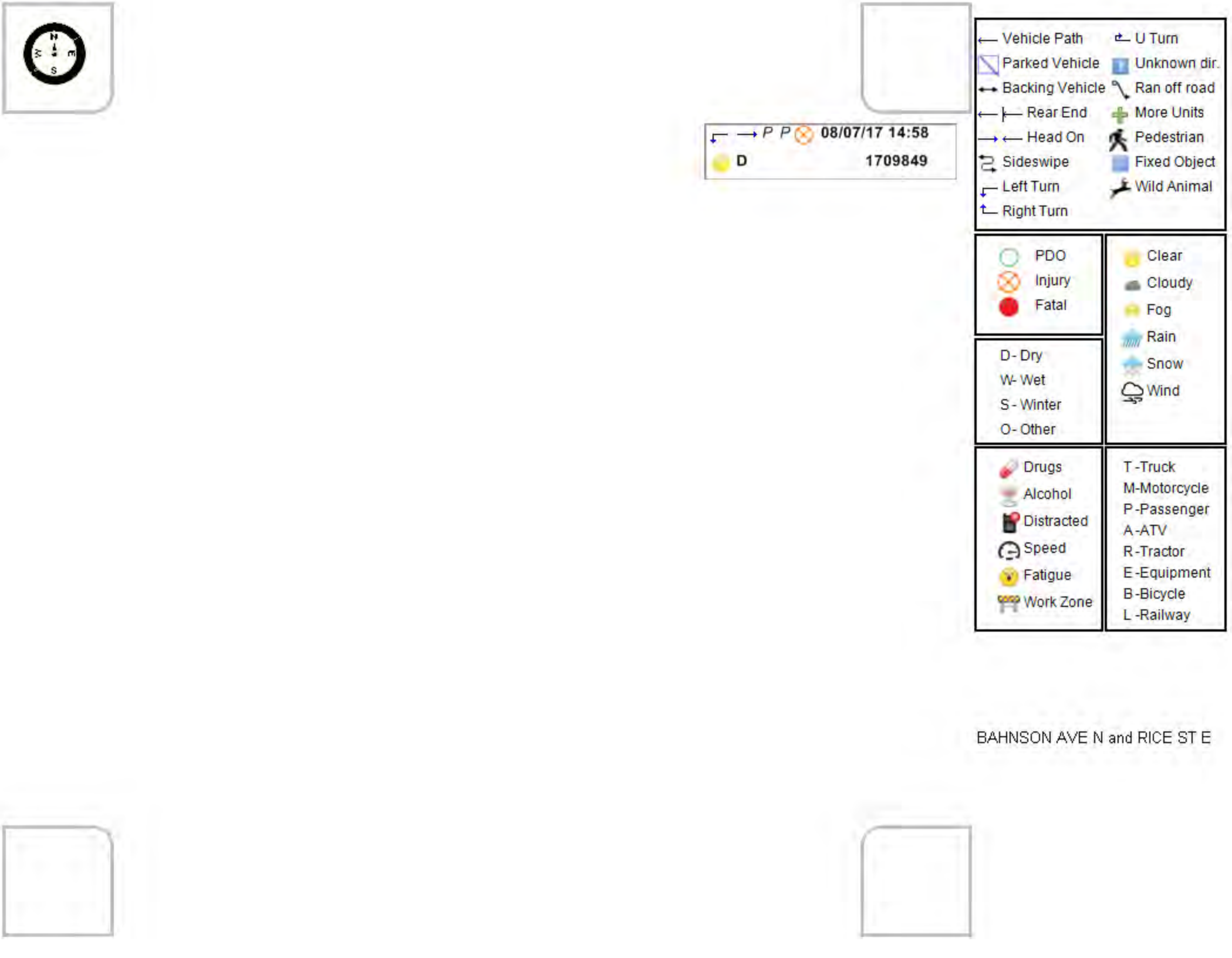
D 1309468
11/16/15 17:33
W 1516265
04/09/13 17:31
S 1303804
07/03/13 13:32
D 1308853
06/17/14 09:00
D 1407245
05/08/15 07:51
D 1506181
06/23/15 09:43
D 1508278
02/03/17 19:35
D 1701636
06/03/17 17:31
D 1706653
11/29/17 17:27
D 1716500
02/09/15 14:00
W 1502920
03/03/13 19:41
W 1302441
03/21/13 14:22
D 1303192
09/04/14 07:44
D 1413119
04/08/15 15:37
D 1504867
12/27/15 15:05
D 1517752
12/04/17 17:41
S 1716845
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
S - Winter
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
08/13/15 16:22
D 1510762
08/18/16 06:01
D 1609938
08/26/16 05:56
D 1610427
10/22/16 15:54
D 1613179
05/18/17 15:39
D 1705969
05/24/17 09:55
1 D 1706130
02/23/17 13:09
D 1702408
08/13/13 16:48
D 1309240
09/10/13 06:15
D 1310970
11/26/14 14:39
W 1416610
RICE ST E and I 229 N2


Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
S - Winter
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
P P 06/19/17 05:43
D 1707434
P P 10/22/17 14:00
D 1713788
RICE ST E and I 229 N2

P 04/27/15 11:00	P P 08/17/16 16:59
D 1507686	D 1609866
P 03/01/17 08:05	P P 10/24/17 15:22
S 1702723	D 1714089

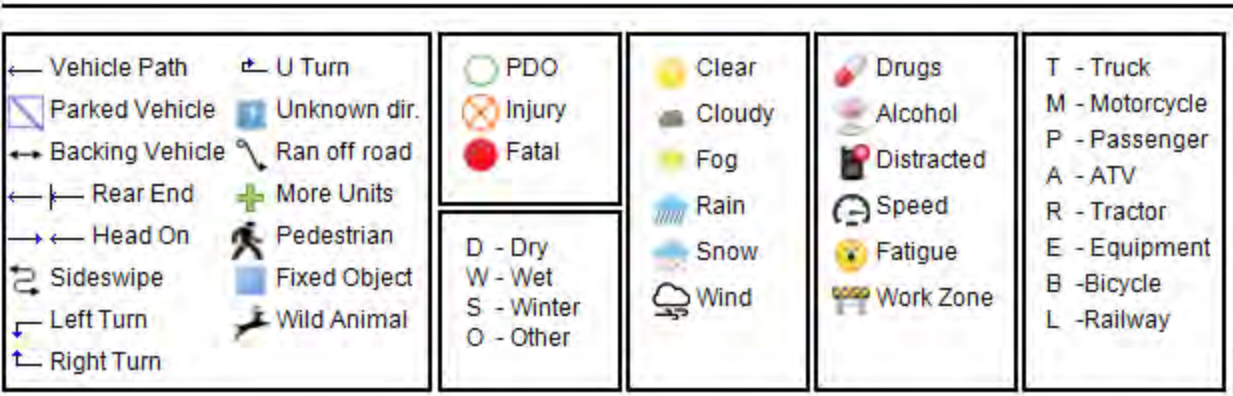
Vehicle Path	U Turn	PDO	Clear	Drugs
Parked Vehicle	Unknown dir.	Injury	Cloudy	Alcohol
Backing Vehicle	Ran off road	Fatal	Fog	Distracted
Rear End	More Units		Rain	Speed
Head On	Pedestrian	D - Dry	Snow	Fatigue
Sideswipe	Fixed Object	W - Wet	Wind	Work Zone
Left Turn	Wild Animal	S - Winter		
Right Turn		O - Other		

T - Truck
M - Motorcycle
P - Passenger
A - ATV
R - Tractor
E - Equipment
B -Bicycle
L -Railway

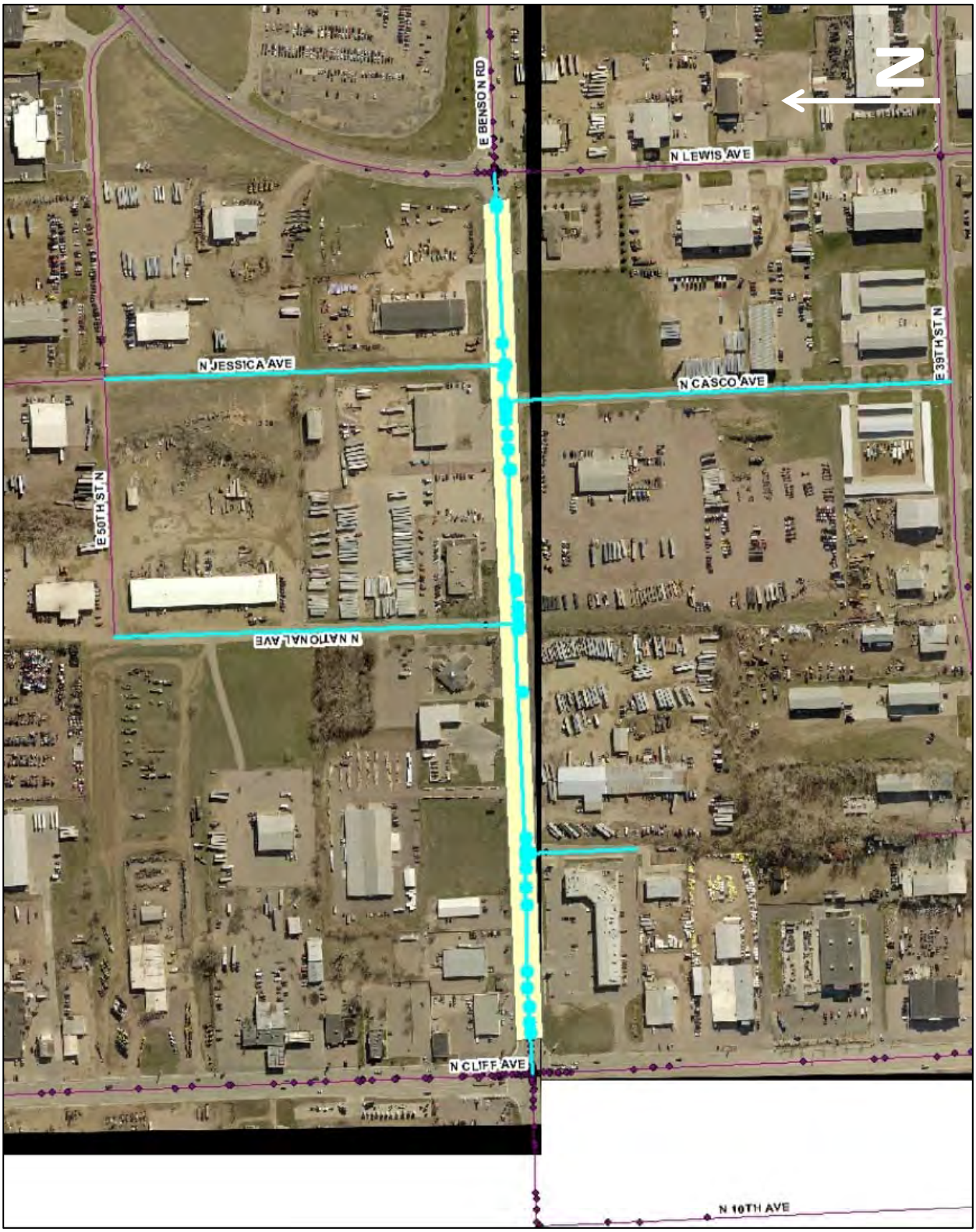

08/07/17 14:58
D
1709849
Vehicle Path
Parked Vehicle
Backing Vehicle
Rear End
Head On
Sideswipe
Left Turn
Right Turn
U Turn
Unknown dir.
Ran off road
More Units
Pedestrian
Fixed Object
Wild Animal
PDO
Injury
Fatal
Clear
Cloudy
Fog
Rain
Snow
Wind
D- Dry
W- Wet
S - Winter
O- Other
Drugs
Alcohol
Distracted
Speed
Fatigue
Work Zone
T -Truck
M-Motorcycle
P -Passenger
A -ATV
R -Tractor
E -Equipment
B -Bicycle
L -Railway
BAHNSON AVE N and RICE ST E

P 10/01/16 19:18

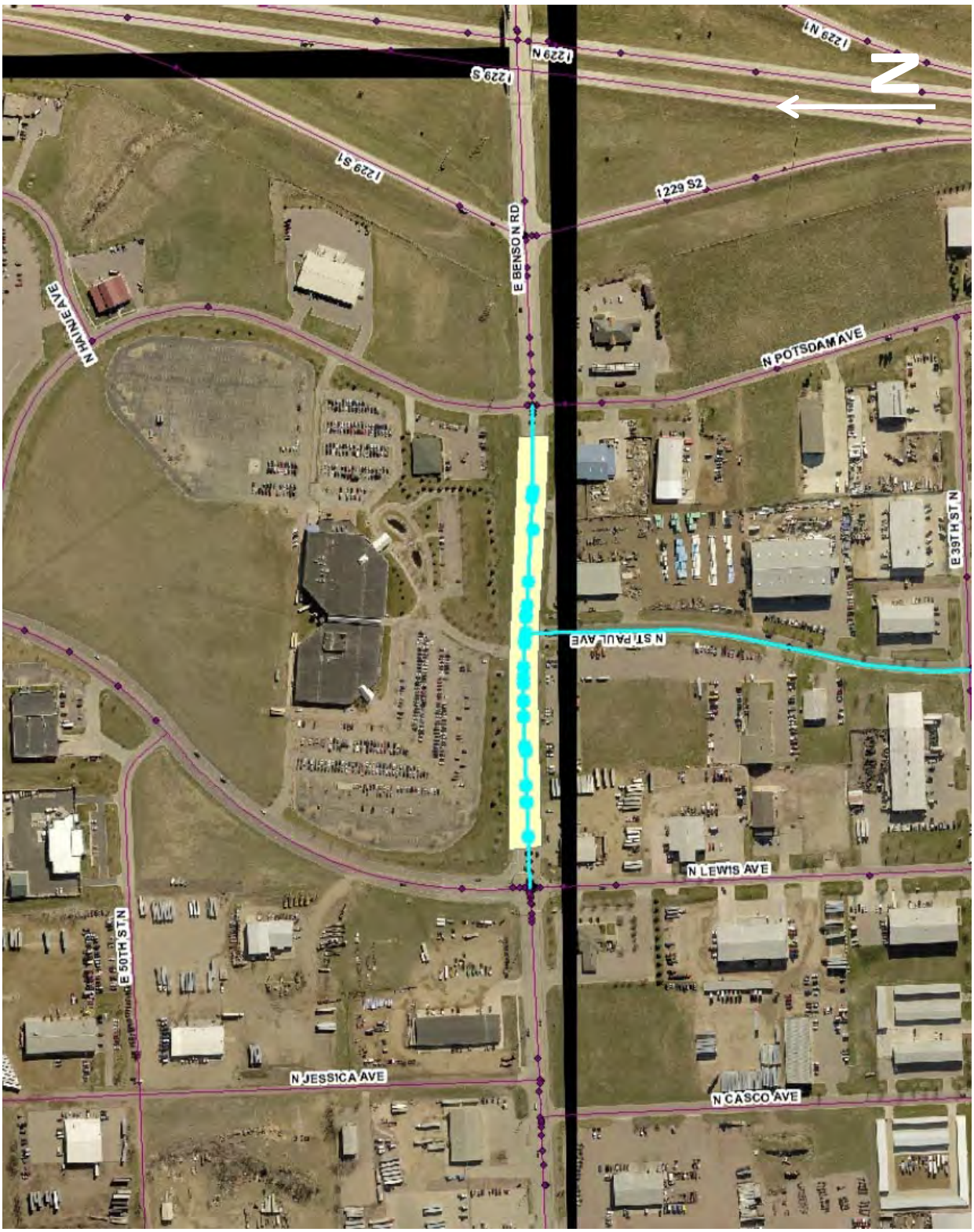
D 1612012



ARTERIAL SEGMENT CRASH MAPS

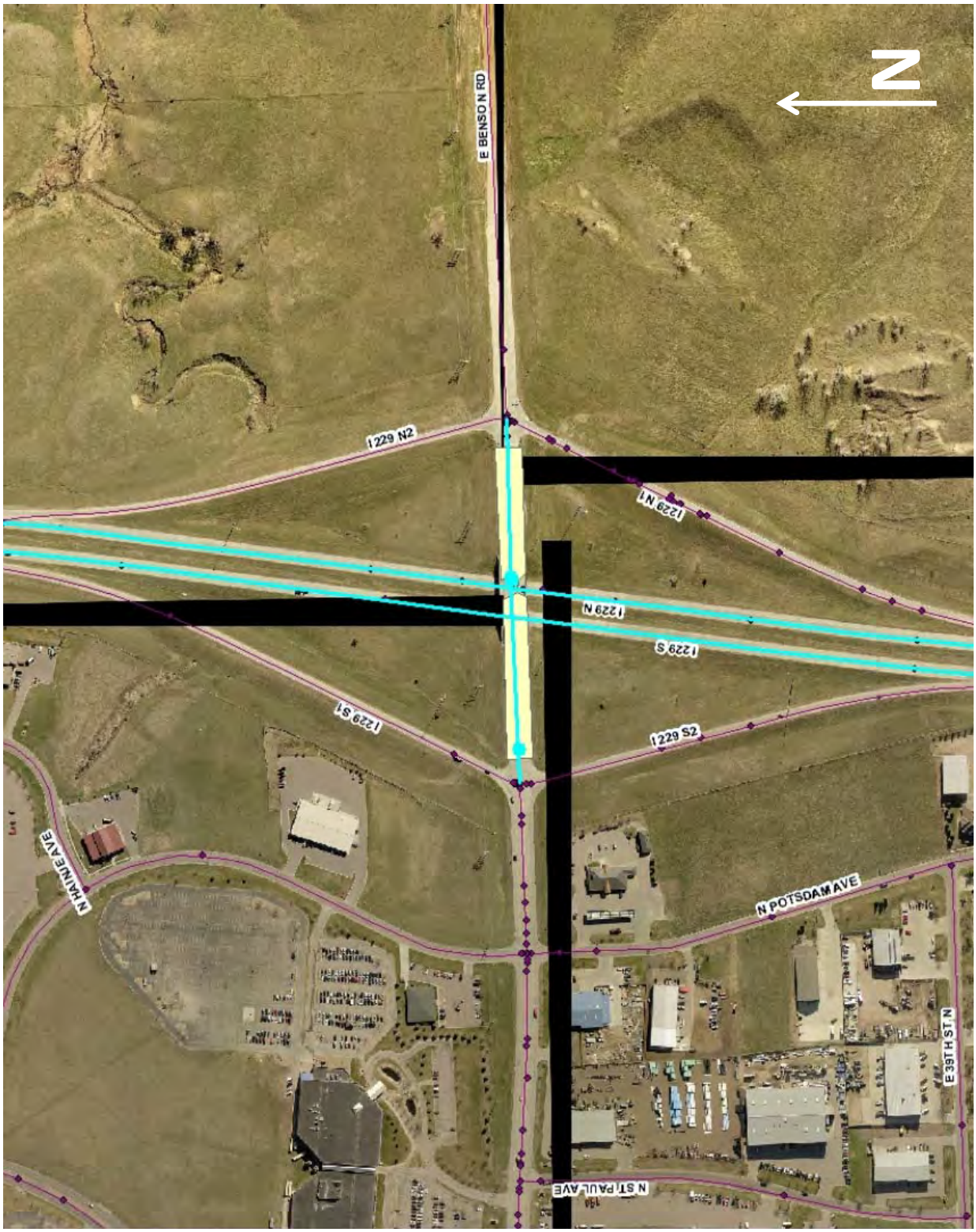


Arterial Segment Crash Map – Benson, Cliff to Lewis



Arterial Segment Crash Map – Benson, Lewis to Potsdam

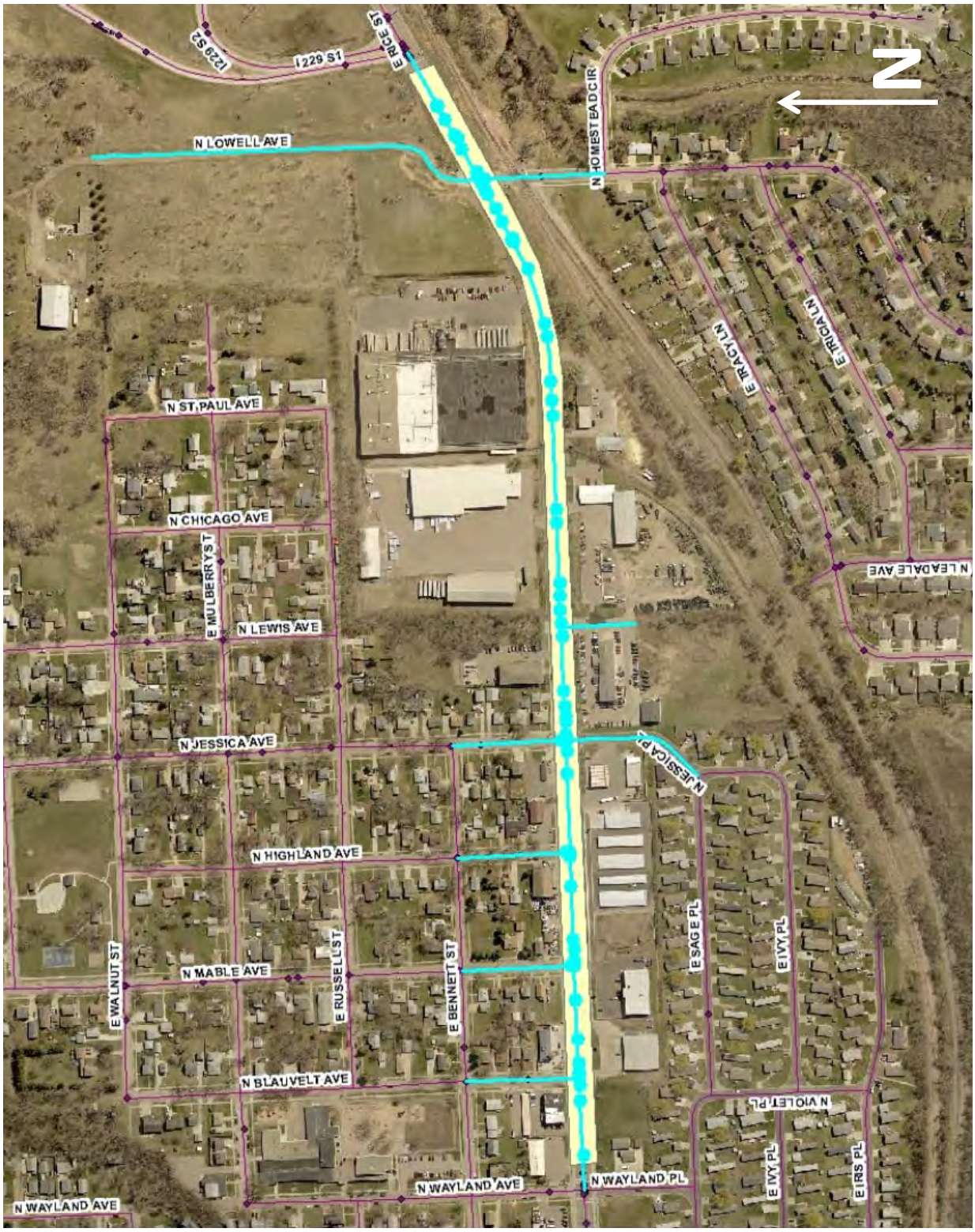
Arterial Segment Crash Map – Benson, Potsdam to I-229 SB



Arterial Segment Crash Map – Benson, I-229 SB to I-229 NB

Arterial Crash Map – Benson, I-229 NB to Hall

Arterial Segment Crash Map – Rice, Cliff to Wayland



Arterial Segment Crash Map – Rice, Wayland to I-229 SB

Arterial Segment Crash Map – Benson, I-229 SB to I-229 NB

Arterial Segment Crash Map – Benson, I-229 NB to Bahnson

SECTION 5

FUTURE TRAFFIC MEMORANDUM

Future Year No-Build Traffic Conditions Technical Memorandum

I-229 Benson Road Interchange Modification Study

Sioux Falls, South Dakota

May 16, 2018

City of Sioux Falls
SOUTH DAKOTA

South Dakota DOT
Connecting South Dakota and the Nation

This memorandum provides the results of no-build operations analysis for the year 2023 and 2045 traffic conditions in the project study area (Figure 1). The analysis was prepared using the procedures and inputs specified in the approved Methods and Assumptions document for this study. Analysis output documents are provided in the appendix to this memorandum.

1.0 Traffic Volume Development

Traffic counts on the Interstate roadway segments were gathered by SDDOT in 2017. Traffic counts on the arterial street system were available in City of Sioux Falls and HDR files. Count data were assembled and balanced to produce a representation of peak hour traffic flows through the study area. Peak hour traffic volumes for Benson Road, Rice Street, and I-229 for year 2023 and 2045 are shown in Figures 13, 14, 17, 18,19, and 22.

Traffic forecasts for 2023 and 2045 were prepared using the regional travel demand model maintained by the City of Sioux Falls and the Sioux Falls Metropolitan Planning Organization. The forecasts were based on the latest land development information and modeling updated from the 2035 model used in the I-229 Major Investment Study.

It is assumed in the 2023 volume projections that a Benson Road extension, east to Rice Street, will not occur prior to 2023.

2.0 Traffic Operations

Level of service on Interstate 229 was calculated for mainline, ramp merge-diverge, and weave areas for peak hours under 2023 and 2045 conditions. The level of service results are shown in Figures 17 and 22. Note that several Interstate mainline segments were analyzed both as regular mainline segments and weaving segments. If it was determined that the segment satisfied the conditions for weaving, the weaving level of service was reported and indicated by an asterisk (*) next to the level of service result.

Intersection turning volumes and level of service for peak hours under 2023 and 2045 conditions are shown in Figures 13,14, 18, and 19 for Benson Road and Rice Street. Multimodal levels of service for the Benson Road and Rice Street arterial corridors are shown in Figures 15, 16, 20, and 21.

2.1 2023 Traffic Conditions

The 2023 conditions analysis shows that Interstate facilities within the study area operate at an acceptable level of service, LOS C or better (Figure 17).

The arterial street system experiences peak hour congestion (LOS E or worse) at the following locations during the 2023 conditions analysis:

- Benson Road/Potsdam Avenue (AM/PM)
- Benson Road/I-229 Southbound (AM)
- Benson Road/I-229 Northbound (AM)
- Benson Road/Hall Avenue (PM)
- Rice Street/Bahnson Avenue (PM)

Certain movements experienced low levels of service or queues that exceeded the length of the available storage during particular peak hours. The southbound left turn during the PM peak hour at Rice Street/Cliff Avenue is an example of this characteristic, with the left turn queue extending through the Bennett Street/Cliff Avenue intersection. The southbound left turn queues at Rice Street/I-229 SB Ramp exceeded the length of the available storage during the PM peak hour extending onto the interstate. The northbound left turn queues at Benson Road/I-229 NB Ramp exceeded the length of the available storage during the AM peak hour extending onto the interstate.

Multimodal level of service varies widely throughout the Benson Road and Rice Street corridors. The lowest levels of service are related to locations with the absence of specific facilities for pedestrians and bicyclists in these corridors.

2.2 2045 Traffic Conditions

The 2045 conditions analysis shows that Interstate facilities within the study area operate at an acceptable level of service, LOS C or better (Figure 22). The arterial street system experiences peak hour congestion (LOS E or worse) at the following locations during the 2045 conditions analysis:

- Benson Road/Potsdam Avenue (AM/PM)
- Benson Road/I-229 Southbound (AM/PM)
- Benson Road/I-229 Northbound (AM)
- Benson Road/Hall Avenue (AM/PM)
- Rice Street/Cliff Avenue (PM)
- Rice Street/I-229 SB (PM)
- Rice Street/I-229 NB (AM/PM)
- Rice Street/Bahnson Avenue (AM/PM)

Certain movements experienced low levels of service or queues that exceeded the length of the available storage during particular peak hours. The southbound left turn and thru movement during the PM peak hour at Rice Street/Cliff Avenue is an example of this characteristic, with the left turn and thru queue extending through the Bennett Street/Cliff Avenue intersection. The southbound left turn queues at Rice Street/I-229 SB Ramp exceed the length of the available storage during the PM peak hour extending onto the interstate. The eastbound left turn queues at Rice Street/I-229 SB Ramp exceed the length of the available storage during the PM peak hour extending through the Rice Street/Lowell Avenue intersection. The southbound left turn queues at Rice Street/I-229 NB Ramp exceed the length of the available storage during the PM peak hour extending onto the interstate. The eastbound thru queues at Rice Street/I-229 NB Ramp exceed the length of the available storage during the PM peak hour extending through the Rice Street/I-229 SB Ramp intersection. The northbound left turn queues at Benson Road/I-229 NB Ramp exceed the length of the available storage during the AM peak hour extending onto the interstate.

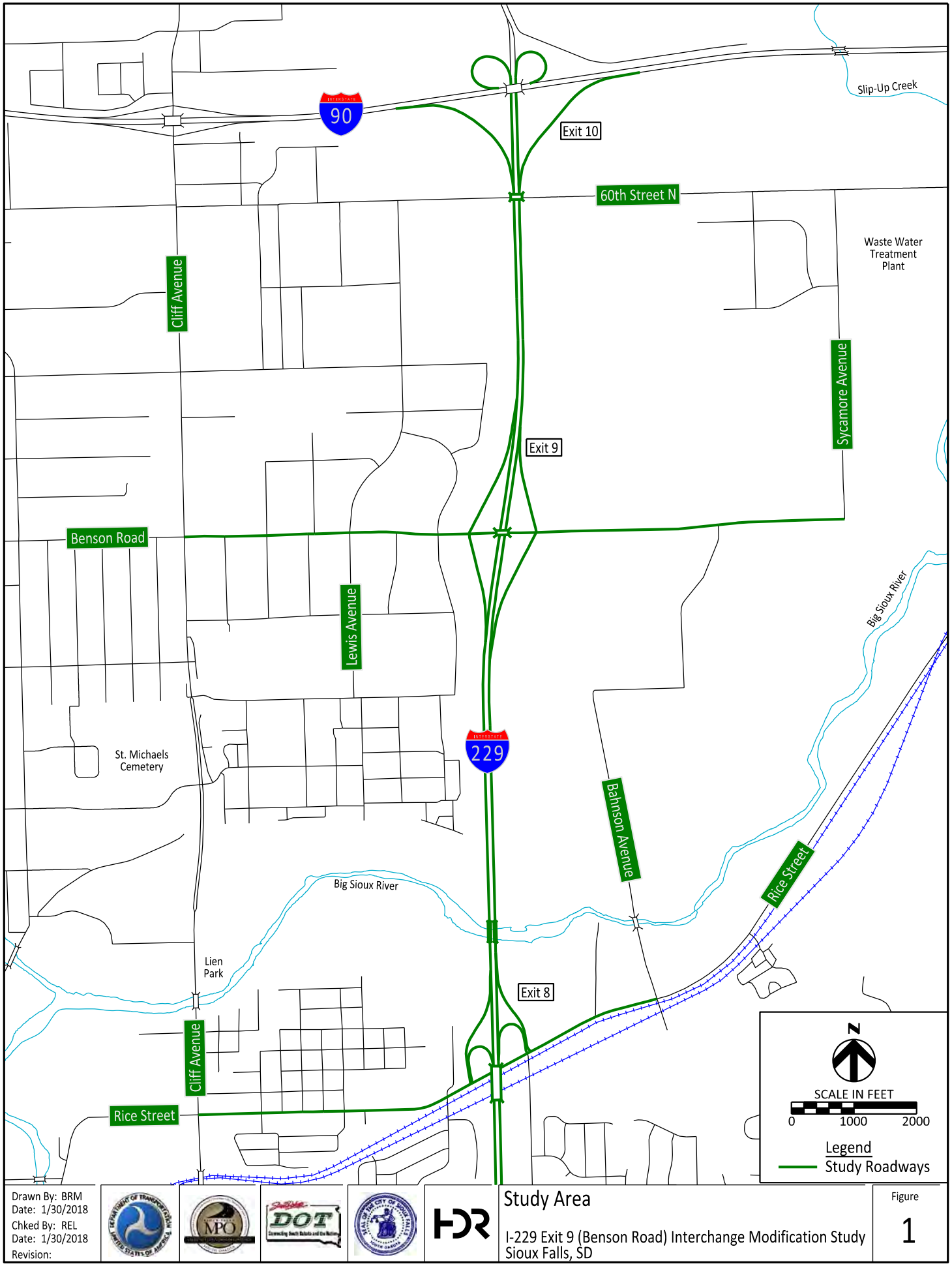
Multimodal level of service varies widely throughout the Benson Road and Rice Street corridors. The lowest levels of service are related to locations with the absence of specific facilities for pedestrians and bicyclists in these corridors.

2.3 Additional Access Points

There are additional access points within the arterial corridors that serve as sources and sinks of traffic for traffic volume balancing, but were not required to be analyzed. These locations appear in the traffic analysis files as intermediate access points and appear in the alternative arterial layouts:

- Benson Road/National Avenue
- Benson Road/Sanford driveway (formerly HSBC)
- Rice Street/Lowell Avenue

Another access point has been identified in the alternative arterial layouts for Benson Road, located half-way between I-229 and Hall Avenue. While this access point may play a role in future development, traffic forecast for the surrounding area has been routed through the Benson/Hall intersection to account for all potential future volumes through the specified analysis intersections.

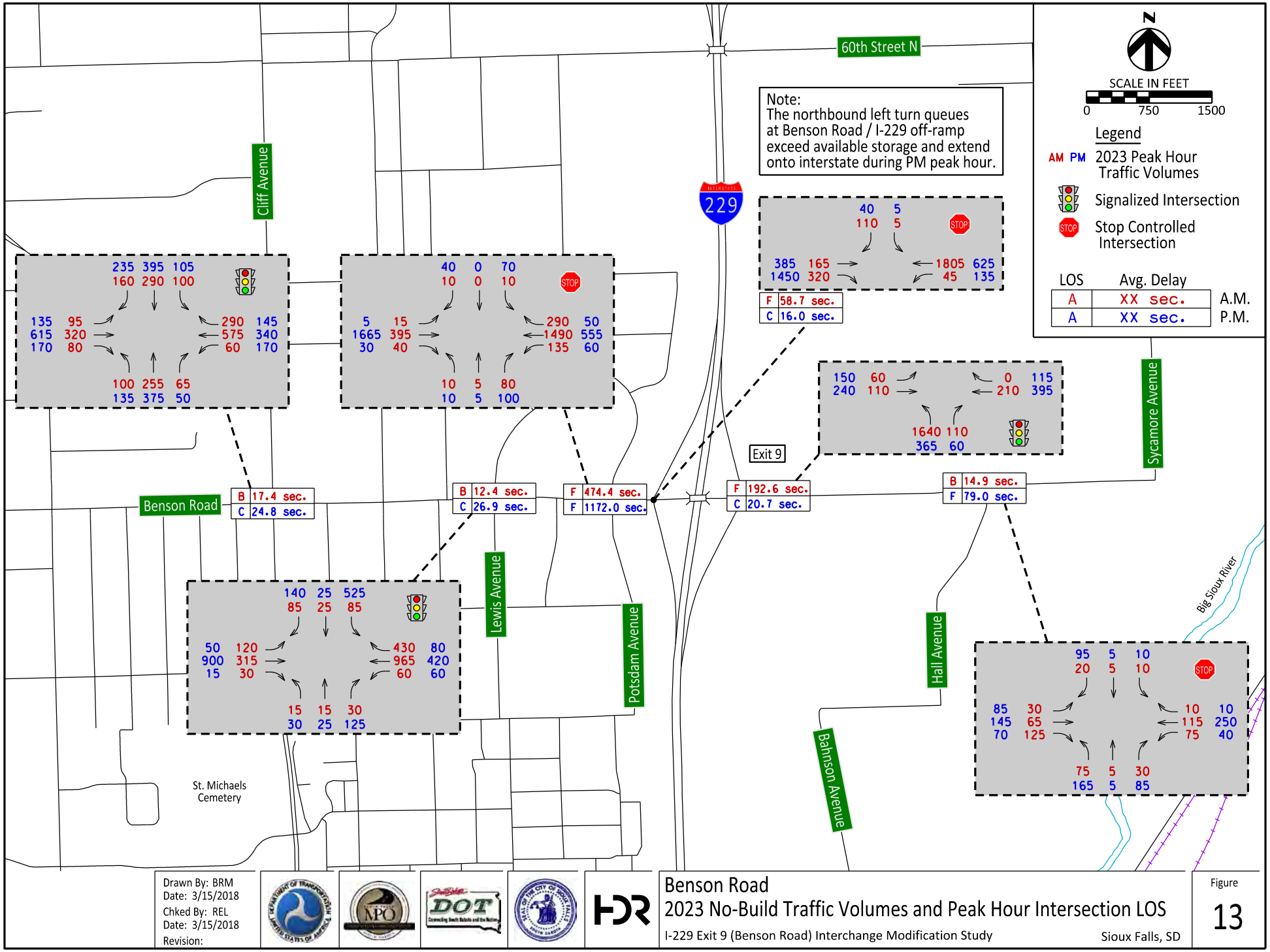


Drawn By: BRM
Date: 1/30/2018
Chked By: REL
Date: 1/30/2018
Revision:

Study Area

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 1



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Date: 3/15/2018
Chked By: REL
Date: 3/15/2018
Revision:

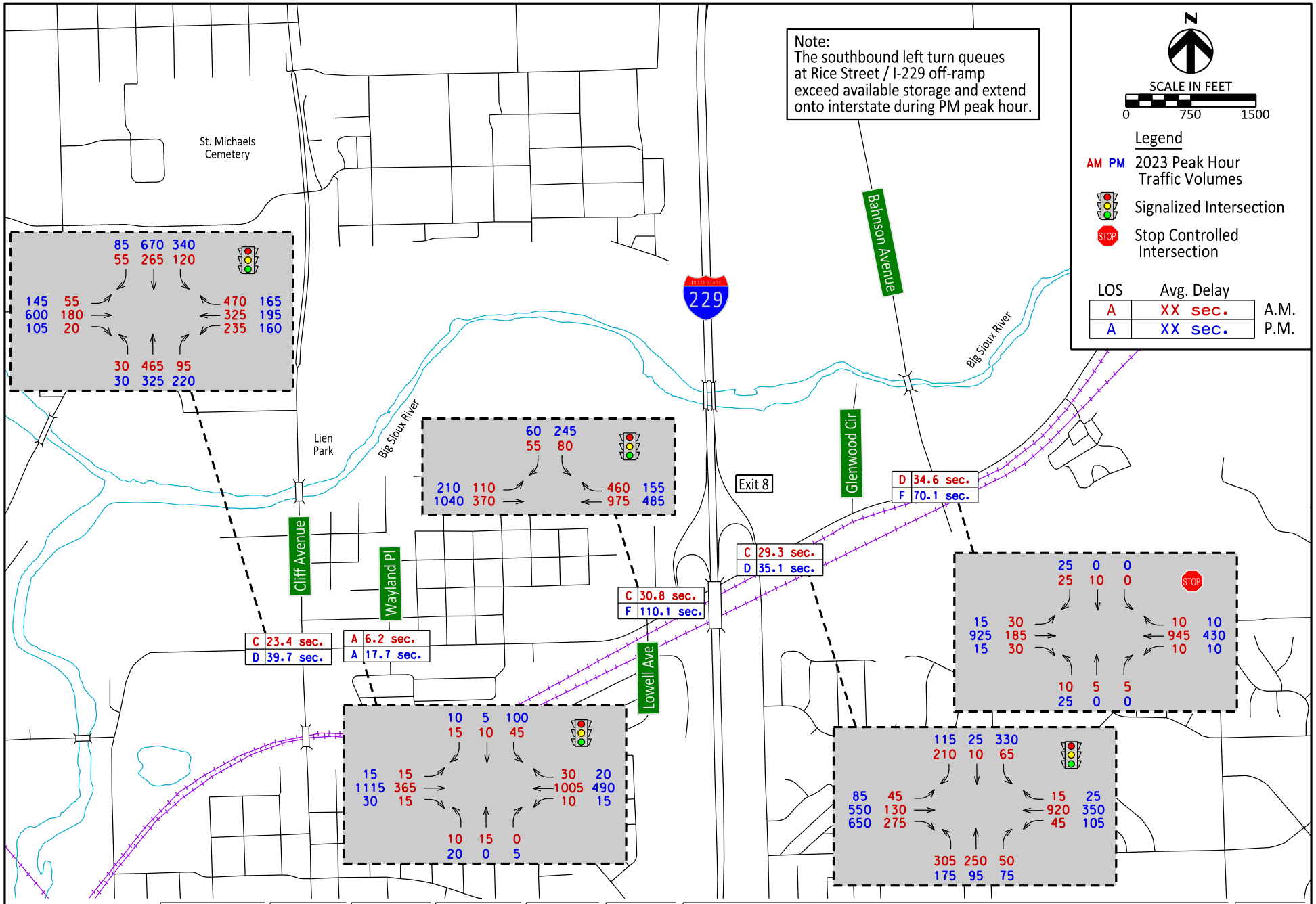
Benson Road
2023 No-Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 13

FILE: ...\Figure 13 (Benson 2023).dgn
PLOTTING DATE: 05-08-2018



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Date: 3/15/2018
Chked By: REL
Date: 3/15/2018
Revision:

Rice Street
2023 No-Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 14

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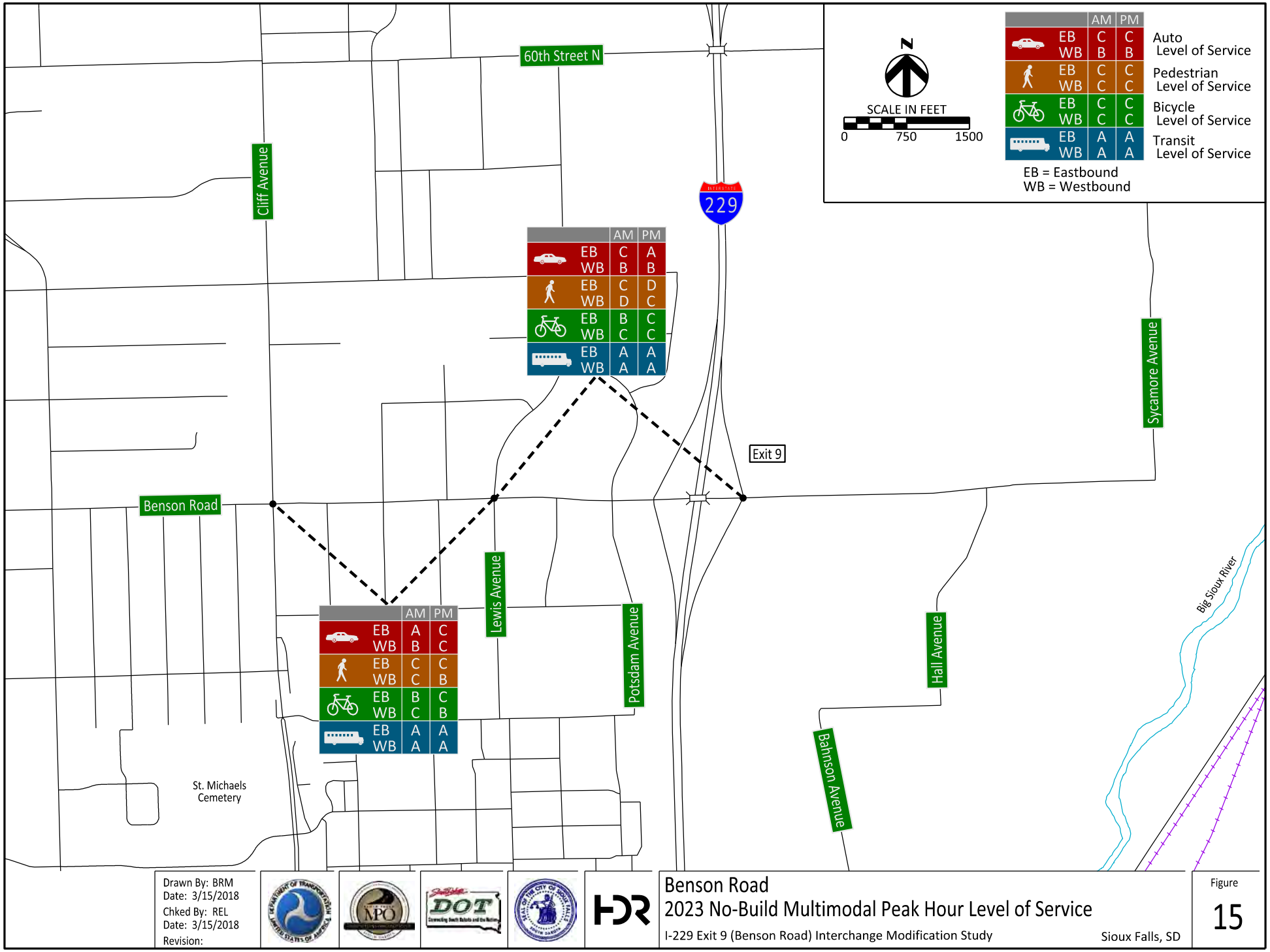
PLOTTING DATE: 03-22-2018



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Date: 3/15/2018
Chked By: REL
Date: 3/15/2018
Revision:

Benson Road
2023 No-Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 15

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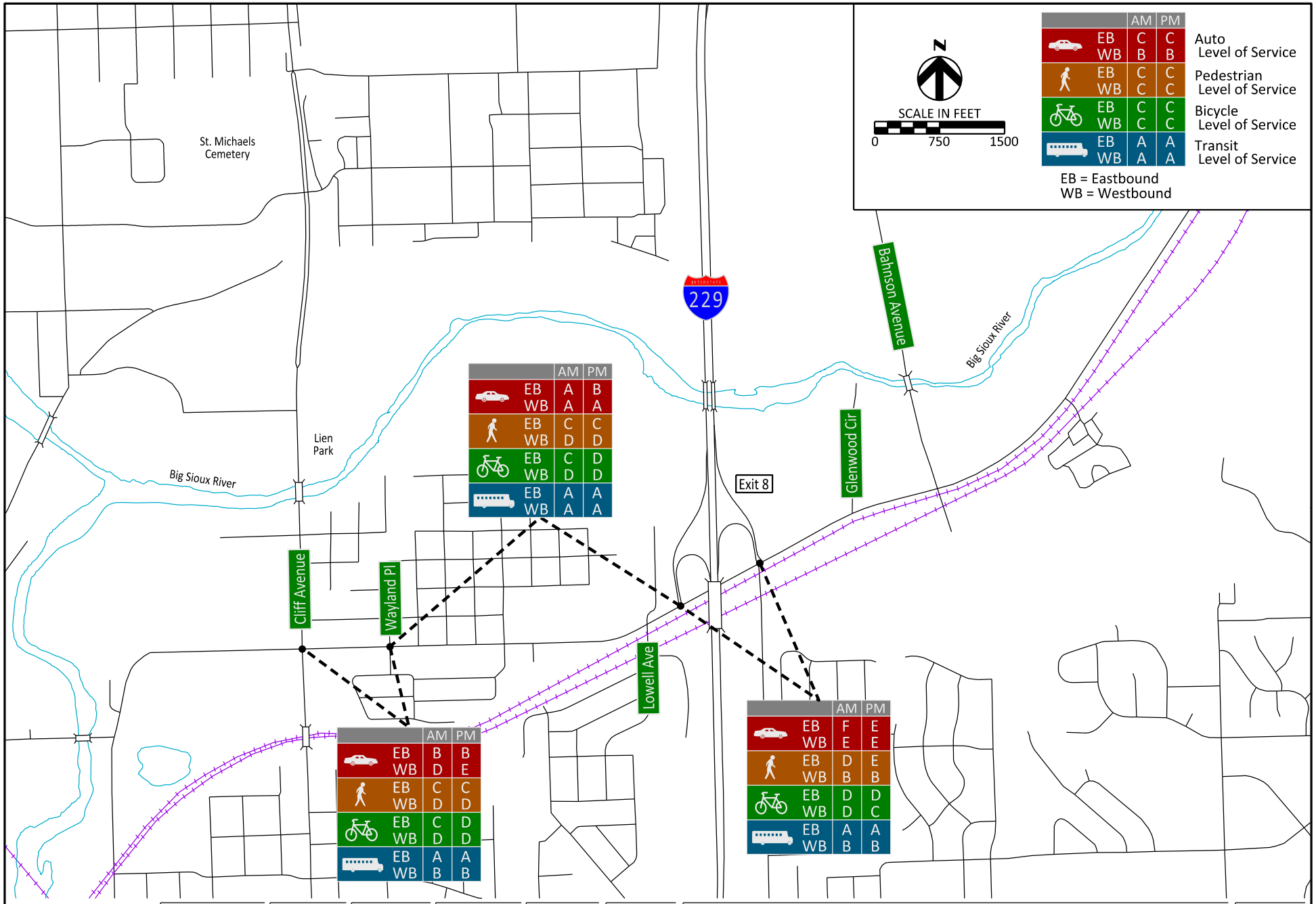
PLOTTING DATE: 05-08-2018



Drawn By: BRM
Date: 3/15/2018
Chked By: REL
Date: 3/15/2018
Revision:

Rice Street
2023 No-Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 16

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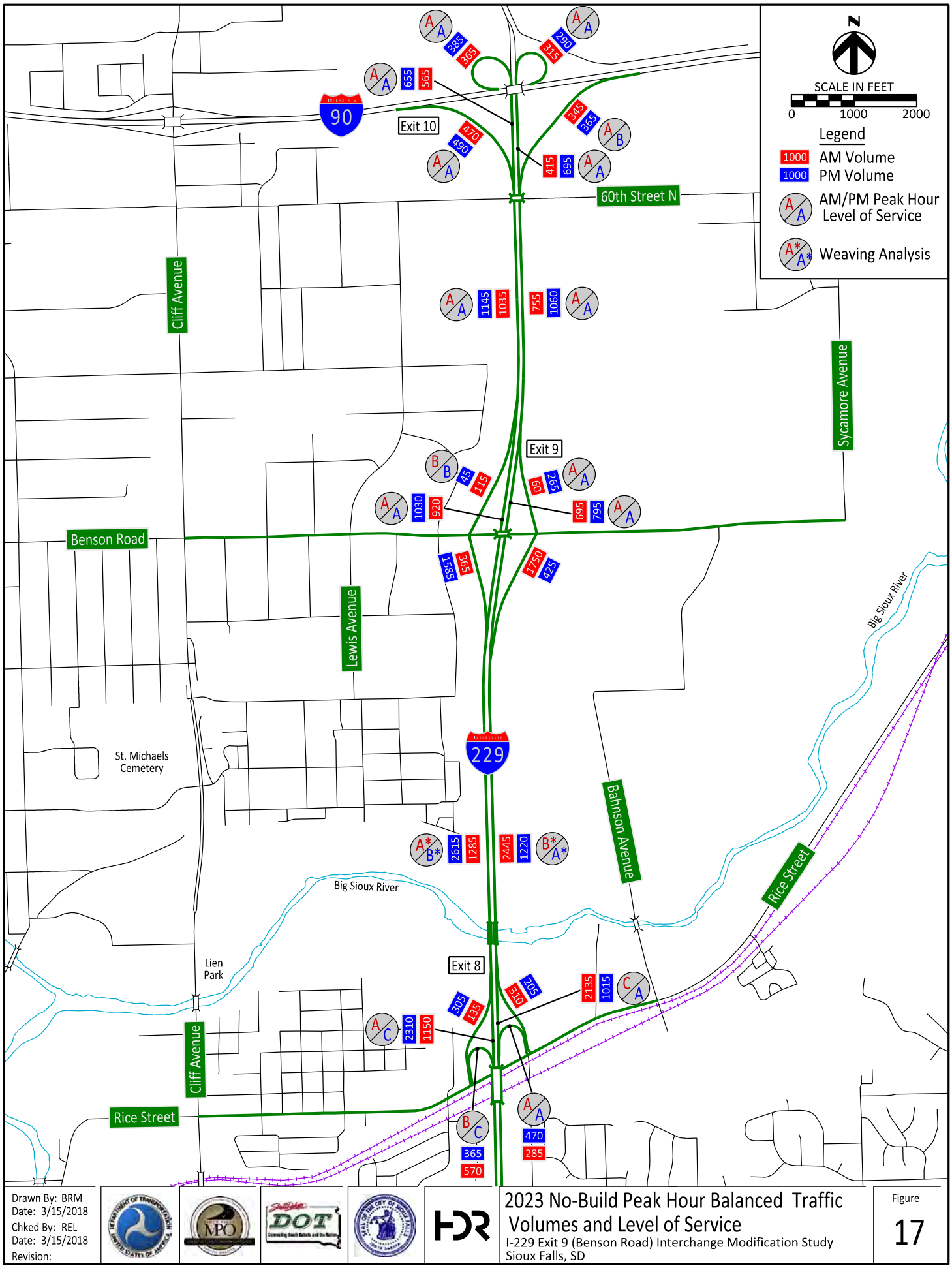
PLOTTING DATE: 03-19-2018



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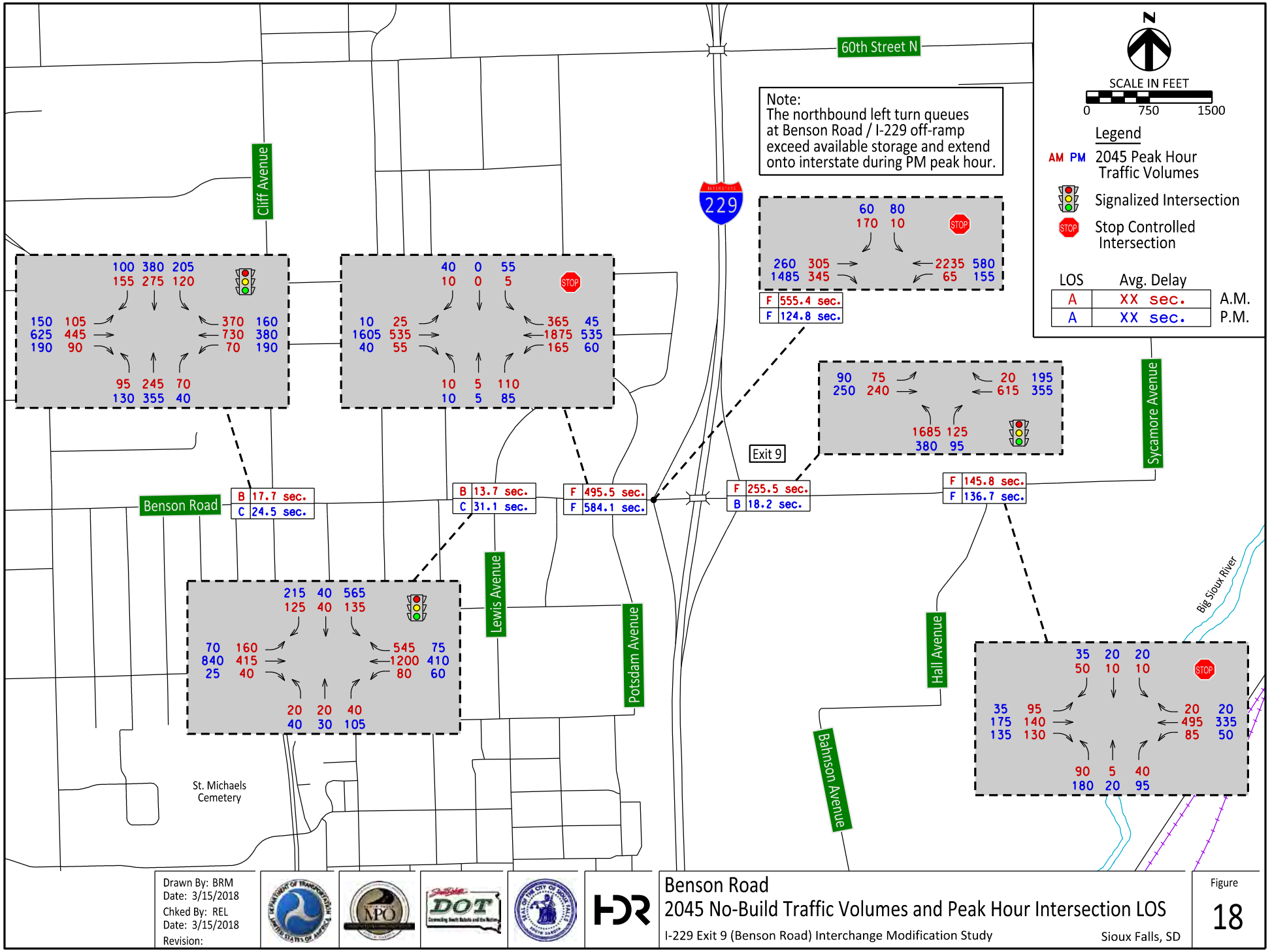
PLOTTING DATE: 05-11-2018

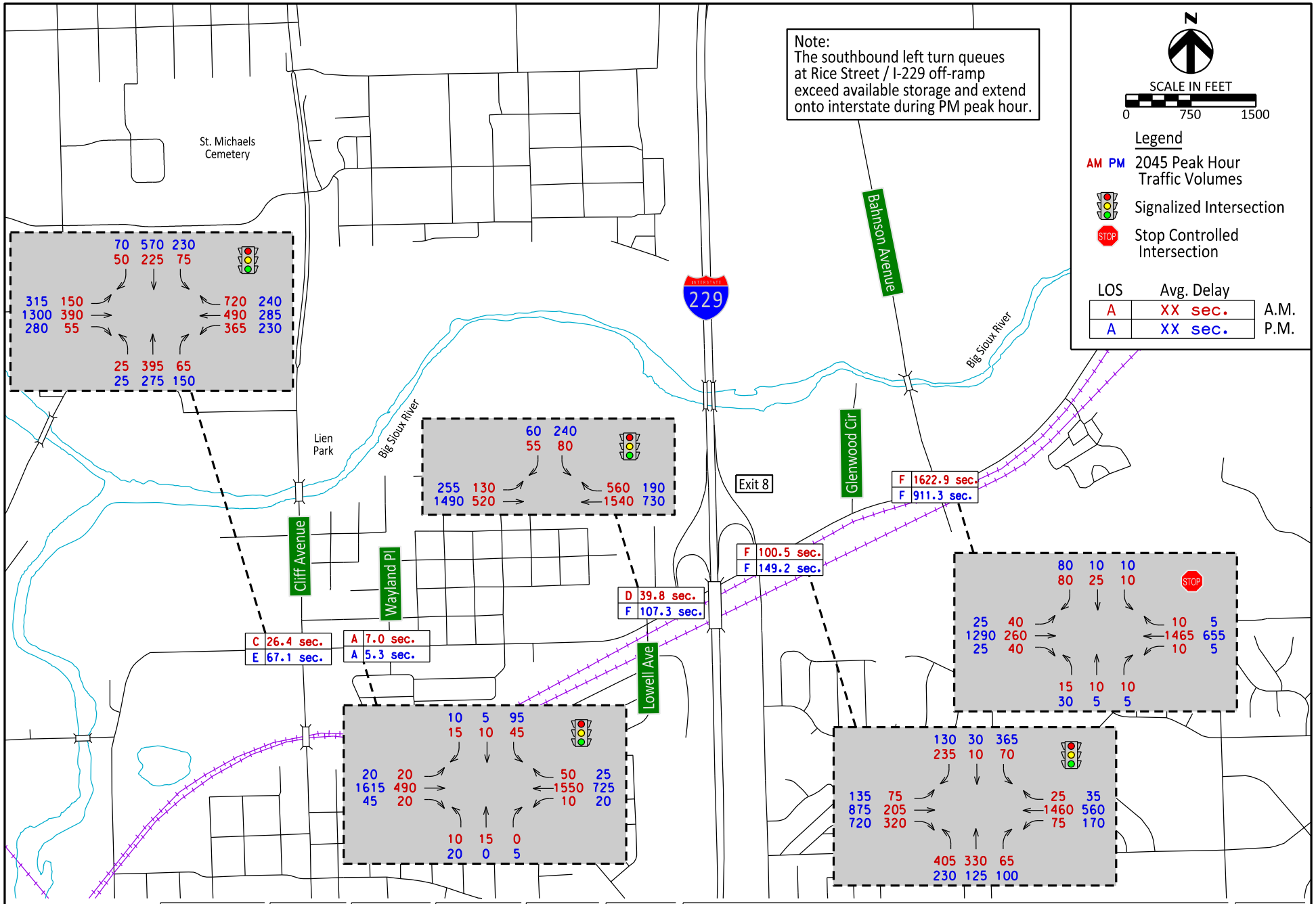
Drawn By: BRM
Date: 3/15/2018
Chked By: REL
Date: 3/15/2018
Revision:

2023 No-Build Peak Hour Balanced Traffic Volumes and Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 17


60th Street N
Cliff Avenue
Benson Road
Lewis Avenue
Potsdam Avenue
Exit 9
Sycamore Avenue
Hall Avenue
Bahnson Avenue
Big Sioux River
St. Michaels Cemetery
229
Note:
The northbound left turn queues at Benson Road / I-229 off-ramp exceed available storage and extend onto interstate during PM peak hour.
SCALE IN FEET
0 750 1500
Legend
AM PM 2045 Peak Hour Traffic Volumes
Signalized Intersection
Stop Controlled Intersection
LOS Avg. Delay
A XX sec. A.M.
A XX sec. P.M.
100 380 205
155 275 120
150 105
625 445
190 90
370 160
730 380
70 190
95 245 70
130 355 40
40 0 55
10 0 5
10 25
1605 535
40 55
365 45
1875 535
165 60
10 5 110
10 5 85
60 80
170 10
260 305
1485 345
2235 580
65 155
F 555.4 sec.
F 124.8 sec.
90 75
250 240
20 195
615 355
1685 125
380 95
B 17.7 sec.
C 24.5 sec.
B 13.7 sec.
C 31.1 sec.
F 495.5 sec.
F 584.1 sec.
F 255.5 sec.
B 18.2 sec.
F 145.8 sec.
F 136.7 sec.
215 40 565
125 40 135
70 160
840 415
25 40
545 75
1200 410
80 60
20 20 40
40 30 105
35 20 20
50 10 10
35 95
175 140
135 130
20 20
495 335
85 50
90 5 40
180 20 95
Drawn By: BRM
Date: 3/15/2018
Chked By: REL
Date: 3/15/2018
Revision:
Benson Road
2045 No-Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD
Figure
18
FILE: ...\Figure 18 (Benson 2045).dgn
PLOTTING DATE: 05-08-2018



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Date: 3/15/2018
Chked By: REL
Date: 3/15/2018
Revision:

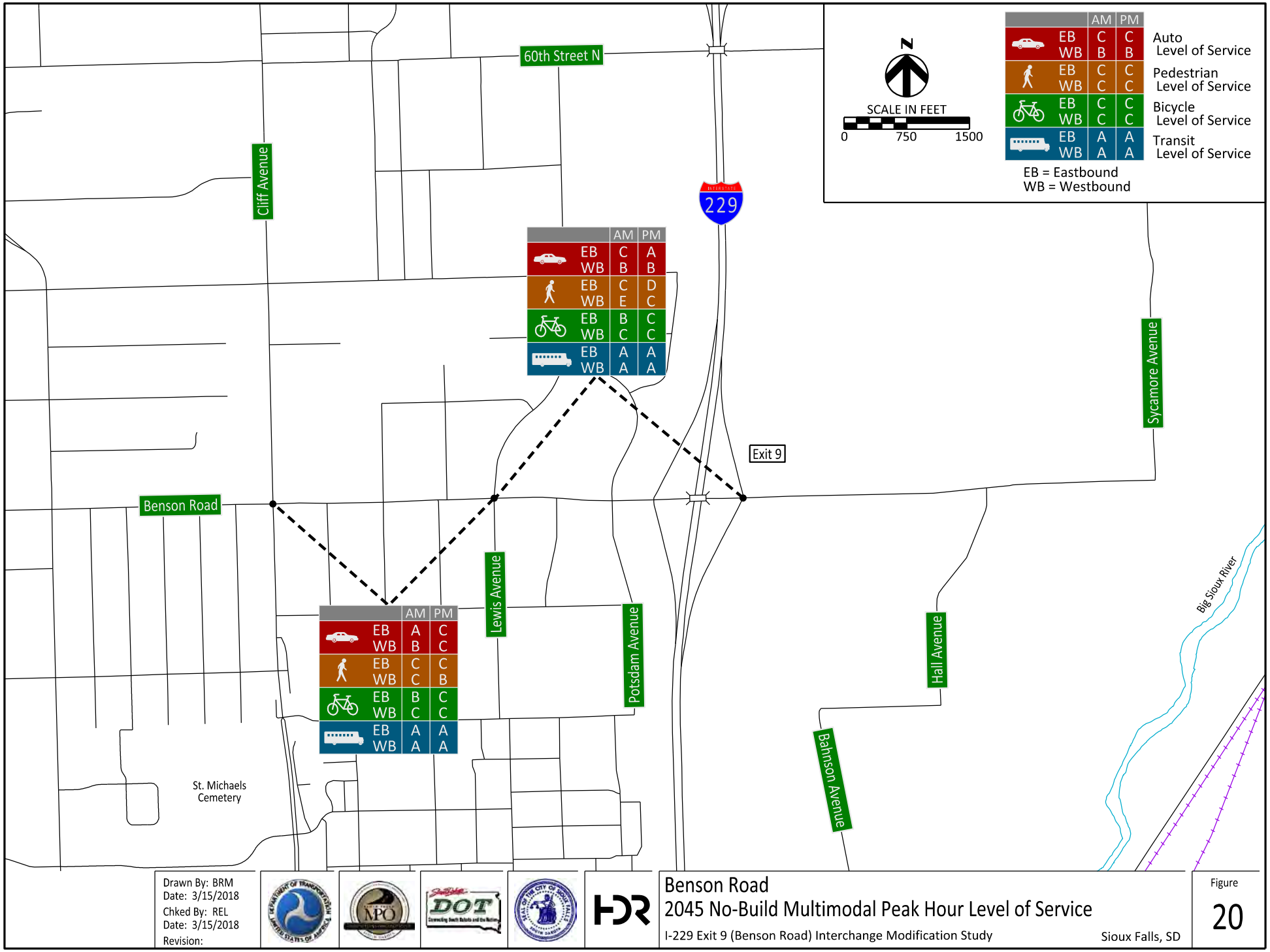
Rice Street
2045 No-Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 19

FILE: ...\Figure 19 (Rice 2045).dgn
PLOTTING DATE: 03-22-2018



Drawn By: BRM
Date: 3/15/2018
Chked By: REL
Date: 3/15/2018
Revision:

Benson Road
2045 No-Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 20

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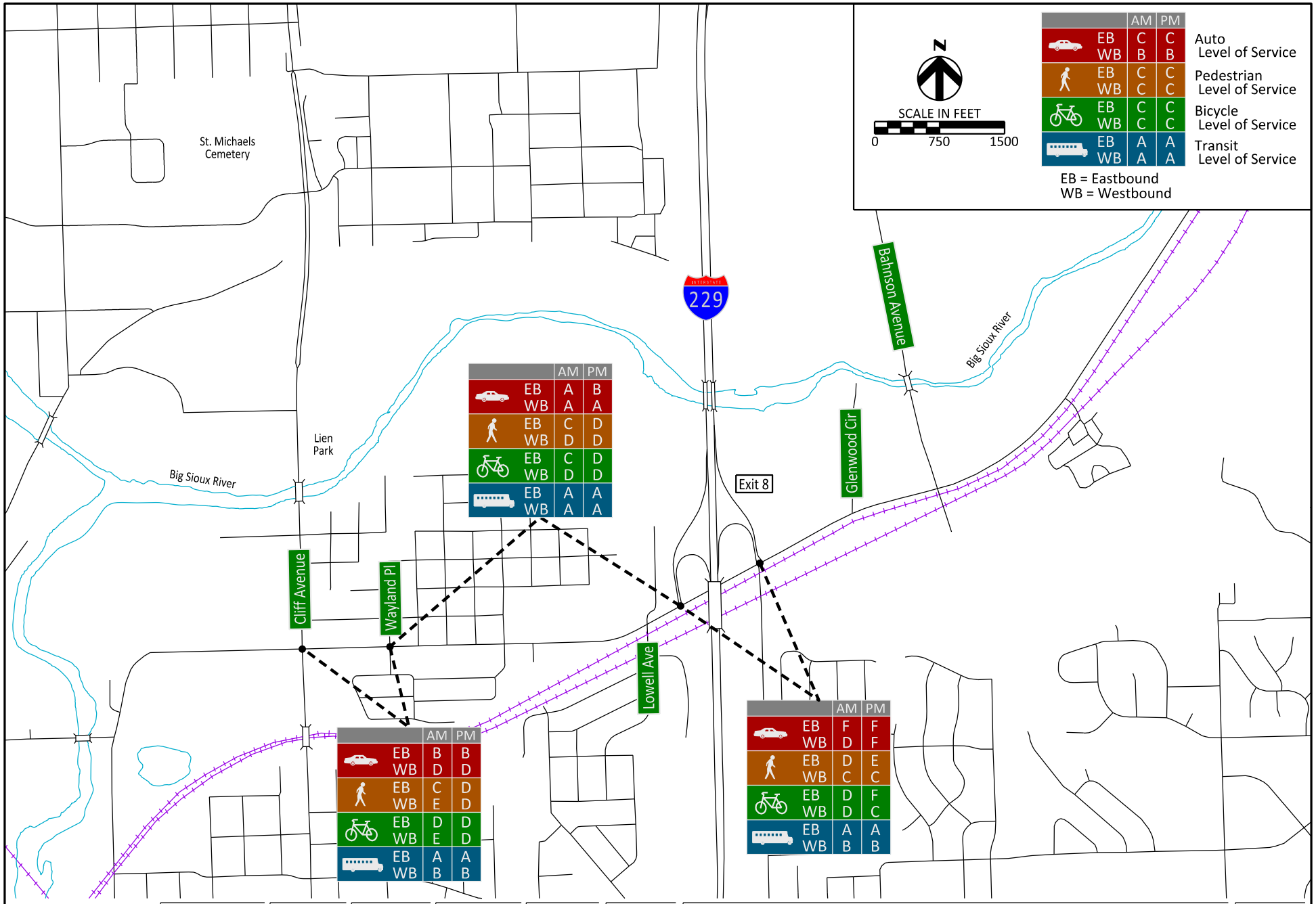
PLOTTING DATE: 05-08-2018



Drawn By: BRM
Date: 3/15/2018
Chked By: REL
Date: 3/15/2018
Revision:

Rice Street
2045 No-Build Multimodal Peak Hour Level of Service
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 21

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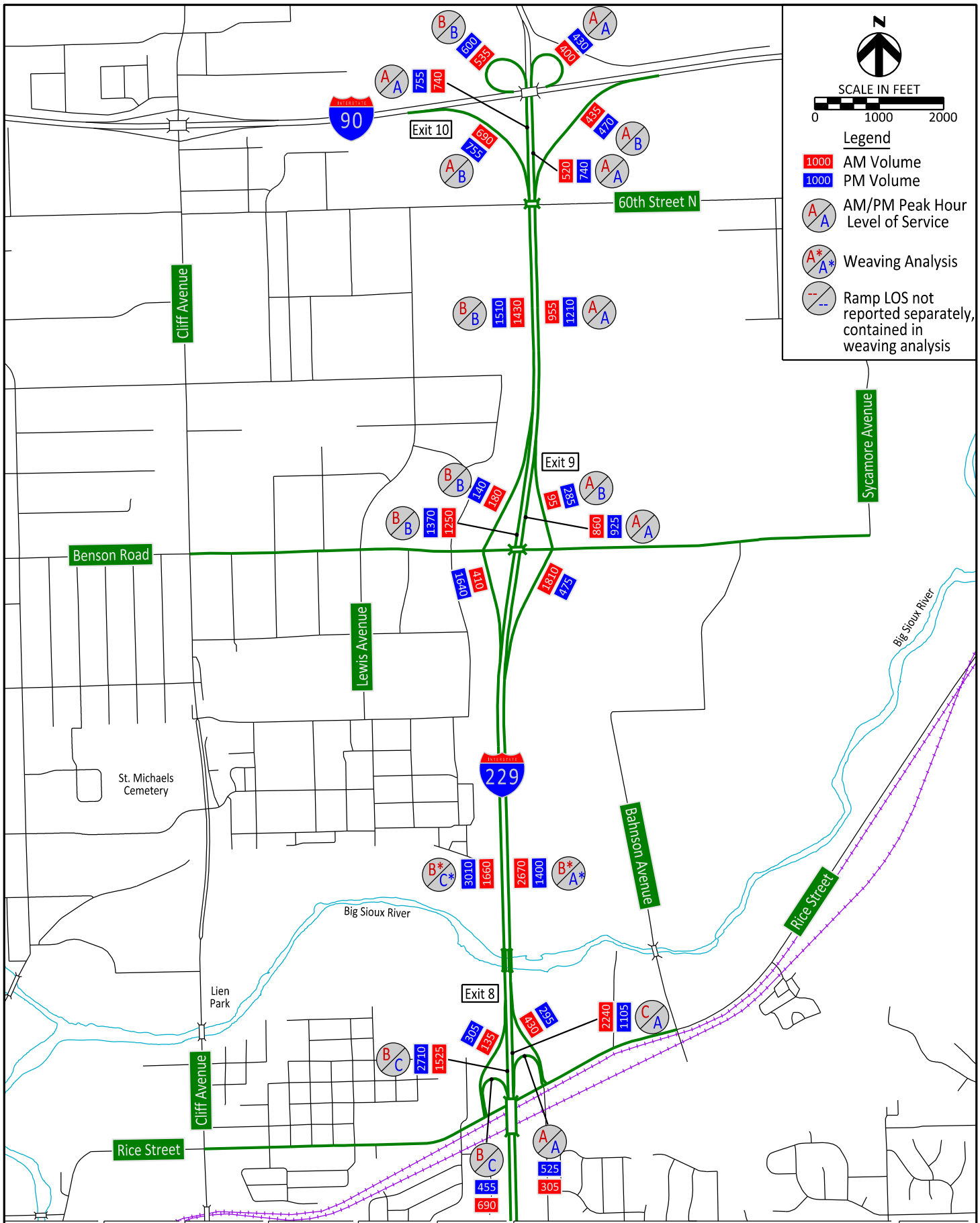

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PLOTTING DATE: 05-11-2018

Drawn By: BRM
Date: 3/15/2018
Chked By: REL
Date: 3/15/2018
Revision:

2045 No-Build Peak Hour Balanced Traffic Volumes and Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 22

APPENDIX

I. 2023 Freeway Analysis – Mainline
II. 2023 Freeway Analysis – Ramps
III. 2023 Freeway Analysis – Weaving
IV. 2023 Arterial Analysis
V. 2045 Freeway Analysis – Mainline
VI. 2045 Freeway Analysis – Ramps
VII. 2045 Freeway Analysis – Weaving
VIII. 2045 Arterial Analysis

I. 2023 Freeway Analysis – Mainline

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes (N), ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Volume (V), veh/h	565	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor (PHF)	0.90	Flow Rate (v_p), pc/h/ln	346
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Capacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.15
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	5.1
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1035	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	632
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.28
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	9.4
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	920	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	562
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.24
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	8.4
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1285	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	509
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.22
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	7.6
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1150	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	684
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.30
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	10.2
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	2135	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	1268
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.55
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	18.8
Total Ramp Density Adjustment	-	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	2445	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	969
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.42
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	14.4
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	695	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	425
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.19
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	6.3
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	755	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	462
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.20
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	6.9
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes (N), ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Volume (V), veh/h	415	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor (PHF)	0.90	Flow Rate (v_p), pc/h/ln	254
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Capacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.11
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	3.8
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes (N), ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Volume (V), veh/h	655	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor (PHF)	0.90	Flow Rate (v_p), pc/h/ln	400
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Capacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.17
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	5.9
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1145	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	700
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.30
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	10.4
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1030	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	630
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.27
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	9.4
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	2615	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	1036
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.45
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	15.4
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	2310	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	1372
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.60
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.0
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	20.5
Total Ramp Density Adjustment	-	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1015	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	603
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.26
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	9.0
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1220	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	483
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.21
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	7.2
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	795	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	486
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.21
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	7.2
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1060	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	648
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.28
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	9.6
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes (N), ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Volume (V), veh/h	695	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor (PHF)	0.90	Flow Rate (v_p), pc/h/ln	425
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Capacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.19
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	6.3
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

II. 2023 Freeway Analysis – Ramps

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3655	1500
Terrain Type	Rolling	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	920	365
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	20.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.714	0.833
Flow Rate (v_i), pc/h	1432	487
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.42	0.24

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.216
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.8
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1432	Ramp Junction Speed (S), mi/h	61.8
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1919	Average Density (D), pc/mi/ln	15.5
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5705	1500
Terrain Type	Rolling	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1285	135
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.877	0.877
Flow Rate (v_i), pc/h	1628	171
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.24	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	1.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.328
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	421
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	59.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.711	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	1207	Ramp Junction Speed (S), mi/h	62.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	8.7
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1080	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	1150	570
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1367	722
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.46	0.37

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.250
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1367	Ramp Junction Speed (S), mi/h	61.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	2089	Average Density (D), pc/mi/ln	17.1
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5500	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	2420	285
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.833
Flow Rate (v_i), pc/h	2876	380
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.42	0.19

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.4
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.347
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	821
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.5
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.671	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	2055	Ramp Junction Speed (S), mi/h	62.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	15.4
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1000	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	2135	310
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	2537	393
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.64	0.19

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	18.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.262
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	60.7
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	2537	Ramp Junction Speed (S), mi/h	60.7
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	2930	Average Density (D), pc/mi/ln	24.1
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	2
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5195	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	2445	1750
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	2906	2217
Capacity (c), pc/h	6824	4066
Volume-to-Capacity Ratio (v/c)	0.43	0.55

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.5
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.512
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	379
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	54.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.450	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	2527	Ramp Junction Speed (S), mi/h	56.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	17.2
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	695	60
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	850	73
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.20	0.04

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	6.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.239
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	850	Ramp Junction Speed (S), mi/h	61.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	923	Average Density (D), pc/mi/ln	7.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	4075	550
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	755	345
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	923	422
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.20	0.21

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	7.2
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.350
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	923	Ramp Junction Speed (S), mi/h	58.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	7.9
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Deceleration Length (L_D), ft	1885	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	415	315
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	507	385
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.11	0.20

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	0.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.474
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	55.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	507	Ramp Junction Speed (S), mi/h	55.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	4.6
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1750	250
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Volume (V_i), veh/h	200	365
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	2.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.980	0.909
Flow Rate (v_i), pc/h	227	446
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.15	0.23

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	9.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.312
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	59.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	227	Ramp Junction Speed (S), mi/h	59.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	673	Average Density (D), pc/mi/ln	5.7
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Volume (V_i), veh/h	565	470
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	691	575
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.28

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	5.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.203
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	62.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	691	Ramp Junction Speed (S), mi/h	62.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1266	Average Density (D), pc/mi/ln	10.2
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1035	115
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1265	141
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.07

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.325
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1265	Ramp Junction Speed (S), mi/h	59.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	10.7
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5705	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	2615	305
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	3108	386
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.46	0.19

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	9.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.347
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	912
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.5
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.665	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	2196	Ramp Junction Speed (S), mi/h	62.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	16.6
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1080	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	2310	365
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	2745	462
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.70	0.24

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	20.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.315
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	59.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	2745	Ramp Junction Speed (S), mi/h	59.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	3207	Average Density (D), pc/mi/ln	27.0
Level of Service (LOS)	C		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5500	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	1485	470
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1765	595
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.26	0.29

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	2.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.366
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	364
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.689	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	1401	Ramp Junction Speed (S), mi/h	60.7
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	9.7
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1000	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	1015	205
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1206	260
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.32	0.13

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	7.5
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.206
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	62.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1206	Ramp Junction Speed (S), mi/h	62.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1466	Average Density (D), pc/mi/ln	11.8
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	2
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5195	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1220	425
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1450	538
Capacity (c), pc/h	6824	4066
Volume-to-Capacity Ratio (v/c)	0.21	0.13

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	0.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.361
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	502
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.450	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	948	Ramp Junction Speed (S), mi/h	62.8
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	7.7
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	795	265
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	972	324
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.16

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.243
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	972	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1296	Average Density (D), pc/mi/ln	10.6
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	4075	550
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1060	365
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1296	446
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.22

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.4
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.352
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1296	Ramp Junction Speed (S), mi/h	58.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	11.1
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Deceleration Length (L_D), ft	1885	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Volume (V_i), veh/h	695	290
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	850	354
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.19	0.18

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	0.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.472
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	55.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	850	Ramp Junction Speed (S), mi/h	55.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	7.7
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1750	250
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Volume (V_i), veh/h	270	385
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	2.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.980	0.909
Flow Rate (v_i), pc/h	306	471
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.17	0.24

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	9.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.312
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	59.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	306	Ramp Junction Speed (S), mi/h	59.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	777	Average Density (D), pc/mi/ln	6.5
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Volume (V_i), veh/h	655	490
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	801	599
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.31	0.29

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	6.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.205
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	62.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	801	Ramp Junction Speed (S), mi/h	62.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1400	Average Density (D), pc/mi/ln	11.3
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1145	45
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1400	55
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.31	0.03

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	13.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.317
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1400	Ramp Junction Speed (S), mi/h	59.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	11.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3655	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1030	1585
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.833
Flow Rate (v_i), pc/h	1259	2114
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.74	1.04

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	21.5
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	-
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	59.6
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1259	Ramp Junction Speed (S), mi/h	-
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	3373	Average Density (D), pc/mi/ln	-
Level of Service (LOS)	F		

III. 2023 Freeway Analysis – Weaving

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	5705	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	800	350	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	951	443	19	152

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	970	Density-Based Capacity (c_{IWL}), pc/h/ln	2315
Total Flow Rate (v), pc/h	1565	Demand Flow-Based Capacity (c_{IW}), pc/h	6316
Volume Ratio (VR)	0.380	Weaving Segment Capacity (c_W), veh/h	5905
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	6265
Maximum Weaving Length (L_{MAX}), ft	6458	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	365	Average Weaving Speed (S_W), mi/h	61.2
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1905	Average Non-Weaving Speed (S_{NW}), mi/h	60.5
Weaving Lane Change Rate (LC_W), lc/h	982	Average Speed (S), mi/h	60.8
Total Lane Change Rate (LC_{All}), lc/h	2887	Density (D), pc/mi/ln	8.6
Weaving Intensity Factor (W)	0.132	Level of Service (LOS)	A

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	5705	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	755	1555	30	275
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	897	1970	38	348

Weaving Flow Rate (v_w), pc/h	2318	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	935	Density-Based Capacity (c_{IWL}), pc/h/ln	2012
Total Flow Rate (v), pc/h	3253	Demand Flow-Based Capacity (c_{IW}), pc/h	3366
Volume Ratio (VR)	0.713	Weaving Segment Capacity (c_W), veh/h	3147
Minimum Lane Change Rate (LC_{MIN}), lc/h	2318	Adjusted Weaving Area Capacity, pc/h	3410
Maximum Weaving Length (L_{MAX}), ft	10420	Volume-to-Capacity Ratio (v/c)	0.95

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	352	Average Weaving Speed (S_W), mi/h	58.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1898	Average Non-Weaving Speed (S_{NW}), mi/h	45.4
Weaving Lane Change Rate (LC_W), lc/h	2705	Average Speed (S), mi/h	54.3
Total Lane Change Rate (LC_{All}), lc/h	4603	Density (D), pc/mi/ln	20.0
Weaving Intensity Factor (W)	0.191	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	510	185	125	1625
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	606	234	158	2059

Weaving Flow Rate (v_w), pc/h	2293	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	764	Density-Based Capacity (c_{IWL}), pc/h/ln	1908
Total Flow Rate (v), pc/h	3057	Demand Flow-Based Capacity (c_{IW}), pc/h	3200
Volume Ratio (VR)	0.750	Weaving Segment Capacity (c_W), veh/h	2992
Minimum Lane Change Rate (LC_{MIN}), lc/h	2293	Adjusted Weaving Area Capacity, pc/h	3259
Maximum Weaving Length (L_{MAX}), ft	10892	Volume-to-Capacity Ratio (v/c)	0.94

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	243	Average Weaving Speed (S_W), mi/h	58.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1859	Average Non-Weaving Speed (S_{NW}), mi/h	45.9
Weaving Lane Change Rate (LC_W), lc/h	2647	Average Speed (S), mi/h	54.5
Total Lane Change Rate (LC_{All}), lc/h	4506	Density (D), pc/mi/ln	18.7
Weaving Intensity Factor (W)	0.214	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	670	125	80	345
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	796	158	101	437

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	897	Density-Based Capacity (c_{IWL}), pc/h/ln	2231
Total Flow Rate (v), pc/h	1492	Demand Flow-Based Capacity (c_{IW}), pc/h	6015
Volume Ratio (VR)	0.399	Weaving Segment Capacity (c_W), veh/h	5624
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	5992
Maximum Weaving Length (L_{MAX}), ft	6670	Volume-to-Capacity Ratio (v/c)	0.25

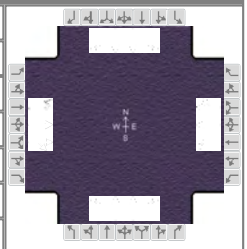
Speed and Density

Non-Weaving Vehicle Index (I_{NW})	285	Average Weaving Speed (S_W), mi/h	60.5
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1889	Average Non-Weaving Speed (S_{NW}), mi/h	60.6
Weaving Lane Change Rate (LC_W), lc/h	949	Average Speed (S), mi/h	60.6
Total Lane Change Rate (LC_{All}), lc/h	2838	Density (D), pc/mi/ln	8.2
Weaving Intensity Factor (W)	0.149	Level of Service (LOS)	A

IV. 2023 Arterial Analysis

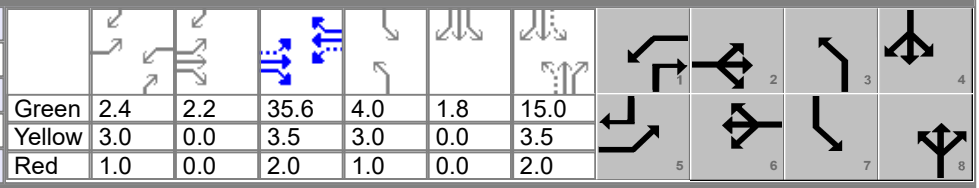
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	95	320	80	60	575	290	100	255	65	100	290	160

Signal Information			
Cycle, s	80.0	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	2.4	2.2	35.6	4.0	1.8	15.0						
Yellow	3.0	0.0	3.5	3.0	0.0	3.5						
Red	1.0	0.0	2.0	1.0	0.0	2.0						

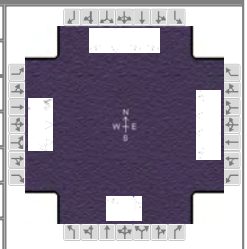
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	8.6	43.3	6.4	41.1	8.0	20.5	9.8	22.3
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	4.7		3.1		6.0	8.2	6.3	8.9
Green Extension Time (g_e), s	0.4	0.0	0.1	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.90		0.60		0.92	1.00	0.92	1.00
Max Out Probability	0.00		0.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	106	209	202	41	264	247	111	283	44	111	322	106
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1633	1714	1634	1633	1714	1577	1633	1632	1453	1633	1632	1453
Queue Service Time (g_s), s	2.7	5.9	6.0	1.1	5.9	5.5	4.0	6.2	2.0	4.3	6.9	4.6
Cycle Queue Clearance Time (g_c), s	2.7	5.9	6.0	1.1	5.9	5.5	4.0	6.2	2.0	4.3	6.9	4.6
Green Ratio (*g/C*)	0.51	0.47	0.47	0.47	0.44	0.44	0.24	0.19	0.22	0.26	0.21	0.27
Capacity (*c*), veh/h	504	810	772	490	762	701	273	612	316	326	686	389
Volume-to-Capacity Ratio (*X*)	0.210	0.258	0.262	0.083	0.346	0.352	0.408	0.463	0.141	0.341	0.470	0.271
Back of Queue (*Q*), ft/ln (95 th percentile)	42	101	94.9	17.3	94.5	78.3	80.5	107.6	29.2	76.5	119.8	66.8
Back of Queue (*Q*), veh/ln (95 th percentile)	1.6	3.9	3.8	0.7	3.6	3.1	3.1	4.1	1.2	2.9	4.6	2.7
Queue Storage Ratio (*RQ*) (95 th percentile)	0.22	0.00	0.00	0.12	0.00	0.00	0.27	0.00	0.13	0.21	0.00	0.22
Uniform Delay (d_1), s/veh	10.7	12.7	12.7	11.8	9.4	8.4	25.9	28.9	25.3	23.8	27.7	23.1
Incremental Delay (d_2), s/veh	0.3	0.8	0.8	0.1	1.2	1.3	1.4	0.2	0.1	0.9	0.2	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	0.0	0.0
Control Delay (*d*), s/veh	11.0	13.4	13.5	11.9	10.5	9.7	27.3	29.1	25.3	24.6	27.9	23.3
Level of Service (LOS)	B	B	B	B	B	A	C	C	C	C	C	C
Approach Delay, s/veh / LOS	13.0	B		10.3	B		28.3	C		26.3	C	
Intersection Delay, s/veh / LOS	19.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.3	C	3.3	C	3.1	C
Bicycle LOS Score / LOS	2.7	B	3.0	C	2.7	B	2.8	C

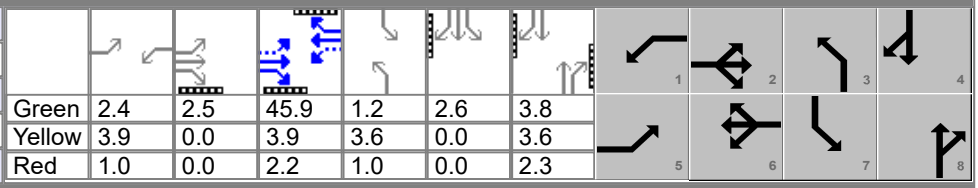
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	315	30	60	965	430	15	15	30	85	25	85

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.4	2.5		45.9	1.2	2.6	3.8					
Yellow	3.9	0.0		3.9	3.6	0.0	3.6					
Red	1.0	0.0		2.2	1.0	0.0	2.3					

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	9.9	54.5	7.3	52.0	5.8	9.7	8.4	12.3
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	4.8		2.8		2.8	4.0	4.3	4.9
Green Extension Time (g_e), s	0.5	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Phase Call Probability	0.95		0.60		0.31	0.95	0.88	0.99
Max Out Probability	0.00		0.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	133	187	185	42	671	191	17	39		94	28	56
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1633	1714	1678	1633	1632	1453	1633	1554		1585	1714	1453
Queue Service Time (g_s), s	2.8	4.0	4.1	0.8	9.8	5.8	0.8	2.0		2.3	1.2	2.9
Cycle Queue Clearance Time (g_c), s	2.8	4.0	4.1	0.8	9.8	5.8	0.8	2.0		2.3	1.2	2.9
Green Ratio (*g/C*)	0.64	0.61	0.61	0.60	0.57	0.57	0.02	0.05		0.05	0.08	0.08
Capacity (*c*), veh/h	525	1037	1016	657	1871	833	25	74		153	138	117
Volume-to-Capacity Ratio (*X*)	0.254	0.181	0.182	0.064	0.359	0.230	0.660	0.524		0.619	0.202	0.476
Back of Queue (*Q*), ft/ln (95 th percentile)	29.4	60	58.1	10.9	103.3	56.9	26.2	34.3		46.7	23.4	46.6
Back of Queue (*Q*), veh/ln (95 th percentile)	1.1	2.3	2.3	0.4	4.0	2.3	1.0	1.4		1.8	0.9	1.9
Queue Storage Ratio (*RQ*) (95 th percentile)	0.15	0.00	0.00	0.16	0.00	0.31	0.65	0.00		0.17	0.00	0.00
Uniform Delay (d_1), s/veh	5.6	7.2	7.3	6.5	10.7	9.8	39.2	37.2		37.4	34.4	35.2
Incremental Delay (d_2), s/veh	0.3	0.4	0.4	0.0	0.0	0.1	34.6	2.1		5.7	0.3	1.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	5.9	7.6	7.7	6.5	10.8	0.0	73.8	39.3		43.1	34.7	36.3
Level of Service (LOS)	A	A	A	A	B	A	E	D		D	C	D
Approach Delay, s/veh / LOS	7.2	A		8.3	A		49.7	D		39.6	D	
Intersection Delay, s/veh / LOS	12.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.9	C	3.5	C	3.1	C
Bicycle LOS Score / LOS	2.7	B	3.5	C	2.0	B	2.4	B

HCS7 Two-Way Stop-Control Report

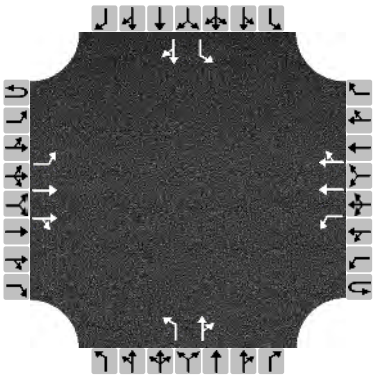
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2023
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume, V (veh/h)		5	1665	30		60	555	50		10	5	100		70	0	40
Percent Heavy Vehicles (%)		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.20				4.20				7.60	6.60	7.00		7.60	6.60	7.00
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.25				2.25				3.55	4.05	3.35		3.55	4.05	3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		6				67				11		117		78		44
Capacity, c (veh/h)		894				303				15		145		19		651
v/c Ratio		0.01				0.22				0.74		0.81		4.14		0.07
95% Queue Length, Q_{95} (veh)		0.0				0.8				1.8		5.1		10.2		0.2
Control Delay (s/veh)		9.1				20.2				480.9		90.9		1826.9		10.9
Level of Service, LOS		A				C				F		F		F		B
Approach Delay (s/veh)		0.0				1.8				124.4				1172.0		
Approach LOS										F				F		

HCS 2010 Two-Way Stop Control Summary Report

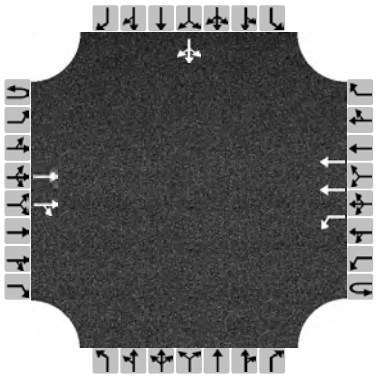
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2023
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/I-229 SB
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	I-229 SB
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

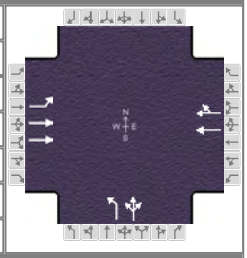
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	1	2	0		0	0	0		0	1	0
Configuration			T	TR		L	T								LTR	
Volume (veh/h)			165	320		45	1805							5	0	110
Percent Heavy Vehicles						5								5	5	5
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						50									128	
Capacity						1005									186	
v/c Ratio						0.05									0.69	
95% Queue Length						0.2									4.2	
Control Delay (s/veh)						8.8									58.7	
Level of Service (LOS)						A									F	
Approach Delay (s/veh)					0.2								58.7			
Approach LOS													F			

HCS 2010 Signalized Intersection Results Summary

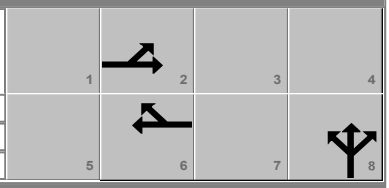
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	60	110			210	0	1640	0	110			

Signal Information			
Cycle, s	80.0	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	9.5	59.5	0.0	0.0	0.0	0.0	
Yellow	3.5	3.5	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		8.0		10.0		
Phase Duration, s		15.0		15.0		65.0		
Change Period, (*Y+R c*), s		5.5		5.5		5.5		
Max Allow Headway (*MAH*), s		0.0		0.0		5.0		
Queue Clearance Time (*g s*), s						61.5		
Green Extension Time (*g e*), s		0.0		0.0		0.0		
Phase Call Probability						1.00		
Max Out Probability						1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	65	119			233	0	1822	117				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1110	1534			1621	0	1633	1374				
Queue Service Time (*g s*), s	4.0	2.8			5.5	0.0	59.5	1.9				
Cycle Queue Clearance Time (*g c*), s	9.5	2.8			5.5	0.0	59.5	1.9				
Green Ratio (*g/C*)	0.12	0.12			0.12		0.74	0.74				
Capacity (*c*), veh/h	146	364			385		1214	1022				
Volume-to-Capacity Ratio (*X*)	0.446	0.327			0.606	0.000	1.501	0.114				
Back of Queue (*Q*), ft/ln (95 th percentile)	70.9	52.1			112.7	0	3557.5	13.1				
Back of Queue (*Q*), veh/ln (95 th percentile)	2.7	2.0			4.3	0.0	136.8	0.5				
Queue Storage Ratio (*RQ*) (95 th percentile)	0.71	0.00			0.00	0.00	0.00	0.00				
Uniform Delay (*d 1*), s/veh	35.9	32.0			33.5		10.3	2.9				
Incremental Delay (*d 2*), s/veh	9.3	2.3			6.9	0.0	229.7	0.1				
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0	0.0	0.0				
Control Delay (*d*), s/veh	45.1	34.3			40.4		239.9	2.9				
Level of Service (LOS)	D	C			D		F	A				
Approach Delay, s/veh / LOS	38.1	D		40.4	D		225.6	F		0.0		
Intersection Delay, s/veh / LOS	192.6						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	1.9	A	2.8	C	3.2	C
Bicycle LOS Score / LOS	2.6	B	2.7	B	5.4	F		

HCS 2010 Two-Way Stop Control Summary Report

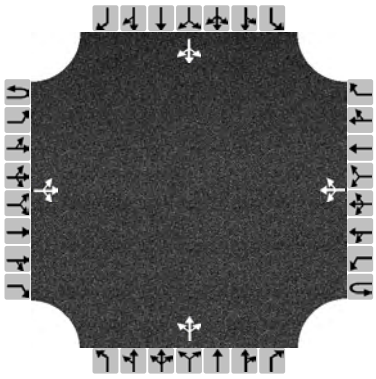
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2023
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/HALL
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	HALL AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		30	65	125		75	115	10		75	5	30		10	5	20
Percent Heavy Vehicles		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		33				83					122				39	
Capacity		1429				1345					485				583	
v/c Ratio		0.02				0.06					0.25				0.07	
95% Queue Length		0.1				0.2					1.0				0.2	
Control Delay (s/veh)		7.6				7.9					14.9				11.6	
Level of Service (LOS)		A				A					B				B	
Approach Delay (s/veh)	1.2				3.3				14.9				11.6			
Approach LOS									B				B			

File Name: BENSON AM.xus
Analyst: RL
Agency/Co.: HDR
Analysis Date: Mar 7, 2018
Time Period: AM PEAK
Jurisdiction: CITY OF SIOUX FALLS
Analysis Year: 2023
Project Description: I-229/BENSON IMJR
Urban Street: BENSON ROAD
Analysis Period: 1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	3
Number of Segments	2
Analysis period duration, h	0.25
System cycle length, s	80
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	2955	2955	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.09			43.51	
1	Running Speed, mph		41.85			41.45	
1	Through Delay, s/veh		7.67			10.2	
1	Travel Speed, mph		35.53			33.57	
1	Stop Rate, stops/veh		0.31			0.33	
1	Spatial Stop Rate, stops/mi		0.62			0.65	
1	Through vol/cap ratio		0.18			0.39	
1	Percent of Base FFS		80.62			76.18	
1	Level of Service		A			B	
1	Automobile Perception Score		2.23			2.24	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		47.72			49.21	
2	Running Speed, mph		42.22			40.94	
2	Through Delay, s/veh		34.19			11.59	
2	Travel Speed, mph		24.6			33.14	
2	Stop Rate, stops/veh		0.84			0.45	
2	Spatial Stop Rate, stops/mi		1.5			0.81	
2	Through vol/cap ratio		0.32			0.4	
2	Percent of Base FFS		55.81			75.19	
2	Level of Service		C			B	
2	Automobile Perception Score		2.42			2.36	

Facility Travel Time, s	132.67	114.52
Facility Travel Speed, mph	28.78	33.34
Facility Spatial Stop Rate, stops/mi	1.08	0.73
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	65.3	75.65
Facility Level of Service	C	B
Facility Automobile Perception Score	2.33	2.3
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.26	4.26
Facility Pedestrian LOS Score	2.98	3.67
Facility Pedestrian LOS	C	D
Facility Bicycle Travel Speed	14.03	13.04
Facility Bicycle LOS Score	2.62	2.97
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	35.58	33.42
Facility Transit LOS Score	0.95	0.81
Facility Transit LOS	A	A

SPILLBACK TIME, h 999

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.15	4.15
1	Ped LOS Score for Intersection	1.97	2.86
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.61	0.99
1	Speed Adjustment Factor	0.7	0.69
1	Ped LOS Score for Link	2.62	2.98
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.08	1.03
1	Ped LOS Score for Segment	2.96	3.17
1	Ped Segment LOS	C	C
1	Bicycle Travel Speed	13.72	14.15
1	Bicycle LOS Score for Intersection	2.68	3.01
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.13	2.38
1	Speed Adjustment Factor	0.85	0.84
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.04	3.28
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.65	2.82
1	Bicycle Segment LOS	B	C
1	Transit Running Speed, mi/h	41.85	41.45
1	g/C Ratio	0.6	0.45
1	Transit Running Time, s	43.09	43.51
1	Delay at Intersection, s/veh	7.6	10.46
1	Transit Travel Speed, mi/h	35.58	33.42
1	Transit Wait-Ride Score	3.88	3.8
1	Ped LOS Score for Link	2.62	2.98
1	Transit LOS Score for Segment	0.57	0.75
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.36	4.35
2	Ped LOS Score for Intersection	3.14	2.59
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.54	1.66
2	Speed Adjustment Factor	0.71	0.67
2	Ped LOS Score for Link	2.56	3.64
2	Ped Link LOS	C	D
2	Roadway Crossing Difficulty Factor	1.1	1.19
2	Ped LOS Score for Segment	2.99	4.11
2	Ped Segment LOS	C	D
2	Bicycle Travel Speed	14.33	12.18
2	Bicycle LOS Score for Intersection	2.63	3.45
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.07	2.64
2	Speed Adjustment Factor	0.85	0.84
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	2.98	3.54
2	Bicycle Link LOS	C	D
2	Number of access point approaches	0	0
2	Segment Length, ft	2955	2955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.6	3.1
2	Bicycle Segment LOS	B	C
2	Transit Running Speed, mi/h	42.22	40.94
2	g/C Ratio	0.12	0.57
2	Transit Running Time, s	47.72	49.21
2	Delay at Intersection, s/veh	34.19	11.59
2	Transit Travel Speed, mi/h	24.6	33.14
2	Transit Wait-Ride Score	3.4	3.79
2	Ped LOS Score for Link	2.56	3.64
2	Transit LOS Score for Segment	1.29	0.86
2	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

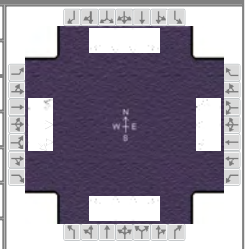
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	517	22.2	0	752	114	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.14	0	0	0.02	0	0	0.16	0.16	0.02	0.16	0.16	0.14
1: Thru veh delay		0.02			0.06							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	478	0	0	1189	44.9	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.02	0	0	0.02	0.02	0.02	0.02	0.02	0
1: Thru veh delay		0			0.04							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	16.6	437	44.2	110	1213	236	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0	0	0	0	0	0	0	0	0	0	0	0
2: Thru veh delay		0.03			0.14							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											
3: Volume, veh/h	0	179	348	8.03	1450	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0	0	0	0	0	0	0	0	0	0	0	0
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

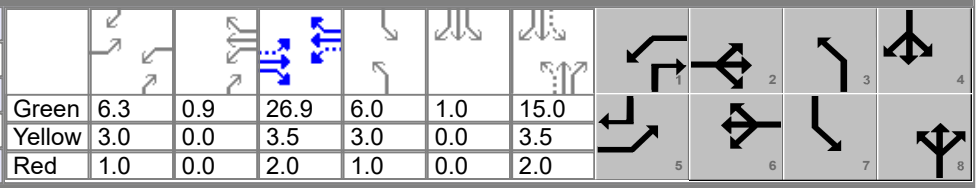
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	135	615	170	170	340	145	135	375	50	235	395	105

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	6.3	0.9	26.9	6.0	1.0	15.0						
Yellow	3.0	0.0	3.5	3.0	0.0	3.5						
Red	1.0	0.0	2.0	1.0	0.0	2.0						

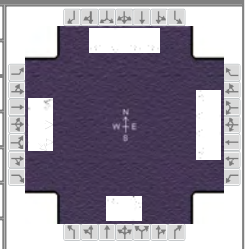
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	10.3	32.4	11.1	33.2	10.0	20.5	11.0	21.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	6.2		7.0		7.4	10.7	9.0	11.1
Green Extension Time (g_e), s	0.4	0.0	0.3	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.96		0.98		0.96	1.00	1.00	1.00
Max Out Probability	0.26		1.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	150	407	388	180	231	219	150	417	33	261	439	72
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1645	1647	1730	1611	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	4.2	14.8	14.8	5.0	7.3	7.1	5.4	8.7	1.2	7.0	9.1	2.7
Cycle Queue Clearance Time (g_c), s	4.2	14.8	14.8	5.0	7.3	7.1	5.4	8.7	1.2	7.0	9.1	2.7
Green Ratio (*g/C*)	0.44	0.36	0.36	0.45	0.37	0.37	0.28	0.20	0.30	0.29	0.21	0.30
Capacity (*c*), veh/h	460	620	589	360	640	596	289	659	433	329	703	435
Volume-to-Capacity Ratio (*X*)	0.326	0.657	0.658	0.501	0.361	0.368	0.519	0.633	0.077	0.793	0.625	0.166
Back of Queue (*Q*), ft/ln (95 th percentile)	67.3	269.8	251	88.4	134.1	115.5	97.9	150.3	18.2	114.4	156.2	40.6
Back of Queue (*Q*), veh/ln (95 th percentile)	2.6	10.4	10.0	3.4	5.2	4.6	3.8	5.8	0.7	4.4	6.0	1.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.34	0.00	0.00	0.63	0.00	0.00	0.33	0.00	0.08	0.31	0.00	0.13
Uniform Delay (d_1), s/veh	13.4	20.2	20.2	15.6	17.2	16.0	22.2	27.5	19.1	25.6	26.8	19.5
Incremental Delay (d_2), s/veh	0.6	5.4	5.7	1.5	1.5	1.7	2.2	0.4	0.0	13.1	0.3	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	0.0	0.0
Control Delay (*d*), s/veh	14.0	25.6	25.9	17.0	18.7	17.7	24.4	27.9	19.1	38.7	27.1	19.6
Level of Service (LOS)	B	C	C	B	B	B	C	C	B	D	C	B
Approach Delay, s/veh / LOS	23.8	C		17.8	B		26.5	C		30.3	C	
Intersection Delay, s/veh / LOS	24.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.3	C	3.3	C	3.2	C
Bicycle LOS Score / LOS	3.0	C	2.8	C	2.9	C	3.0	C

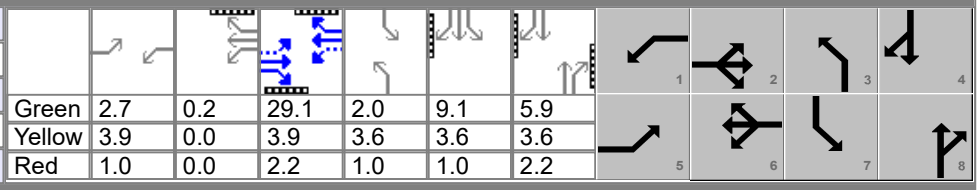
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	50	900	15	60	420	80	30	25	125	525	25	140

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.7	0.2	29.1	2.0	9.1	5.9
Yellow	3.9	0.0	3.9	3.6	3.6	3.6
Red	1.0	0.0	2.2	1.0	1.0	2.2

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	7.6	35.2	7.8	35.4	6.6	11.7	20.3	25.4
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.8	4.6	5.8
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	3.5		3.7		3.5	7.4	15.2	5.8
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
Phase Call Probability	0.68		0.73		0.50	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	55	502	500	63	443	63	33	111		583	28	94
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1723	1647	1647		1647	1524		1600	1730	1466
Queue Service Time (g_s), s	1.5	17.6	17.6	1.7	4.8		1.5	5.4		13.2	0.9	3.8
Cycle Queue Clearance Time (g_c), s	1.5	17.6	17.6	1.7	4.8		1.5	5.4		13.2	0.9	3.8
Green Ratio (*g/C*)	0.42	0.39	0.39	0.43	0.39		0.03	0.08		0.21	0.26	0.26
Capacity (*c*), veh/h	432	670	668	244	1285		44	120		669	452	383
Volume-to-Capacity Ratio (*X*)	0.127	0.749	0.749	0.259	0.345		0.758	0.925		0.872	0.061	0.247
Back of Queue (*Q*), ft/ln (95 th percentile)	22.1	251	240.5	28.2	70		44.9	181.1		255.6	16.4	58.6
Back of Queue (*Q*), veh/ln (95 th percentile)	0.8	9.7	9.6	1.1	2.7		1.7	7.0		9.8	0.6	2.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.11	0.00	0.00	0.40	0.00		1.12	0.00		0.95	0.00	0.00
Uniform Delay (d_1), s/veh	12.3	16.4	16.4	15.0	9.5		36.3	34.3		28.7	20.8	21.9
Incremental Delay (d_2), s/veh	0.1	5.2	5.3	0.6	0.6		30.7	58.3		11.7	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	12.4	21.7	21.7	15.7	10.1	0.0	67.0	92.6		40.4	20.8	22.0
Level of Service (LOS)	B	C	C	B	B	A	E	F		D	C	C
Approach Delay, s/veh / LOS	21.2	C		9.6	A		86.7	F		37.2	D	
Intersection Delay, s/veh / LOS	26.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.9	C	3.4	C	3.1	C
Bicycle LOS Score / LOS	3.1	C	2.8	C	2.2	B	3.2	C

HCS7 Two-Way Stop-Control Report

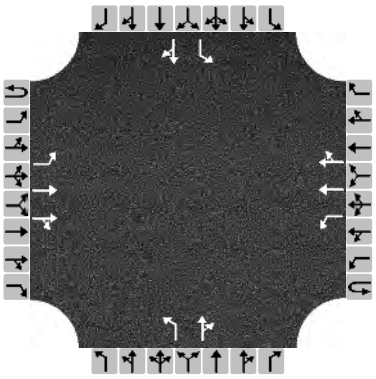
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2023
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume, V (veh/h)		5	1665	30		60	555	50		10	5	100		70	0	40
Percent Heavy Vehicles (%)		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.20				4.20				7.60	6.60	7.00		7.60	6.60	7.00
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.25				2.25				3.55	4.05	3.35		3.55	4.05	3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		6				67				11		117		78		44
Capacity, c (veh/h)		894				303				15		145		19		651
v/c Ratio		0.01				0.22				0.74		0.81		4.14		0.07
95% Queue Length, Q_{95} (veh)		0.0				0.8				1.8		5.1		10.2		0.2
Control Delay (s/veh)		9.1				20.2				480.9		90.9		1826.9		10.9
Level of Service, LOS		A				C				F		F		F		B
Approach Delay (s/veh)		0.0				1.8				124.4				1172.0		
Approach LOS										F				F		

HCS 2010 Two-Way Stop Control Summary Report

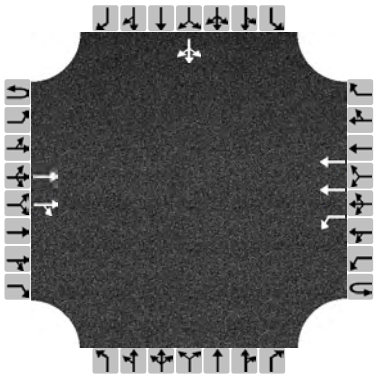
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	03/07/2018
Analysis Year	2023
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/I-229 SB
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	I-229 SB
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

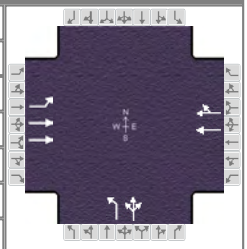
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	1	2	0		0	0	0		0	1	0
Configuration			T	TR		L	T								LTR	
Volume (veh/h)			385	1450		135	625							5	0	40
Percent Heavy Vehicles						5								5	5	5
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						150									50	
Capacity						262									376	
v/c Ratio						0.57									0.13	
95% Queue Length						3.3									0.5	
Control Delay (s/veh)						35.6									16.0	
Level of Service (LOS)						E									C	
Approach Delay (s/veh)					6.3								16.0			
Approach LOS													C			

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	150	240			395	115	365	0	60			

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

								1	2	3	4	
Green	43.0	21.0	0.0	0.0	0.0	0.0						
Yellow	3.5	3.5	0.0	0.0	0.0	0.0		5	6	7	8	
Red	2.0	2.0	0.0	0.0	0.0	0.0						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		8.0		10.0		
Phase Duration, s		48.5		48.5		26.5		
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		
Max Allow Headway (*MAH*), s		0.0		0.0		5.1		
Queue Clearance Time (g_s), s						19.9		
Green Extension Time (g_e), s		0.0		0.0		1.1		
Phase Call Probability						1.00		
Max Out Probability						1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	81	129			264	253	406	56				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	856	1535			1643	1555	1633	1365				
Queue Service Time (g_s), s	4.0	1.4			6.5	6.2	17.9	2.3				
Cycle Queue Clearance Time (g_c), s	10.5	1.4			6.5	6.2	17.9	2.3				
Green Ratio (*g/C*)	0.57	0.57			0.57	0.57	0.28	0.28				
Capacity (*c*), veh/h	513	1761			943	892	456	382				
Volume-to-Capacity Ratio (*X*)	0.157	0.073			0.280	0.283	0.889	0.146				
Back of Queue (*Q*), ft/ln (95 th percentile)	32.7	17.9			90.7	84.1	335.6	31				
Back of Queue (*Q*), veh/ln (95 th percentile)	1.3	0.7			3.5	3.4	12.9	1.2				
Queue Storage Ratio (*RQ*) (95 th percentile)	0.33	0.00			0.00	0.00	0.00	0.00				
Uniform Delay (d_1), s/veh	10.9	7.1			8.1	8.1	25.9	20.3				
Incremental Delay (d_2), s/veh	0.3	0.0			0.7	0.8	16.0	0.2				
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0				
Control Delay (*d*), s/veh	11.2	7.2			8.9	8.9	41.9	20.5				
Level of Service (LOS)	B	A			A	A	D	C				
Approach Delay, s/veh / LOS	8.7	A		8.9	A		39.3	D		0.0		
Intersection Delay, s/veh / LOS	20.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	1.9	A	2.9	C	3.1	C
Bicycle LOS Score / LOS	2.8	C	2.9	C	2.9	C		

HCS 2010 Two-Way Stop Control Summary Report

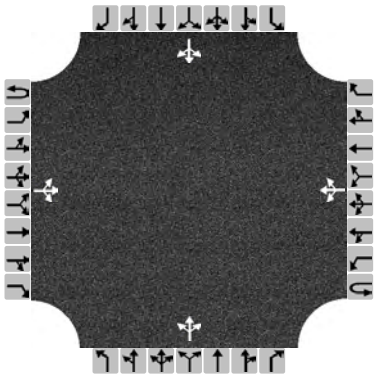
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	03/07/2018
Analysis Year	2023
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/HALL
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	HALL AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		85	145	70		40	250	10		165	5	85		10	5	95
Percent Heavy Vehicles		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		94				44					283				123	
Capacity		1259				1313					297				585	
v/c Ratio		0.07				0.03					0.95				0.21	
95% Queue Length		0.2				0.1					9.4				0.8	
Control Delay (s/veh)		8.1				7.8					79.0				12.8	
Level of Service (LOS)		A				A					F				B	
Approach Delay (s/veh)	2.8				1.3				79.0				12.8			
Approach LOS									F				B			

File Name: BENSON PM.xus
Analyst: RL
Agency/Co.: HDR
Analysis Date: Mar 7, 2018
Time Period: PM PEAK
Jurisdiction: CITY OF SIOUX FALLS
Analysis Year: 2023
Project Description: I-229/BENSON IMJR
Urban Street: BENSON ROAD
Analysis Period: 1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	3
Number of Segments	2
Analysis period duration, h	0.25
System cycle length, s	75
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	95
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	0.51
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

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	40	40	2	2	2610	2610	50	50	0	0	70	70	0	0
2	40	40	2	2	2990	2990	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	880	20	0	590	0	30	0	45	40	0	35
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1335	0	0	360	30	0	0	0	130	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	5	1435	25	40	340	30	10	5	95	70	0	40
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1410											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	170	1430	25	380	0	0	0	0	0	0	30
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1920											
3: Peak Hour Factor	1											

Number of access points: 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.1			42.65	
1	Running Speed, mph		41.29			41.73	
1	Through Delay, s/veh		21.66			18.29	
1	Travel Speed, mph		27.48			29.2	
1	Stop Rate, stops/veh		0.6			0.58	
1	Spatial Stop Rate, stops/mi		1.21			1.18	
1	Through vol/cap ratio		0.75			0.36	
1	Percent of Base FFS		62.36			66.26	
1	Level of Service		C			C	
1	Automobile Perception Score		2.32			2.32	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		50.04			48.6	
2	Running Speed, mph		40.74			41.95	
2	Through Delay, s/veh		7.1			10.08	
2	Travel Speed, mph		35.68			34.74	
2	Stop Rate, stops/veh		0.28			0.32	
2	Spatial Stop Rate, stops/mi		0.5			0.57	
2	Through vol/cap ratio		0.07			0.34	
2	Percent of Base FFS		80.96			78.82	
2	Level of Service		A			B	
2	Automobile Perception Score		2.27			2.33	

Facility Travel Time, s	121.89	119.62
Facility Travel Speed, mph	31.32	31.92
Facility Spatial Stop Rate, stops/mi	0.83	0.86
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	71.08	72.42
Facility Level of Service	B	B
Facility Automobile Perception Score	2.29	2.32
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.24	4.24
Facility Pedestrian LOS Score	3.5	3.06
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	13.44	13.87
Facility Bicycle LOS Score	2.98	2.74
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	27.48	29.03
Facility Transit LOS Score	0.95	0.81
Facility Transit LOS	A	A

SPILLBACK TIME, h 999

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.16	4.16
1	Ped LOS Score for Intersection	2.1	2.88
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	1.14	0.72
1	Speed Adjustment Factor	0.68	0.7
1	Ped LOS Score for Link	3.13	2.72
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.02	0.87
1	Ped LOS Score for Segment	3.23	2.66
1	Ped Segment LOS	C	B
1	Bicycle Travel Speed	13.27	13.42
1	Bicycle LOS Score for Intersection	3.14	2.81
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.45	2.22
1	Speed Adjustment Factor	0.84	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.35	3.12
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2610	2610
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.91	2.72
1	Bicycle Segment LOS	C	B
1	Transit Running Speed, mi/h	41.29	41.73
1	g/C Ratio	0.39	0.37
1	Transit Running Time, s	43.1	42.65
1	Delay at Intersection, s/veh	21.66	18.65
1	Transit Travel Speed, mi/h	27.48	29.03
1	Transit Wait-Ride Score	3.54	3.61
1	Ped LOS Score for Link	3.13	2.72
1	Transit LOS Score for Segment	1.16	0.99
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.31	4.31
2	Ped LOS Score for Intersection	1.97	2.64
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	1.95	0.83
2	Speed Adjustment Factor	0.66	0.7
2	Ped LOS Score for Link	3.92	2.84
2	Ped Link LOS	D	C
2	Roadway Crossing Difficulty Factor	0.98	1.19
2	Ped LOS Score for Segment	3.74	3.4
2	Ped Segment LOS	D	C
2	Bicycle Travel Speed	13.59	14.29
2	Bicycle LOS Score for Intersection	2.84	2.76
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.72	2.29
2	Speed Adjustment Factor	0.84	0.85
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.61	3.19
2	Bicycle Link LOS	D	C
2	Number of access point approaches	0	0
2	Segment Length, ft	2990	2990
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	3.05	2.75
2	Bicycle Segment LOS	C	C
2	Transit Running Speed, mi/h	40.74	41.95
2	g/C Ratio	0.58	0.39
2	Transit Running Time, s	50.04	48.6
2	Delay at Intersection, s/veh	7.1	10.08
2	Transit Travel Speed, mi/h	35.68	34.74
2	Transit Wait-Ride Score	3.89	3.85
2	Ped LOS Score for Link	3.92	2.84
2	Transit LOS Score for Segment	0.76	0.65
2	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

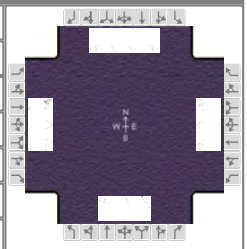
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	978	22.2	0	632	0	30	0	45	40	0	35
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.04	0	0	0.15	0	0	0.19	0.19	0.15	0.19	0.19	0.04
1: Thru veh delay		0.02			0							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1713	0	0	591	49.3	0	0	0	130	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.41	0	0	0.41	0.41	0.41	0.41	0.41	0
1: Thru veh delay		0			0.03							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	6.29	1806	31.5	69.5	590	52.1	10	5	95	70	0	40
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0	0	0	0.43	0	0	0.43	0.43	0.43	0.43	0.43	0
2: Thru veh delay		0.04			0.04							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1410											
3: Volume, veh/h	0	209	1761	44.9	682	0	0	0	0	0	0	30
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0	0	0	0.48	0	0	0.48	0.48	0.48	0.48	0.48	0
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1920											

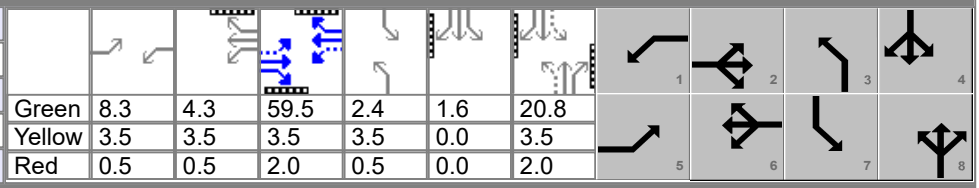
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	150	390	55	365	490	720	25	395	65	75	225	50

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	8.3	4.3		59.5	2.4	1.6		20.8				
Yellow	3.5	3.5		3.5	3.5	0.0		3.5				
Red	0.5	0.5		2.0	0.5	0.0		2.0				

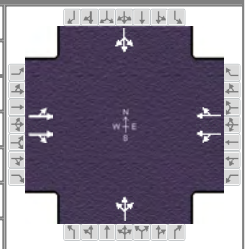
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	3.0
Phase Duration, s	12.3	65.0	20.7	73.4	6.4	26.3	8.0	27.9
Change Period, (*Y+R c*), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.1
Queue Clearance Time (*g s*), s	8.1		15.3		3.7	18.5	6.0	10.0
Green Extension Time (*g e*), s	0.3	0.0	1.4	0.0	0.0	2.3	0.0	2.8
Phase Call Probability	1.00		1.00		0.60	1.00	0.94	1.00
Max Out Probability	0.15		0.00		1.00	0.14	1.00	0.01

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	167	239	234	386	519	455	28	245	239	83	250	28
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1594	1674	1625	1594	1674	1418	1647	1730	1674	1647	1647	
Queue Service Time (*g s*), s	6.1	10.1	10.1	13.3	22.4	23.6	1.7	16.3	16.5	4.0	8.0	
Cycle Queue Clearance Time (*g c*), s	6.1	10.1	10.1	13.3	22.4	23.6	1.7	16.3	16.5	4.0	8.0	
Green Ratio (*g/C*)	0.57	0.50	0.50	0.65	0.57	0.57	0.19	0.17	0.17	0.21	0.19	
Capacity (*c*), veh/h	472	831	806	640	947	802	207	300	290	147	614	
Volume-to-Capacity Ratio (*X*)	0.353	0.287	0.290	0.604	0.548	0.567	0.134	0.817	0.823	0.568	0.407	
Back of Queue (*Q*), ft/ln (95 th percentile)	104.5	193.6	177	200.1	334.1	303.7	32.2	316.8	300.6	40	153.8	
Back of Queue (*Q*), veh/ln (95 th percentile)	3.9	7.2	7.1	7.5	12.5	11.3	1.2	12.2	12.0	1.5	5.9	
Queue Storage Ratio (*RQ*) (95 th percentile)	1.04	0.00	0.00	1.25	0.00	0.00	0.29	0.00	0.00	0.27	0.00	
Uniform Delay (*d 1*), s/veh	14.0	17.8	17.8	10.8	15.2	15.4	40.0	47.8	47.8	44.2	43.0	
Incremental Delay (*d 2*), s/veh	0.4	0.9	0.9	0.7	1.7	2.2	0.3	8.1	8.9	5.1	0.4	
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	14.4	18.6	18.7	11.5	16.9	17.5	40.3	55.9	56.7	49.3	43.4	0.0
Level of Service (LOS)	B	B	B	B	B	B	D	E	E	D	D	A
Approach Delay, s/veh / LOS	17.6	B		15.6	B		55.4	E		41.4	D	
Intersection Delay, s/veh / LOS	26.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.2	C	3.6	D	2.7	C
Bicycle LOS Score / LOS	2.5	B	4.6	E	2.7	C	2.6	C

HCS7 Signalized Intersection Results Summary

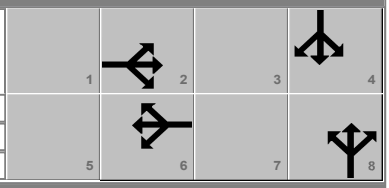
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	WAYLAND AVE	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	490	20	10	1550	50	10	15	0	45	10	15

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	101.7	7.7	0.0	0.0	0.0	0.0	
Yellow	3.9	3.0	0.0	0.0	0.0	0.0	
Red	1.2	2.5	0.0	0.0	0.0	0.0	



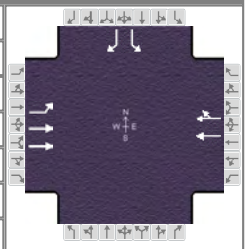
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		106.8		106.8		13.2		13.2
Change Period, ($Y+R_c$), s		5.1		5.1		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		4.2		4.2
Queue Clearance Time (g_s), s						3.8		7.7
Green Extension Time (g_e), s		0.0		0.0		0.3		0.3
Phase Call Probability						0.96		0.96
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	270		308	889		808		28			72	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1228		1513	1666		1512		1655			1478	
Queue Service Time (g_s), s	1.7		2.5	0.0		27.1		0.0			4.0	
Cycle Queue Clearance Time (g_c), s	28.9		2.5	26.8		27.1		1.8			5.7	
Green Ratio (*g/C*)	0.85		0.85	0.85		0.85		0.06			0.06	
Capacity (*c*), veh/h	1073		1282	1442		1281		148			146	
Volume-to-Capacity Ratio (*X*)	0.252		0.240	0.617		0.631		0.187			0.495	
Back of Queue (*Q*), ft/ln (95 th percentile)	20.2		22.5	279.4		261.8		37.9			103.7	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.8		0.9	11.2		10.5		1.5			4.1	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00		0.00	0.00		0.00		0.00			0.00	
Uniform Delay (d_1), s/veh	0.9		0.8	4.8		4.8		53.4			55.2	
Incremental Delay (d_2), s/veh	0.5		0.4	1.1		1.3		0.6			2.6	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (*d*), s/veh	1.5		1.2	5.9		6.1		54.0			57.8	
Level of Service (LOS)	A		A	A		A		D			E	
Approach Delay, s/veh / LOS	1.3	A		6.0	A		54.0	D		57.8	E	
Intersection Delay, s/veh / LOS	7.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	3.1	C	3.1	C
Bicycle LOS Score / LOS	2.6	C	3.6	D	2.7	C	2.8	C

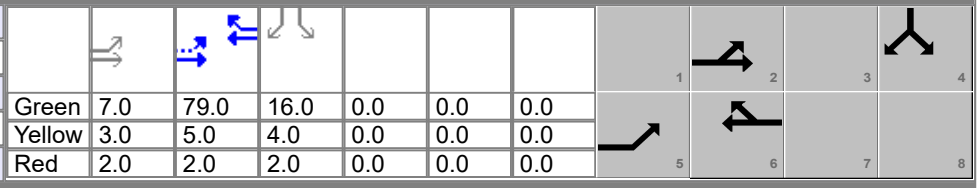
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	130	520			1540	560				80		55

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	75	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.0	79.0	16.0	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0

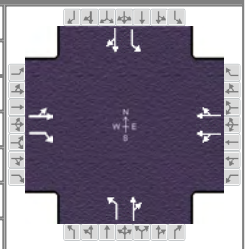
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				9.0
Phase Duration, s	12.0	98.0		86.0				22.0
Change Period, ($Y+R_c$), s	5.0	7.0		7.0				6.0
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.2
Queue Clearance Time (g_s), s	9.0							18.0
Green Extension Time (g_e), s	0.0	0.0		0.0				0.0
Phase Call Probability	0.99							0.99
Max Out Probability	1.00							1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	142	566			1002	1002				89		61
Adjusted Saturation Flow Rate (*s*), veh/h/ln	645	1673			1948	1830				377		1439
Queue Service Time (g_s), s	7.0	6.6			59.7	52.9				16.0		4.6
Cycle Queue Clearance Time (g_c), s	7.0	6.6			59.7	52.9				16.0		4.6
Green Ratio (*g/C*)	0.73	0.76			0.66	0.66				0.13		0.13
Capacity (*c*), veh/h	111	2538			1282	1205				50		192
Volume-to-Capacity Ratio (*X*)	1.277	0.223			0.781	0.831				1.768		0.319
Back of Queue (*Q*), ft/ln (95 th percentile)	527.8	91.5			534.8	601.7				589.7		76.3
Back of Queue (*Q*), veh/ln (95 th percentile)	12.9	3.7			21.4	24.1				13.1		3.1
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00	0.00				0.00		0.00
Uniform Delay (d_1), s/veh	31.6	4.9			16.5	19.3				52.0		47.1
Incremental Delay (d_2), s/veh	176.5	0.2			0.5	0.7				414.2		0.9
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	208.0	5.1			17.0	20.0				466.2		48.0
Level of Service (LOS)	F	A			B	C				F		D
Approach Delay, s/veh / LOS	45.7		D	18.5		B	0.0			295.8		F
Intersection Delay, s/veh / LOS	39.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.6	A	2.2	B	3.1	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	2.2	B				F

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	75	205	320	75	1460	25	405	330	65	70	10	235

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

							1	2	3	4
Green	66.0	4.0	32.0	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	4.0	4.0	0.0	0.0	0.0				
Red	2.0	2.0	2.0	0.0	0.0	0.0				

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8	7	4
Case Number		7.0		8.0		6.3	1.0	4.0
Phase Duration, s		72.0		72.0		38.0	10.0	48.0
Change Period, (*Y+R c*), s		6.0		6.0		6.0	6.0	6.0
Max Allow Headway (*MAH*), s		0.0		0.0		6.4	6.0	6.4
Queue Clearance Time (*g s*), s						34.0	6.0	12.8
Green Extension Time (*g e*), s		0.0		0.0		0.0	0.0	11.1
Phase Call Probability						1.00	0.93	1.00
Max Out Probability						1.00	1.00	0.22

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		281	191	866		856	450	411		78	167	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		208	1365	1484		1630	1190	1691		1594	1374	
Queue Service Time (*g s*), s		6.3	9.9	0.0		59.7	31.2	28.3		4.0	10.8	
Cycle Queue Clearance Time (*g c*), s		66.0	9.9	66.0		59.7	32.0	28.3		4.0	10.8	
Green Ratio (*g/C*)		0.55	0.55	0.55		0.55	0.27	0.27		0.32	0.35	
Capacity (*c*), veh/h		153	751	849		896	370	451		142	481	
Volume-to-Capacity Ratio (*X*)		1.844	0.254	1.021		0.955	1.217	0.912		0.549	0.347	
Back of Queue (*Q*), ft/ln (95 th percentile)		938.6	157.9	1027.1		877.3	914.1	543.9		90.1	171.4	
Back of Queue (*Q*), veh/ln (95 th percentile)		35.0	5.9	41.1		35.1	35.2	20.9		3.4	6.4	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.00		0.00	6.09	0.00		0.90	0.00	
Uniform Delay (*d 1*), s/veh		33.7	16.6	26.5		27.0	46.9	42.6		34.7	28.9	
Incremental Delay (*d 2*), s/veh		401.7	0.7	36.2		20.9	120.0	23.4		7.7	0.9	
Initial Queue Delay (*d 3*), s/veh		0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		435.3	17.3	62.7		47.9	166.9	66.1		42.4	29.8	
Level of Service (LOS)		F	B	F		D	F	E		D	C	
Approach Delay, s/veh / LOS	266.3	F		55.4	E		118.8	F		33.8	C	
Intersection Delay, s/veh / LOS	100.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	C	2.7	C	2.8	C	3.7	D
Bicycle LOS Score / LOS	3.2	C	2.0	B	3.6	D	2.6	C

HCS7 Two-Way Stop-Control Report

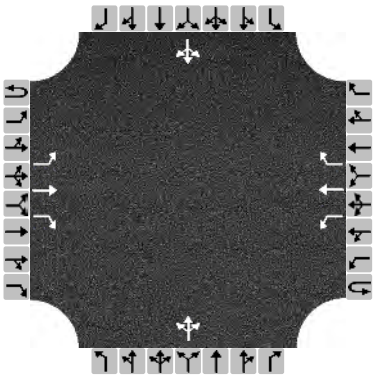
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/8/2018
Analysis Year	2045
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BAHNSON AVENUE
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	RICE STREET
North/South Street	BAHNSON AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	1	0	1	1	1		0	1	0		0	1	0
Configuration		L	T	R		L	T	R			LTR				LTR	
Volume, V (veh/h)		40	260	40		10	1465	10		15	10	10		10	25	80
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.13				4.13				7.13	6.53	6.23		7.13	6.53	6.23
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23				2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		44				11					39				128	
Capacity, c (veh/h)		392				1219					12				79	
v/c Ratio		0.11				0.01					3.21				1.62	
95% Queue Length, Q_{95} (veh)		0.4				0.0					5.9				10.6	
Control Delay (s/veh)		15.3				8.0					1622.9				420.2	
Level of Service, LOS		C				A					F				F	
Approach Delay (s/veh)		1.8				0.1				1622.9				420.2		
Approach LOS										F				F		

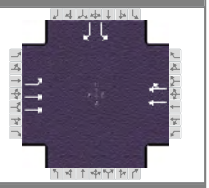
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Parclo AB-2Q
Analyst	RL	Analysis Date	Mar 8, 2018	Segment Distance, ft	1020
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	RICE AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	130	520			1540	560				80		55
Intersection Two Demand (*v*), veh/h	75	205	320	75	1460	25	405	330	65	70	10	235

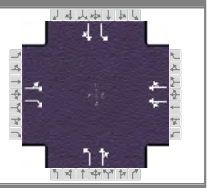
Signal One Information	
Cycle, s	120.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	7.0	79.0	16.0	0.0	0.0	0.0	1	2	3	4		
Yellow	3.0	5.0	4.0	0.0	0.0	0.0	5	6	7	8		
Red	2.0	2.0	2.0	0.0	0.0	0.0						



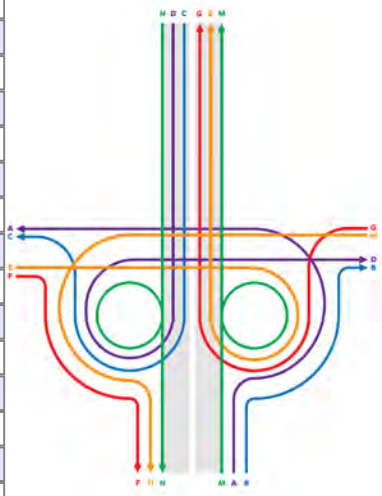
Signal Two Information	
Cycle, s	120.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	66.0	4.0	32.0	0.0	0.0	0.0	1	2	3	4		
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	5	6	7	8		
Red	2.0	2.0	2.0	0.0	0.0	0.0						



Interchange Results

O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	120	183.9	0.0	183.9	Yes	Yes	F
B	44	66.1	0.0	66.1	No	No	D
C	0	0.0	5.0	5.0	No	No	A
D	0	0.0	5.0	5.0	No	No	A
E	191	22.4	5.0	27.4	Yes	No	B
F	0	5.1	0.0	5.1	No	No	A
G	83	62.7	5.0	67.7	Yes	No	F
H	0	0.0	0.0	0.0	No	No	A
I	536	5.1	0.0	5.1	Yes	No	A
J	1195	17.0	0.0	17.0	No	No	B
K	-	-	0.0	-	-	-	-
L	-	-	0.0	-	-	-	-
M	330	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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	208.0	5.1			17.0	20.0				466.2		48.0
Level of Service (LOS)	F	A			B	C				F		D
Approach Delay, s/veh / LOS	45.7	D		18.5	B		0.0			295.8	F	
Intersection Delay, s/veh / LOS	39.8						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		435.3	17.3	62.7		47.9	166.9	66.1		42.4	29.8	
Level of Service (LOS)		F	B	F		D	F	E		D	C	
Approach Delay, s/veh / LOS	266.3	F		55.4	E		118.8	F		33.8	C	
Intersection Delay, s/veh / LOS	100.5						F					

This Urban Streets text report was created on March 12, 2018 at 10:26:54

Period number = 1

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	120
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	95
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	0.51
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

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	35	35	2	1	1020	1020	50	50	0	0	70	70	0	0
2	35	35	2	2	3460	3460	50	50	0	0	70	70	0	0
3	35	35	1	2	1020	1020	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	520	15	20	1575	0	35	0	130	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Location, ft	3030											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 3

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				999.27		
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		20.03			23.1	
1	Running Speed, mph		34.71			30.1	
1	Through Delay, s/veh		1.33			16.88	
1	Travel Speed, mph		32.55			17.39	
1	Stop Rate, stops/veh		0.05			0.48	
1	Spatial Stop Rate, stops/mi		0.26			2.51	
1	Through vol/cap ratio		0.25			0.55	
1	Percent of Base FFS		78.01			41.69	
1	Level of Service		B			D	
1	Automobile Perception Score		2.38			2.76	
2	Bay/Lane Spillback Time, h	0	999	999	999	999	999
2	ShrdLane Spillback Time, h						
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		58.48			60.56	
2	Running Speed, mph		40.34			38.95	
2	Through Delay, s/veh		5.08			5.97	
2	Travel Speed, mph		37.11			35.46	
2	Stop Rate, stops/veh		0.22			0.21	
2	Spatial Stop Rate, stops/mi		0.33			0.33	
2	Through vol/cap ratio		0.22			0.62	
2	Percent of Base FFS		88.96			84.99	
2	Level of Service		A			A	
2	Automobile Perception Score		2.29			2.29	
3	Bay/Lane Spillback Time, h	0	0.38	999	999	999	999
3	ShrdLane Spillback Time, h						
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		20.43			21.28	
3	Running Speed, mph		34.04			32.67	
3	Through Delay, s/veh		435.33			18.17	
3	Travel Speed, mph		1.53			17.63	
3	Stop Rate, stops/veh		2.58			0.6	
3	Spatial Stop Rate, stops/mi		13.33			3.12	
3	Through vol/cap ratio		1.84			0.8	
3	Percent of Base FFS		3.66			42.25	
3	Level of Service		F			D	
3	Automobile Perception Score		4.82			2.87	
Facility Travel Time, s			540.69			145.97	
Facility Travel Speed, mph			6.94			25.69	
Facility Spatial Stop Rate, veh/mi			2.73			1.25	
Facility Base Free Flow Speed, mph			41.72			41.72	
Facility Percent Base Free Flow Speed			16.62			61.58	
Facility Level of Service			F			C	
Facility Automobile Perception Score			2.56			2.46	
Facility Pedestrian Space			Infinity			Infinity	
Facility Pedestrian Travel Speed			4.4			4.4	
Facility Pedestrian LOS Score			3.3			3.97	
Facility Pedestrian LOS			C			D	
Facility Bicycle Travel Speed			13.88			13.86	
Facility Bicycle LOS Score			3.49			3.97	
Facility Bicycle LOS			C			D	
Facility Transit Travel Speed			34.04			18.17	
Facility Transit LOS Score			0.56			1.2	
Facility Transit LOS			A			A	
SPILLBACK TIME, h			0.38				

Multimodal Results

1	Roadway crossing difficulty factor	1.2	1.2
1	Ped LOS Score for Link	2.47	5.51
1	Ped LOS Score for Intersection	2.16	3.23
1	Ped LOS Score for Segment	3.44	4.88
1	Ped Segment LOS	C	E
1	Bicycle LOS Score for Link	3.3	4.1
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	2.65	4.62
1	Number of access point approaches	0	0
1	Segment Length, ft	1020	1020
1	Bicycle LOS Score for Segment	3.53	4.62
1	Bicycle Segment LOS	D	E
1	Transit Wait-Ride Score	3.85	2.97
1	Ped LOS Score for Link	2.47	5.51
1	Transit LOS Score for Segment	0.6	2.38
1	Transit Segment LOS	A	B
2	Roadway crossing difficulty factor	1.2	1.2
2	Ped LOS Score for Link	2.65	3.87
2	Ped LOS Score for Intersection	0.65	2.19
2	Ped LOS Score for Segment	3.11	3.98
2	Ped Segment LOS	C	D
2	Bicycle LOS Score for Link	3.37	3.89
2	Indicator Variable	1	1
2	Bicycle LOS Score for Intersection	1.08	3.63
2	Number of access point approaches	0	0
2	Segment Length, ft	3460	3460
2	Bicycle LOS Score for Segment	3.42	3.89
2	Bicycle Segment LOS	C	D
2	Transit Wait-Ride Score	3.94	4
2	Ped LOS Score for Link	2.65	3.87
2	Transit LOS Score for Segment	0.49	0.58
2	Transit Segment LOS	A	A
3	Roadway crossing difficulty factor	1.2	0.86
3	Ped LOS Score for Link	3.19	4.31
3	Ped LOS Score for Intersection	2.59	2.24
3	Ped LOS Score for Segment	3.83	2.99
3	Ped Segment LOS	D	C
3	Bicycle LOS Score for Link	3.66	3.94
3	Indicator Variable	1	1
3	Bicycle LOS Score for Intersection	3.19	2.21
3	Number of access point approaches	0	0
3	Segment Length, ft	1020	1020
3	Bicycle LOS Score for Segment	3.7	3.58
3	Bicycle Segment LOS	D	D
3	Transit Wait-Ride Score	3.82	3.02
3	Ped LOS Score for Link	3.19	4.31
3	Transit LOS Score for Segment	0.74	2.12
3	Transit Segment LOS	A	B

ACCESS POINT DATA

SEGMENT 1

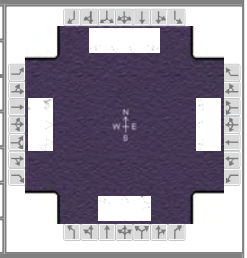
SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	578	16.7	21.4	1685	0	35	0	130	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Prop blocked	0	0	0	0	0	0	0	0	0	0	0	0
1: Thru veh delay		0.01			0							
1: Prob inside blk		0			0							
1: Dist to upstream signal	3030											

SEGMENT 3

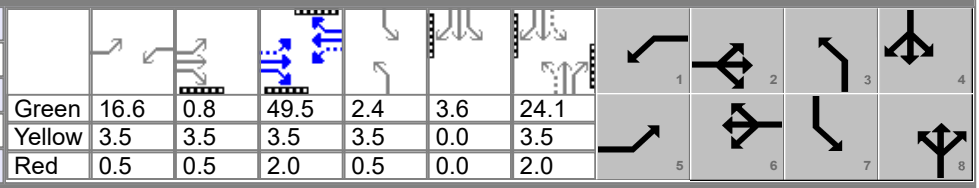
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	395	1300	280	230	285	240	25	275	150	230	570	70

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	16.6	0.8	49.5	2.4	3.6	24.1						
Yellow	3.5	3.5	3.5	3.5	0.0	3.5						
Red	0.5	0.5	2.0	0.5	0.0	2.0						

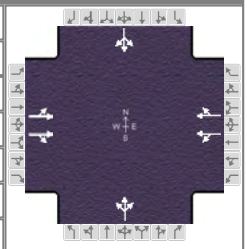
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	3.0
Phase Duration, s	25.4	59.8	20.6	55.0	6.4	29.6	10.0	33.2
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.1
Queue Clearance Time (g_s), s	19.9		16.4		3.6	15.6	8.0	24.0
Green Extension Time (g_e), s	1.5	0.0	0.2	0.0	0.0	4.2	0.0	3.7
Phase Call Probability	1.00		1.00		0.60	1.00	1.00	1.00
Max Out Probability	0.01		1.00		1.00	0.08	1.00	0.21

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	439	826	807	253	314	160	28	209	197	256	633	50
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1594	1674	1606	1594	1674	1418	1647	1730	1585	1647	1647	
Queue Service Time (g_s), s	17.9	54.3	54.3	14.4	13.5	7.1	1.6	13.2	13.6	6.0	22.0	
Cycle Queue Clearance Time (g_c), s	17.9	54.3	54.3	14.4	13.5	7.1	1.6	13.2	13.6	6.0	22.0	
Green Ratio (*g/C*)	0.61	0.45	0.45	0.55	0.41	0.41	0.22	0.20	0.20	0.26	0.23	
Capacity (*c*), veh/h	646	758	727	280	691	585	117	347	318	226	760	
Volume-to-Capacity Ratio (*X*)	0.679	1.090	1.111	0.903	0.455	0.273	0.237	0.601	0.619	1.131	0.834	
Back of Queue (*Q*), ft/ln (95 th percentile)	278.9	1231.2	1171.7	406.9	230	110.5	31.8	251.8	232.5	421.4	373.6	
Back of Queue (*Q*), veh/ln (95 th percentile)	10.4	45.9	46.9	15.2	8.6	4.1	1.2	9.7	9.3	16.2	14.4	
Queue Storage Ratio (*RQ*) (95 th percentile)	2.79	0.00	0.00	2.54	0.00	0.00	0.29	0.00	0.00	2.81	0.00	
Uniform Delay (d_1), s/veh	14.5	32.8	32.8	41.3	18.9	17.3	38.8	43.6	43.8	47.6	44.0	
Incremental Delay (d_2), s/veh	1.5	60.0	68.0	26.2	2.0	1.1	1.0	1.7	2.0	99.6	4.9	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	16.0	92.8	100.9	67.5	20.9	18.4	39.9	45.3	45.7	147.2	48.8	0.0
Level of Service (LOS)	B	F	F	E	C	B	D	D	D	F	D	A
Approach Delay, s/veh / LOS	79.7	E		36.6	D		45.1	D		73.0	E	
Intersection Delay, s/veh / LOS	67.1						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.3	C	3.4	C	2.9	C
Bicycle LOS Score / LOS	3.7	D	3.5	C	2.6	C	3.0	C

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	WAYLAND AVE	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	1615	45	20	725	25	20	0	5	95	5	10

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

							1	2	3	4
Green	97.5	11.9	0.0	0.0	0.0	0.0	5	6	7	8
Yellow	3.9	3.0	0.0	0.0	0.0	0.0				
Red	1.2	2.5	0.0	0.0	0.0	0.0				

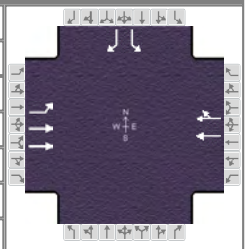
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		102.6		102.6		17.4		17.4
Change Period, ($Y+R_c$), s		5.1		5.1		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		4.2		4.2
Queue Clearance Time (g_s), s						4.0		11.6
Green Extension Time (g_e), s		0.0		0.0		0.4		0.4
Phase Call Probability						0.99		0.99
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	880		805	409		428		28			117	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1643		1514	1440		1513		1467			1430	
Queue Service Time (g_s), s	0.0		14.8	0.0		8.6		0.0			7.6	
Cycle Queue Clearance Time (g_c), s	14.5		14.8	7.1		8.6		2.0			9.6	
Green Ratio (*g/C*)	0.81		0.81	0.81		0.81		0.10			0.10	
Capacity (*c*), veh/h	1366		1231	1202		1229		199			199	
Volume-to-Capacity Ratio (*X*)	0.644		0.654	0.341		0.348		0.140			0.587	
Back of Queue (*Q*), ft/ln (95 th percentile)	67.2		62.2	82.5		89.6		36.2			165.8	
Back of Queue (*Q*), veh/ln (95 th percentile)	2.7		2.5	3.3		3.6		1.4			6.5	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00		0.00	0.00		0.00		0.00			0.00	
Uniform Delay (d_1), s/veh	1.8		1.8	2.7		2.8		49.6			53.0	
Incremental Delay (d_2), s/veh	0.2		0.2	0.6		0.6		0.3			2.7	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (*d*), s/veh	2.0		2.0	3.3		3.4		49.9			55.8	
Level of Service (LOS)	A		A	A		A		D			E	
Approach Delay, s/veh / LOS	2.0		A	3.3		A	49.9		D	55.8		E
Intersection Delay, s/veh / LOS	5.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	3.2	C	3.2	C
Bicycle LOS Score / LOS	3.7	D	2.9	C	2.7	C	2.9	C

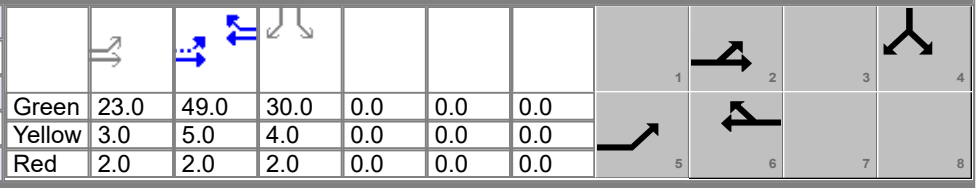
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	255	1490			730	190				240		60

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	65	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	23.0	49.0	30.0	0.0	0.0	0.0						
Yellow	3.0	5.0	4.0	0.0	0.0	0.0						
Red	2.0	2.0	2.0	0.0	0.0	0.0						

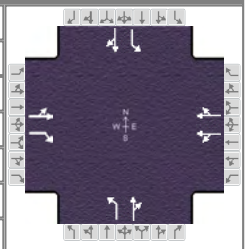
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				9.0
Phase Duration, s	28.0	84.0		56.0				36.0
Change Period, (*Y+R c*), s	5.0	7.0		7.0				6.0
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.2
Queue Clearance Time (*g s*), s	25.0							32.0
Green Extension 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	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	260	1520			481	458				267		67
Adjusted Saturation Flow Rate (*s*), veh/h/ln	645	1810			1814	1721				377		1440
Queue Service Time (*g s*), s	23.0	29.6			25.7	27.7				30.0		4.4
Cycle Queue Clearance Time (*g c*), s	23.0	29.6			25.7	27.7				30.0		4.4
Green Ratio (*g/C*)	0.62	0.64			0.41	0.41				0.25		0.25
Capacity (*c*), veh/h	224	2322			741	703				94		360
Volume-to-Capacity Ratio (*X*)	1.161	0.654			0.649	0.652				2.828		0.185
Back of Queue (*Q*), ft/ln (95 th percentile)	612.5	384.7			423.4	426.4				1965.8		69.9
Back of Queue (*Q*), veh/ln (95 th percentile)	14.9	15.4			16.9	17.1				43.7		2.8
Queue Storage Ratio (*RQ*) (95 th percentile)	7.66	0.00			0.00	0.00				19.66		0.00
Uniform Delay (*d 1*), s/veh	23.7	12.0			31.8	34.3				45.0		35.4
Incremental Delay (*d 2*), s/veh	102.1	1.0			2.7	2.9				851.3		0.2
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	125.8	13.0			34.5	37.3				896.3		35.6
Level of Service (LOS)	F	B			C	D				F		D
Approach Delay, s/veh / LOS	29.5	C		35.9	D		0.0			724.1	F	
Intersection Delay, s/veh / LOS	107.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.7	A	2.3	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.1	B	1.3	A				F

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	135	875	720	170	560	35	230	125	100	365	30	130

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	72.0	10.0	20.0	0.0	0.0	0.0	1	2	3	4		
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	5	6	7	8		
Red	2.0	2.0	2.0	0.0	0.0	0.0						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8	7	4
Case Number		7.0		8.0		6.3	1.0	4.0
Phase Duration, s		78.0		78.0		26.0	16.0	42.0
Change Period, (*Y+R c*), s		6.0		6.0		6.0	6.0	6.0
Max Allow Headway (*MAH*), s		0.0		0.0		6.3	6.0	6.3
Queue Clearance Time (*g s*), s						22.0	12.0	10.0
Green Extension Time (*g e*), s		0.0		0.0		0.0	0.0	5.3
Phase Call Probability						1.00	1.00	1.00
Max Out Probability						1.00	1.00	0.05

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		906	386	189		644	256	206		406	122	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		955	1408	445		1568	1239	1577		1594	1409	
Queue Service Time (*g s*), s		38.5	23.9	0.0		33.5	20.0	15.0		10.0	8.0	
Cycle Queue Clearance Time (*g c*), s		72.0	23.9	35.4		33.5	20.0	15.0		10.0	8.0	
Green Ratio (*g/C*)		0.60	0.60	0.60		0.60	0.17	0.17		0.27	0.30	
Capacity (*c*), veh/h		607	845	327		941	266	263		239	423	
Volume-to-Capacity Ratio (*X*)		1.494	0.457	0.578		0.685	0.959	0.782		1.695	0.289	
Back of Queue (*Q*), ft/ln (95 th percentile)		2171.6	287.7	181		449.1	429.3	296.9		1026.3	131.9	
Back of Queue (*Q*), veh/ln (95 th percentile)		81.0	10.7	7.2		18.0	16.5	11.4		38.3	4.9	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.00		0.00	2.86	0.00		10.26	0.00	
Uniform Delay (*d 1*), s/veh		46.5	21.3	16.7		16.7	51.9	47.9		44.5	32.2	
Incremental Delay (*d 2*), s/veh		223.4	0.3	7.3		4.0	44.4	16.2		330.4	0.8	
Initial Queue Delay (*d 3*), s/veh		0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		269.9	21.6	23.9		20.8	96.3	64.1		374.9	33.0	
Level of Service (LOS)		F	C	C		C	F	E		F	C	
Approach Delay, s/veh / LOS	195.8	F		21.5	C		81.9	F		295.7	F	
Intersection Delay, s/veh / LOS	149.2						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	C	2.6	C	2.9	C	3.9	D
Bicycle LOS Score / LOS	5.0	E	1.3	A	2.9	C	3.0	C

HCS7 Two-Way Stop-Control Report

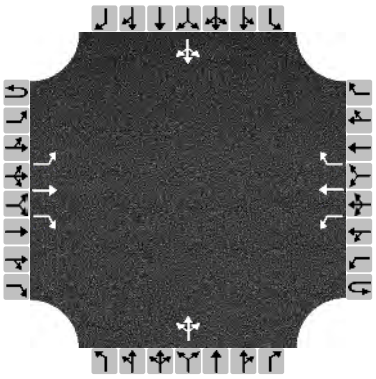
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/8/2018
Analysis Year	2045
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BAHNSON AVENUE
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	RICE STREET
North/South Street	BAHNSON AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	1	0	1	1	1		0	1	0		0	1	0
Configuration		L	T	R		L	T	R			LTR				LTR	
Volume, V (veh/h)		25	1290	25		5	655	5		30	5	5		10	10	80
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.13				4.13				7.13	6.53	6.23		7.13	6.53	6.23
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23				2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		28				6					45				111	
Capacity, c (veh/h)		866				459					21				120	
v/c Ratio		0.03				0.01					2.14				0.92	
95% Queue Length, Q_{95} (veh)		0.1				0.0					5.9				5.9	
Control Delay (s/veh)		9.3				12.9					911.3				130.8	
Level of Service, LOS		A				B					F				F	
Approach Delay (s/veh)		0.2				0.1				911.3				130.8		
Approach LOS										F				F		

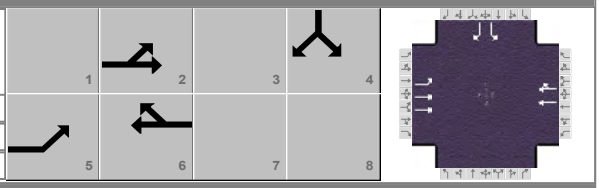
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Parclo AB-2Q
Analyst	RL	Analysis Date	Mar 8, 2018	Segment Distance, ft	1020
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	RICE PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	255	1490			730	190				240		60
Intersection Two Demand (*v*), veh/h	135	875	720	170	560	35	230	125	100	365	30	130

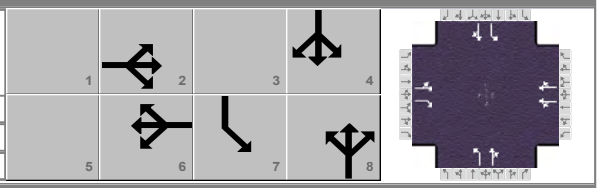
Signal One Information	
Cycle, s	120.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	23.0	49.0	30.0	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



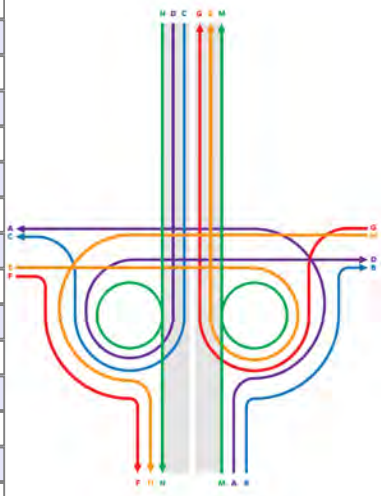
Signal Two Information	
Cycle, s	120.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	72.0	10.0	20.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Interchange Results

O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	131	130.8	0.0	130.8	No	Yes	F
B	67	64.1	0.0	64.1	No	No	D
C	0	0.0	5.0	5.0	No	No	A
D	0	0.0	5.0	5.0	No	No	A
E	386	34.6	5.0	39.6	Yes	No	C
F	0	13.0	0.0	13.0	No	No	A
G	189	23.9	5.0	28.9	No	No	B
H	0	0.0	0.0	0.0	No	No	A
I	910	13.0	0.0	13.0	Yes	No	A
J	556	34.5	0.0	34.5	No	No	C
K	-	-	0.0	-	-	-	-
L	-	-	0.0	-	-	-	-
M	125	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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	125.8	13.0			34.5	37.3				896.3		35.6
Level of Service (LOS)	F	B			C	D				F		D
Approach Delay, s/veh / LOS	29.5	C		35.9	D		0.0			724.1	F	
Intersection Delay, s/veh / LOS	107.3						F					

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		269.9	21.6	23.9		20.8	96.3	64.1		374.9	33.0	
Level of Service (LOS)		F	C	C		C	F	E		F	C	
Approach Delay, s/veh / LOS	195.8	F		21.5	C		81.9	F		295.7	F	
Intersection Delay, s/veh / LOS	149.2						F					

This Urban Streets text report was created on March 12, 2018 at 10:31:40

Period number = 1

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	120
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	95
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	0.51
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

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	35	35	2	1	1020	1020	50	50	0	0	70	70	0	0
2	35	35	2	2	3460	3460	50	50	0	0	70	70	0	0
3	35	35	1	2	1020	1020	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1700	15	80	710	0	60	0	45	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Location, ft	3030											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 3

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				999.22		
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		20.78			20.75	
1	Running Speed, mph		33.47			33.52	
1	Through Delay, s/veh		1.99			20.91	
1	Travel Speed, mph		30.54			16.7	
1	Stop Rate, stops/veh		0.07			0.48	
1	Spatial Stop Rate, stops/mi		0.34			2.48	
1	Through vol/cap ratio		0.65			0.45	
1	Percent of Base FFS		73.21			40.02	
1	Level of Service		B			D	
1	Automobile Perception Score		2.4			2.76	
2	Bay/Lane Spillback Time, h	0.09	999	999	999	999	999
2	ShrdLane Spillback Time, h	2.85					
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		60.68			58.94	
2	Running Speed, mph		38.88			40.03	
2	Through Delay, s/veh		13.04			3.35	
2	Travel Speed, mph		32			37.88	
2	Stop Rate, stops/veh		0.43			0.14	
2	Spatial Stop Rate, stops/mi		0.65			0.21	
2	Through vol/cap ratio		0.65			0.34	
2	Percent of Base FFS		76.7			90.78	
2	Level of Service		B			A	
2	Automobile Perception Score		2.34			2.27	
3	Bay/Lane Spillback Time, h	0	0.14	999	999	999	999
3	ShrdLane Spillback Time, h						
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		22.76			20.29	
3	Running Speed, mph		30.55			34.28	
3	Through Delay, s/veh		269.93			35.64	
3	Travel Speed, mph		2.38			12.43	
3	Stop Rate, stops/veh		2.04			0.79	
3	Spatial Stop Rate, stops/mi		10.58			4.1	
3	Through vol/cap ratio		1.49			0.65	
3	Percent of Base FFS		5.7			29.8	
3	Level of Service		F			F	
3	Automobile Perception Score		4.32			3.05	
Facility Travel Time, s			389.18			159.87	
Facility Travel Speed, mph			9.64			23.46	
Facility Spatial Stop Rate, veh/mi			2.44			1.35	
Facility Base Free Flow Speed, mph			41.72			41.72	
Facility Percent Base Free Flow Speed			23.1			56.22	
Facility Level of Service			F			C	
Facility Automobile Perception Score			2.57			2.47	
Facility Pedestrian Space			Infinity			Infinity	
Facility Pedestrian Travel Speed			4.4			4.4	
Facility Pedestrian LOS Score			3.86			3.61	
Facility Pedestrian LOS			D			D	
Facility Bicycle Travel Speed			13.5			13.26	
Facility Bicycle LOS Score			3.91			3.62	
Facility Bicycle LOS			D			D	
Facility Transit Travel Speed			30.55			12.69	
Facility Transit LOS Score			1.01			1.11	
Facility Transit LOS			A			A	
SPILLBACK TIME, h			0.14				

Multimodal Results

1	Roadway crossing difficulty factor	1.2	1.2
1	Ped LOS Score for Link	3.71	3.66
1	Ped LOS Score for Intersection	2.17	3.27
1	Ped LOS Score for Segment	3.9	4.19
1	Ped Segment LOS	D	D
1	Bicycle LOS Score for Link	3.82	3.8
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	3.69	3.47
1	Number of access point approaches	0	0
1	Segment Length, ft	1020	1020
1	Bicycle LOS Score for Segment	3.9	3.81
1	Bicycle Segment LOS	D	D
1	Transit Wait-Ride Score	3.8	2.92
1	Ped LOS Score for Link	3.71	3.66
1	Transit LOS Score for Segment	0.86	2.17
1	Transit Segment LOS	A	B
2	Roadway crossing difficulty factor	1.2	1.2
2	Ped LOS Score for Link	3.92	2.96
2	Ped LOS Score for Intersection	0.68	2.19
2	Ped LOS Score for Segment	3.6	3.63
2	Ped Segment LOS	D	D
2	Bicycle LOS Score for Link	3.9	3.57
2	Indicator Variable	1	1
2	Bicycle LOS Score for Intersection	2.09	2.87
2	Number of access point approaches	0	0
2	Segment Length, ft	3460	3460
2	Bicycle LOS Score for Segment	3.56	3.61
2	Bicycle Segment LOS	D	D
2	Transit Wait-Ride Score	3.74	4.04
2	Ped LOS Score for Link	3.92	2.96
2	Transit LOS Score for Segment	0.98	0.39
2	Transit Segment LOS	A	A
3	Roadway crossing difficulty factor	1.2	0.98
3	Ped LOS Score for Link	5.37	2.95
3	Ped LOS Score for Intersection	2.64	2.28
3	Ped LOS Score for Segment	4.67	2.97
3	Ped Segment LOS	E	C
3	Bicycle LOS Score for Link	4.09	3.57
3	Indicator Variable	1	1
3	Bicycle LOS Score for Intersection	4.96	1.26
3	Number of access point approaches	0	0
3	Segment Length, ft	1020	1020
3	Bicycle LOS Score for Segment	5.08	3.46
3	Bicycle Segment LOS	F	C
3	Transit Wait-Ride Score	3.68	2.61
3	Ped LOS Score for Link	5.37	2.95
3	Transit LOS Score for Segment	1.29	2.52
3	Transit Segment LOS	A	B

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1735	15.3	88.9	789	0	60	0	45	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Prop blocked	0	0	0	0.15	0	0	0.15	0.15	0.15	0.15	0.15	0
1: Thru veh delay		0.02			0							
1: Prob inside blk		0			0							
1: Dist to upstream signal	3030											

SEGMENT 3

V. 2045 Freeway Analysis – Mainline

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes (N), ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Volume (V), veh/h	740	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor (PHF)	0.90	Flow Rate (v_p), pc/h/ln	452
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Capacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.20
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	6.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1430	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	874
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.38
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	13.0
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1250	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	764
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.33
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	11.4
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1660	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	658
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.29
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	9.8
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1525	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	906
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.39
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	13.5
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	2240	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	1331
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.58
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.1
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	19.8
Total Ramp Density Adjustment	-	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	2670	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	1058
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.46
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	15.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	860	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	526
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.23
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	7.8
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

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Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	955	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	584
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.25
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	8.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	520	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	318
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.14
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	4.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
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Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1370	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	838
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.36
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	12.5
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	3010	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	1192
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.52
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	17.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

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Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	2710	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	1610
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.70
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	65.2
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	24.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	C
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

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Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1105	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	656
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.29
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	9.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	3	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1400	Heavy Vehicle Adjustment Factor (f_{HV})	0.935
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	555
Total Trucks, %	7.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.24
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	8.2
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	925	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	566
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.25
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	8.4
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

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Project Information

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Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1210	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	740
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.32
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	11.0
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

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Project Information

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Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	740	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	452
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.20
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	6.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	755	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	462
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.20
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	6.9
Total Ramp Density Adjustment	-	Level of Service (LOS)	A
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

HCS7 Basic Freeway Report

Project Information

Analyst	RL	Date	5/03/2018
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Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON ROAD IMJR		

Geometric Data

Number of Lanes, ln	2	Terrain Type	Level
Segment Length (L), ft	-	Percent Grade, %	-
Measured or Base Free-Flow Speed	Measured	Grade Length, mi	-
Base Free-Flow Speed (BFFS), mi/h	69.0	Total Ramp Density (TRD), ramps/mi	-
Lane Width, ft	-	Free-Flow Speed (FFS), mi/h	69.0
Right-Side Lateral Clearance, ft	-		

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

Demand Volume veh/h	1510	Heavy Vehicle Adjustment Factor (f_{HV})	0.909
Peak Hour Factor	0.90	Flow Rate (V_p), pc/h/ln	923
Total Trucks, %	10.00	Capacity (c), pc/h/ln	2373
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	2297
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.40
Passenger Car Equivalent (E_T)	2.000		

Speed and Density

Lane Width Adjustment (f_{LW})	-	Average Speed (S), mi/h	67.3
Right-Side Lateral Clearance Adj. (f_{RLC})	-	Density (D), pc/mi/ln	13.7
Total Ramp Density Adjustment	-	Level of Service (LOS)	B
Adjusted Free-Flow Speed (FFS_{adj}), mi/h	67.3		

VI. 2045 Freeway Analysis – Ramps

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1750	250
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	155	600
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	2.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.980	0.909
Flow Rate (v_i), pc/h	176	733
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.20	0.38

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.7
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.314
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	59.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	176	Ramp Junction Speed (S), mi/h	59.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	909	Average Density (D), pc/mi/ln	7.7
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Volume (V_i), veh/h	740	690
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	905	843
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.38	0.41

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	9.4
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.212
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.9
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	905	Ramp Junction Speed (S), mi/h	61.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1748	Average Density (D), pc/mi/ln	14.1
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1430	180
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1748	220
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.38	0.11

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	16.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.332
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	58.9
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1748	Ramp Junction Speed (S), mi/h	58.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	14.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3655	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1250	410
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1485	519
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.44	0.26

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	11.5
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.218
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.8
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1485	Ramp Junction Speed (S), mi/h	61.8
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	2004	Average Density (D), pc/mi/ln	16.2
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5705	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	1660	135
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1973	171
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.29	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	3.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.328
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	535
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	59.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.703	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	1438	Ramp Junction Speed (S), mi/h	62.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	10.5
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1080	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	1525	690
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1812	874
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.59	0.45

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	16.7
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.276
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	60.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1812	Ramp Junction Speed (S), mi/h	60.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	2686	Average Density (D), pc/mi/ln	22.3
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5500	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	2545	305
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	3024	386
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.44	0.19

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	9.2
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.347
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	878
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.5
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.667	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	2146	Ramp Junction Speed (S), mi/h	62.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	16.2
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1000	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	2240	430
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	2662	545
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.70	0.27

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	20.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.286
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	60.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	2662	Ramp Junction Speed (S), mi/h	60.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	3207	Average Density (D), pc/mi/ln	26.7
Level of Service (LOS)	C		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	2
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5195	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	2670	1810
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	3173	2293
Capacity (c), pc/h	6824	4066
Volume-to-Capacity Ratio (v/c)	0.46	0.56

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	13.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.519
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	484
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	54.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.450	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	2689	Ramp Junction Speed (S), mi/h	56.5
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	18.7
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	860	95
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1051	116
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.26	0.06

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.241
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1051	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1167	Average Density (D), pc/mi/ln	9.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	5/11/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229 BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	1500	550
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	955	435
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1167	532
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.26	0.26

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	9.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.360
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	58.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1167	Ramp Junction Speed (S), mi/h	58.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	10.0
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Deceleration Length (L_D), ft	1885	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	520	400
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	636	489
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.14	0.25

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	0.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.484
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	55.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	636	Ramp Junction Speed (S), mi/h	55.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	5.8
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1750	250
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	155	600
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	2.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.980	0.909
Flow Rate (v_i), pc/h	176	733
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.20	0.38

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.7
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.314
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	59.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	176	Ramp Junction Speed (S), mi/h	59.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	909	Average Density (D), pc/mi/ln	7.7
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1500	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	755	755
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	923	923
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.41	0.45

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.214
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.9
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	923	Ramp Junction Speed (S), mi/h	61.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1846	Average Density (D), pc/mi/ln	14.9
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1510	140
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1846	171
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.41	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	17.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.328
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1846	Ramp Junction Speed (S), mi/h	59.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	15.6
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3655	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1370	1640
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1628	2078
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.81	1.02

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	24.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	-
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	58.5
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1628	Ramp Junction Speed (S), mi/h	-
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	3706	Average Density (D), pc/mi/ln	-
Level of Service (LOS)	F		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5705	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	3010	305
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	3577	386
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.52	0.19

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.347
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	1107
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.5
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.653	Outer Lanes Freeway Speed (S_O), mi/h	73.4
Flow in Lanes 1 and 2 (v_{12}), pc/h	2470	Ramp Junction Speed (S), mi/h	62.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	19.1
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Acceleration Length (L_A), ft	1080	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	2710	455
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	3220	576
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.83	0.30

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	25.5
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.392
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	57.4
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	3220	Ramp Junction Speed (S), mi/h	57.4
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	3796	Average Density (D), pc/mi/ln	33.1
Level of Service (LOS)	C		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5500	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1630	525
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1937	665
Capacity (c), pc/h	6824	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.33

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	3.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.372
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	406
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	57.9
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.681	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	1531	Ramp Junction Speed (S), mi/h	60.6
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	10.7
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	2/26/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	1000	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	1105	295
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1313	374
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.37	0.18

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	9.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.210
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	62.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1313	Ramp Junction Speed (S), mi/h	62.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1687	Average Density (D), pc/mi/ln	13.6
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	3	2
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	5195	1500
Terrain Type	Level	Rolling
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1400	475
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	7.00	7.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877
Flow Rate (v_i), pc/h	1664	602
Capacity (c), pc/h	6824	4066
Volume-to-Capacity Ratio (v/c)	0.24	0.15

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	0.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.366
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	584
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.450	Outer Lanes Freeway Speed (S_O), mi/h	73.8
Flow in Lanes 1 and 2 (v_{12}), pc/h	1080	Ramp Junction Speed (S), mi/h	62.7
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	8.8
Level of Service (LOS)	A		

HCS7 Freeway Merge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	925	285
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1131	348
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.33	0.17

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.246
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1131	Ramp Junction Speed (S), mi/h	61.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1479	Average Density (D), pc/mi/ln	12.1
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	4075	550
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1210	470
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1479	575
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.33	0.28

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.364
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	10000	Off-Ramp Influence Area Speed (S_R), mi/h	58.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1479	Ramp Junction Speed (S), mi/h	58.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	12.7
Level of Service (LOS)	B		

HCS7 Freeway Diverge Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	35.0
Segment Length (L) / Deceleration Length (L_D), ft	1885	1500
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	740	430
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	905	526
Capacity (c), pc/h	4550	1936
Volume-to-Capacity Ratio (v/c)	0.20	0.27

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	0.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.487
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	55.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	905	Ramp Junction Speed (S), mi/h	55.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	8.2
Level of Service (LOS)	A		

VII. 2045 Freeway Analysis – Weaving

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	5705	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1130	395	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1343	500	19	152

Weaving Flow Rate (v_w), pc/h	652	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1362	Density-Based Capacity (c_{IWL}), pc/h/ln	2362
Total Flow Rate (v), pc/h	2014	Demand Flow-Based Capacity (c_{IW}), pc/h	7407
Volume Ratio (VR)	0.324	Weaving Segment Capacity (c_W), veh/h	6625
Minimum Lane Change Rate (LC_{MIN}), lc/h	652	Adjusted Weaving Area Capacity, pc/h	7003
Maximum Weaving Length (L_{MAX}), ft	5843	Volume-to-Capacity Ratio (v/c)	0.29

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	513	Average Weaving Speed (S_W), mi/h	61.0
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1993	Average Non-Weaving Speed (S_{NW}), mi/h	59.4
Weaving Lane Change Rate (LC_W), lc/h	1039	Average Speed (S), mi/h	59.9
Total Lane Change Rate (LC_{All}), lc/h	3032	Density (D), pc/mi/ln	11.2
Weaving Intensity Factor (W)	0.137	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	5705	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1100	1610	30	270
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1307	2040	38	342

Weaving Flow Rate (v_w), pc/h	2382	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1345	Density-Based Capacity (c_{IWL}), pc/h/ln	2083
Total Flow Rate (v), pc/h	3727	Demand Flow-Based Capacity (c_{IW}), pc/h	3756
Volume Ratio (VR)	0.639	Weaving Segment Capacity (c_W), veh/h	3512
Minimum Lane Change Rate (LC_{MIN}), lc/h	2382	Adjusted Weaving Area Capacity, pc/h	3789
Maximum Weaving Length (L_{MAX}), ft	9496	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	506	Average Weaving Speed (S_W), mi/h	58.7
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1989	Average Non-Weaving Speed (S_{NW}), mi/h	44.2
Weaving Lane Change Rate (LC_W), lc/h	2769	Average Speed (S), mi/h	52.5
Total Lane Change Rate (LC_{All}), lc/h	4758	Density (D), pc/mi/ln	23.7
Weaving Intensity Factor (W)	0.196	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	605	255	175	1635
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	719	323	222	2071

Weaving Flow Rate (v_w), pc/h	2394	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	941	Density-Based Capacity (c_{IWL}), pc/h/ln	1940
Total Flow Rate (v), pc/h	3335	Demand Flow-Based Capacity (c_{IW}), pc/h	3343
Volume Ratio (VR)	0.718	Weaving Segment Capacity (c_W), veh/h	3125
Minimum Lane Change Rate (LC_{MIN}), lc/h	323	Adjusted Weaving Area Capacity, pc/h	3401
Maximum Weaving Length (L_{MAX}), ft	10484	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	299	Average Weaving Speed (S_W), mi/h	61.0
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1899	Average Non-Weaving Speed (S_{NW}), mi/h	59.6
Weaving Lane Change Rate (LC_W), lc/h	677	Average Speed (S), mi/h	60.6
Total Lane Change Rate (LC_{All}), lc/h	2576	Density (D), pc/mi/ln	18.3
Weaving Intensity Factor (W)	0.138	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	750	175	120	355
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	891	222	152	450

Weaving Flow Rate (v_w), pc/h	672	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1043	Density-Based Capacity (c_{IWL}), pc/h/ln	2237
Total Flow Rate (v), pc/h	1715	Demand Flow-Based Capacity (c_{IW}), pc/h	6122
Volume Ratio (VR)	0.392	Weaving Segment Capacity (c_W), veh/h	5724
Minimum Lane Change Rate (LC_{MIN}), lc/h	672	Adjusted Weaving Area Capacity, pc/h	6109
Maximum Weaving Length (L_{MAX}), ft	6592	Volume-to-Capacity Ratio (v/c)	0.28

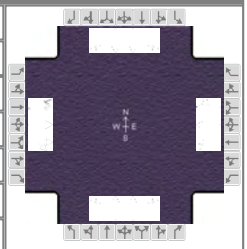
Speed and Density

Non-Weaving Vehicle Index (I_{NW})	332	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1922	Average Non-Weaving Speed (S_{NW}), mi/h	59.7
Weaving Lane Change Rate (LC_W), lc/h	1026	Average Speed (S), mi/h	60.0
Total Lane Change Rate (LC_{All}), lc/h	2948	Density (D), pc/mi/ln	9.5
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	A

VIII. 2045 Arterial Analysis

HCS7 Signalized Intersection Results Summary

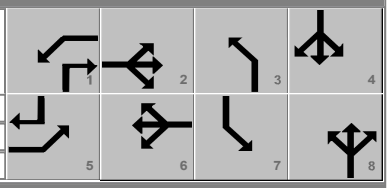
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	105	445	90	70	730	370	95	245	70	120	275	155

Signal Information			
Cycle, s	80.0	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	2.7	2.0	37.3	4.0	15.0	0.0	
Yellow	3.0	0.0	3.5	3.0	3.5	0.0	
Red	1.0	0.0	2.0	1.0	2.0	0.0	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	8.7	44.8	6.7	42.8	8.0	20.5	8.0	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	4.9		3.3		6.0	7.9	6.0	8.6
Green Extension Time (g_e), s	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.93		0.67		0.90	1.00	0.95	1.00
Max Out Probability	1.00		1.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	117	282	273	50	351	325	106	272	44	133	306	106
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1663	1647	1730	1592	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	2.9	7.9	8.0	1.3	6.5	5.6	4.0	5.9	1.9	4.0	6.6	4.7
Cycle Queue Clearance Time (g_c), s	2.9	7.9	8.0	1.3	6.5	5.6	4.0	5.9	1.9	4.0	6.6	4.7
Green Ratio (*g/C*)	0.53	0.49	0.49	0.50	0.47	0.47	0.24	0.19	0.22	0.24	0.19	0.25
Capacity (*c*), veh/h	473	850	817	450	807	743	256	618	324	269	618	361
Volume-to-Capacity Ratio (*X*)	0.247	0.332	0.334	0.111	0.435	0.438	0.413	0.441	0.137	0.496	0.495	0.293
Back of Queue (*Q*), ft/ln (95 th percentile)	44.5	136.7	128.4	20	95.5	72	76.5	102.7	30.2	29.7	116.7	72.1
Back of Queue (*Q*), veh/ln (95 th percentile)	1.7	5.3	5.1	0.8	3.7	2.9	2.9	3.9	1.2	1.1	4.5	2.8
Queue Storage Ratio (*RQ*) (95 th percentile)	0.23	0.00	0.00	0.14	0.00	0.00	0.26	0.00	0.13	0.08	0.00	0.23
Uniform Delay (d_1), s/veh	10.0	12.4	12.4	11.1	6.8	5.4	25.7	28.8	25.0	27.6	29.1	24.5
Incremental Delay (d_2), s/veh	0.4	1.0	1.1	0.1	1.5	1.6	1.5	0.2	0.1	2.0	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	0.0	0.0
Control Delay (*d*), s/veh	10.4	13.4	13.5	11.2	8.2	7.0	27.2	29.0	25.1	29.6	29.3	24.7
Level of Service (LOS)	B	B	B	B	A	A	C	C	C	C	C	C
Approach Delay, s/veh / LOS	12.9	B		7.9	A		28.1	C		28.5	C	
Intersection Delay, s/veh / LOS	17.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.3	C	3.4	C	3.2	C
Bicycle LOS Score / LOS	2.8	C	3.2	C	2.7	C	2.8	C

HCS7 Two-Way Stop-Control Report

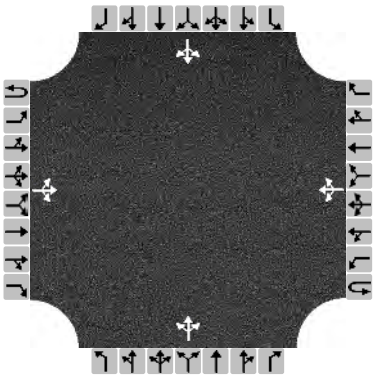
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/8/2018
Analysis Year	2045
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/HALL
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	HALL AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		95	140	20		20	495	20		30	5	10		10	10	50
Percent Heavy Vehicles (%)		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.15				4.15				7.15	6.55	6.25		7.15	6.55	6.25
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.24				2.24				3.54	4.04	3.34		3.54	4.04	3.34

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		106				22					50				78	
Capacity, c (veh/h)		988				1383					205				359	
v/c Ratio		0.11				0.02					0.24				0.22	
95% Queue Length, Q_{95} (veh)		0.4				0.0					0.9				0.8	
Control Delay (s/veh)		9.1				7.6					28.1				17.8	
Level of Service, LOS		A				A					D				C	
Approach Delay (s/veh)		4.1				0.5				28.1				17.8		
Approach LOS										D				C		

HCS7 Two-Way Stop-Control Report

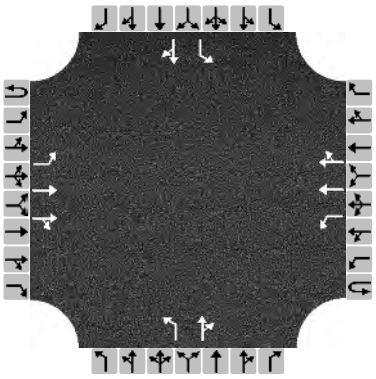
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/8/2018
Analysis Year	2045
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume, V (veh/h)		25	535	55		165	1875	365		10	5	110		5	0	10
Percent Heavy Vehicles (%)		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.20				4.20				7.60	6.60	7.00		7.60	6.60	7.00
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.25				2.25				3.55	4.05	3.35		3.55	4.05	3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		28				183				11		128		6		11
Capacity, c (veh/h)		173				908				20		71		0		162
v/c Ratio		0.16				0.20				0.54		1.81				0.07
95% Queue Length, Q_{95} (veh)		0.6				0.8				1.5		11.4				0.2
Control Delay (s/veh)		29.8				10.0				313.4		511.6				28.9
Level of Service, LOS		D				A				F		F				D
Approach Delay (s/veh)		1.2				0.7				495.9						
Approach LOS										F						

HCS 2010 Two-Way Stop Control Summary Report

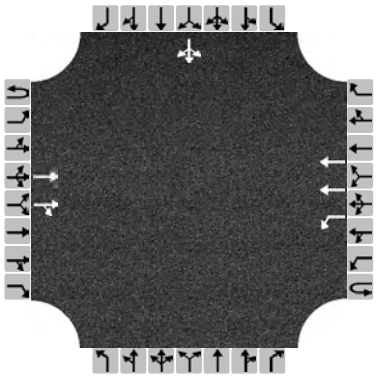
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/8/2018
Analysis Year	2045
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/I-229 SB
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	I-229 SB
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

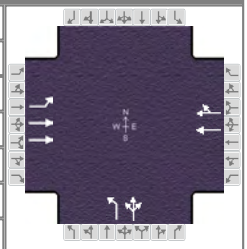
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	1	2	0		0	0	0		0	1	0
Configuration			T	TR		L	T								LTR	
Volume (veh/h)			305	345		65	2235							10	0	170
Percent Heavy Vehicles						5								5	5	5
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						72									200	
Capacity						856									100	
v/c Ratio						0.08									2.00	
95% Queue Length						0.3									16.9	
Control Delay (s/veh)						9.6									555.4	
Level of Service (LOS)						A									F	
Approach Delay (s/veh)					0.3								555.4			
Approach LOS													F			

HCS 2010 Signalized Intersection Results Summary

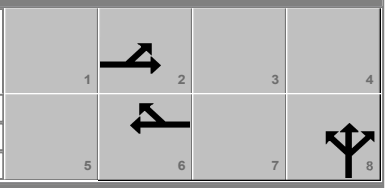
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	75	240			615	20	1685	0	125			

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	18.5	50.5	0.0	0.0	0.0	0.0	
Yellow	3.5	3.5	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		8.0		10.0		
Phase Duration, s		24.0		24.0		56.0		
Change Period, (*Y+R c*), s		5.5		5.5		5.5		
Max Allow Headway (*MAH*), s		0.0		0.0		5.0		
Queue Clearance Time (*g s*), s						52.5		
Green Extension Time (*g e*), s		0.0		0.0		0.0		
Phase Call Probability						1.00		
Max Out Probability						1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	81	260			351	349	1872	133				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	722	1546			1661	1646	1633	1376				
Queue Service Time (*g s*), s	2.0	5.8			15.9	16.5	50.5	3.2				
Cycle Queue Clearance Time (*g c*), s	18.5	5.8			15.9	16.5	50.5	3.2				
Green Ratio (*g/C*)	0.23	0.23			0.23	0.23	0.63	0.63				
Capacity (*c*), veh/h	108	715			384	381	1031	869				
Volume-to-Capacity Ratio (*X*)	0.754	0.364			0.915	0.916	1.817	0.153				
Back of Queue (*Q*), ft/ln (95 th percentile)	126	102			367.8	352.6	5014.1	31.9				
Back of Queue (*Q*), veh/ln (95 th percentile)	4.8	3.9			14.1	14.1	192.8	1.3				
Queue Storage Ratio (*RQ*) (95 th percentile)	1.26	0.00			0.00	0.00	0.00	0.00				
Uniform Delay (*d 1*), s/veh	42.3	27.0			30.0	30.0	14.8	6.0				
Incremental Delay (*d 2*), s/veh	36.2	1.3			28.7	29.1	371.3	0.1				
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0	0.0	0.0				
Control Delay (*d*), s/veh	78.5	28.4			58.7	59.1	386.1	6.1				
Level of Service (LOS)	E	C			E	E	F	A				
Approach Delay, s/veh / LOS	40.3	D		58.9	E		360.8	F		0.0		
Intersection Delay, s/veh / LOS	255.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	1.9	A	2.9	C	3.3	C
Bicycle LOS Score / LOS	2.8	C	3.1	C	5.5	F		

HCS 2010 Two-Way Stop Control Summary Report

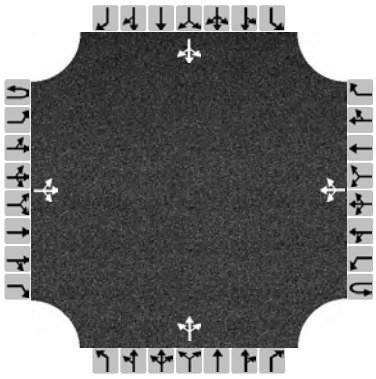
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/8/2018
Analysis Year	2045
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/HALL
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	HALL AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		95	140	130		85	495	20		90	5	40		10	10	50
Percent Heavy Vehicles		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		106				94					150				78	
Capacity		988				1247					145				273	
v/c Ratio		0.11				0.08					1.04				0.29	
95% Queue Length		0.4				0.2					7.8				1.1	
Control Delay (s/veh)		9.1				8.1					145.8				23.3	
Level of Service (LOS)		A				A					F				C	
Approach Delay (s/veh)	3.3				1.9				145.8				23.3			
Approach LOS									F				C			

HCS7 Streets Text Report

File Name:	BENSON AM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Mar 8, 2018
Time Period:	AM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2045
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	3
Number of Segments	2
Analysis period duration, h	0.25
System cycle length, s	80
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	2955	2955	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	615	20	0	1170	175	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 2

Movement	EB LT 1	EB TH 2	EB RT 3	WB LT 4	WB TH 5	WB RT 6	NB LT 7	NB TH 8	NB RT 9	SB LT 10	SB TH 11	SB RT 12
1: Volume, veh/h	0	590	0	0	1825	70	0	0	0	25	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	25	535	55	165	1875	365	10	5	110	5	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	305	345	15	2235	0	0	0	0	10	0	170
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.28			43.78	
1	Running Speed, mph		41.67			41.2	
1	Through Delay, s/veh		6.69			7.85	
1	Travel Speed, mph		36.1			34.93	
1	Stop Rate, stops/veh		0.26			0.25	
1	Spatial Stop Rate, stops/mi		0.51			0.49	
1	Through vol/cap ratio		0.25			0.46	
1	Percent of Base FFS		81.9			79.26	
1	Level of Service		A			B	
1	Automobile Perception Score		2.22			2.21	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		47.95			49.74	
2	Running Speed, mph		42.02			40.51	
2	Through Delay, s/veh		28.36			12.98	
2	Travel Speed, mph		26.41			32.13	
2	Stop Rate, stops/veh		0.75			0.47	
2	Spatial Stop Rate, stops/mi		1.34			0.85	
2	Through vol/cap ratio		0.36			0.52	
2	Percent of Base FFS		59.91			72.9	
2	Level of Service		C			B	
2	Automobile Perception Score		2.4			2.37	

Facility Travel Time, s	126.27	114.34
Facility Travel Speed, mph	30.24	33.39
Facility Spatial Stop Rate, stops/mi	0.95	0.68
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	68.62	75.77
Facility Level of Service	B	B
Facility Automobile Perception Score	2.31	2.29
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.25	4.25
Facility Pedestrian LOS Score	3.1	3.82
Facility Pedestrian LOS	C	D
Facility Bicycle Travel Speed	14.02	13.3
Facility Bicycle LOS Score	2.73	3.05
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	35.99	34.67
Facility Transit LOS Score	0.9	0.85
Facility Transit LOS	A	A

SPILLBACK TIME, h 999

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.15	4.15
1	Ped LOS Score for Intersection	2.01	2.87
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.8	1.21
1	Speed Adjustment Factor	0.69	0.68
1	Ped LOS Score for Link	2.8	3.2
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.07	1
1	Ped LOS Score for Segment	3.09	3.25
1	Ped Segment LOS	C	C
1	Bicycle Travel Speed	13.81	13.97
1	Bicycle LOS Score for Intersection	2.81	3.2
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.27	2.48
1	Speed Adjustment Factor	0.85	0.84
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.17	3.38
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.75	2.91
1	Bicycle Segment LOS	B	C
1	Transit Running Speed, mi/h	41.67	41.2
1	g/C Ratio	0.57	0.47
1	Transit Running Time, s	43.28	43.78
1	Delay at Intersection, s/veh	6.82	8.23
1	Transit Travel Speed, mi/h	35.99	34.67
1	Transit Wait-Ride Score	3.9	3.85
1	Ped LOS Score for Link	2.8	3.2
1	Transit LOS Score for Segment	0.57	0.71
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.35	4.34
2	Ped LOS Score for Intersection	3.18	2.64
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.75	1.96
2	Speed Adjustment Factor	0.71	0.66
2	Ped LOS Score for Link	2.76	3.92
2	Ped Link LOS	C	D
2	Roadway Crossing Difficulty Factor	1.09	1.18
2	Ped LOS Score for Segment	3.12	4.33
2	Ped Segment LOS	C	E
2	Bicycle Travel Speed	14.22	12.76
2	Bicycle LOS Score for Intersection	2.77	3.79
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.23	2.72
2	Speed Adjustment Factor	0.85	0.83
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.14	3.62
2	Bicycle Link LOS	C	D
2	Number of access point approaches	0	0
2	Segment Length, ft	2955	2955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.72	3.17
2	Bicycle Segment LOS	B	C
2	Transit Running Speed, mi/h	42.02	40.51
2	g/C Ratio	0.23	0.53
2	Transit Running Time, s	47.95	49.74
2	Delay at Intersection, s/veh	28.36	12.98
2	Transit Travel Speed, mi/h	26.41	32.13
2	Transit Wait-Ride Score	3.49	3.75
2	Ped LOS Score for Link	2.76	3.92
2	Transit LOS Score for Segment	1.18	0.97
2	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	683	22.2	0	928	139	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.18	0	0	0.06	0	0	0.24	0.24	0.06	0.24	0.24	0.18
1: Thru veh delay		0.02			0.08							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	656	0	0	1431	54.9	0	0	0	25	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.08	0	0	0.08	0.08	0.08	0.08	0.08	0
1: Thru veh delay		0			0.06							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	27.7	592	60.9	129	1466	285	10	5	110	5	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0	0	0	0.02	0	0	0.02	0.02	0.02	0.02	0.02	0
2: Thru veh delay		0.04			0.22							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											
3: Volume, veh/h	0	332	375	11.5	1711	0	0	0	0	10	0	170
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0	0	0	0	0	0	0	0	0	0	0	0
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

HCS7 Two-Way Stop-Control Report

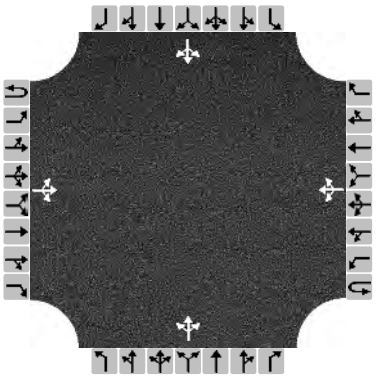
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2045
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/HALL
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	HALL AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		35	65	95		20	335	20		30	20	30		20	20	35
Percent Heavy Vehicles (%)		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

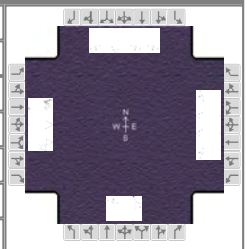
Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.15				4.15				7.15	6.55	6.25		7.15	6.55	6.25
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.24				2.24				3.54	4.04	3.34		3.54	4.04	3.34

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		39				22					88				83	
Capacity, c (veh/h)		1151				1383					442				438	
v/c Ratio		0.03				0.02					0.20				0.19	
95% Queue Length, Q_{95} (veh)		0.1				0.0					0.7				0.7	
Control Delay (s/veh)		8.2				7.6					15.2				15.1	
Level of Service, LOS		A				A					C				C	
Approach Delay (s/veh)		1.7				0.6				15.2				15.1		
Approach LOS										C				C		

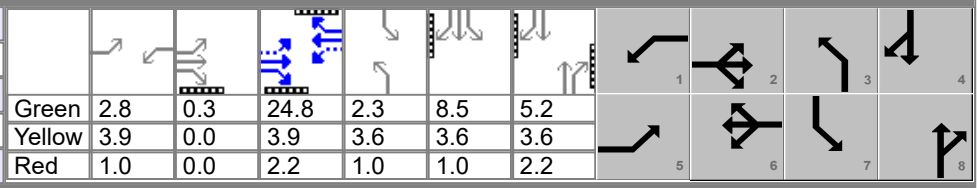
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	70	840	25	60	410	75	40	30	105	565	40	215

Signal Information			
Cycle, s	70.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.8	0.3	24.8	2.3	8.5	5.2						
Yellow	3.9	0.0	3.9	3.6	3.6	3.6						
Red	1.0	0.0	2.2	1.0	1.0	2.2						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	8.1	31.3	7.7	30.9	6.9	11.0	20.0	24.1
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.8	4.6	5.8
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	4.1		3.7		3.9	6.8	15.3	7.7
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phase Call Probability	0.78		0.70		0.58	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	77	472	469	63	427	57	44	106		628	44	144
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1719	1647	1647		1647	1540		1600	1730	1466
Queue Service Time (g_s), s	2.1	17.9	18.0	1.7	5.9		1.9	4.8		13.3	1.4	5.7
Cycle Queue Clearance Time (g_c), s	2.1	17.9	18.0	1.7	5.9		1.9	4.8		13.3	1.4	5.7
Green Ratio (*g/C*)	0.40	0.36	0.36	0.40	0.35		0.03	0.07		0.22	0.26	0.26
Capacity (*c*), veh/h	431	622	618	212	1169		54	115		702	452	383
Volume-to-Capacity Ratio (*X*)	0.179	0.759	0.759	0.294	0.366		0.816	0.916		0.894	0.098	0.377
Back of Queue (*Q*), ft/ln (95 th percentile)	32.7	319.9	307	27.6	90.8		56.5	164.8		263.9	24.2	85.4
Back of Queue (*Q*), veh/ln (95 th percentile)	1.3	12.3	12.3	1.1	3.5		2.2	6.3		10.1	0.9	3.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.16	0.00	0.00	0.39	0.00		1.41	0.00		0.98	0.00	0.00
Uniform Delay (d_1), s/veh	13.6	24.8	24.9	16.3	13.7		33.6	32.2		26.5	19.6	21.2
Incremental Delay (d_2), s/veh	0.2	5.5	5.5	0.8	0.7		32.4	57.4		14.2	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	13.8	30.3	30.4	17.1	14.4	0.0	66.0	89.6		40.7	19.6	21.4
Level of Service (LOS)	B	C	C	B	B	A	E	F		D	B	C
Approach Delay, s/veh / LOS	29.1	C		13.2	B		82.6	F		36.1	D	
Intersection Delay, s/veh / LOS	31.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	3.0	C	3.4	C	3.1	C
Bicycle LOS Score / LOS	3.1	C	2.7	C	2.2	B	3.4	C

HCS7 Two-Way Stop-Control Report

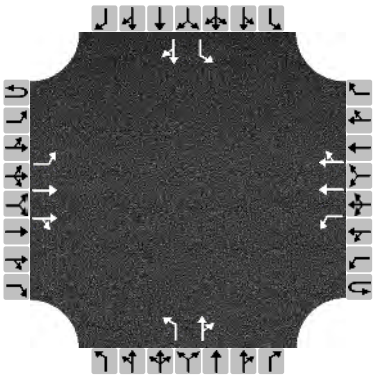
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2045
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		1	1	0		1	1	0
Configuration		L	T	TR		L	T	TR		L		TR		L		TR
Volume, V (veh/h)		10	1605	40		60	535	45		10	5	85		55	0	40
Percent Heavy Vehicles (%)		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.5	6.5	6.9		7.5	6.5	6.9
Critical Headway (sec)		4.20				4.20				7.60	6.60	7.00		7.60	6.60	7.00
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.25				2.25				3.55	4.05	3.35		3.55	4.05	3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		11				67				11		100		61		44
Capacity, c (veh/h)		917				319				17		147		25		665
v/c Ratio		0.01				0.21				0.66		0.68		2.46		0.07
95% Queue Length, Q_{95} (veh)		0.0				0.8				1.7		3.8		7.6		0.2
Control Delay (s/veh)		9.0				19.3				407.6		70.0		997.6		10.8
Level of Service, LOS		A				C				F		F		F		B
Approach Delay (s/veh)		0.1				1.8				103.4				584.1		
Approach LOS										F				F		

HCS 2010 Two-Way Stop Control Summary Report

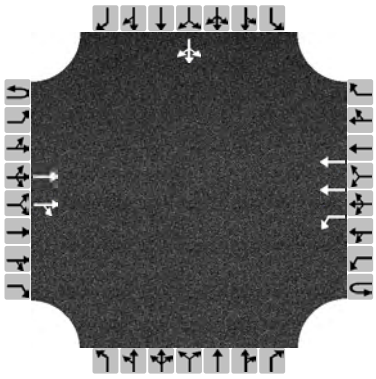
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2045
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/I-229 SB
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	I-229 SB
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

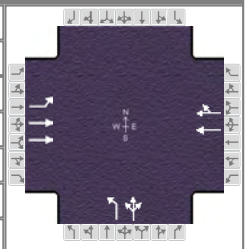
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	2	0	0	1	2	0		0	0	0		0	1	0
Configuration			T	TR		L	T								LTR	
Volume (veh/h)			260	1485		155	580							80	0	60
Percent Heavy Vehicles						5								5	5	5
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)						172									156	
Capacity						288									158	
v/c Ratio						0.60									0.98	
95% Queue Length						3.6									7.5	
Control Delay (s/veh)						34.6									124.8	
Level of Service (LOS)						D									F	
Approach Delay (s/veh)					7.3								124.8			
Approach LOS													F			

HCS 2010 Signalized Intersection Results Summary

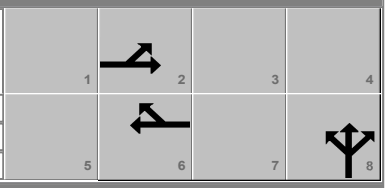
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	90	250			355	195	380	0	95			

Signal Information			
Cycle, s	70.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	38.0	21.0	0.0	0.0	0.0	0.0	
Yellow	3.5	3.5	0.0	0.0	0.0	0.0	
Red	2.0	2.0	0.0	0.0	0.0	0.0	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		8.0		10.0		
Phase Duration, s		43.5		43.5		26.5		
Change Period, (*Y+R c*), s		5.5		5.5		5.5		
Max Allow Headway (*MAH*), s		0.0		0.0		5.1		
Queue Clearance Time (*g s*), s						19.1		
Green Extension Time (*g e*), s		0.0		0.0		2.0		
Phase Call Probability						1.00		
Max Out Probability						0.42		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	55	152			280	259	422	100				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	838	1536			1643	1490	1633	1370				
Queue Service Time (*g s*), s	2.7	1.7			7.4	6.7	17.1	3.9				
Cycle Queue Clearance Time (*g c*), s	10.2	1.7			7.4	6.7	17.1	3.9				
Green Ratio (*g/C*)	0.54	0.54			0.54	0.54	0.30	0.30				
Capacity (*c*), veh/h	469	1666			891	808	491	412				
Volume-to-Capacity Ratio (*X*)	0.117	0.091			0.314	0.320	0.861	0.243				
Back of Queue (*Q*), ft/ln (95 th percentile)	22.2	21.2			98.4	89.3	298.6	51				
Back of Queue (*Q*), veh/ln (95 th percentile)	0.9	0.8			3.8	3.6	11.5	2.0				
Queue Storage Ratio (*RQ*) (95 th percentile)	0.22	0.00			0.00	0.00	0.00	0.00				
Uniform Delay (*d 1*), s/veh	11.9	7.7			8.8	8.9	23.1	18.5				
Incremental Delay (*d 2*), s/veh	0.2	0.0			0.9	1.0	10.3	0.4				
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0	0.0	0.0				
Control Delay (*d*), s/veh	12.1	7.8			9.8	9.9	33.4	18.9				
Level of Service (LOS)	B	A			A	A	C	B				
Approach Delay, s/veh / LOS	8.9	A		9.8	A		30.6	C		0.0		
Intersection Delay, s/veh / LOS	18.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	1.9	A	3.0	C	3.1	C
Bicycle LOS Score / LOS	2.8	C	2.9	C	3.0	C		

HCS 2010 Two-Way Stop Control Summary Report

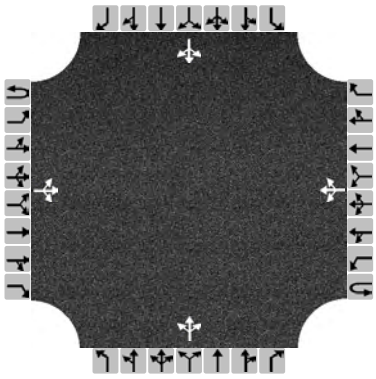
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2045
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/HALL
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	HALL AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		35	175	135		50	335	20		180	20	95		20	20	35
Percent Heavy Vehicles		5				5				5	5	5		5	5	5
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		39				56					328				83	
Capacity		1151				1201					287				312	
v/c Ratio		0.03				0.05					1.14				0.27	
95% Queue Length		0.1				0.1					14.0				1.0	
Control Delay (s/veh)		8.2				8.1					136.7				20.7	
Level of Service (LOS)		A				A					F				C	
Approach Delay (s/veh)	1.2				1.4				136.7				20.7			
Approach LOS									F				C			

HCS7 Streets Text Report

File Name:	BENSON PM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Mar 8, 2018
Time Period:	PM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2045
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	3
Number of Segments	2
Analysis period duration, h	0.25
System cycle length, s	70
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	95
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	0.51
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

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	40	40	2	2	2610	2610	50	50	0	0	70	70	0	0
2	40	40	2	2	2990	2990	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	850	20	0	665	0	30	0	45	40	0	35
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1510	0	0	545	40	0	0	0	145	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	5	1435	25	40	340	30	10	5	95	70	0	40
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1410											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	170	1430	25	380	0	0	0	0	0	0	30
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1920											
3: Peak Hour Factor	1											

Number of access points: 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.05			42.82	
1	Running Speed, mph		41.33			41.56	
1	Through Delay, s/veh		30.42			20.44	
1	Travel Speed, mph		24.22			28.13	
1	Stop Rate, stops/veh		0.92			0.67	
1	Spatial Stop Rate, stops/mi		1.87			1.36	
1	Through vol/cap ratio		0.77			0.45	
1	Percent of Base FFS		54.96			63.83	
1	Level of Service		C			C	
1	Automobile Perception Score		2.43			2.35	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		49.96			48.72	
2	Running Speed, mph		40.81			41.84	
2	Through Delay, s/veh		7.47			16.04	
2	Travel Speed, mph		35.5			31.48	
2	Stop Rate, stops/veh		0.3			0.52	
2	Spatial Stop Rate, stops/mi		0.52			0.91	
2	Through vol/cap ratio		0.09			0.43	
2	Percent of Base FFS		80.56			71.43	
2	Level of Service		A			B	
2	Automobile Perception Score		2.27			2.38	

Facility Travel Time, s	130.89	128.02
Facility Travel Speed, mph	29.17	29.83
Facility Spatial Stop Rate, stops/mi	1.15	1.12
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	66.19	67.67
Facility Level of Service	C	B
Facility Automobile Perception Score	2.34	2.36
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.25	4.25
Facility Pedestrian LOS Score	3.4	3.08
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	13.44	13.81
Facility Bicycle LOS Score	2.97	2.79
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	24.25	28.52
Facility Transit LOS Score	1.06	0.95
Facility Transit LOS	A	A

SPILLBACK TIME, h 999

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.18	4.18
1	Ped LOS Score for Intersection	2.1	2.87
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	1.1	0.89
1	Speed Adjustment Factor	0.68	0.69
1	Ped LOS Score for Link	3.09	2.89
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	0.99	0.84
1	Ped LOS Score for Segment	3.13	2.71
1	Ped Segment LOS	C	B
1	Bicycle Travel Speed	13.3	13.36
1	Bicycle LOS Score for Intersection	3.11	2.87
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.43	2.32
1	Speed Adjustment Factor	0.84	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.33	3.23
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2610	2610
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.89	2.8
1	Bicycle Segment LOS	C	C
1	Transit Running Speed, mi/h	41.33	41.56
1	g/C Ratio	0.36	0.37
1	Transit Running Time, s	43.05	42.82
1	Delay at Intersection, s/veh	30.34	19.57
1	Transit Travel Speed, mi/h	24.25	28.52
1	Transit Wait-Ride Score	3.38	3.59
1	Ped LOS Score for Link	3.09	2.89
1	Transit LOS Score for Segment	1.4	1.05
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.31	4.31
2	Ped LOS Score for Intersection	2.04	2.7
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	1.9	0.93
2	Speed Adjustment Factor	0.67	0.7
2	Ped LOS Score for Link	3.87	2.94
2	Ped Link LOS	D	C
2	Roadway Crossing Difficulty Factor	0.96	1.16
2	Ped LOS Score for Segment	3.64	3.41
2	Ped Segment LOS	D	C
2	Bicycle Travel Speed	13.56	14.24
2	Bicycle LOS Score for Intersection	2.79	2.74
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.71	2.35
2	Speed Adjustment Factor	0.84	0.85
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.6	3.25
2	Bicycle Link LOS	D	C
2	Number of access point approaches	0	0
2	Segment Length, ft	2990	2990
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	3.04	2.79
2	Bicycle Segment LOS	C	C
2	Transit Running Speed, mi/h	40.81	41.84
2	g/C Ratio	0.54	0.35
2	Transit Running Time, s	49.96	48.72
2	Delay at Intersection, s/veh	7.47	16.04
2	Transit Travel Speed, mi/h	35.5	31.48
2	Transit Wait-Ride Score	3.88	3.72
2	Ped LOS Score for Link	3.87	2.94
2	Transit LOS Score for Segment	0.76	0.86
2	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

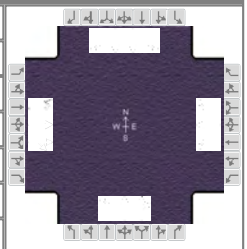
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	944	22.2	0	783	0	30	0	45	40	0	35
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.1	0	0	0.17	0	0	0.17	0.17	0.17	0.17	0.17	0.1
1: Thru veh delay		0.02			0							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1669	0	0	661	48.5	0	0	0	145	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.41	0	0	0.41	0.41	0.41	0.41	0.41	0
1: Thru veh delay		0			0.04							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	6.19	1777	31	77.6	660	58.2	10	5	95	70	0	40
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0	0	0	0.43	0	0	0.43	0.43	0.43	0.43	0.43	0
2: Thru veh delay		0.04			0.04							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1410											
3: Volume, veh/h	0	206	1736	50.3	765	0	0	0	0	0	0	30
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0	0	0	0.46	0	0	0.46	0.46	0.46	0.46	0.46	0
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1920											

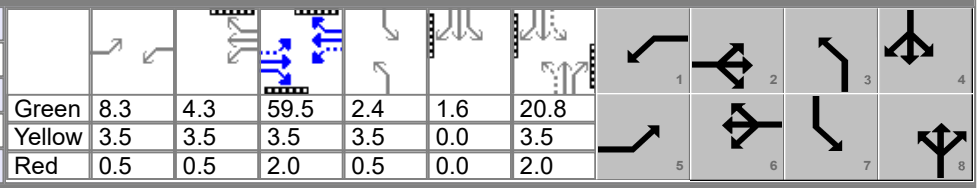
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	150	390	55	365	490	720	25	395	65	75	225	50

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	8.3	4.3		59.5	2.4	1.6		20.8				
Yellow	3.5	3.5		3.5	3.5	0.0		3.5				
Red	0.5	0.5		2.0	0.5	0.0		2.0				

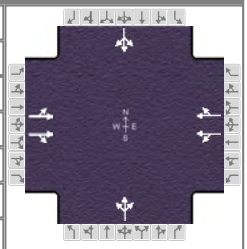
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	3.0
Phase Duration, s	12.3	65.0	20.7	73.4	6.4	26.3	8.0	27.9
Change Period, (*Y+R c*), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.1
Queue Clearance Time (*g s*), s	8.1		15.3		3.7	18.5	6.0	10.0
Green Extension Time (*g e*), s	0.3	0.0	1.4	0.0	0.0	2.3	0.0	2.8
Phase Call Probability	1.00		1.00		0.60	1.00	0.94	1.00
Max Out Probability	0.15		0.00		1.00	0.14	1.00	0.01

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	167	239	234	386	519	455	28	245	239	83	250	28
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1594	1674	1625	1594	1674	1418	1647	1730	1674	1647	1647	
Queue Service Time (*g s*), s	6.1	10.1	10.1	13.3	22.4	23.6	1.7	16.3	16.5	4.0	8.0	
Cycle Queue Clearance Time (*g c*), s	6.1	10.1	10.1	13.3	22.4	23.6	1.7	16.3	16.5	4.0	8.0	
Green Ratio (*g/C*)	0.57	0.50	0.50	0.65	0.57	0.57	0.19	0.17	0.17	0.21	0.19	
Capacity (*c*), veh/h	472	831	806	640	947	802	207	300	290	147	614	
Volume-to-Capacity Ratio (*X*)	0.353	0.287	0.290	0.604	0.548	0.567	0.134	0.817	0.823	0.568	0.407	
Back of Queue (*Q*), ft/ln (95 th percentile)	104.5	193.6	177	200.1	334.1	303.7	32.2	316.8	300.6	40	153.8	
Back of Queue (*Q*), veh/ln (95 th percentile)	3.9	7.2	7.1	7.5	12.5	11.3	1.2	12.2	12.0	1.5	5.9	
Queue Storage Ratio (*RQ*) (95 th percentile)	1.04	0.00	0.00	1.25	0.00	0.00	0.29	0.00	0.00	0.27	0.00	
Uniform Delay (*d 1*), s/veh	14.0	17.8	17.8	10.8	15.2	15.4	40.0	47.8	47.8	44.2	43.0	
Incremental Delay (*d 2*), s/veh	0.4	0.9	0.9	0.7	1.7	2.2	0.3	8.1	8.9	5.1	0.4	
Initial Queue Delay (*d 3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	14.4	18.6	18.7	11.5	16.9	17.5	40.3	55.9	56.7	49.3	43.4	0.0
Level of Service (LOS)	B	B	B	B	B	B	D	E	E	D	D	A
Approach Delay, s/veh / LOS	17.6	B		15.6	B		55.4	E		41.4	D	
Intersection Delay, s/veh / LOS	26.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.2	C	3.6	D	2.7	C
Bicycle LOS Score / LOS	2.5	B	4.6	E	2.7	C	2.6	C

HCS7 Signalized Intersection Results Summary

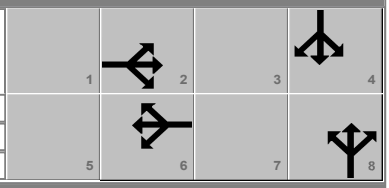
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	WAYLAND AVE	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	490	20	10	1550	50	10	15	0	45	10	15

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	101.7	7.7	0.0	0.0	0.0	0.0	
Yellow	3.9	3.0	0.0	0.0	0.0	0.0	
Red	1.2	2.5	0.0	0.0	0.0	0.0	



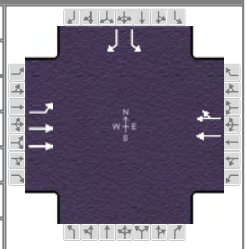
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		106.8		106.8		13.2		13.2
Change Period, ($Y+R_c$), s		5.1		5.1		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		4.2		4.2
Queue Clearance Time (g_s), s						3.8		7.7
Green Extension Time (g_e), s		0.0		0.0		0.3		0.3
Phase Call Probability						0.96		0.96
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	270		308	889		808		28			72	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1228		1513	1666		1512		1655			1478	
Queue Service Time (g_s), s	1.7		2.5	0.0		27.1		0.0			4.0	
Cycle Queue Clearance Time (g_c), s	28.9		2.5	26.8		27.1		1.8			5.7	
Green Ratio (*g/C*)	0.85		0.85	0.85		0.85		0.06			0.06	
Capacity (*c*), veh/h	1073		1282	1442		1281		148			146	
Volume-to-Capacity Ratio (*X*)	0.252		0.240	0.617		0.631		0.187			0.495	
Back of Queue (*Q*), ft/ln (95 th percentile)	20.2		22.5	279.4		261.8		37.9			103.7	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.8		0.9	11.2		10.5		1.5			4.1	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00		0.00	0.00		0.00		0.00			0.00	
Uniform Delay (d_1), s/veh	0.9		0.8	4.8		4.8		53.4			55.2	
Incremental Delay (d_2), s/veh	0.5		0.4	1.1		1.3		0.6			2.6	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (*d*), s/veh	1.5		1.2	5.9		6.1		54.0			57.8	
Level of Service (LOS)	A		A	A		A		D			E	
Approach Delay, s/veh / LOS	1.3	A		6.0	A		54.0	D		57.8	E	
Intersection Delay, s/veh / LOS	7.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	3.1	C	3.1	C
Bicycle LOS Score / LOS	2.6	C	3.6	D	2.7	C	2.8	C

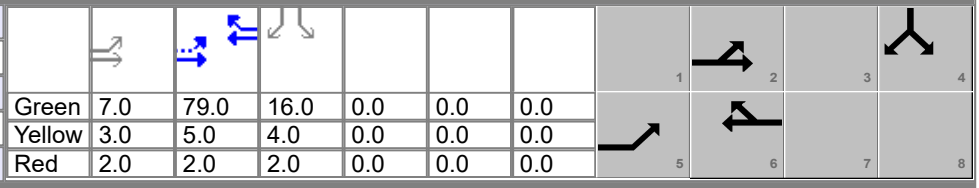
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	130	520			1540	560				80		55

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	75	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.0	79.0	16.0	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0

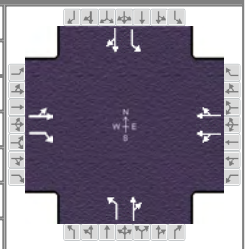
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				9.0
Phase Duration, s	12.0	98.0		86.0				22.0
Change Period, ($Y+R_c$), s	5.0	7.0		7.0				6.0
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.2
Queue Clearance Time (g_s), s	9.0							18.0
Green Extension Time (g_e), s	0.0	0.0		0.0				0.0
Phase Call Probability	0.99							0.99
Max Out Probability	1.00							1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	142	566			1002	1002				89		61
Adjusted Saturation Flow Rate (*s*), veh/h/ln	645	1673			1948	1830				377		1439
Queue Service Time (g_s), s	7.0	6.6			59.7	52.9				16.0		4.6
Cycle Queue Clearance Time (g_c), s	7.0	6.6			59.7	52.9				16.0		4.6
Green Ratio (*g/C*)	0.73	0.76			0.66	0.66				0.13		0.13
Capacity (*c*), veh/h	111	2538			1282	1205				50		192
Volume-to-Capacity Ratio (*X*)	1.277	0.223			0.781	0.831				1.768		0.319
Back of Queue (*Q*), ft/ln (95 th percentile)	527.8	91.5			534.8	601.7				589.7		76.3
Back of Queue (*Q*), veh/ln (95 th percentile)	12.9	3.7			21.4	24.1				13.1		3.1
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00	0.00				0.00		0.00
Uniform Delay (d_1), s/veh	31.6	4.9			16.5	19.3				52.0		47.1
Incremental Delay (d_2), s/veh	176.5	0.2			0.5	0.7				414.2		0.9
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	208.0	5.1			17.0	20.0				466.2		48.0
Level of Service (LOS)	F	A			B	C				F		D
Approach Delay, s/veh / LOS	45.7		D	18.5		B	0.0			295.8		F
Intersection Delay, s/veh / LOS	39.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.6	A	2.2	B	3.1	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	2.2	B				F

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	RICE AM.xus		
Project Description	I-229/BENSON 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	75	205	320	75	1460	25	405	330	65	70	10	235

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

							1	2	3	4
Green	66.0	4.0	32.0	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	4.0	4.0	0.0	0.0	0.0				
Red	2.0	2.0	2.0	0.0	0.0	0.0				

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8	7	4
Case Number		7.0		8.0		6.3	1.0	4.0
Phase Duration, s		72.0		72.0		38.0	10.0	48.0
Change Period, (*Y+R c*), s		6.0		6.0		6.0	6.0	6.0
Max Allow Headway (*MAH*), s		0.0		0.0		6.4	6.0	6.4
Queue Clearance Time (*g s*), s						34.0	6.0	12.8
Green Extension Time (*g e*), s		0.0		0.0		0.0	0.0	11.1
Phase Call Probability						1.00	0.93	1.00
Max Out Probability						1.00	1.00	0.22

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		281	191	866		856	450	411		78	167	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		208	1365	1484		1630	1190	1691		1594	1374	
Queue Service Time (*g s*), s		6.3	9.9	0.0		59.7	31.2	28.3		4.0	10.8	
Cycle Queue Clearance Time (*g c*), s		66.0	9.9	66.0		59.7	32.0	28.3		4.0	10.8	
Green Ratio (*g/C*)		0.55	0.55	0.55		0.55	0.27	0.27		0.32	0.35	
Capacity (*c*), veh/h		153	751	849		896	370	451		142	481	
Volume-to-Capacity Ratio (*X*)		1.844	0.254	1.021		0.955	1.217	0.912		0.549	0.347	
Back of Queue (*Q*), ft/ln (95 th percentile)		938.6	157.9	1027.1		877.3	914.1	543.9		90.1	171.4	
Back of Queue (*Q*), veh/ln (95 th percentile)		35.0	5.9	41.1		35.1	35.2	20.9		3.4	6.4	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.00		0.00	6.09	0.00		0.90	0.00	
Uniform Delay (*d 1*), s/veh		33.7	16.6	26.5		27.0	46.9	42.6		34.7	28.9	
Incremental Delay (*d 2*), s/veh		401.7	0.7	36.2		20.9	120.0	23.4		7.7	0.9	
Initial Queue Delay (*d 3*), s/veh		0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		435.3	17.3	62.7		47.9	166.9	66.1		42.4	29.8	
Level of Service (LOS)		F	B	F		D	F	E		D	C	
Approach Delay, s/veh / LOS	266.3	F		55.4	E		118.8	F		33.8	C	
Intersection Delay, s/veh / LOS	100.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	C	2.7	C	2.8	C	3.7	D
Bicycle LOS Score / LOS	3.2	C	2.0	B	3.6	D	2.6	C

HCS7 Two-Way Stop-Control Report

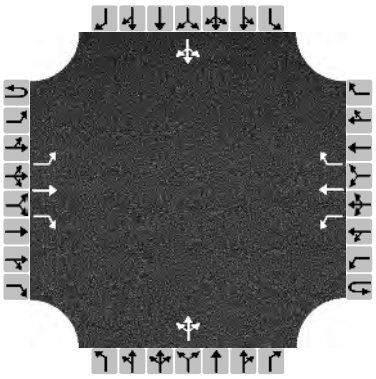
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/8/2018
Analysis Year	2045
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BAHNSON AVENUE
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	RICE STREET
North/South Street	BAHNSON AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	1	0	1	1	1		0	1	0		0	1	0
Configuration		L	T	R		L	T	R			LTR				LTR	
Volume, V (veh/h)		40	260	40		10	1465	10		15	10	10		10	25	80
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.13				4.13				7.13	6.53	6.23		7.13	6.53	6.23
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23				2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		44				11					39				128	
Capacity, c (veh/h)		392				1219					12				79	
v/c Ratio		0.11				0.01					3.21				1.62	
95% Queue Length, Q_{95} (veh)		0.4				0.0					5.9				10.6	
Control Delay (s/veh)		15.3				8.0					1622.9				420.2	
Level of Service, LOS		C				A					F				F	
Approach Delay (s/veh)		1.8				0.1				1622.9				420.2		
Approach LOS										F				F		

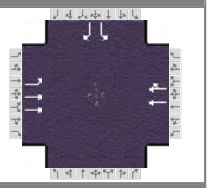
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Parclo AB-2Q
Analyst	RL	Analysis Date	Mar 8, 2018	Segment Distance, ft	1020
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	RICE AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	130	520			1540	560				80		55
Intersection Two Demand (*v*), veh/h	75	205	320	75	1460	25	405	330	65	70	10	235

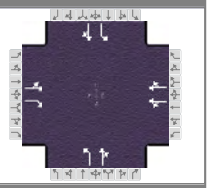
Signal One Information	
Cycle, s	120.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	7.0	79.0	16.0	0.0	0.0	0.0	1	2	3	4		
Yellow	3.0	5.0	4.0	0.0	0.0	0.0	5	6	7	8		
Red	2.0	2.0	2.0	0.0	0.0	0.0						



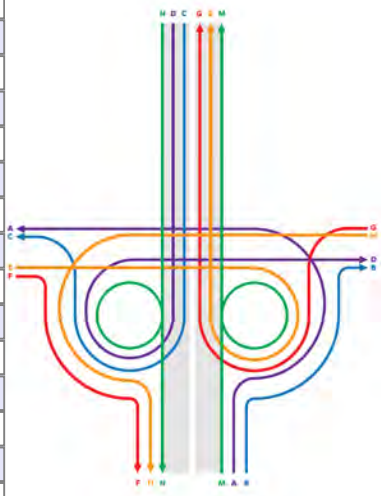
Signal Two Information	
Cycle, s	120.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	66.0	4.0	32.0	0.0	0.0	0.0	1	2	3	4		
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	5	6	7	8		
Red	2.0	2.0	2.0	0.0	0.0	0.0						



Interchange Results

O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	120	183.9	0.0	183.9	Yes	Yes	F
B	44	66.1	0.0	66.1	No	No	D
C	0	0.0	5.0	5.0	No	No	A
D	0	0.0	5.0	5.0	No	No	A
E	191	22.4	5.0	27.4	Yes	No	B
F	0	5.1	0.0	5.1	No	No	A
G	83	62.7	5.0	67.7	Yes	No	F
H	0	0.0	0.0	0.0	No	No	A
I	536	5.1	0.0	5.1	Yes	No	A
J	1195	17.0	0.0	17.0	No	No	B
K	-	-	0.0	-	-	-	-
L	-	-	0.0	-	-	-	-
M	330	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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	208.0	5.1			17.0	20.0				466.2		48.0
Level of Service (LOS)	F	A			B	C				F		D
Approach Delay, s/veh / LOS	45.7	D		18.5	B		0.0			295.8	F	
Intersection Delay, s/veh / LOS	39.8						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		435.3	17.3	62.7		47.9	166.9	66.1		42.4	29.8	
Level of Service (LOS)		F	B	F		D	F	E		D	C	
Approach Delay, s/veh / LOS	266.3	F		55.4	E		118.8	F		33.8	C	
Intersection Delay, s/veh / LOS	100.5						F					

This Urban Streets text report was created on March 12, 2018 at 10:26:54

Period number = 1

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	120
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	95
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	0.51
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

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	35	35	2	1	1020	1020	50	50	0	0	70	70	0	0
2	35	35	2	2	3460	3460	50	50	0	0	70	70	0	0
3	35	35	1	2	1020	1020	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	520	15	20	1575	0	35	0	130	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Location, ft	3030											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 3

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				999.27		
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		20.03			23.1	
1	Running Speed, mph		34.71			30.1	
1	Through Delay, s/veh		1.33			16.88	
1	Travel Speed, mph		32.55			17.39	
1	Stop Rate, stops/veh		0.05			0.48	
1	Spatial Stop Rate, stops/mi		0.26			2.51	
1	Through vol/cap ratio		0.25			0.55	
1	Percent of Base FFS		78.01			41.69	
1	Level of Service		B			D	
1	Automobile Perception Score		2.38			2.76	
2	Bay/Lane Spillback Time, h	0	999	999	999	999	999
2	ShrdLane Spillback Time, h						
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		58.48			60.56	
2	Running Speed, mph		40.34			38.95	
2	Through Delay, s/veh		5.08			5.97	
2	Travel Speed, mph		37.11			35.46	
2	Stop Rate, stops/veh		0.22			0.21	
2	Spatial Stop Rate, stops/mi		0.33			0.33	
2	Through vol/cap ratio		0.22			0.62	
2	Percent of Base FFS		88.96			84.99	
2	Level of Service		A			A	
2	Automobile Perception Score		2.29			2.29	
3	Bay/Lane Spillback Time, h	0	0.38	999	999	999	999
3	ShrdLane Spillback Time, h						
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		20.43			21.28	
3	Running Speed, mph		34.04			32.67	
3	Through Delay, s/veh		435.33			18.17	
3	Travel Speed, mph		1.53			17.63	
3	Stop Rate, stops/veh		2.58			0.6	
3	Spatial Stop Rate, stops/mi		13.33			3.12	
3	Through vol/cap ratio		1.84			0.8	
3	Percent of Base FFS		3.66			42.25	
3	Level of Service		F			D	
3	Automobile Perception Score		4.82			2.87	
Facility Travel Time, s			540.69			145.97	
Facility Travel Speed, mph			6.94			25.69	
Facility Spatial Stop Rate, veh/mi			2.73			1.25	
Facility Base Free Flow Speed, mph			41.72			41.72	
Facility Percent Base Free Flow Speed			16.62			61.58	
Facility Level of Service			F			C	
Facility Automobile Perception Score			2.56			2.46	
Facility Pedestrian Space			Infinity			Infinity	
Facility Pedestrian Travel Speed			4.4			4.4	
Facility Pedestrian LOS Score			3.3			3.97	
Facility Pedestrian LOS			C			D	
Facility Bicycle Travel Speed			13.88			13.86	
Facility Bicycle LOS Score			3.49			3.97	
Facility Bicycle LOS			C			D	
Facility Transit Travel Speed			34.04			18.17	
Facility Transit LOS Score			0.56			1.2	
Facility Transit LOS			A			A	
SPILLBACK TIME, h			0.38				

Multimodal Results

1	Roadway crossing difficulty factor	1.2	1.2
1	Ped LOS Score for Link	2.47	5.51
1	Ped LOS Score for Intersection	2.16	3.23
1	Ped LOS Score for Segment	3.44	4.88
1	Ped Segment LOS	C	E
1	Bicycle LOS Score for Link	3.3	4.1
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	2.65	4.62
1	Number of access point approaches	0	0
1	Segment Length, ft	1020	1020
1	Bicycle LOS Score for Segment	3.53	4.62
1	Bicycle Segment LOS	D	E
1	Transit Wait-Ride Score	3.85	2.97
1	Ped LOS Score for Link	2.47	5.51
1	Transit LOS Score for Segment	0.6	2.38
1	Transit Segment LOS	A	B
2	Roadway crossing difficulty factor	1.2	1.2
2	Ped LOS Score for Link	2.65	3.87
2	Ped LOS Score for Intersection	0.65	2.19
2	Ped LOS Score for Segment	3.11	3.98
2	Ped Segment LOS	C	D
2	Bicycle LOS Score for Link	3.37	3.89
2	Indicator Variable	1	1
2	Bicycle LOS Score for Intersection	1.08	3.63
2	Number of access point approaches	0	0
2	Segment Length, ft	3460	3460
2	Bicycle LOS Score for Segment	3.42	3.89
2	Bicycle Segment LOS	C	D
2	Transit Wait-Ride Score	3.94	4
2	Ped LOS Score for Link	2.65	3.87
2	Transit LOS Score for Segment	0.49	0.58
2	Transit Segment LOS	A	A
3	Roadway crossing difficulty factor	1.2	0.86
3	Ped LOS Score for Link	3.19	4.31
3	Ped LOS Score for Intersection	2.59	2.24
3	Ped LOS Score for Segment	3.83	2.99
3	Ped Segment LOS	D	C
3	Bicycle LOS Score for Link	3.66	3.94
3	Indicator Variable	1	1
3	Bicycle LOS Score for Intersection	3.19	2.21
3	Number of access point approaches	0	0
3	Segment Length, ft	1020	1020
3	Bicycle LOS Score for Segment	3.7	3.58
3	Bicycle Segment LOS	D	D
3	Transit Wait-Ride Score	3.82	3.02
3	Ped LOS Score for Link	3.19	4.31
3	Transit LOS Score for Segment	0.74	2.12
3	Transit Segment LOS	A	B

ACCESS POINT DATA

SEGMENT 1

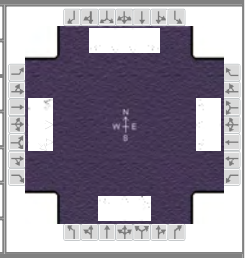
SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	578	16.7	21.4	1685	0	35	0	130	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Prop blocked	0	0	0	0	0	0	0	0	0	0	0	0
1: Thru veh delay		0.01			0							
1: Prob inside blk		0			0							
1: Dist to upstream signal	3030											

SEGMENT 3

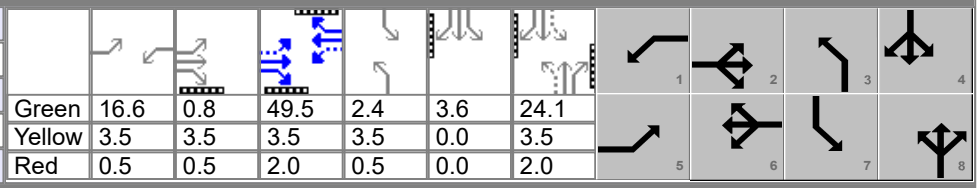
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	395	1300	280	230	285	240	25	275	150	230	570	70

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	16.6	0.8	49.5	2.4	3.6	24.1						
Yellow	3.5	3.5	3.5	3.5	0.0	3.5						
Red	0.5	0.5	2.0	0.5	0.0	2.0						

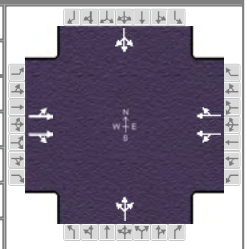
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	3.0
Phase Duration, s	25.4	59.8	20.6	55.0	6.4	29.6	10.0	33.2
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.1
Queue Clearance Time (g_s), s	19.9		16.4		3.6	15.6	8.0	24.0
Green Extension Time (g_e), s	1.5	0.0	0.2	0.0	0.0	4.2	0.0	3.7
Phase Call Probability	1.00		1.00		0.60	1.00	1.00	1.00
Max Out Probability	0.01		1.00		1.00	0.08	1.00	0.21

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	439	826	807	253	314	160	28	209	197	256	633	50
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1594	1674	1606	1594	1674	1418	1647	1730	1585	1647	1647	
Queue Service Time (g_s), s	17.9	54.3	54.3	14.4	13.5	7.1	1.6	13.2	13.6	6.0	22.0	
Cycle Queue Clearance Time (g_c), s	17.9	54.3	54.3	14.4	13.5	7.1	1.6	13.2	13.6	6.0	22.0	
Green Ratio (*g/C*)	0.61	0.45	0.45	0.55	0.41	0.41	0.22	0.20	0.20	0.26	0.23	
Capacity (*c*), veh/h	646	758	727	280	691	585	117	347	318	226	760	
Volume-to-Capacity Ratio (*X*)	0.679	1.090	1.111	0.903	0.455	0.273	0.237	0.601	0.619	1.131	0.834	
Back of Queue (*Q*), ft/ln (95 th percentile)	278.9	1231.2	1171.7	406.9	230	110.5	31.8	251.8	232.5	421.4	373.6	
Back of Queue (*Q*), veh/ln (95 th percentile)	10.4	45.9	46.9	15.2	8.6	4.1	1.2	9.7	9.3	16.2	14.4	
Queue Storage Ratio (*RQ*) (95 th percentile)	2.79	0.00	0.00	2.54	0.00	0.00	0.29	0.00	0.00	2.81	0.00	
Uniform Delay (d_1), s/veh	14.5	32.8	32.8	41.3	18.9	17.3	38.8	43.6	43.8	47.6	44.0	
Incremental Delay (d_2), s/veh	1.5	60.0	68.0	26.2	2.0	1.1	1.0	1.7	2.0	99.6	4.9	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	16.0	92.8	100.9	67.5	20.9	18.4	39.9	45.3	45.7	147.2	48.8	0.0
Level of Service (LOS)	B	F	F	E	C	B	D	D	D	F	D	A
Approach Delay, s/veh / LOS	79.7	E		36.6	D		45.1	D		73.0	E	
Intersection Delay, s/veh / LOS	67.1						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.3	C	3.4	C	2.9	C
Bicycle LOS Score / LOS	3.7	D	3.5	C	2.6	C	3.0	C

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	WAYLAND AVE	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	1615	45	20	725	25	20	0	5	95	5	10

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

							1	2	3	4
Green	97.5	11.9	0.0	0.0	0.0	0.0	5	6	7	8
Yellow	3.9	3.0	0.0	0.0	0.0	0.0				
Red	1.2	2.5	0.0	0.0	0.0	0.0				

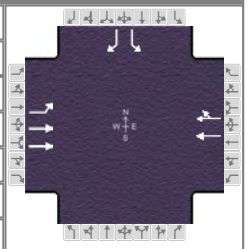
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		102.6		102.6		17.4		17.4
Change Period, ($Y+R_c$), s		5.1		5.1		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		4.2		4.2
Queue Clearance Time (g_s), s						4.0		11.6
Green Extension Time (g_e), s		0.0		0.0		0.4		0.4
Phase Call Probability						0.99		0.99
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	880		805	409		428		28			117	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1643		1514	1440		1513		1467			1430	
Queue Service Time (g_s), s	0.0		14.8	0.0		8.6		0.0			7.6	
Cycle Queue Clearance Time (g_c), s	14.5		14.8	7.1		8.6		2.0			9.6	
Green Ratio (*g/C*)	0.81		0.81	0.81		0.81		0.10			0.10	
Capacity (*c*), veh/h	1366		1231	1202		1229		199			199	
Volume-to-Capacity Ratio (*X*)	0.644		0.654	0.341		0.348		0.140			0.587	
Back of Queue (*Q*), ft/ln (95 th percentile)	67.2		62.2	82.5		89.6		36.2			165.8	
Back of Queue (*Q*), veh/ln (95 th percentile)	2.7		2.5	3.3		3.6		1.4			6.5	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00		0.00	0.00		0.00		0.00			0.00	
Uniform Delay (d_1), s/veh	1.8		1.8	2.7		2.8		49.6			53.0	
Incremental Delay (d_2), s/veh	0.2		0.2	0.6		0.6		0.3			2.7	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (*d*), s/veh	2.0		2.0	3.3		3.4		49.9			55.8	
Level of Service (LOS)	A		A	A		A		D			E	
Approach Delay, s/veh / LOS	2.0		A	3.3		A	49.9		D	55.8		E
Intersection Delay, s/veh / LOS	5.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	3.2	C	3.2	C
Bicycle LOS Score / LOS	3.7	D	2.9	C	2.7	C	2.9	C

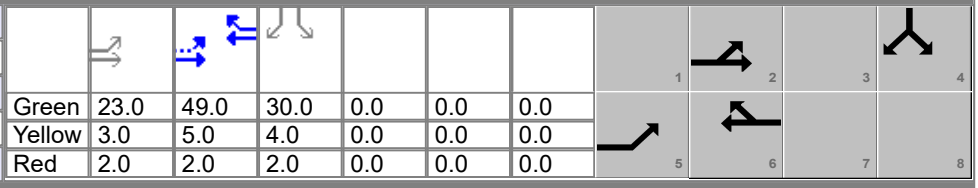
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	255	1490			730	190				240		60

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	65	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	23.0	49.0	30.0	0.0	0.0	0.0						
Yellow	3.0	5.0	4.0	0.0	0.0	0.0						
Red	2.0	2.0	2.0	0.0	0.0	0.0						

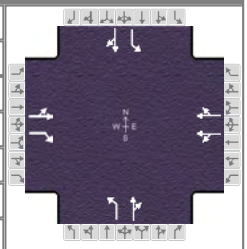
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				9.0
Phase Duration, s	28.0	84.0		56.0				36.0
Change Period, (*Y+R c*), s	5.0	7.0		7.0				6.0
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.2
Queue Clearance Time (*g s*), s	25.0							32.0
Green Extension 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	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	260	1520			481	458				267		67
Adjusted Saturation Flow Rate (*s*), veh/h/ln	645	1810			1814	1721				377		1440
Queue Service Time (*g s*), s	23.0	29.6			25.7	27.7				30.0		4.4
Cycle Queue Clearance Time (*g c*), s	23.0	29.6			25.7	27.7				30.0		4.4
Green Ratio (*g/C*)	0.62	0.64			0.41	0.41				0.25		0.25
Capacity (*c*), veh/h	224	2322			741	703				94		360
Volume-to-Capacity Ratio (*X*)	1.161	0.654			0.649	0.652				2.828		0.185
Back of Queue (*Q*), ft/ln (95 th percentile)	612.5	384.7			423.4	426.4				1965.8		69.9
Back of Queue (*Q*), veh/ln (95 th percentile)	14.9	15.4			16.9	17.1				43.7		2.8
Queue Storage Ratio (*RQ*) (95 th percentile)	7.66	0.00			0.00	0.00				19.66		0.00
Uniform Delay (*d 1*), s/veh	23.7	12.0			31.8	34.3				45.0		35.4
Incremental Delay (*d 2*), s/veh	102.1	1.0			2.7	2.9				851.3		0.2
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	125.8	13.0			34.5	37.3				896.3		35.6
Level of Service (LOS)	F	B			C	D				F		D
Approach Delay, s/veh / LOS	29.5	C		35.9	D		0.0			724.1	F	
Intersection Delay, s/veh / LOS	107.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.7	A	2.3	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.1	B	1.3	A				F

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 8, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM	PHF	0.90
Urban Street	RICE STREET	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	RICE PM.xus		
Project Description	I-229/BENSON 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	135	875	720	170	560	35	230	125	100	365	30	130

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	72.0	10.0	20.0	0.0	0.0	0.0	1	2	3	4		
Yellow	4.0	4.0	4.0	0.0	0.0	0.0	5	6	7	8		
Red	2.0	2.0	2.0	0.0	0.0	0.0						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8	7	4
Case Number		7.0		8.0		6.3	1.0	4.0
Phase Duration, s		78.0		78.0		26.0	16.0	42.0
Change Period, (*Y+R c*), s		6.0		6.0		6.0	6.0	6.0
Max Allow Headway (*MAH*), s		0.0		0.0		6.3	6.0	6.3
Queue Clearance Time (*g s*), s						22.0	12.0	10.0
Green Extension Time (*g e*), s		0.0		0.0		0.0	0.0	5.3
Phase Call Probability						1.00	1.00	1.00
Max Out Probability						1.00	1.00	0.05

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		906	386	189		644	256	206		406	122	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		955	1408	445		1568	1239	1577		1594	1409	
Queue Service Time (*g s*), s		38.5	23.9	0.0		33.5	20.0	15.0		10.0	8.0	
Cycle Queue Clearance Time (*g c*), s		72.0	23.9	35.4		33.5	20.0	15.0		10.0	8.0	
Green Ratio (*g/C*)		0.60	0.60	0.60		0.60	0.17	0.17		0.27	0.30	
Capacity (*c*), veh/h		607	845	327		941	266	263		239	423	
Volume-to-Capacity Ratio (*X*)		1.494	0.457	0.578		0.685	0.959	0.782		1.695	0.289	
Back of Queue (*Q*), ft/ln (95 th percentile)		2171.6	287.7	181		449.1	429.3	296.9		1026.3	131.9	
Back of Queue (*Q*), veh/ln (95 th percentile)		81.0	10.7	7.2		18.0	16.5	11.4		38.3	4.9	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.00		0.00	2.86	0.00		10.26	0.00	
Uniform Delay (*d 1*), s/veh		46.5	21.3	16.7		16.7	51.9	47.9		44.5	32.2	
Incremental Delay (*d 2*), s/veh		223.4	0.3	7.3		4.0	44.4	16.2		330.4	0.8	
Initial Queue Delay (*d 3*), s/veh		0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		269.9	21.6	23.9		20.8	96.3	64.1		374.9	33.0	
Level of Service (LOS)		F	C	C		C	F	E		F	C	
Approach Delay, s/veh / LOS	195.8	F		21.5	C		81.9	F		295.7	F	
Intersection Delay, s/veh / LOS	149.2						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	C	2.6	C	2.9	C	3.9	D
Bicycle LOS Score / LOS	5.0	E	1.3	A	2.9	C	3.0	C

HCS7 Two-Way Stop-Control Report

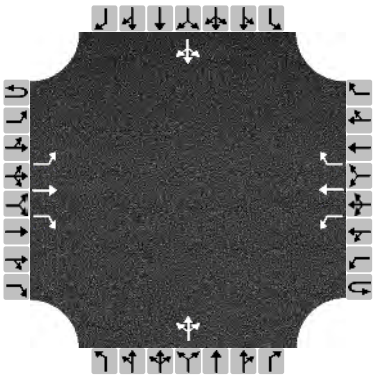
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/8/2018
Analysis Year	2045
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BAHNSON AVENUE
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	RICE STREET
North/South Street	BAHNSON AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	1	0	1	1	1		0	1	0		0	1	0
Configuration		L	T	R		L	T	R			LTR				LTR	
Volume, V (veh/h)		25	1290	25		5	655	5		30	5	5		10	10	80
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.13				4.13				7.13	6.53	6.23		7.13	6.53	6.23
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23				2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		28				6					45				111	
Capacity, c (veh/h)		866				459					21				120	
v/c Ratio		0.03				0.01					2.14				0.92	
95% Queue Length, Q_{95} (veh)		0.1				0.0					5.9				5.9	
Control Delay (s/veh)		9.3				12.9					911.3				130.8	
Level of Service, LOS		A				B					F				F	
Approach Delay (s/veh)		0.2				0.1				911.3				130.8		
Approach LOS										F				F		

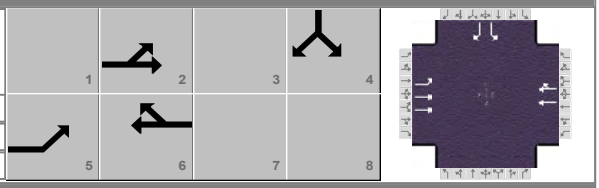
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Parclo AB-2Q
Analyst	RL	Analysis Date	Mar 8, 2018	Segment Distance, ft	1020
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	RICE PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	255	1490			730	190				240		60
Intersection Two Demand (*v*), veh/h	135	875	720	170	560	35	230	125	100	365	30	130

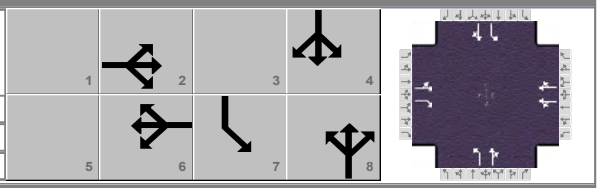
Signal One Information	
Cycle, s	120.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	23.0	49.0	30.0	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



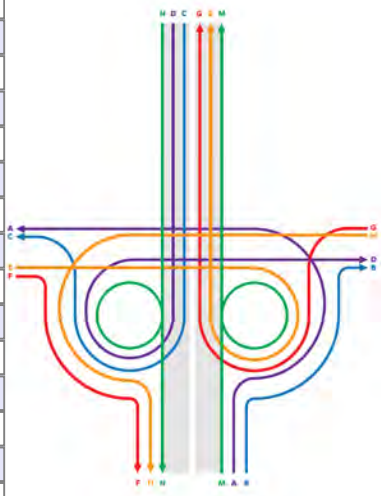
Signal Two Information	
Cycle, s	120.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	72.0	10.0	20.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Interchange Results

O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	131	130.8	0.0	130.8	No	Yes	F
B	67	64.1	0.0	64.1	No	No	D
C	0	0.0	5.0	5.0	No	No	A
D	0	0.0	5.0	5.0	No	No	A
E	386	34.6	5.0	39.6	Yes	No	C
F	0	13.0	0.0	13.0	No	No	A
G	189	23.9	5.0	28.9	No	No	B
H	0	0.0	0.0	0.0	No	No	A
I	910	13.0	0.0	13.0	Yes	No	A
J	556	34.5	0.0	34.5	No	No	C
K	-	-	0.0	-	-	-	-
L	-	-	0.0	-	-	-	-
M	125	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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	125.8	13.0			34.5	37.3				896.3		35.6
Level of Service (LOS)	F	B			C	D				F		D
Approach Delay, s/veh / LOS	29.5	C		35.9	D		0.0			724.1	F	
Intersection Delay, s/veh / LOS	107.3						F					

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		269.9	21.6	23.9		20.8	96.3	64.1		374.9	33.0	
Level of Service (LOS)		F	C	C		C	F	E		F	C	
Approach Delay, s/veh / LOS	195.8	F		21.5	C		81.9	F		295.7	F	
Intersection Delay, s/veh / LOS	149.2						F					

This Urban Streets text report was created on March 12, 2018 at 10:31:40

Period number = 1

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	120
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	95
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	0.51
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

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	35	35	2	1	1020	1020	50	50	0	0	70	70	0	0
2	35	35	2	2	3460	3460	50	50	0	0	70	70	0	0
3	35	35	1	2	1020	1020	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1700	15	80	710	0	60	0	45	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Location, ft	3030											
1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 3

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				999.22		
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		20.78			20.75	
1	Running Speed, mph		33.47			33.52	
1	Through Delay, s/veh		1.99			20.91	
1	Travel Speed, mph		30.54			16.7	
1	Stop Rate, stops/veh		0.07			0.48	
1	Spatial Stop Rate, stops/mi		0.34			2.48	
1	Through vol/cap ratio		0.65			0.45	
1	Percent of Base FFS		73.21			40.02	
1	Level of Service		B			D	
1	Automobile Perception Score		2.4			2.76	
2	Bay/Lane Spillback Time, h	0.09	999	999	999	999	999
2	ShrdLane Spillback Time, h	2.85					
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		60.68			58.94	
2	Running Speed, mph		38.88			40.03	
2	Through Delay, s/veh		13.04			3.35	
2	Travel Speed, mph		32			37.88	
2	Stop Rate, stops/veh		0.43			0.14	
2	Spatial Stop Rate, stops/mi		0.65			0.21	
2	Through vol/cap ratio		0.65			0.34	
2	Percent of Base FFS		76.7			90.78	
2	Level of Service		B			A	
2	Automobile Perception Score		2.34			2.27	
3	Bay/Lane Spillback Time, h	0	0.14	999	999	999	999
3	ShrdLane Spillback Time, h						
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		22.76			20.29	
3	Running Speed, mph		30.55			34.28	
3	Through Delay, s/veh		269.93			35.64	
3	Travel Speed, mph		2.38			12.43	
3	Stop Rate, stops/veh		2.04			0.79	
3	Spatial Stop Rate, stops/mi		10.58			4.1	
3	Through vol/cap ratio		1.49			0.65	
3	Percent of Base FFS		5.7			29.8	
3	Level of Service		F			F	
3	Automobile Perception Score		4.32			3.05	
Facility Travel Time, s			389.18			159.87	
Facility Travel Speed, mph			9.64			23.46	
Facility Spatial Stop Rate, veh/mi			2.44			1.35	
Facility Base Free Flow Speed, mph			41.72			41.72	
Facility Percent Base Free Flow Speed			23.1			56.22	
Facility Level of Service			F			C	
Facility Automobile Perception Score			2.57			2.47	
Facility Pedestrian Space			Infinity			Infinity	
Facility Pedestrian Travel Speed			4.4			4.4	
Facility Pedestrian LOS Score			3.86			3.61	
Facility Pedestrian LOS			D			D	
Facility Bicycle Travel Speed			13.5			13.26	
Facility Bicycle LOS Score			3.91			3.62	
Facility Bicycle LOS			D			D	
Facility Transit Travel Speed			30.55			12.69	
Facility Transit LOS Score			1.01			1.11	
Facility Transit LOS			A			A	
SPILLBACK TIME, h			0.14				

Multimodal Results

1	Roadway crossing difficulty factor	1.2	1.2
1	Ped LOS Score for Link	3.71	3.66
1	Ped LOS Score for Intersection	2.17	3.27
1	Ped LOS Score for Segment	3.9	4.19
1	Ped Segment LOS	D	D
1	Bicycle LOS Score for Link	3.82	3.8
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	3.69	3.47
1	Number of access point approaches	0	0
1	Segment Length, ft	1020	1020
1	Bicycle LOS Score for Segment	3.9	3.81
1	Bicycle Segment LOS	D	D
1	Transit Wait-Ride Score	3.8	2.92
1	Ped LOS Score for Link	3.71	3.66
1	Transit LOS Score for Segment	0.86	2.17
1	Transit Segment LOS	A	B
2	Roadway crossing difficulty factor	1.2	1.2
2	Ped LOS Score for Link	3.92	2.96
2	Ped LOS Score for Intersection	0.68	2.19
2	Ped LOS Score for Segment	3.6	3.63
2	Ped Segment LOS	D	D
2	Bicycle LOS Score for Link	3.9	3.57
2	Indicator Variable	1	1
2	Bicycle LOS Score for Intersection	2.09	2.87
2	Number of access point approaches	0	0
2	Segment Length, ft	3460	3460
2	Bicycle LOS Score for Segment	3.56	3.61
2	Bicycle Segment LOS	D	D
2	Transit Wait-Ride Score	3.74	4.04
2	Ped LOS Score for Link	3.92	2.96
2	Transit LOS Score for Segment	0.98	0.39
2	Transit Segment LOS	A	A
3	Roadway crossing difficulty factor	1.2	0.98
3	Ped LOS Score for Link	5.37	2.95
3	Ped LOS Score for Intersection	2.64	2.28
3	Ped LOS Score for Segment	4.67	2.97
3	Ped Segment LOS	E	C
3	Bicycle LOS Score for Link	4.09	3.57
3	Indicator Variable	1	1
3	Bicycle LOS Score for Intersection	4.96	1.26
3	Number of access point approaches	0	0
3	Segment Length, ft	1020	1020
3	Bicycle LOS Score for Segment	5.08	3.46
3	Bicycle Segment LOS	F	C
3	Transit Wait-Ride Score	3.68	2.61
3	Ped LOS Score for Link	5.37	2.95
3	Transit LOS Score for Segment	1.29	2.52
3	Transit Segment LOS	A	B

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1735	15.3	88.9	789	0	60	0	45	0	0	0
1: Lanes	0	2	0	1	2	0	0	1	0	0	0	0
1: Prop blocked	0	0	0	0.15	0	0	0.15	0.15	0.15	0.15	0.15	0
1: Thru veh delay		0.02			0							
1: Prob inside blk		0			0							
1: Dist to upstream signal	3030											

SEGMENT 3

Future Year Build Traffic Conditions Technical Memorandum

I-229 Benson Road Interchange Modification Study

Sioux Falls, South Dakota

June 5, 2018

City of Sioux Falls
SOUTH DAKOTA

South Dakota DOT
Connecting South Dakota and the Nation

This memorandum provides the results of build operations analysis for the year 2023 and 2045 traffic conditions in the project study area (Figure 1). The analysis was prepared using the procedures and inputs specified in the approved Methods and Assumptions document for this study. Analysis output documents are provided in the appendix to this memorandum.

1.0 Traffic Volume Development

Traffic counts on the Interstate roadway segments were gathered by SDDOT in 2017. Traffic counts on the arterial street system were available in City of Sioux Falls and HDR files. Count data were assembled and balanced to produce a representation of peak hour traffic flows through the study area. The peak hour traffic volumes for Benson Road and I-229 for year 2023 and 2045 developed for the No-Build Scenario have been utilized in the analysis of the Alternative Scenarios for the I-229 Interchange and Benson Road Corridor.

Traffic forecasts for 2023 and 2045 were prepared using the regional travel demand model maintained by the City of Sioux Falls and the Sioux Falls Metropolitan Planning Organization. The forecasts were based on the latest land development information and modeling updated from the 2035 model used in the I-229 Major Investment Study.

It is assumed in the 2023 volume projections that a Benson Road extension, east to Rice Street, will not occur prior to 2023. Also, as a result of the build condition with a raised median on Benson, the thru movements and left turns at Potsdam were re-routed to the Lewis Avenue intersection and the left turns for the HSBC driveway were also re-routed through the Lewis Avenue intersection.

2.0 Traffic Operations

Level of service on I-229 was calculated for ramp merge-diverge, and weave areas for peak hours under 2023 and 2045 conditions in the immediate vicinity of the Benson Road interchange. The level of service results are shown in Figures 1 through 7 of the Build Option Alternative Scenarios. Note that ramp merge-diverge segments for the I-229 SB Benson merge and I-229 NB Benson diverge are reported as part of the weaving segment between Benson Road and Rice Street. If it was determined that the segment satisfied the conditions for weaving, the weaving level of service was reported and indicated by an asterisk (*) next to the level of service result.

Intersection turning volumes and level of service for peak hours under 2023 and 2045 conditions are shown in Figures 23 through 29 and 37 through 43, respectively for Benson Road. Multimodal levels of service for the Benson Road arterial corridor are shown in Figures 30 through 36 and 44 – 50, respectively for 2023 and 2045 conditions.

2.1 2023 Traffic Conditions

The 2023 conditions analysis shows that Interstate facilities within the Benson Road interchange area continue operate at an acceptable level of service, LOS C or better for all build conditions scenarios analyzed.

The arterial street system performs at acceptable level of service for all build conditions scenarios analyzed, with the exception of Alternate 1D and IE at the I-229 southbound ramp terminal. This is a result of the northbound loop ramp traffic being controlled by the traffic signal

at the I-229 northbound ramp terminal and negatively impacts signal timing at the downstream intersection (I-229 southbound ramp terminal). Allowing right on red for the dual southbound rights at the I-229 northbound ramp terminal may improve operations associated with Alternatives 1D and 1E. Alternatives 1A, B, and C address this deficiency by allowing free right turn movements for the southbound right turn at the I-229 northbound ramp terminal. Intersection levels of service for the interchange build alternatives are summarized in the table below.

	2023 CONDITIONS																	
	Existing		No Build		Alt. 1A		Alt. 1B		Alt 1C		Alt. 1D		Alt. 1E		Alt. 4A		Alt. 4B	
Intersection	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Benson/Cliff	B	B	B	C	B	C	B	C	B	C	B	C	B	C	C	C	C	C
Benson/Lewis	B	C	B	C	B	C	B	D	B	C	B	C	B	C	B	D	B	D
Benson/Potsdam	F	F	F	F	C	E	C	E	C	E	C	E	C	E	C	E	C	E
Benson/I-229 SB Ramp	D	A	F	C	B	A	B	A	B	A	F	A	F	A	B	A	B	A
Benson/I-229 NB Ramp	F	B	F	C	A	A	B	A	A	A	C	B	C	B	B	B	B	B
Benson/Hall	A	B	B	F	B	F	B	F	B	F	B	F	B	F	B	F	B	F

The arterial network experiences peak hour congestion (LOS E or worse) at the following locations during the 2023 build conditions analysis:

- Benson Road/Potsdam Avenue (PM) – STOP controlled intersection
- Benson Road/Hall Avenue (PM) – STOP controlled intersection

Certain movements experienced low levels of service or queues that exceeded the length of the available storage during particular peak hours. The southbound left turn during the PM peak hour at Benson Road/Lewis Avenue is an example of this characteristic. Queues however do not impact adjacent streets or accesses and the overall intersection level of service achieves the minimum requirement for LOS D with a specific movement no worse than LOS E. The existing left turn storage could likely be extended over the existing pavement surface by striping modifications.

A northbound right turn lane is necessary at the Benson Road and Lewis Avenue intersection in order to address low levels of service in the PM peak hour. The Benson Road/Hall Avenue intersection low level of service is addressed by the installation of a traffic signal in the 2045 scenario.

Multimodal level of service continues to vary throughout the Benson Road corridor.

2.2 2045 Traffic Conditions

The 2045 conditions analysis shows that Interstate facilities within the Benson Road interchange area continue to operate at an acceptable level of service, LOS C or better for all build scenarios analyzed.

The arterial street system performs at acceptable level of service for all build conditions scenarios analyzed, with the exception of Alternatives 1D and 1E at the I-229 southbound ramp terminal. This is a result of the northbound loop ramp traffic being controlled by the traffic signal at the I-229 northbound ramp terminal and negatively impacts signal timing at the downstream intersection (I-229 southbound ramp terminal). Allowing right on red for the dual southbound rights at the I-229 northbound ramp terminal may improve operations associated with Alternatives 1D and 1E. Alternatives 1A, B, and C address this deficiency by allowing free right turn movements for the southbound right turn at the I-229 northbound ramp terminal. Intersection levels of service under each interchange build alternative are summarized in the table below.

	2045 CONDITIONS																	
	Existing		No Build		Alt. 1A		Alt. 1B		Alt 1C		Alt. 1D		Alt. 1E		Alt. 4A		Alt. 4B	
Intersection	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Benson/Cliff	B	B	B	C	B	C	B	C	B	C	C	C	C	C	C	C	C	C
Benson/Lewis	B	C	B	C	B	C	C	C	B	C	B	C	B	C	B	D	B	D
Benson/Potsdam	F	F	F	F	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Benson/I-229 SB Ramp	D	A	F	F	B	B	B	B	B	B	F	B	F	B	B	A	B	A
Benson/I-229 NB Ramp	F	B	F	B	A	A	B	A	A	A	D	A	E	B	B	B	B	B
Benson/Hall	A	B	F	F	B	B	B	C	B	B	B	B	B	B	C	B	C	B

Certain movements experienced low levels of service or queues that exceeded the length of the available storage during particular peak hours. The southbound left turn during the PM peak hour at Benson Road/Lewis Avenue is an example of this characteristic. Queues however do not impact adjacent streets or accesses and the overall intersection level of service achieves the minimum requirement for LOS D with a specific movement no worse than LOS E. The existing left turn storage could likely be extended over the existing pavement surface by striping modifications.

A northbound right turn lane is necessary at the Benson Road and Lewis Avenue intersection in order to address low levels of service in the PM peak hour. The Benson Road/Hall Avenue intersection low level of service is addressed by the installation of a traffic signal in the 2045 scenario.

Multimodal level of service varies widely throughout the Benson Road corridor.

2.3 Additional Access Points

There are additional access points within the arterial corridors that serve as sources and sinks of traffic for traffic volume balancing, but were not required to be analyzed. These locations appear in the traffic analysis files as intermediate access points and appear in the alternative arterial layouts:

- Benson Road/National Avenue
- Benson Road/Sanford driveway (formerly HSBC)

Another access point has been identified in the alternative arterial layouts for Benson Road, located half-way between I-229 and Hall Avenue. While this access point may play a role in future development, traffic forecast for the surrounding area has been routed through the Benson/Hall intersection to account for all potential future volumes through the specified analysis intersections.

Drawn By: B.Miller
Date: 5/29/2018
Chked By: P.Sanow
Date: 5/29/2018
Revision:

Alternative Scenario 1a
2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
1

Drawn By: B.Miller
Date: 5/29/2018
Chked By: P.Sanow
Date: 5/29/2018
Revision:

Alternative Scenario 1b
2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
2

Drawn By: B.Miller
Date: 5/29/2018
Chked By: P.Sanow
Date: 5/29/2018
Revision:

Alternative Scenario 1c -- 2-Lane Collector-Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp.

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure 3

Drawn By: B.Miller
Date: 5/29/2018
Chked By: P.Sanow
Date: 5/29/2018
Revision:

Alternative Scenario 1d -- 2-Lane Partial Clover Leaf Northeast Quadrant Loop with 2-Lane SB On-Ramp.

I-229 Exit 9 (Benson Road) IMJR Sioux Falls, SD

Figure 4

Drawn By: B.Miller
Date: 5/29/2018
Chked By: P.Sanow
Date: 5/29/2018
Revision:

Alternative Scenario 1E --2-Lane Partial Clover Leaf Northeast Quadrant with CD Lane and 2-Lane SB On-Ramp.

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure 5

Drawn By: B.Miller
Date: 5/29/2018
Chked By: P.Sanow
Date: 5/29/2018
Revision:

Alternative Scenario 4a -- Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add 2 WB Lanes to Existing Overpass.

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure 6

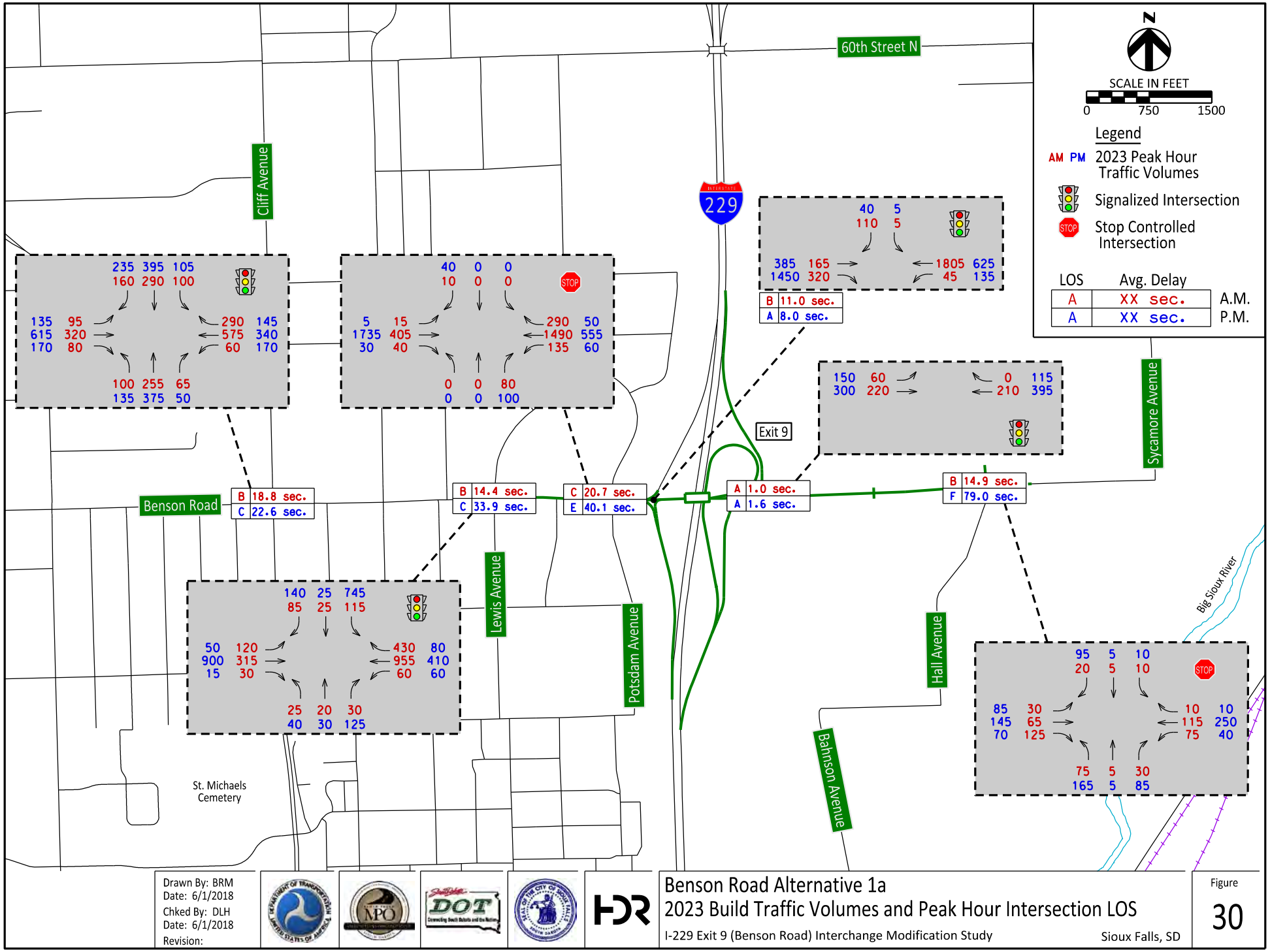
Drawn By: B.Miller
Date: 5/29/2018
Chked By: P.Sanow
Date: 5/29/2018
Revision:

Alternative Scenario 4b -- Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB Lanes.

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure 7



FILE: ...\Figure 30 (2023).dgn
PLOTTING DATE: 06-04-2018

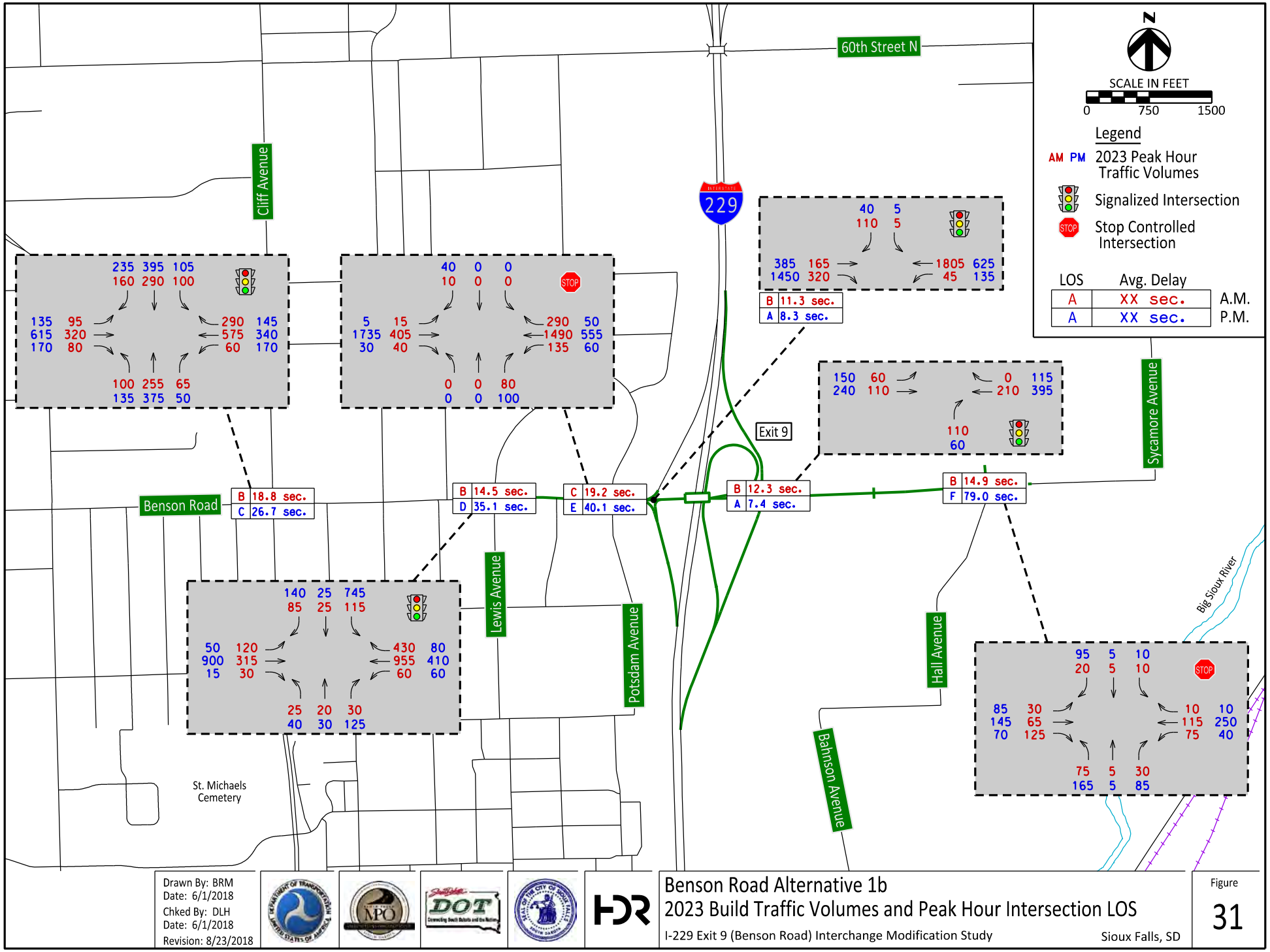
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1a
2023 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 30



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision: 8/23/2018

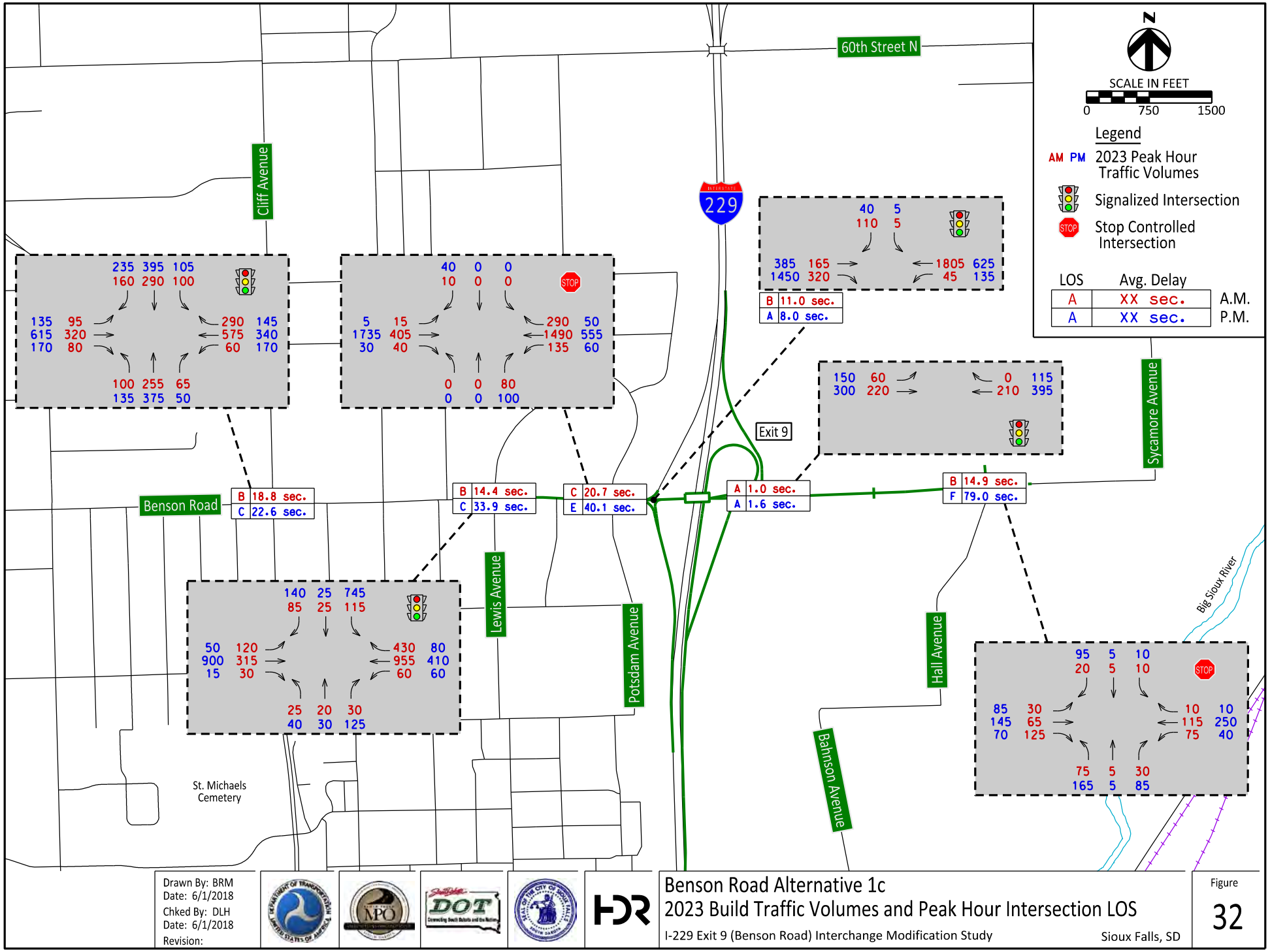
Benson Road Alternative 1b
2023 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 31

FILE: ...\Figure 31 (2023).dgn
PLOTTING DATE: 08-23-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

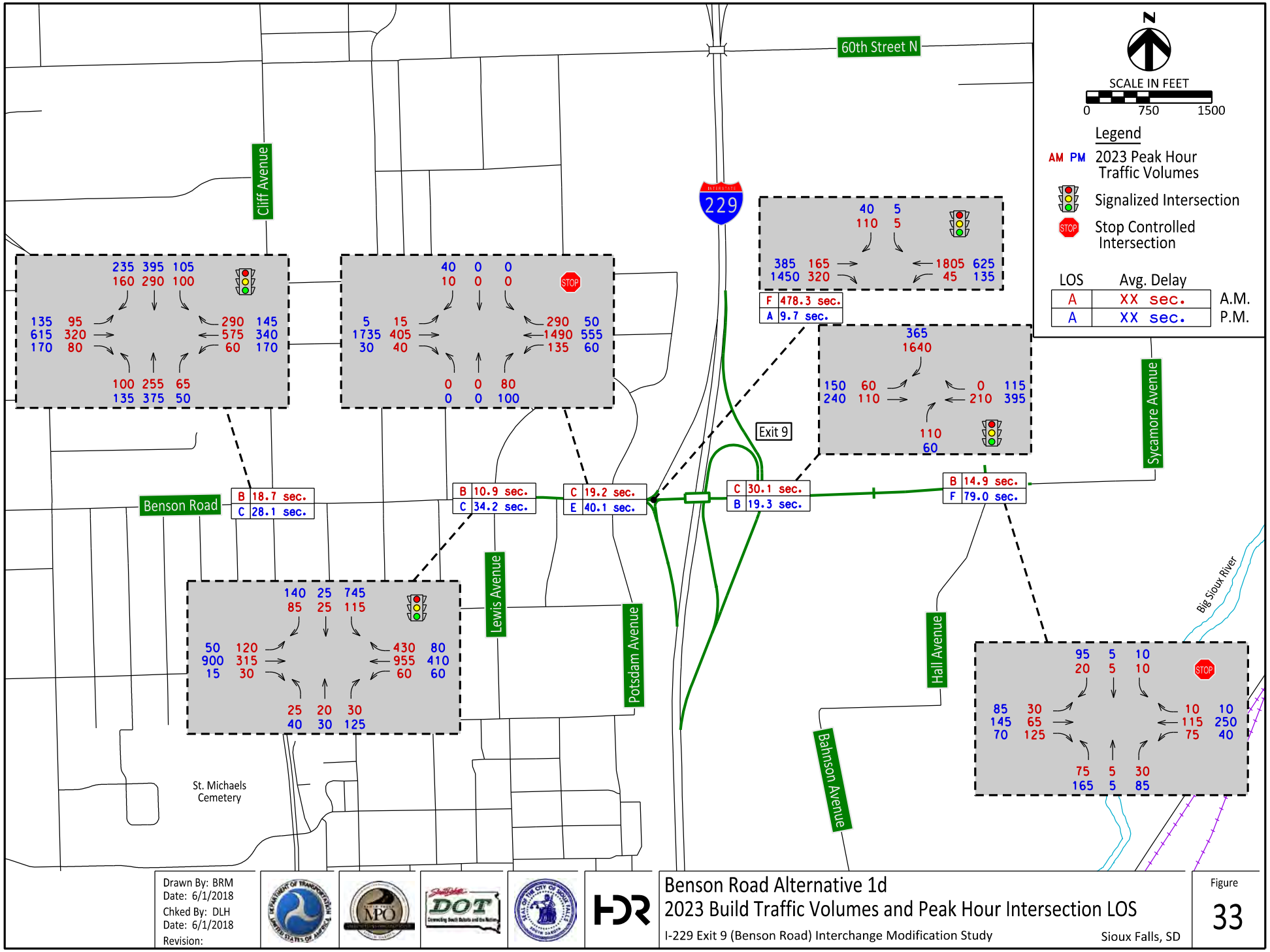
Benson Road Alternative 1c
2023 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 32

FILE: ...\Figure 32 (2023).dgn
PLOTTING DATE: 06-04-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

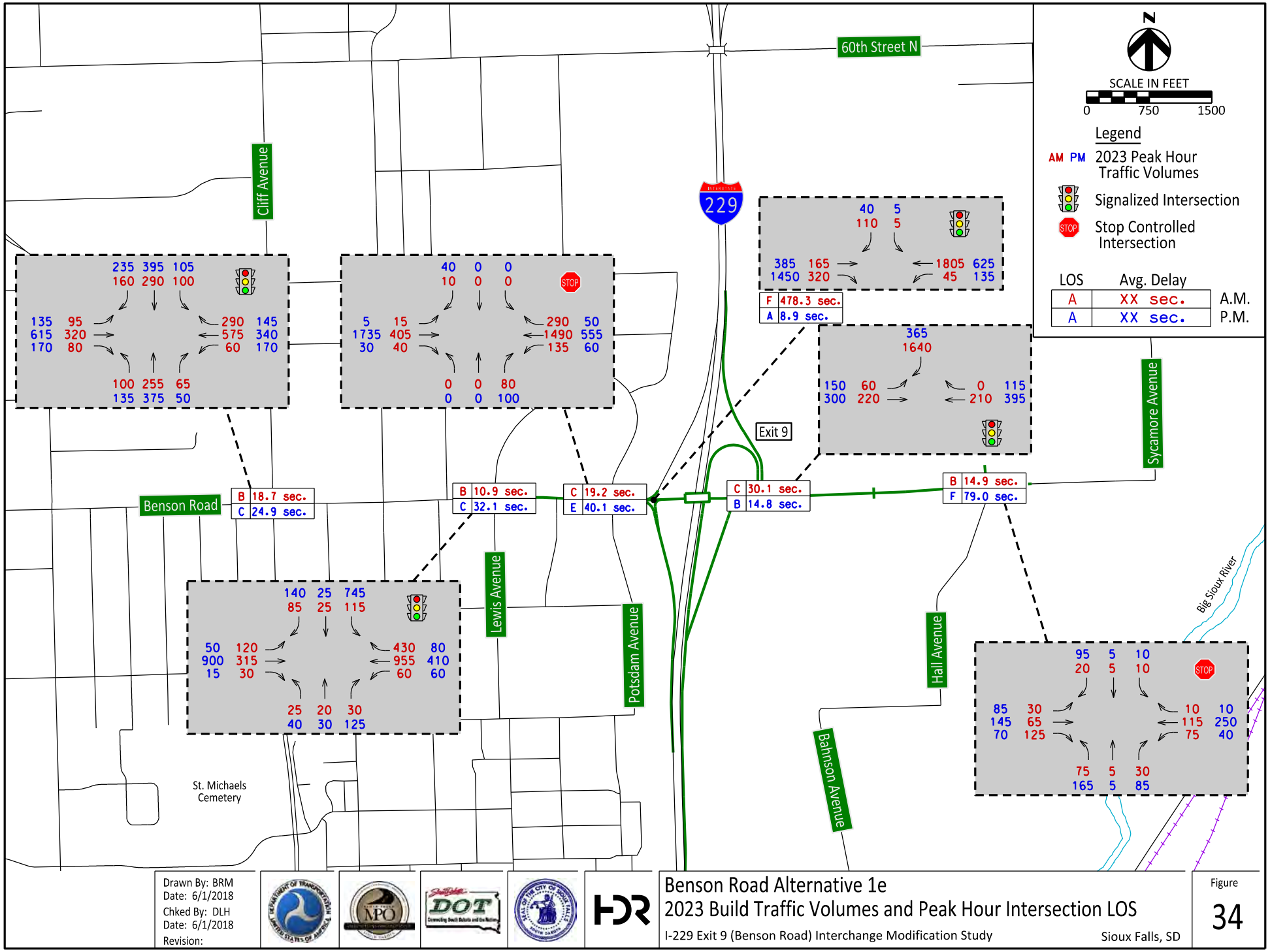
Benson Road Alternative 1d
2023 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 33

FILE: ...\Figure 33 (2023).dgn
PLOTTING DATE: 06-05-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

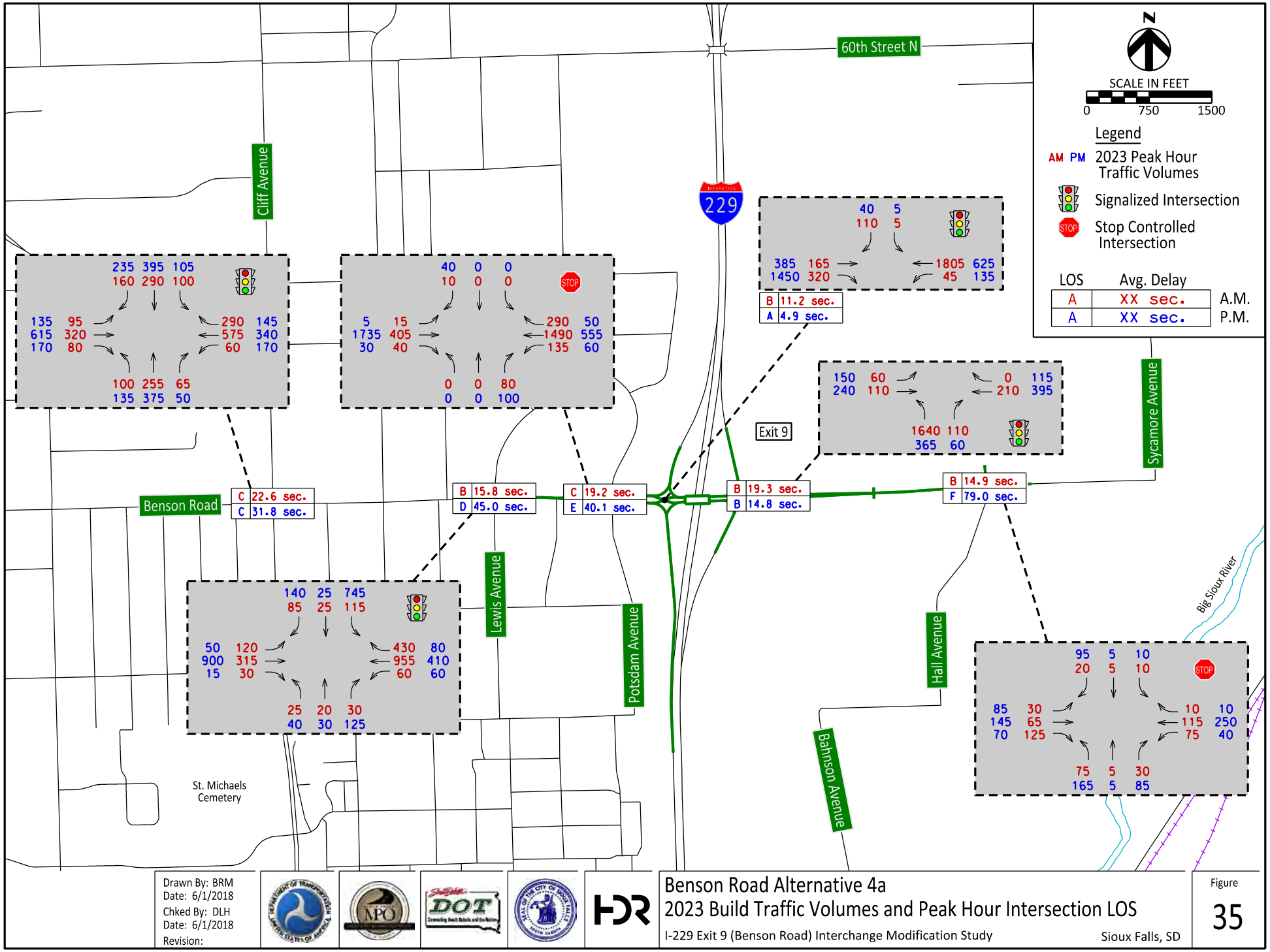
Benson Road Alternative 1e
2023 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 34

FILE: ...\Figure 34 (2023).dgn
PLOTTING DATE: 06-05-2018



FILE: ...\Figure 35 (2023).dgn
PLOTTING DATE: 06-04-2018

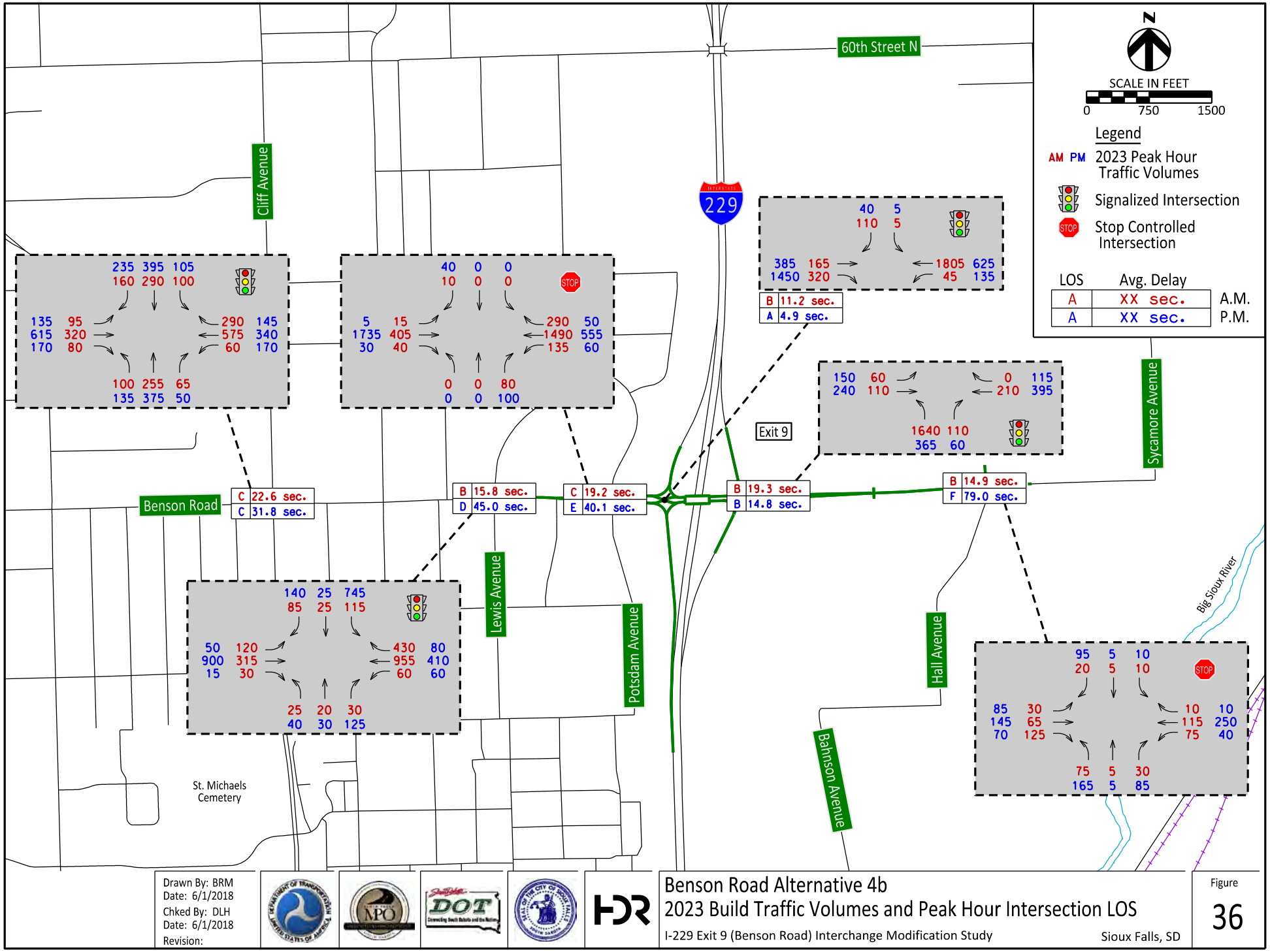
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 4a
2023 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 35



FILE: ...\Figure 36 (2023).dgn
PLOTTING DATE: 06-04-2018

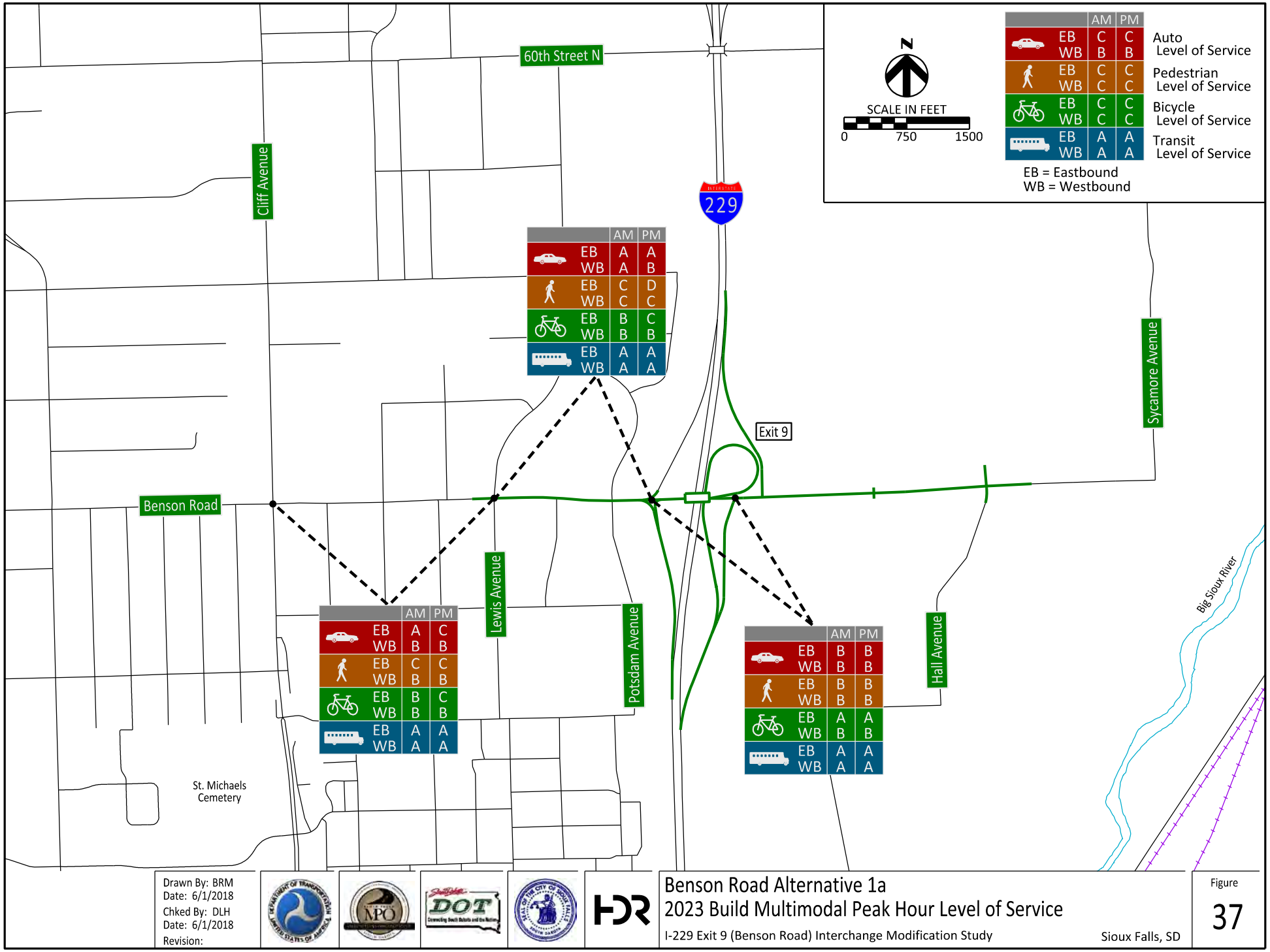
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 4b
2023 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 36



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

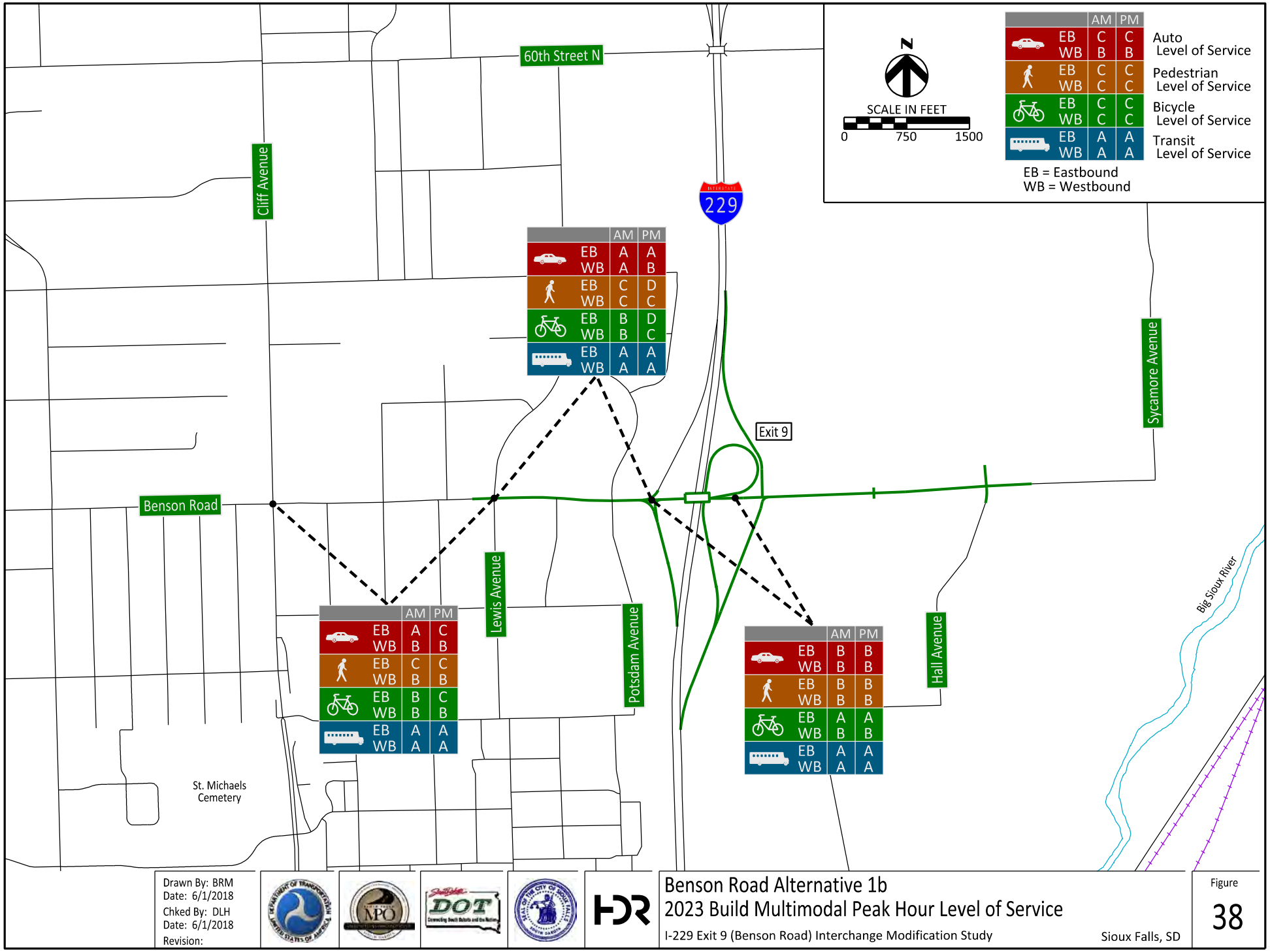
Benson Road Alternative 1a
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 37

FILE: ...\Figure 37 (MM 2023).dgn
PLOTTING DATE: 06-04-2018



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PLOTTING DATE: 06-04-2018

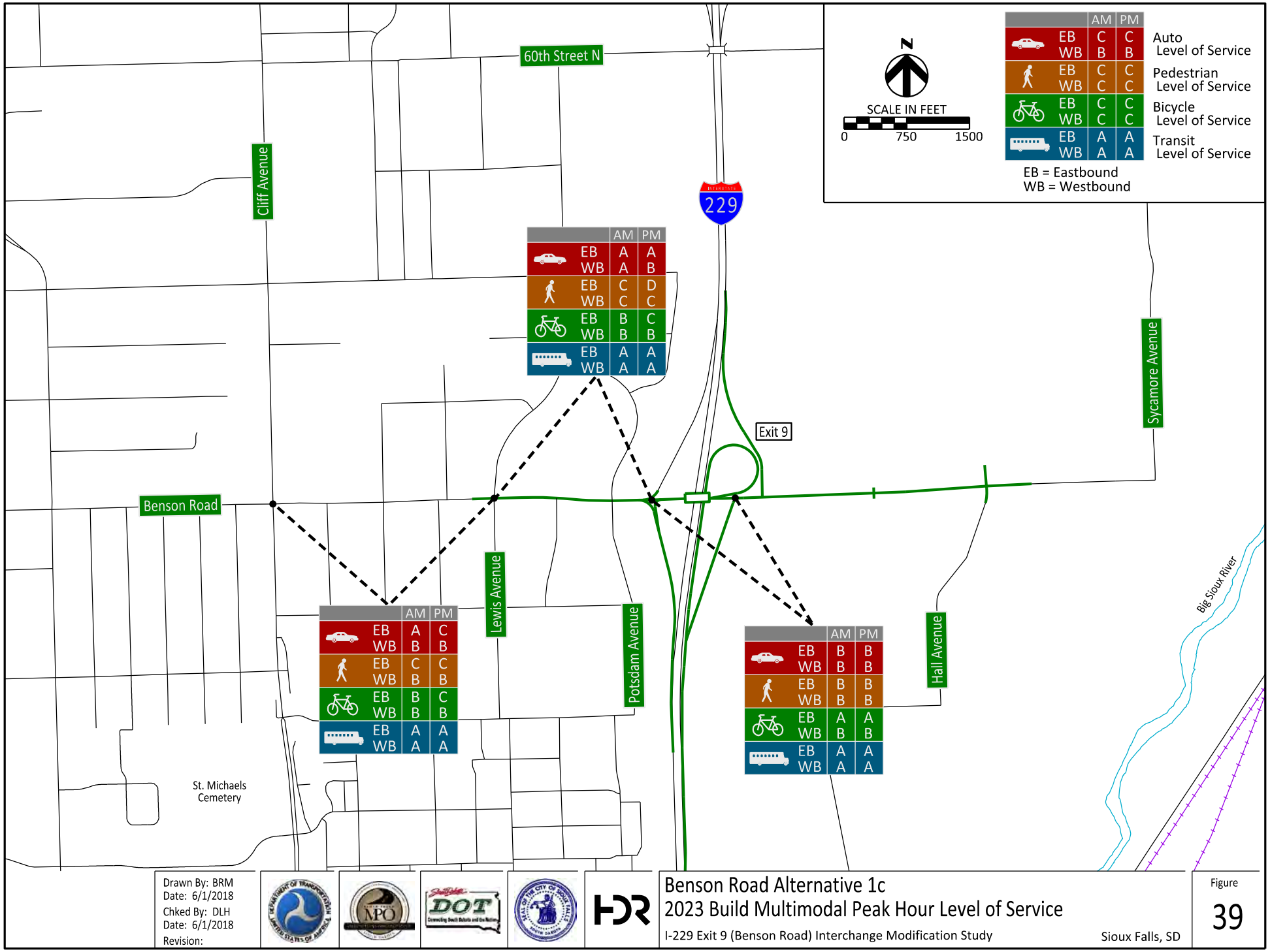
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1b
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure
38



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

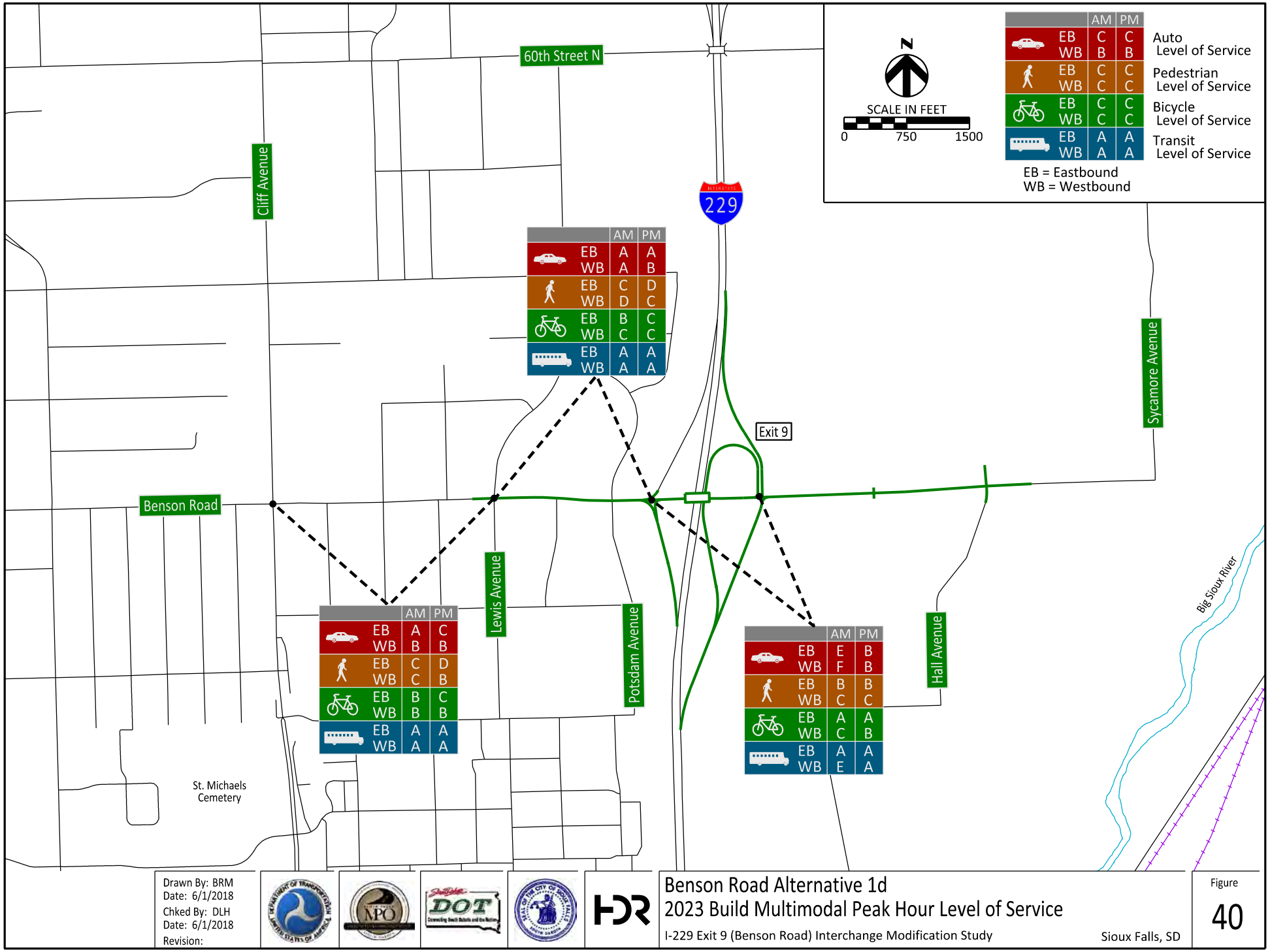
Benson Road Alternative 1c
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 39

FILE: ...\Figure 39 (MM 2023).dgn
PLOTTING DATE: 06-04-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

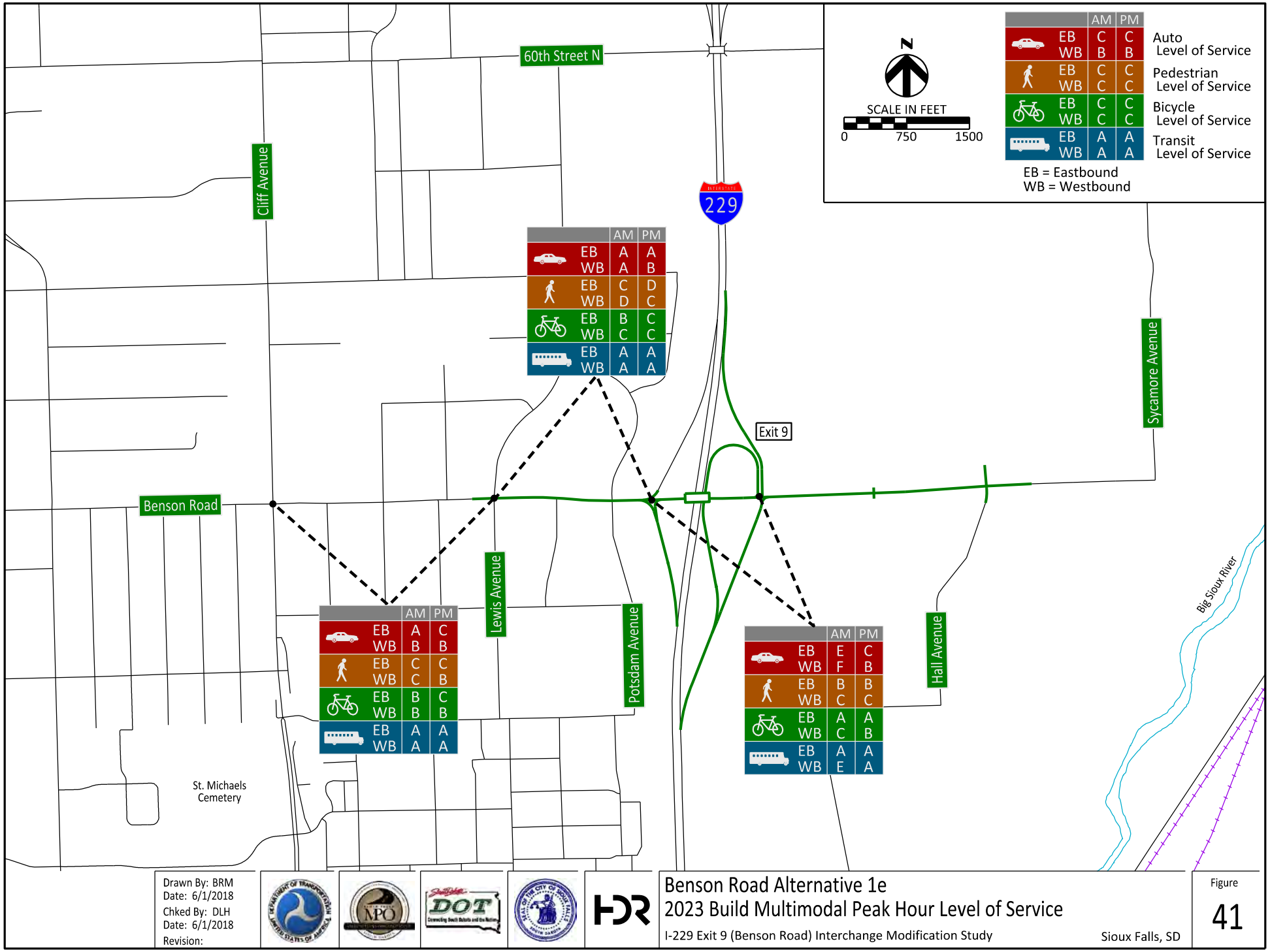
Benson Road Alternative 1d
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 40

FILE: ...\Figure 40 (MM 2023).dgn
PLOTTING DATE: 06-04-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1e
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 41

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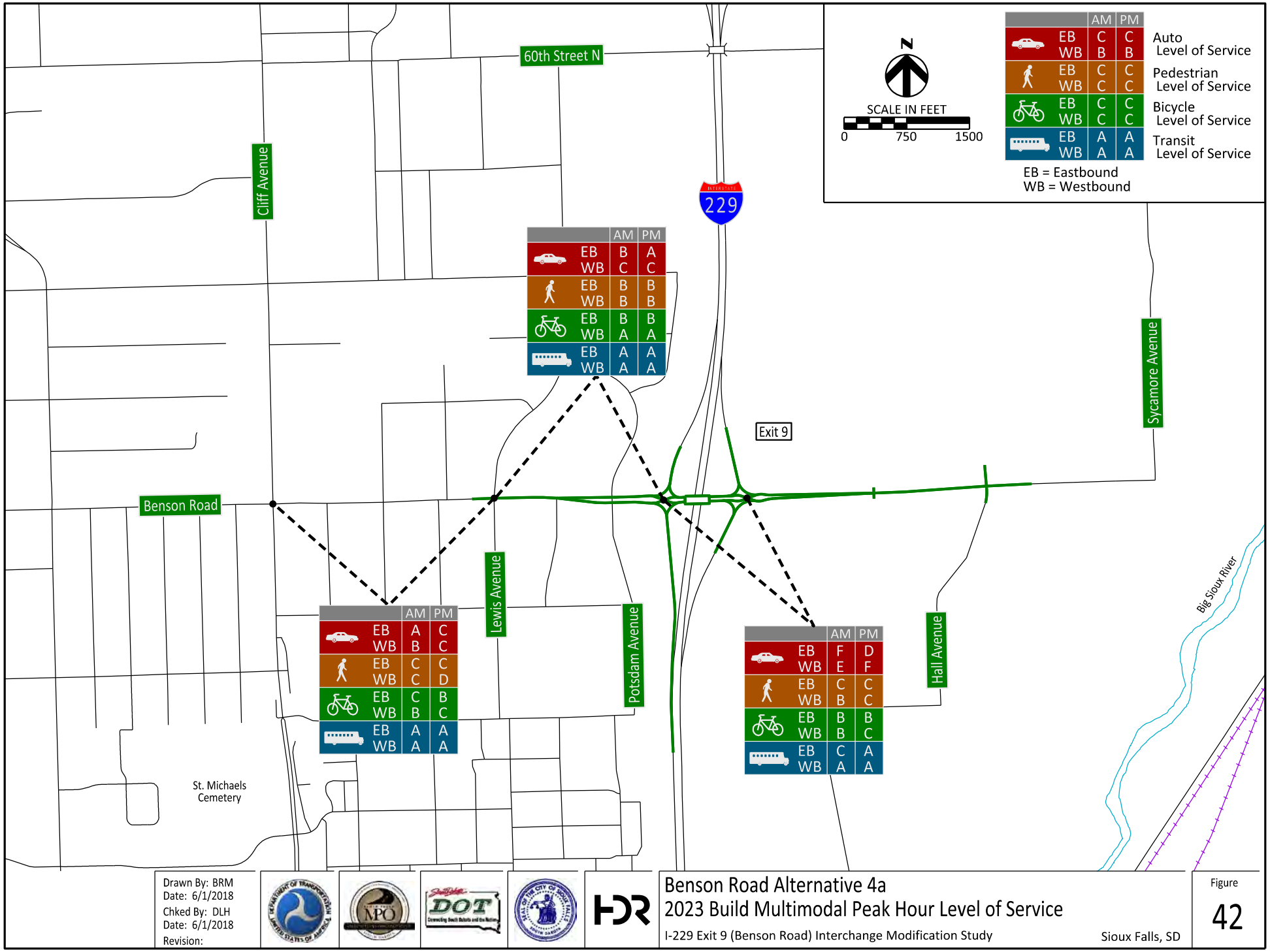
PLOTTING DATE: 06-04-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

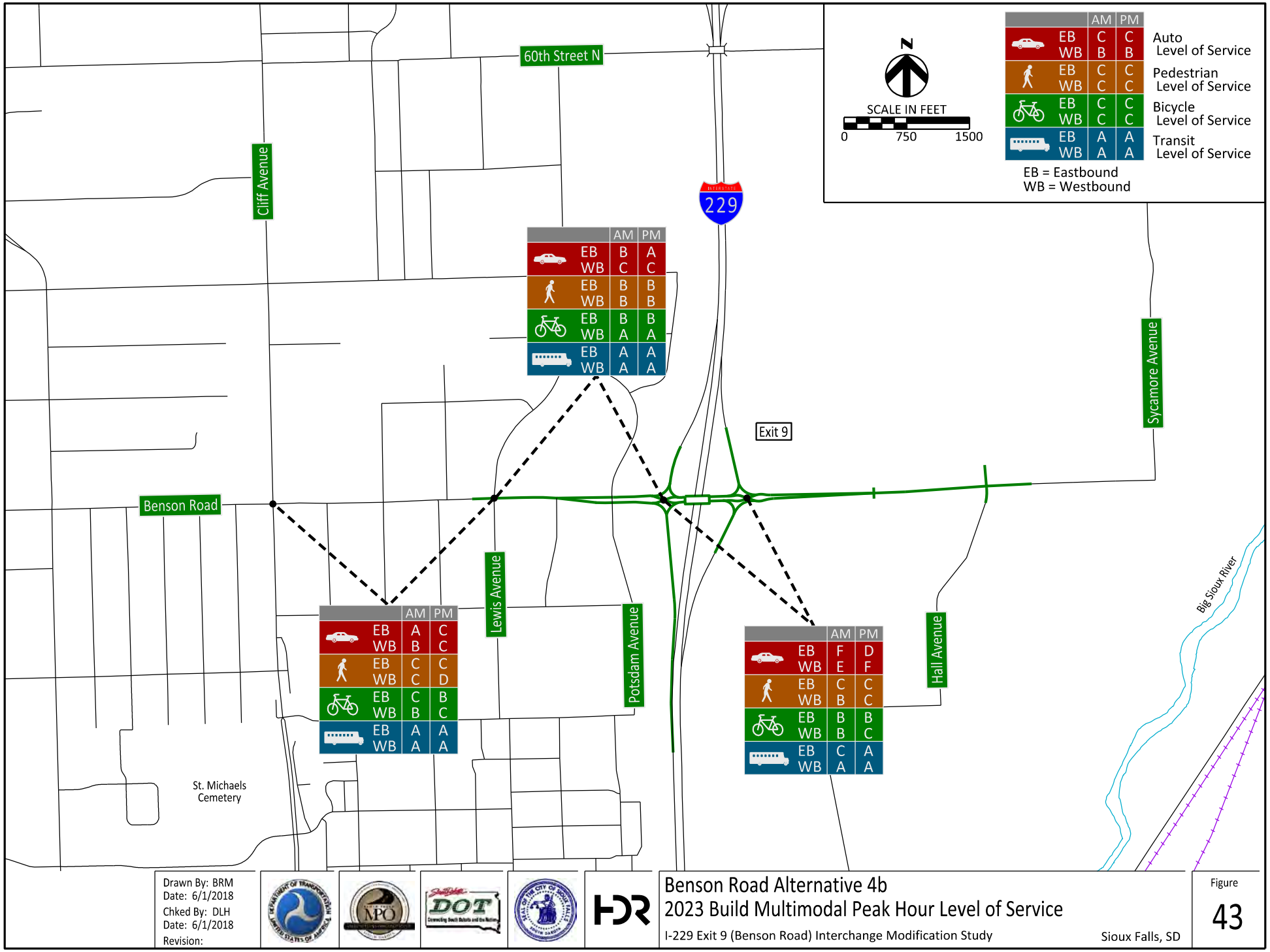
Benson Road Alternative 4a
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 42

FILE: ...\Figure 42 (MM 2023).dgn
PLOTTING DATE: 06-04-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

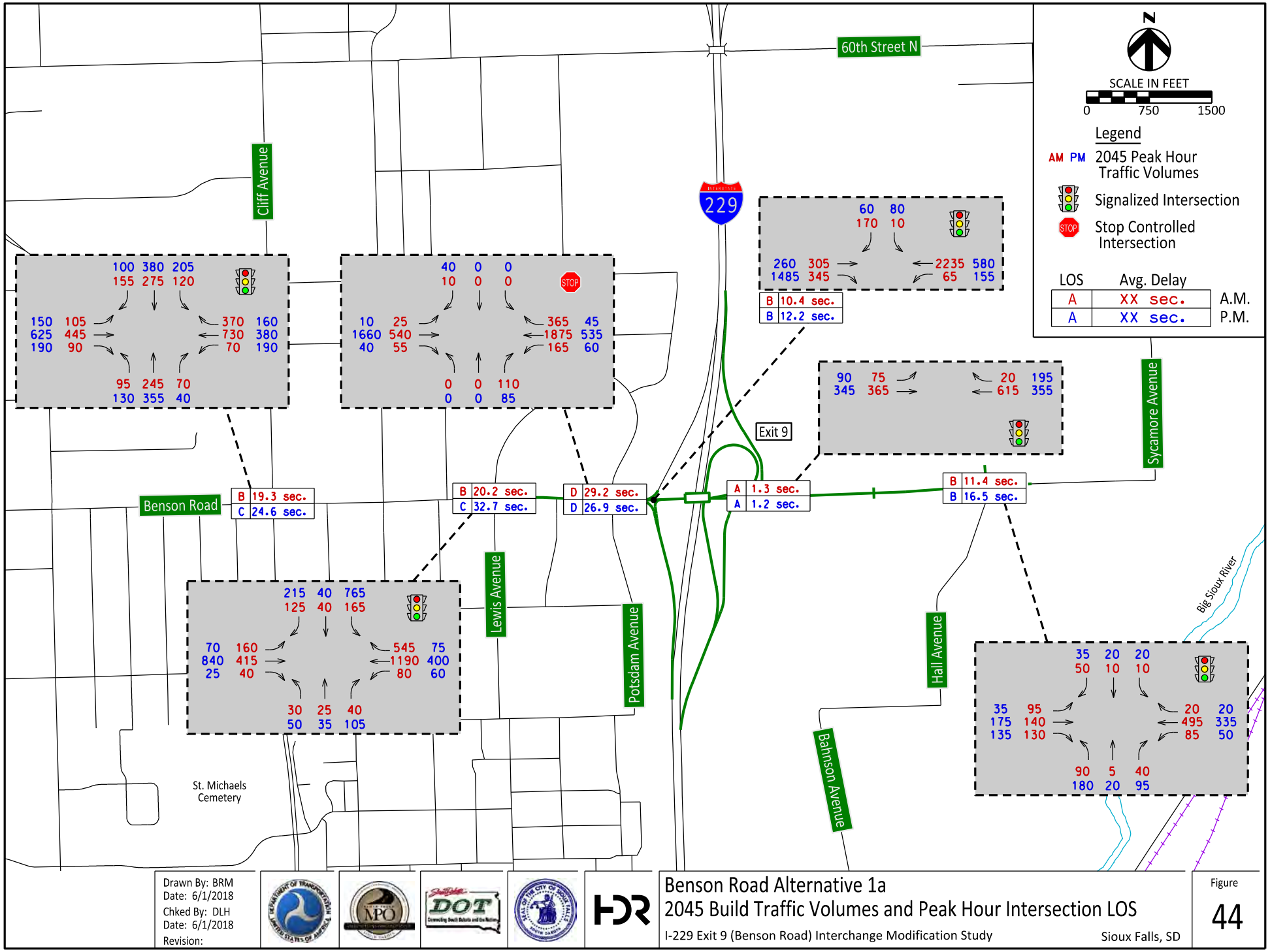
Benson Road Alternative 4b
2023 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 43

FILE: ...\Figure 43 (MM 2023).dgn
PLOTTING DATE: 06-04-2018

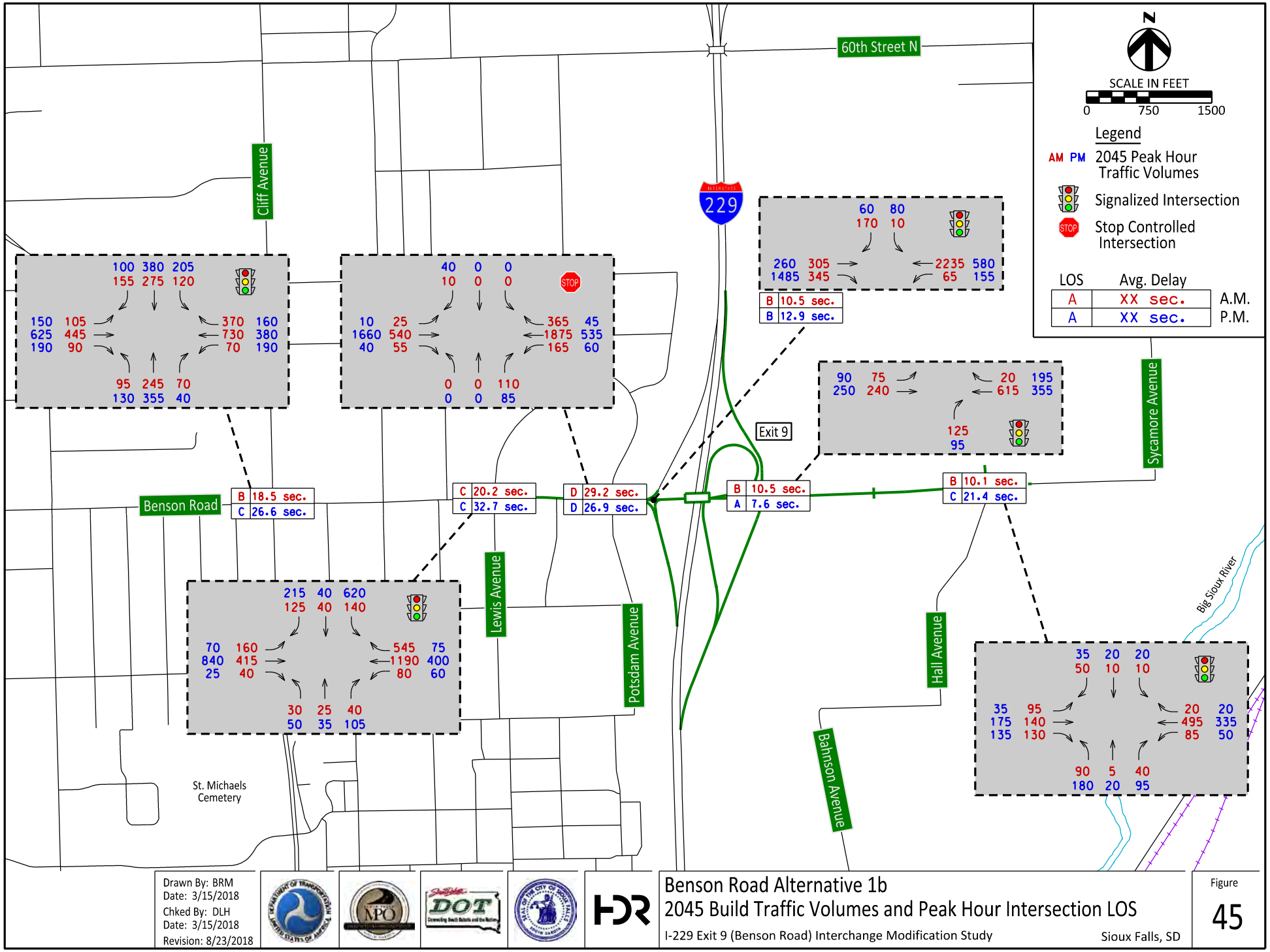


Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1a
2045 Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 44

FILE: ...\Figure 44 (2045).dgn
PLOTTING DATE: 06-04-2018

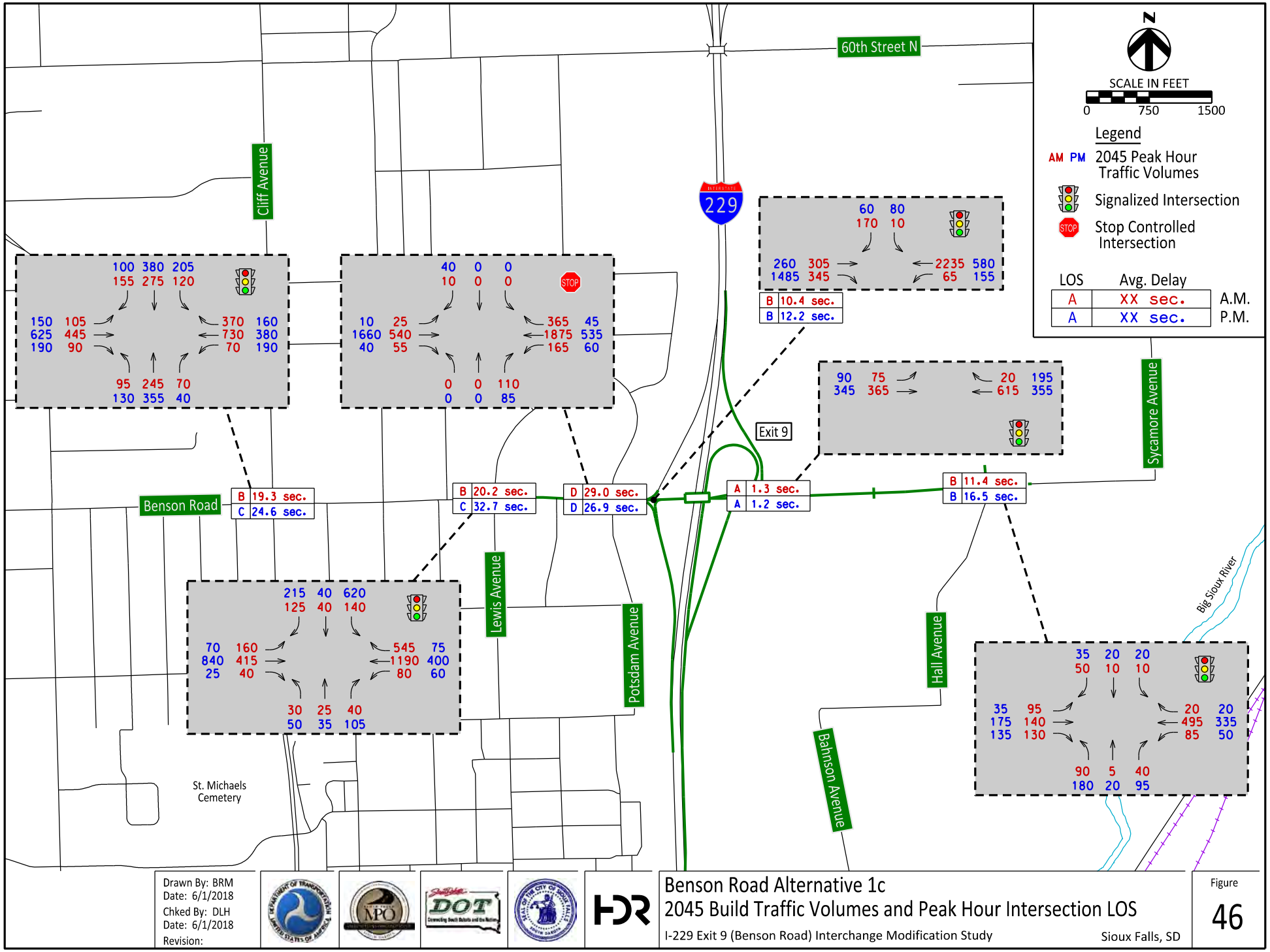


Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision: 8/23/2018

Benson Road Alternative 1b
2045 Build Traffic Volumes and Peak Hour Intersection LOS
I-229 Exit 9 (Benson Road) Interchange Modification Study
Sioux Falls, SD

Figure 45

FILE: ...\Figure 45 (2045).dgn
PLOTTING DATE: 08-23-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

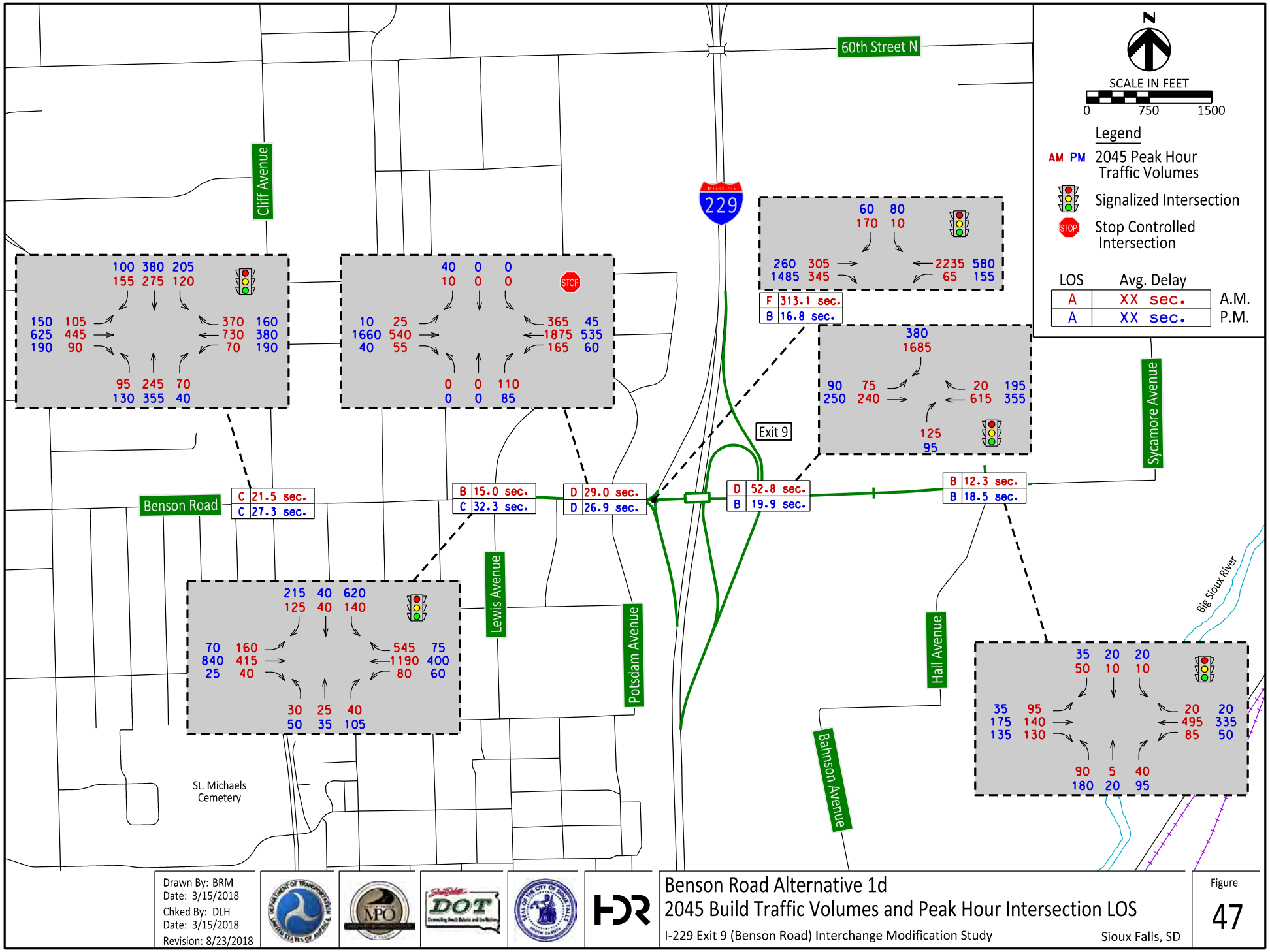
Benson Road Alternative 1c
2045 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 46

FILE: ...\Figure 46 (2045).dgn
PLOTTING DATE: 06-04-2018



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PLOTTING DATE: 08-23-2018

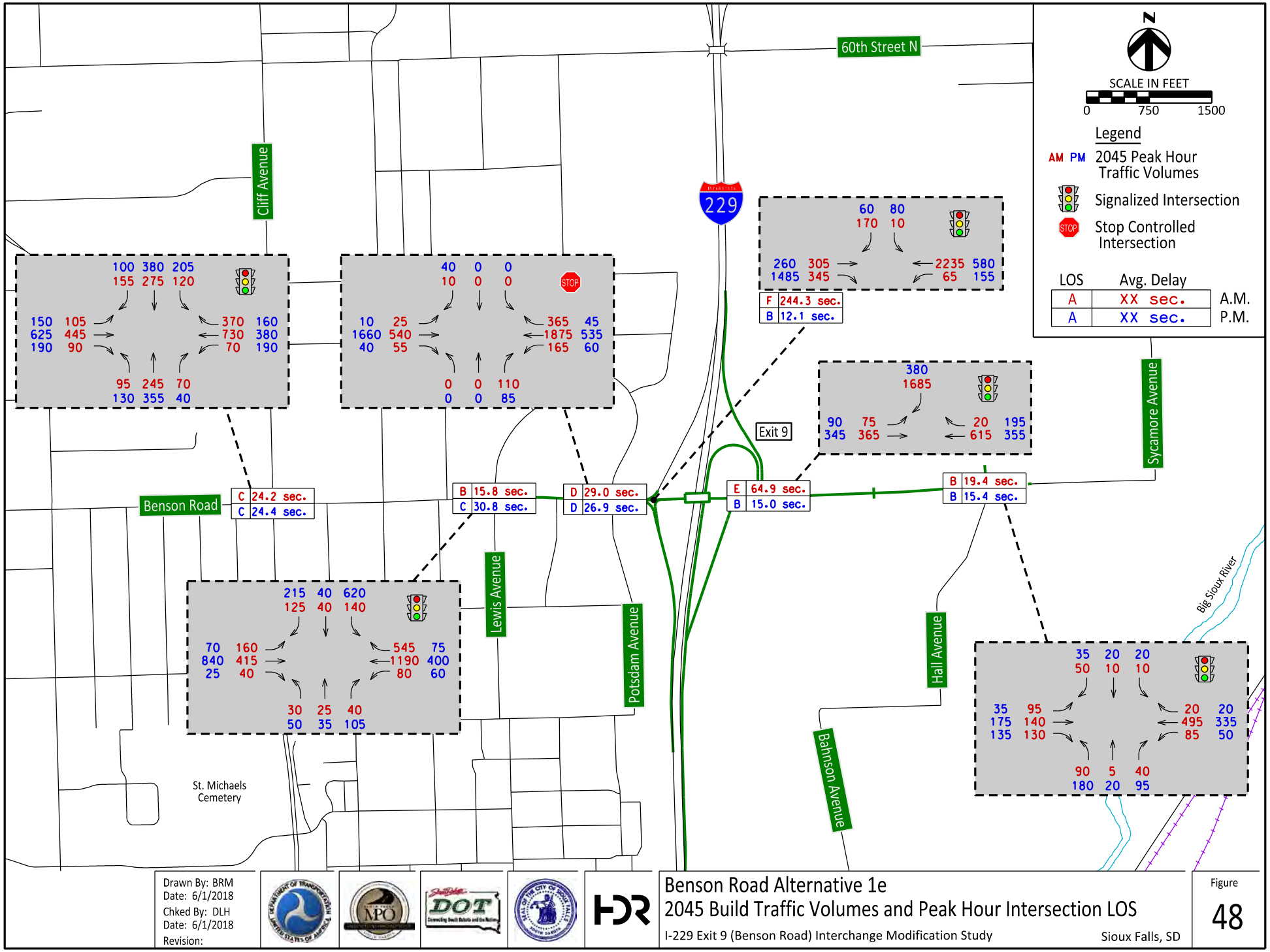
Drawn By: BRM
Date: 3/15/2018
Chked By: DLH
Date: 3/15/2018
Revision: 8/23/2018

Benson Road Alternative 1d
2045 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 47



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PLOTTING DATE: 06-04-2018

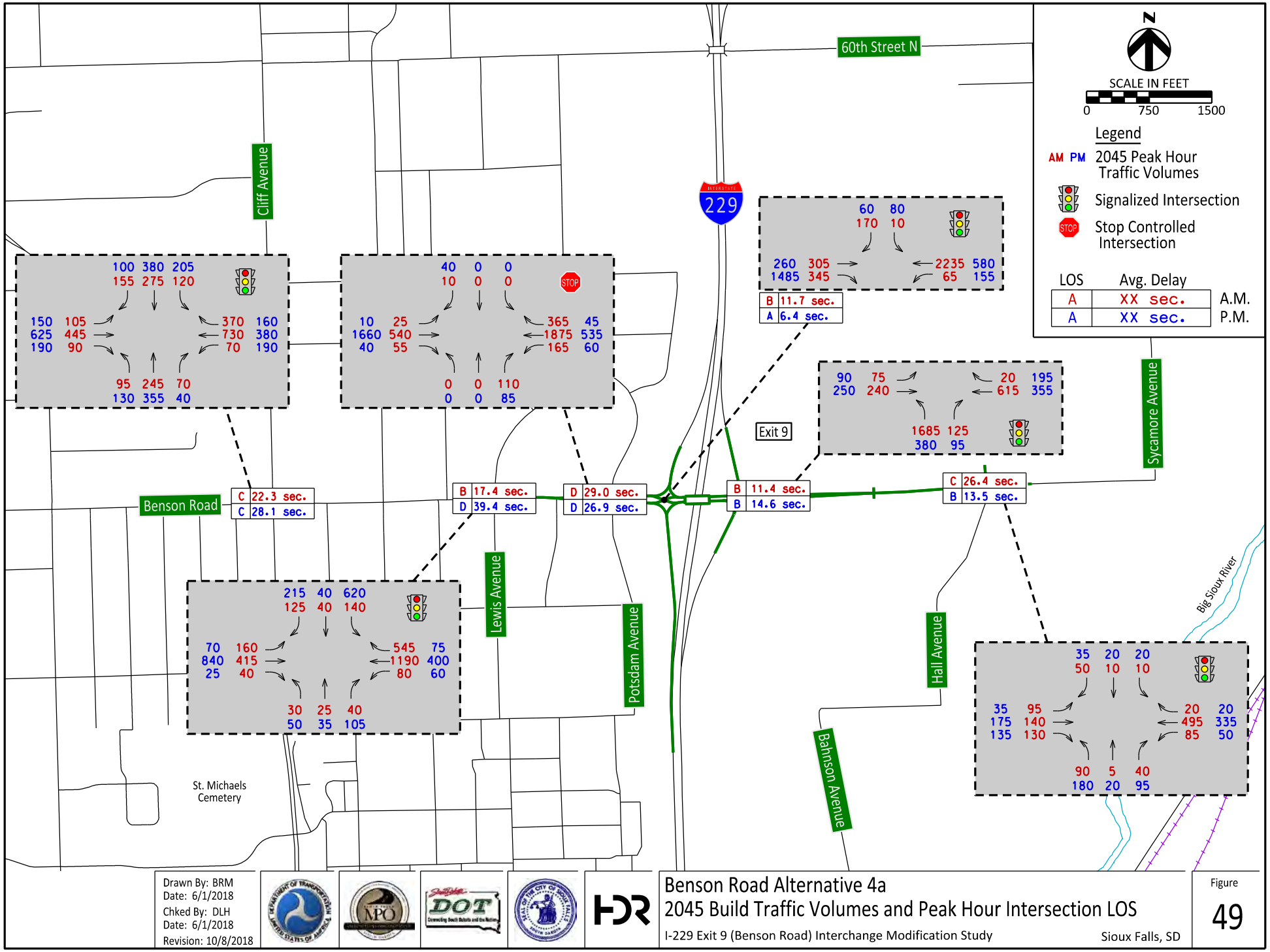
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1e
2045 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 48



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PLOTTING DATE: 10-10-2018

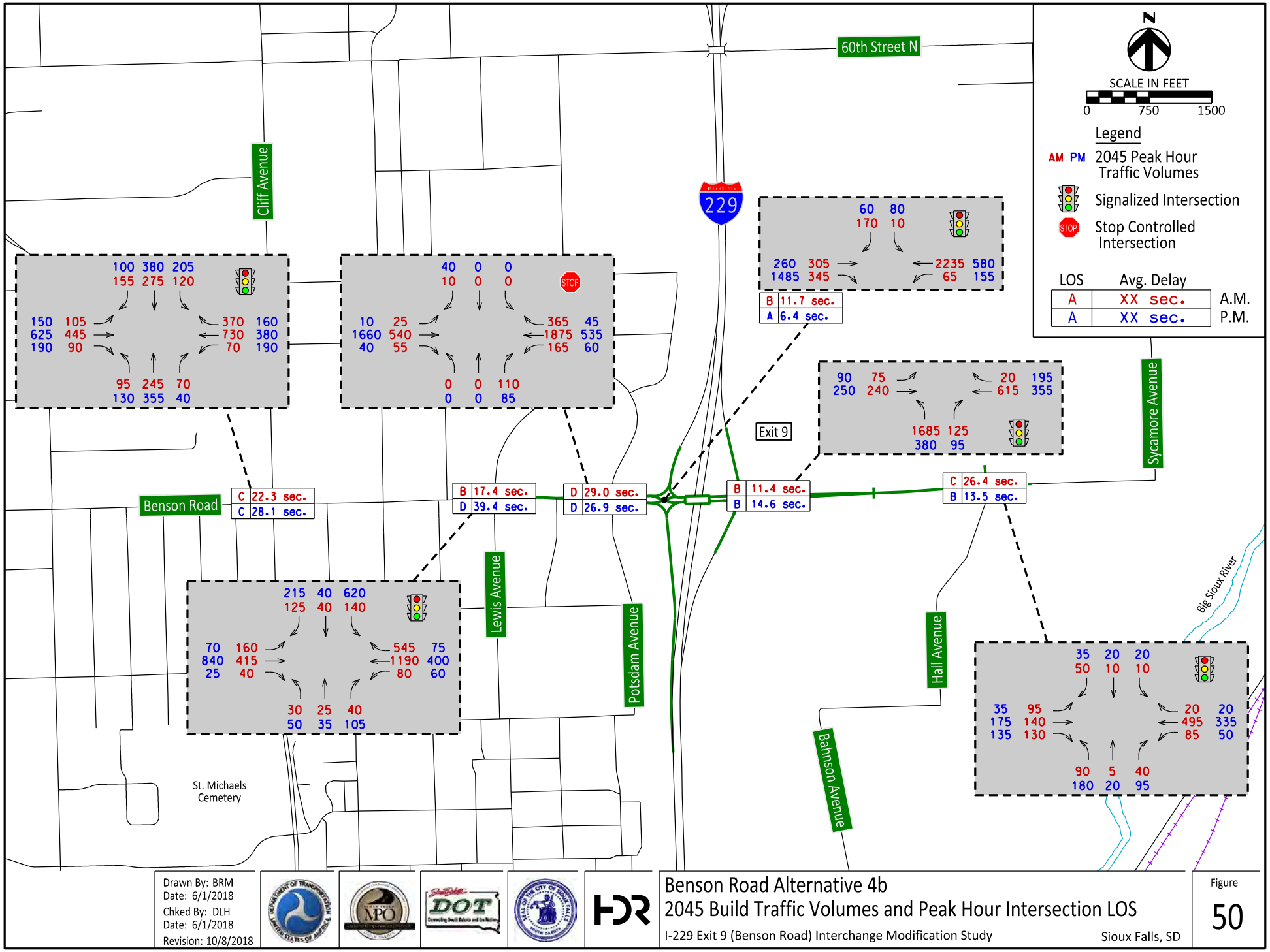
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision: 10/8/2018

Benson Road Alternative 4a
2045 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 49



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PLOTTING DATE: 10-10-2018

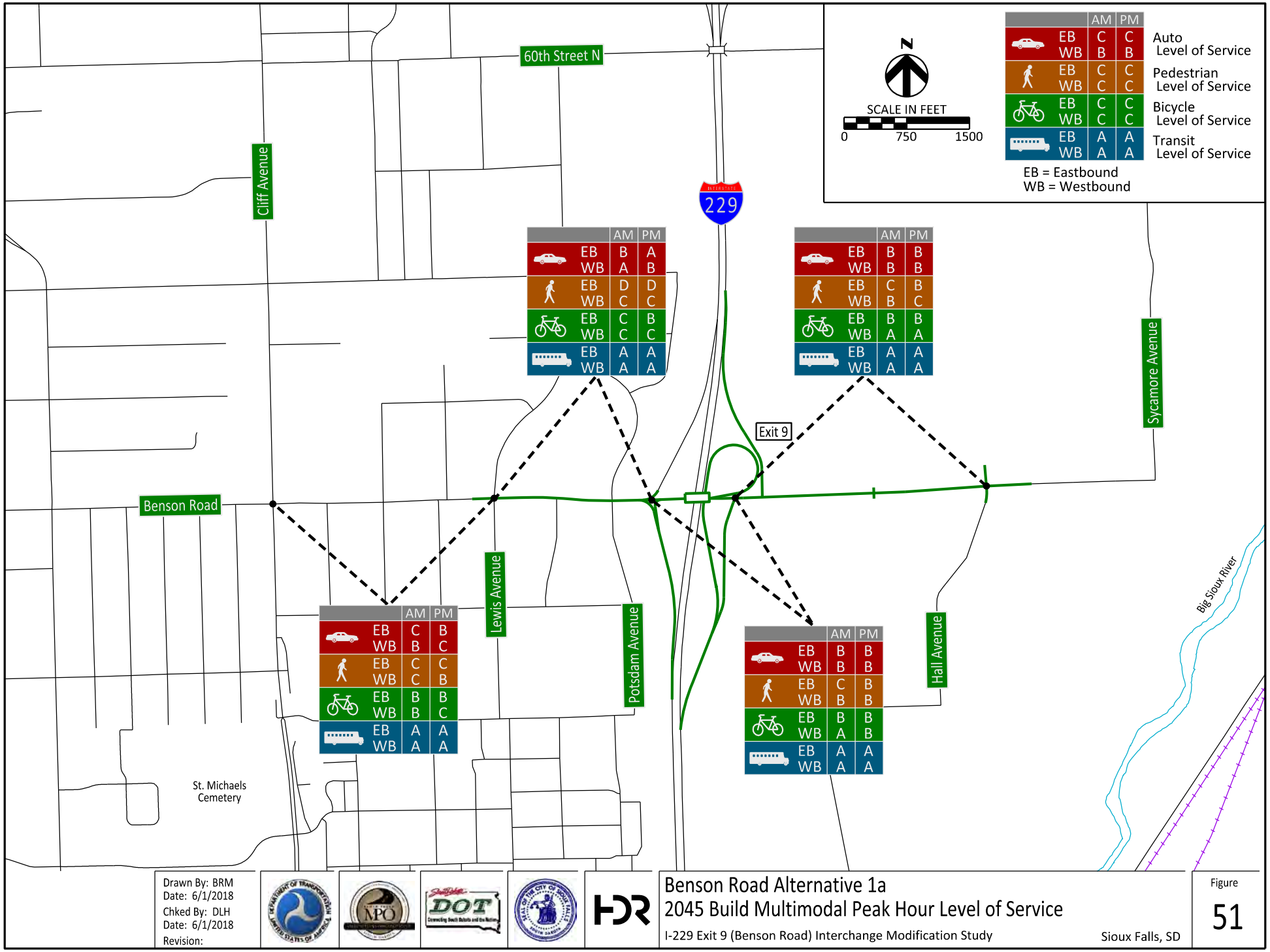
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision: 10/8/2018

Benson Road Alternative 4b
2045 Build Traffic Volumes and Peak Hour Intersection LOS

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 50



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PLOTTING DATE: 06-04-2018

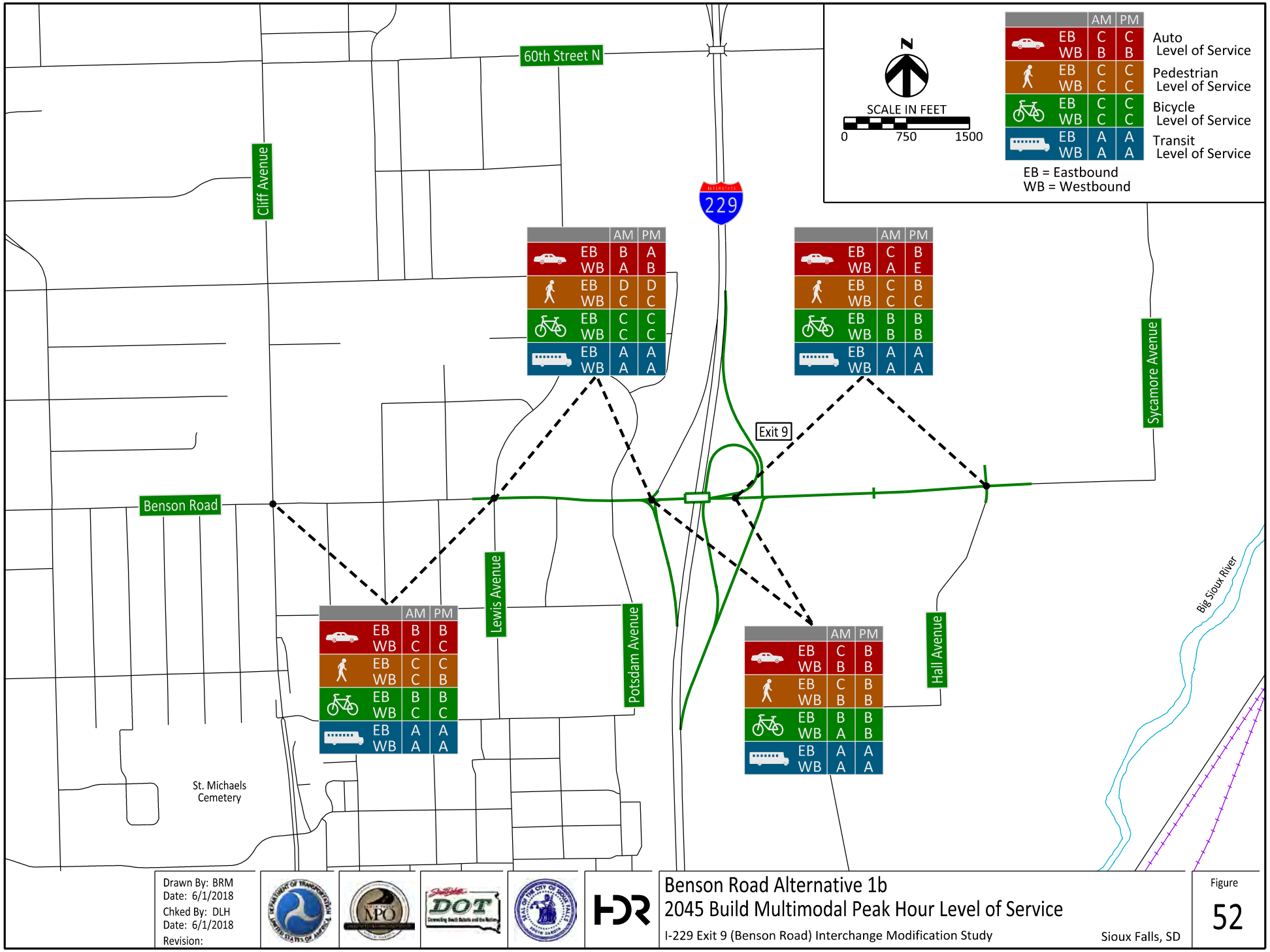
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1a
2045 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure
51



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1b
2045 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 52

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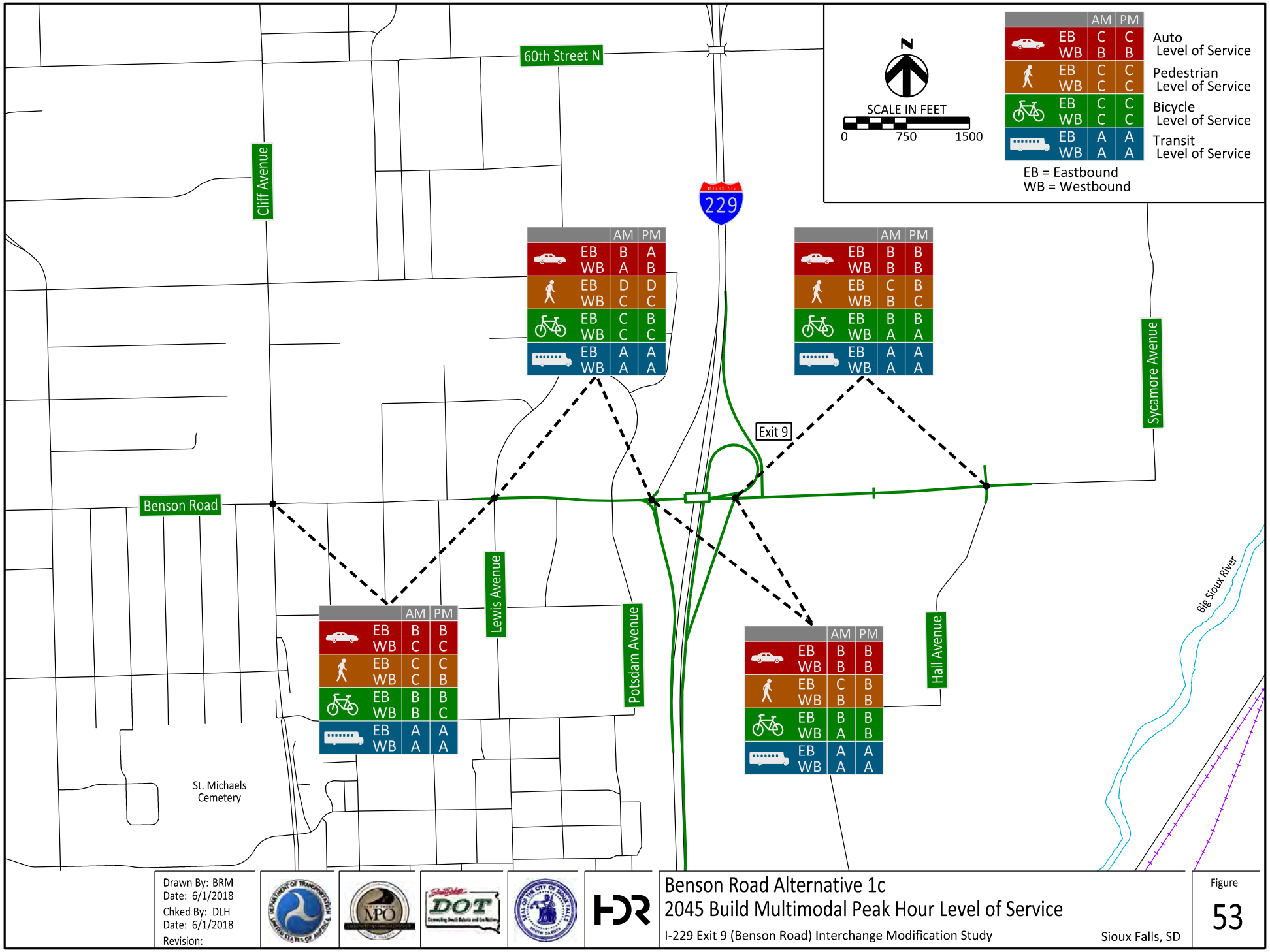


Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

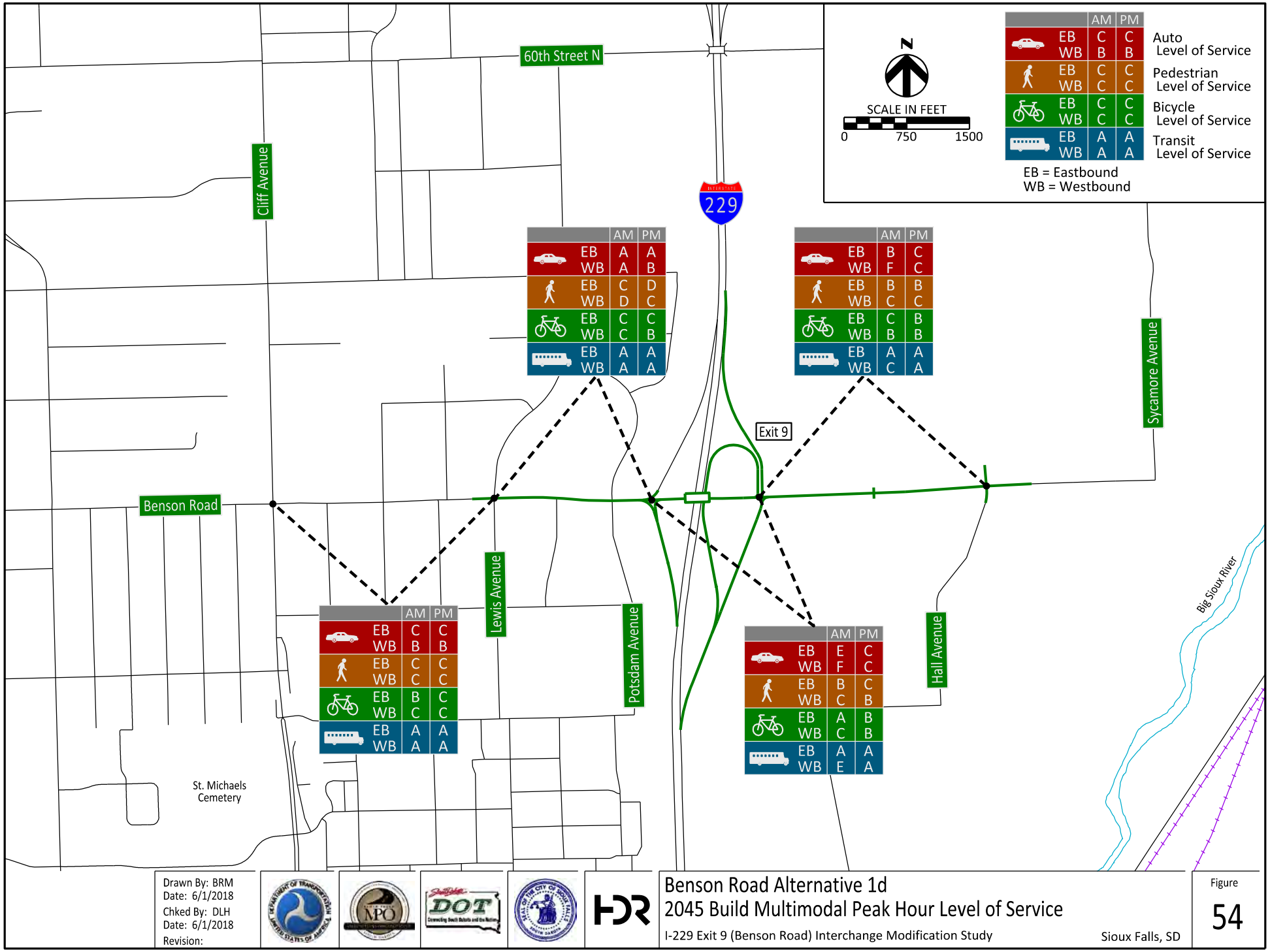
Benson Road Alternative 1c
2045 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 53

FILE: ...\Figure 53 (MM 2045).dgn
PLOTTING DATE: 06-04-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1d
2045 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 54

FILE: ...\Figure 54 (MM 2045).dgn
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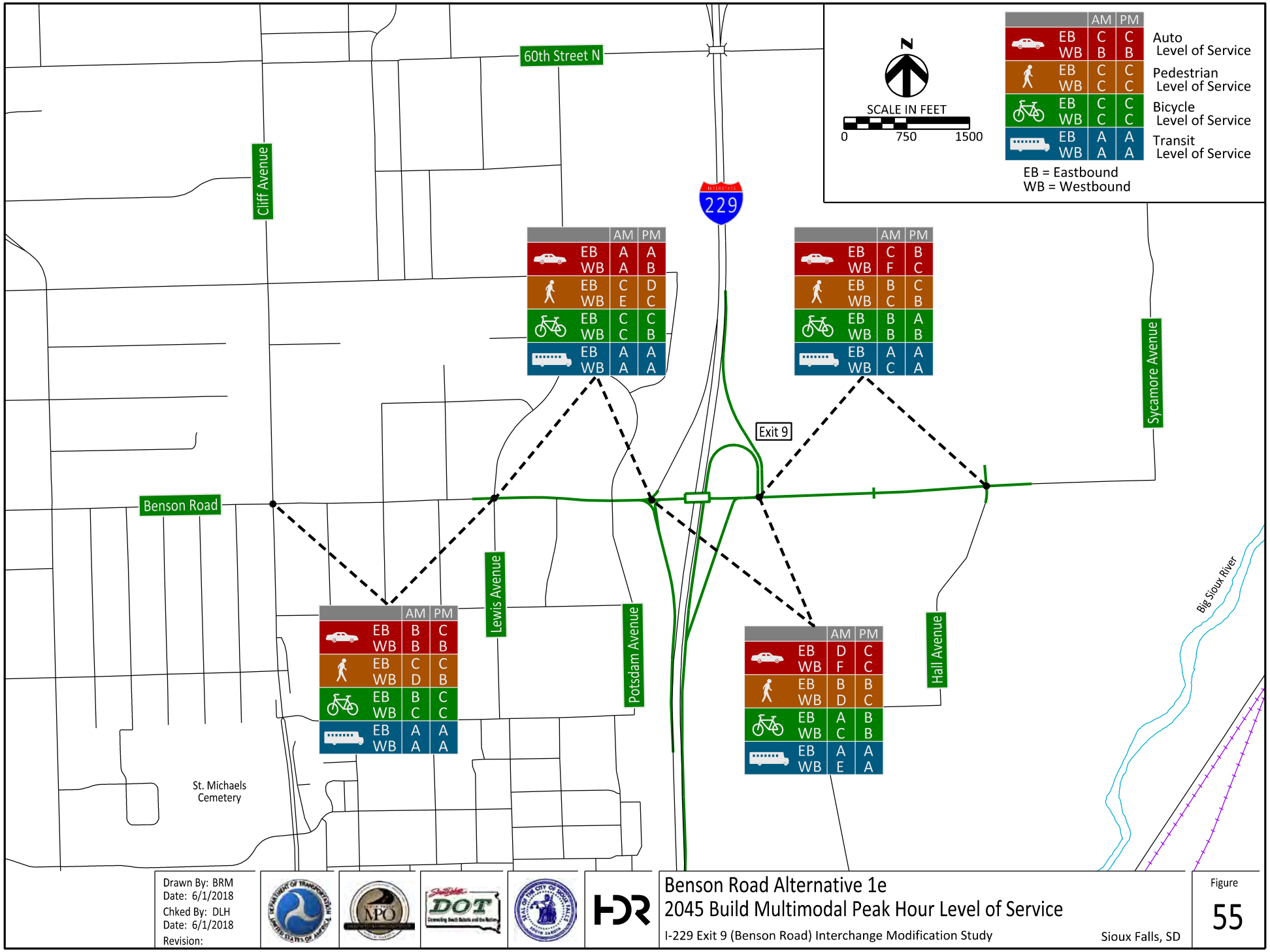

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PLOTTING DATE: 06-04-2018

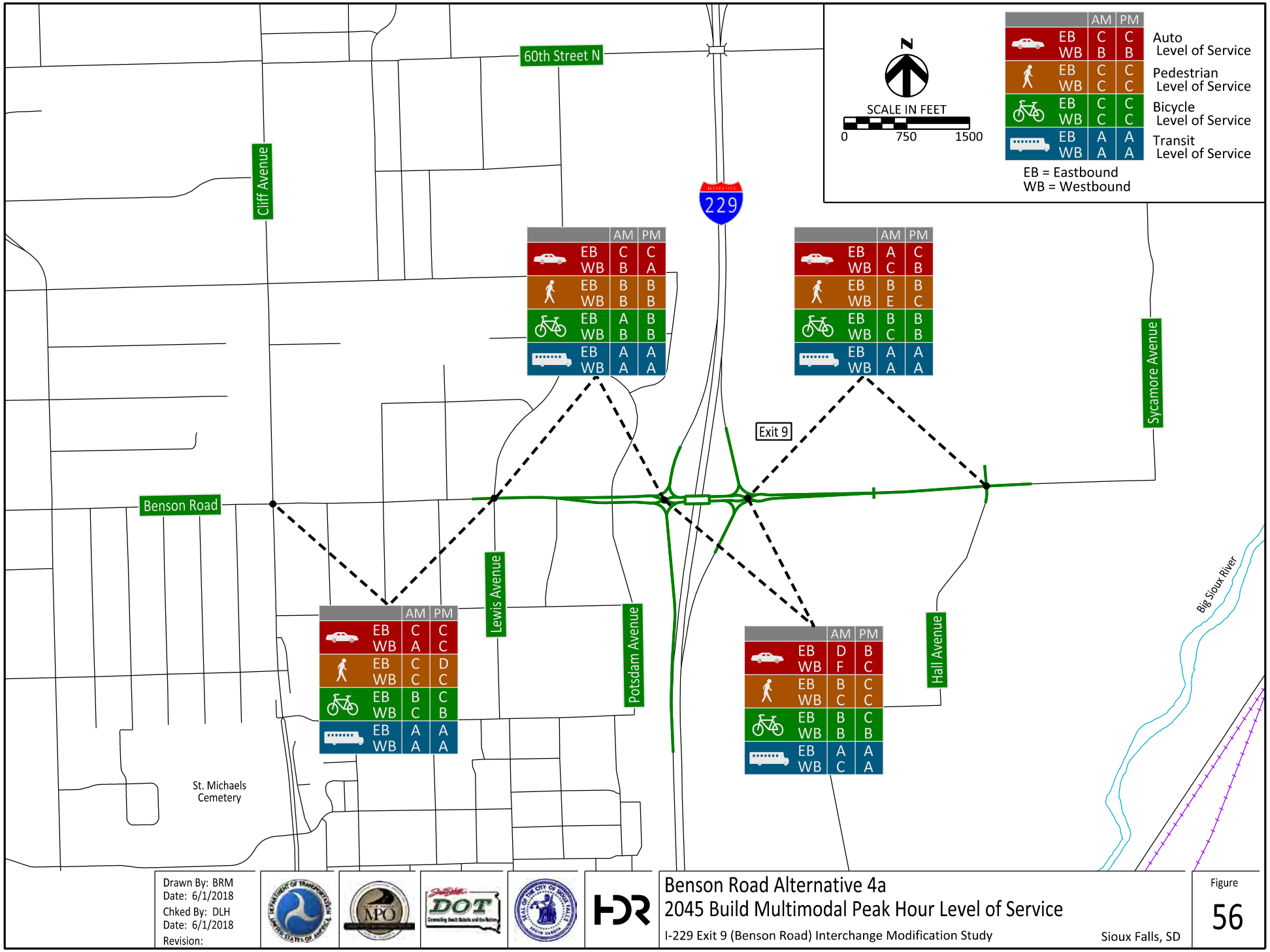
Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 1e
2045 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure
55



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 4a
2045 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 56

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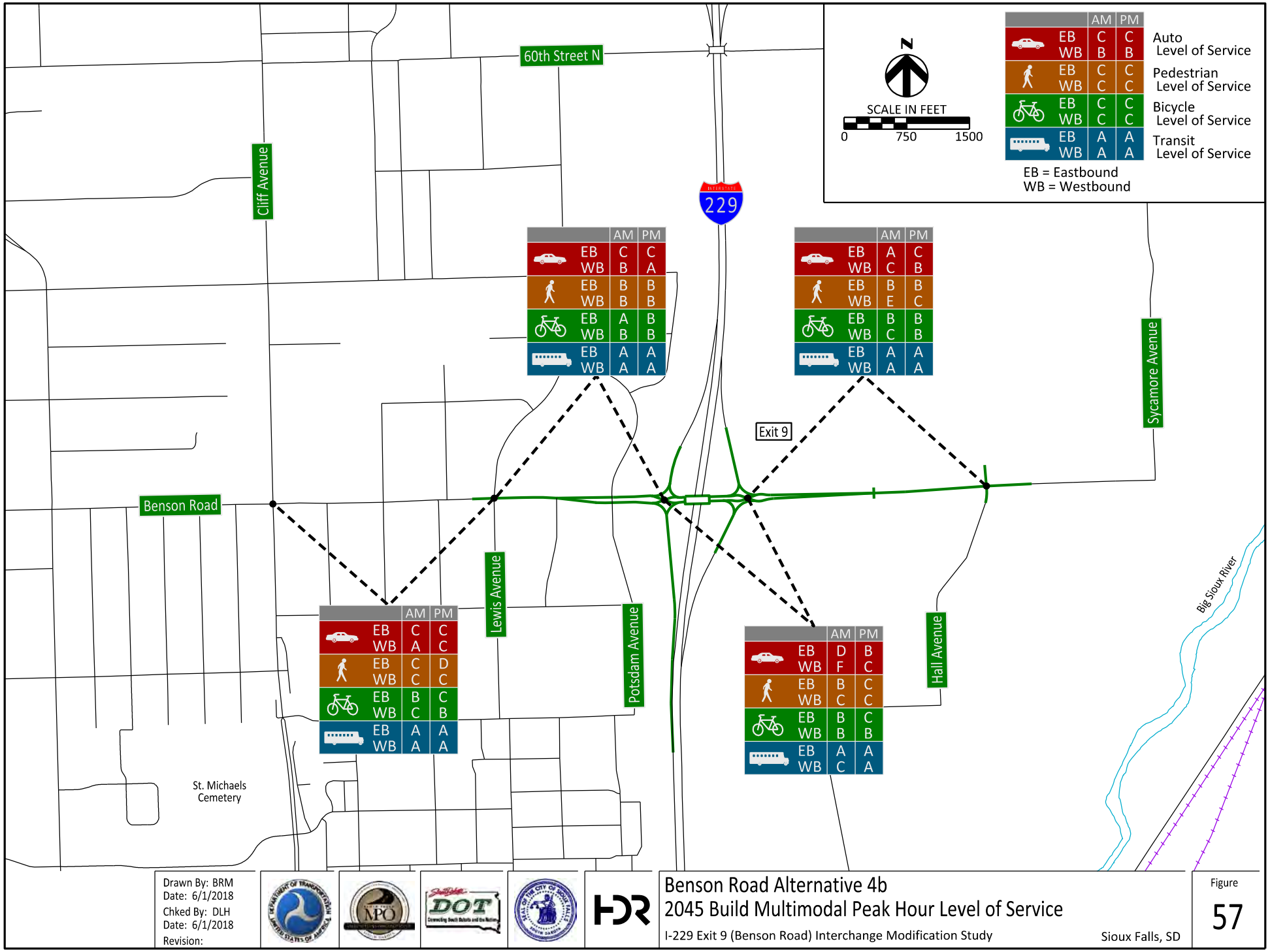
PLOTTING DATE: 06-04-2018



Drawn By: BRM
Date: 6/1/2018
Chked By: DLH
Date: 6/1/2018
Revision:

Benson Road Alternative 4b
2045 Build Multimodal Peak Hour Level of Service

I-229 Exit 9 (Benson Road) Interchange Modification Study

Sioux Falls, SD

Figure 57

FILE: ...\Figure 57 (MM 2045).dgn
PLOTTING DATE: 06-04-2018

APPENDIX

I. 2023 Freeway Analysis - Ramps

II. 2023 Freeway Analysis – Weaving

III. 2023 Arterial Analysis

IV. 2045 Freeway Analysis - Ramps

V. 2045 Freeway Analysis – Weaving

VI. 2045 Arterial Analysis

I. 2023 Freeway Analysis – Ramps

Option 1A

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1035	115
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1265	141
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.07

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.325
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1265	Ramp Junction Speed (S), mi/h	59.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	10.7
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	695	60
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	850	73
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.20	0.04

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	6.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.239
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	850	Ramp Junction Speed (S), mi/h	61.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	923	Average Density (D), pc/mi/ln	7.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1145	45
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1400	55
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.31	0.03

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	13.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.317
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1400	Ramp Junction Speed (S), mi/h	59.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	11.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	795	265
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	972	324
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.16

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.243
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	972	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1296	Average Density (D), pc/mi/ln	10.6
Level of Service (LOS)	A		

Option 1B

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1035	115
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1265	141
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.07

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.325
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1265	Ramp Junction Speed (S), mi/h	59.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	10.7
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	695	60
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	850	73
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.20	0.04

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	6.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.239
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	850	Ramp Junction Speed (S), mi/h	61.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	923	Average Density (D), pc/mi/ln	7.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1145	45
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1400	55
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.31	0.03

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	13.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.317
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1400	Ramp Junction Speed (S), mi/h	59.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	11.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	795	265
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	972	324
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.16

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.243
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	972	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1296	Average Density (D), pc/mi/ln	10.6
Level of Service (LOS)	A		

Option 1C

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1035	115
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1265	141
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.07

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.325
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1265	Ramp Junction Speed (S), mi/h	59.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	10.7
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	695	60
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	850	73
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.20	0.04

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	6.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.239
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	850	Ramp Junction Speed (S), mi/h	61.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	923	Average Density (D), pc/mi/ln	7.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1145	45
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1400	55
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.31	0.03

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	13.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.317
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1400	Ramp Junction Speed (S), mi/h	59.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	11.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	795	265
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	972	324
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.16

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.243
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	972	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1296	Average Density (D), pc/mi/ln	10.6
Level of Service (LOS)	A		

Option 1D

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1035	115
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1265	141
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.07

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.325
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1265	Ramp Junction Speed (S), mi/h	59.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	10.7
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

	Freeway	Ramp
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

	Freeway	Ramp
Demand Volume (V_i), veh/h	695	60
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	850	73
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.20	0.04

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	6.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.239
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	850	Ramp Junction Speed (S), mi/h	61.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	923	Average Density (D), pc/mi/ln	7.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1145	45
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1400	55
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.31	0.03

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	13.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.317
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1400	Ramp Junction Speed (S), mi/h	59.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	11.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	795	265
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	972	324
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.16

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.243
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	972	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1296	Average Density (D), pc/mi/ln	10.6
Level of Service (LOS)	A		

Option 1E

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1035	115
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1265	141
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.07

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.325
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1265	Ramp Junction Speed (S), mi/h	59.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	10.7
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	695	60
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	850	73
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.20	0.04

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	6.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.239
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	850	Ramp Junction Speed (S), mi/h	61.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	923	Average Density (D), pc/mi/ln	7.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1145	45
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1400	55
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.31	0.03

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	13.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.317
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1400	Ramp Junction Speed (S), mi/h	59.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	11.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	795	265
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	972	324
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.16

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.243
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	972	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1296	Average Density (D), pc/mi/ln	10.6
Level of Service (LOS)	A		

Option 4A

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1035	115
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1265	141
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.07

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.325
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1265	Ramp Junction Speed (S), mi/h	59.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	10.7
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	695	60
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	850	73
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.20	0.04

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	6.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.239
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	850	Ramp Junction Speed (S), mi/h	61.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	923	Average Density (D), pc/mi/ln	7.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1145	45
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1400	55
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.31	0.03

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	13.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.317
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1400	Ramp Junction Speed (S), mi/h	59.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	11.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	795	265
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	972	324
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.16

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.243
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	972	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1296	Average Density (D), pc/mi/ln	10.6
Level of Service (LOS)	A		

Option 4B

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2018
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1035	115
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1265	141
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.07

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	12.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.325
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1265	Ramp Junction Speed (S), mi/h	59.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	10.7
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	695	60
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	850	73
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.20	0.04

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	6.1
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.239
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	850	Ramp Junction Speed (S), mi/h	61.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	923	Average Density (D), pc/mi/ln	7.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1145	45
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1400	55
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.31	0.03

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	13.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.317
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1400	Ramp Junction Speed (S), mi/h	59.3
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	11.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	795	265
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	972	324
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.28	0.16

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.9
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.243
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	972	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1296	Average Density (D), pc/mi/ln	10.6
Level of Service (LOS)	A		

II. 2023 Freeway Analysis – Weaving

Option 1A

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	800	350	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	951	443	19	152

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	970	Density-Based Capacity (c_{IWL}), pc/h/ln	2254
Total Flow Rate (v), pc/h	1565	Demand Flow-Based Capacity (c_{IW}), pc/h	6316
Volume Ratio (VR)	0.380	Weaving Segment Capacity (c_W), veh/h	5905
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	6265
Maximum Weaving Length (L_{MAX}), ft	6458	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	314	Average Weaving Speed (S_W), mi/h	60.6
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1905	Average Non-Weaving Speed (S_{NW}), mi/h	60.5
Weaving Lane Change Rate (LC_W), lc/h	952	Average Speed (S), mi/h	60.5
Total Lane Change Rate (LC_{All}), lc/h	2857	Density (D), pc/mi/ln	8.6
Weaving Intensity Factor (W)	0.148	Level of Service (LOS)	A

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	510	185	125	1625
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	606	234	158	2059

Weaving Flow Rate (v_w), pc/h	2293	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	764	Density-Based Capacity (c_{IWL}), pc/h/ln	1838
Total Flow Rate (v), pc/h	3057	Demand Flow-Based Capacity (c_{IW}), pc/h	3200
Volume Ratio (VR)	0.750	Weaving Segment Capacity (c_W), veh/h	2992
Minimum Lane Change Rate (LC_{MIN}), lc/h	2293	Adjusted Weaving Area Capacity, pc/h	3259
Maximum Weaving Length (L_{MAX}), ft	10892	Volume-to-Capacity Ratio (v/c)	0.94

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	197	Average Weaving Speed (S_W), mi/h	57.0
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1696	Average Non-Weaving Speed (S_{NW}), mi/h	45.9
Weaving Lane Change Rate (LC_W), lc/h	2609	Average Speed (S), mi/h	53.8
Total Lane Change Rate (LC_{All}), lc/h	4305	Density (D), pc/mi/ln	18.9
Weaving Intensity Factor (W)	0.244	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	755	1555	30	275
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	897	1970	38	348

Weaving Flow Rate (v_w), pc/h	2318	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	935	Density-Based Capacity (c_{IWL}), pc/h/ln	1951
Total Flow Rate (v), pc/h	3253	Demand Flow-Based Capacity (c_{IW}), pc/h	3366
Volume Ratio (VR)	0.713	Weaving Segment Capacity (c_W), veh/h	3147
Minimum Lane Change Rate (LC_{MIN}), lc/h	2318	Adjusted Weaving Area Capacity, pc/h	3410
Maximum Weaving Length (L_{MAX}), ft	10420	Volume-to-Capacity Ratio (v/c)	0.95

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	303	Average Weaving Speed (S_W), mi/h	58.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1898	Average Non-Weaving Speed (S_{NW}), mi/h	45.4
Weaving Lane Change Rate (LC_W), lc/h	2675	Average Speed (S), mi/h	53.8
Total Lane Change Rate (LC_{All}), lc/h	4573	Density (D), pc/mi/ln	20.2
Weaving Intensity Factor (W)	0.214	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	670	125	80	345
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	796	158	101	437

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	897	Density-Based Capacity (c_{IWL}), pc/h/ln	2161
Total Flow Rate (v), pc/h	1492	Demand Flow-Based Capacity (c_{IW}), pc/h	6015
Volume Ratio (VR)	0.399	Weaving Segment Capacity (c_W), veh/h	5624
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	5992
Maximum Weaving Length (L_{MAX}), ft	6670	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	231	Average Weaving Speed (S_W), mi/h	59.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1723	Average Non-Weaving Speed (S_{NW}), mi/h	60.6
Weaving Lane Change Rate (LC_W), lc/h	911	Average Speed (S), mi/h	60.3
Total Lane Change Rate (LC_{All}), lc/h	2634	Density (D), pc/mi/ln	8.2
Weaving Intensity Factor (W)	0.166	Level of Service (LOS)	A

Option 1B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	800	350	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	951	443	19	152

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	970	Density-Based Capacity (c_{IWL}), pc/h/ln	2254
Total Flow Rate (v), pc/h	1565	Demand Flow-Based Capacity (c_{IW}), pc/h	6316
Volume Ratio (VR)	0.380	Weaving Segment Capacity (c_W), veh/h	5905
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	6265
Maximum Weaving Length (L_{MAX}), ft	6458	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	314	Average Weaving Speed (S_W), mi/h	60.6
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1905	Average Non-Weaving Speed (S_{NW}), mi/h	60.5
Weaving Lane Change Rate (LC_W), lc/h	952	Average Speed (S), mi/h	60.5
Total Lane Change Rate (LC_{All}), lc/h	2857	Density (D), pc/mi/ln	8.6
Weaving Intensity Factor (W)	0.148	Level of Service (LOS)	A

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	510	185	125	1625
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	606	234	158	2059

Weaving Flow Rate (v_w), pc/h	2293	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	764	Density-Based Capacity (c_{IWL}), pc/h/ln	1838
Total Flow Rate (v), pc/h	3057	Demand Flow-Based Capacity (c_{IW}), pc/h	3200
Volume Ratio (VR)	0.750	Weaving Segment Capacity (c_W), veh/h	2992
Minimum Lane Change Rate (LC_{MIN}), lc/h	2293	Adjusted Weaving Area Capacity, pc/h	3259
Maximum Weaving Length (L_{MAX}), ft	10892	Volume-to-Capacity Ratio (v/c)	0.94

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	197	Average Weaving Speed (S_W), mi/h	57.0
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1696	Average Non-Weaving Speed (S_{NW}), mi/h	45.9
Weaving Lane Change Rate (LC_W), lc/h	2609	Average Speed (S), mi/h	53.8
Total Lane Change Rate (LC_{All}), lc/h	4305	Density (D), pc/mi/ln	18.9
Weaving Intensity Factor (W)	0.244	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	755	1555	30	275
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	897	1970	38	348

Weaving Flow Rate (v_w), pc/h	2318	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	935	Density-Based Capacity (c_{IWL}), pc/h/ln	1951
Total Flow Rate (v), pc/h	3253	Demand Flow-Based Capacity (c_{IW}), pc/h	3366
Volume Ratio (VR)	0.713	Weaving Segment Capacity (c_W), veh/h	3147
Minimum Lane Change Rate (LC_{MIN}), lc/h	2318	Adjusted Weaving Area Capacity, pc/h	3410
Maximum Weaving Length (L_{MAX}), ft	10420	Volume-to-Capacity Ratio (v/c)	0.95

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	303	Average Weaving Speed (S_W), mi/h	58.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1898	Average Non-Weaving Speed (S_{NW}), mi/h	45.4
Weaving Lane Change Rate (LC_W), lc/h	2675	Average Speed (S), mi/h	53.8
Total Lane Change Rate (LC_{All}), lc/h	4573	Density (D), pc/mi/ln	20.2
Weaving Intensity Factor (W)	0.214	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	670	125	80	345
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	796	158	101	437

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	897	Density-Based Capacity (c_{IWL}), pc/h/ln	2161
Total Flow Rate (v), pc/h	1492	Demand Flow-Based Capacity (c_{IW}), pc/h	6015
Volume Ratio (VR)	0.399	Weaving Segment Capacity (c_W), veh/h	5624
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	5992
Maximum Weaving Length (L_{MAX}), ft	6670	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	231	Average Weaving Speed (S_W), mi/h	59.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1723	Average Non-Weaving Speed (S_{NW}), mi/h	60.6
Weaving Lane Change Rate (LC_W), lc/h	911	Average Speed (S), mi/h	60.3
Total Lane Change Rate (LC_{All}), lc/h	2634	Density (D), pc/mi/ln	8.2
Weaving Intensity Factor (W)	0.166	Level of Service (LOS)	A

Option 1C

HCS7 Freeway Weaving Report

Project Information

Analyst	RL	Date	5/03/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	800	350	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	951	443	19	152

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	970	Density-Based Capacity (c_{IWL}), pc/h/ln	2254
Total Flow Rate (v), pc/h	1565	Demand Flow-Based Capacity (c_{IW}), pc/h	6316
Volume Ratio (VR)	0.380	Weaving Segment Capacity (c_W), veh/h	5905
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	6265
Maximum Weaving Length (L_{MAX}), ft	6458	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	314	Average Weaving Speed (S_W), mi/h	60.6
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1905	Average Non-Weaving Speed (S_{NW}), mi/h	60.5
Weaving Lane Change Rate (LC_W), lc/h	952	Average Speed (S), mi/h	60.5
Total Lane Change Rate (LC_{All}), lc/h	2857	Density (D), pc/mi/ln	8.6
Weaving Intensity Factor (W)	0.148	Level of Service (LOS)	A

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/17/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	2275	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	510	185	125	1625
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	606	234	158	2059

Weaving Flow Rate (v_w), pc/h	2293	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	764	Density-Based Capacity (c_{IWL}), pc/h/ln	1714
Total Flow Rate (v), pc/h	3057	Demand Flow-Based Capacity (c_{IW}), pc/h	3200
Volume Ratio (VR)	0.750	Weaving Segment Capacity (c_W), veh/h	2992
Minimum Lane Change Rate (LC_{MIN}), lc/h	2293	Adjusted Weaving Area Capacity, pc/h	3259
Maximum Weaving Length (L_{MAX}), ft	10892	Volume-to-Capacity Ratio (v/c)	0.94

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	115	Average Weaving Speed (S_W), mi/h	55.0
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	813	Average Non-Weaving Speed (S_{NW}), mi/h	45.9
Weaving Lane Change Rate (LC_W), lc/h	2527	Average Speed (S), mi/h	52.4
Total Lane Change Rate (LC_{All}), lc/h	3340	Density (D), pc/mi/ln	19.4
Weaving Intensity Factor (W)	0.306	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	755	1555	30	275
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	897	1970	38	348

Weaving Flow Rate (v_w), pc/h	2318	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	935	Density-Based Capacity (c_{IWL}), pc/h/ln	1951
Total Flow Rate (v), pc/h	3253	Demand Flow-Based Capacity (c_{IW}), pc/h	3366
Volume Ratio (VR)	0.713	Weaving Segment Capacity (c_W), veh/h	3147
Minimum Lane Change Rate (LC_{MIN}), lc/h	2318	Adjusted Weaving Area Capacity, pc/h	3410
Maximum Weaving Length (L_{MAX}), ft	10420	Volume-to-Capacity Ratio (v/c)	0.95

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	303	Average Weaving Speed (S_W), mi/h	58.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1898	Average Non-Weaving Speed (S_{NW}), mi/h	45.4
Weaving Lane Change Rate (LC_W), lc/h	2675	Average Speed (S), mi/h	53.8
Total Lane Change Rate (LC_{All}), lc/h	4573	Density (D), pc/mi/ln	20.2
Weaving Intensity Factor (W)	0.214	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	2275	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	670	125	80	345
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	796	158	101	437

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	897	Density-Based Capacity (c_{IWL}), pc/h/ln	2037
Total Flow Rate (v), pc/h	1492	Demand Flow-Based Capacity (c_{IW}), pc/h	6015
Volume Ratio (VR)	0.399	Weaving Segment Capacity (c_W), veh/h	5624
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	5992
Maximum Weaving Length (L_{MAX}), ft	6670	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	135	Average Weaving Speed (S_W), mi/h	59.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	840	Average Non-Weaving Speed (S_{NW}), mi/h	60.6
Weaving Lane Change Rate (LC_W), lc/h	829	Average Speed (S), mi/h	60.1
Total Lane Change Rate (LC_{All}), lc/h	1669	Density (D), pc/mi/ln	8.3
Weaving Intensity Factor (W)	0.177	Level of Service (LOS)	A

Option 1D

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	800	350	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	951	443	19	152

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	970	Density-Based Capacity (c_{IWL}), pc/h/ln	2254
Total Flow Rate (v), pc/h	1565	Demand Flow-Based Capacity (c_{IW}), pc/h	6316
Volume Ratio (VR)	0.380	Weaving Segment Capacity (c_W), veh/h	5905
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	6265
Maximum Weaving Length (L_{MAX}), ft	6458	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	314	Average Weaving Speed (S_W), mi/h	60.6
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1905	Average Non-Weaving Speed (S_{NW}), mi/h	60.5
Weaving Lane Change Rate (LC_W), lc/h	952	Average Speed (S), mi/h	60.5
Total Lane Change Rate (LC_{All}), lc/h	2857	Density (D), pc/mi/ln	8.6
Weaving Intensity Factor (W)	0.148	Level of Service (LOS)	A

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	510	185	125	1625
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	606	234	158	2059

Weaving Flow Rate (v_w), pc/h	2293	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	764	Density-Based Capacity (c_{IWL}), pc/h/ln	1838
Total Flow Rate (v), pc/h	3057	Demand Flow-Based Capacity (c_{IW}), pc/h	3200
Volume Ratio (VR)	0.750	Weaving Segment Capacity (c_W), veh/h	2992
Minimum Lane Change Rate (LC_{MIN}), lc/h	2293	Adjusted Weaving Area Capacity, pc/h	3259
Maximum Weaving Length (L_{MAX}), ft	10892	Volume-to-Capacity Ratio (v/c)	0.94

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	197	Average Weaving Speed (S_W), mi/h	57.0
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1696	Average Non-Weaving Speed (S_{NW}), mi/h	45.9
Weaving Lane Change Rate (LC_W), lc/h	2609	Average Speed (S), mi/h	53.8
Total Lane Change Rate (LC_{All}), lc/h	4305	Density (D), pc/mi/ln	18.9
Weaving Intensity Factor (W)	0.244	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	755	1555	30	275
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	897	1970	38	348

Weaving Flow Rate (v_w), pc/h	2318	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	935	Density-Based Capacity (c_{IWL}), pc/h/ln	1951
Total Flow Rate (v), pc/h	3253	Demand Flow-Based Capacity (c_{IW}), pc/h	3366
Volume Ratio (VR)	0.713	Weaving Segment Capacity (c_W), veh/h	3147
Minimum Lane Change Rate (LC_{MIN}), lc/h	2318	Adjusted Weaving Area Capacity, pc/h	3410
Maximum Weaving Length (L_{MAX}), ft	10420	Volume-to-Capacity Ratio (v/c)	0.95

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	303	Average Weaving Speed (S_W), mi/h	58.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1898	Average Non-Weaving Speed (S_{NW}), mi/h	45.4
Weaving Lane Change Rate (LC_W), lc/h	2675	Average Speed (S), mi/h	53.8
Total Lane Change Rate (LC_{All}), lc/h	4573	Density (D), pc/mi/ln	20.2
Weaving Intensity Factor (W)	0.214	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	670	125	80	345
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	796	158	101	437

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	897	Density-Based Capacity (c_{IWL}), pc/h/ln	2161
Total Flow Rate (v), pc/h	1492	Demand Flow-Based Capacity (c_{IW}), pc/h	6015
Volume Ratio (VR)	0.399	Weaving Segment Capacity (c_W), veh/h	5624
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	5992
Maximum Weaving Length (L_{MAX}), ft	6670	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	231	Average Weaving Speed (S_W), mi/h	59.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1723	Average Non-Weaving Speed (S_{NW}), mi/h	60.6
Weaving Lane Change Rate (LC_W), lc/h	911	Average Speed (S), mi/h	60.3
Total Lane Change Rate (LC_{All}), lc/h	2634	Density (D), pc/mi/ln	8.2
Weaving Intensity Factor (W)	0.166	Level of Service (LOS)	A

Option 1E

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	800	350	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	951	443	19	152

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	970	Density-Based Capacity (c_{IWL}), pc/h/ln	2254
Total Flow Rate (v), pc/h	1565	Demand Flow-Based Capacity (c_{IW}), pc/h	6316
Volume Ratio (VR)	0.380	Weaving Segment Capacity (c_W), veh/h	5905
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	6265
Maximum Weaving Length (L_{MAX}), ft	6458	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	314	Average Weaving Speed (S_W), mi/h	60.6
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1905	Average Non-Weaving Speed (S_{NW}), mi/h	60.5
Weaving Lane Change Rate (LC_W), lc/h	952	Average Speed (S), mi/h	60.5
Total Lane Change Rate (LC_{All}), lc/h	2857	Density (D), pc/mi/ln	8.6
Weaving Intensity Factor (W)	0.148	Level of Service (LOS)	A

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	2275	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	510	185	125	1625
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	606	234	158	2059

Weaving Flow Rate (v_w), pc/h	2293	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	764	Density-Based Capacity (c_{IWL}), pc/h/ln	1714
Total Flow Rate (v), pc/h	3057	Demand Flow-Based Capacity (c_{IW}), pc/h	3200
Volume Ratio (VR)	0.750	Weaving Segment Capacity (c_W), veh/h	2992
Minimum Lane Change Rate (LC_{MIN}), lc/h	2293	Adjusted Weaving Area Capacity, pc/h	3259
Maximum Weaving Length (L_{MAX}), ft	10892	Volume-to-Capacity Ratio (v/c)	0.94

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	115	Average Weaving Speed (S_W), mi/h	55.0
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	813	Average Non-Weaving Speed (S_{NW}), mi/h	45.9
Weaving Lane Change Rate (LC_W), lc/h	2527	Average Speed (S), mi/h	52.4
Total Lane Change Rate (LC_{All}), lc/h	3340	Density (D), pc/mi/ln	19.4
Weaving Intensity Factor (W)	0.306	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	755	1555	30	275
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	897	1970	38	348

Weaving Flow Rate (v_w), pc/h	2318	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	935	Density-Based Capacity (c_{IWL}), pc/h/ln	1951
Total Flow Rate (v), pc/h	3253	Demand Flow-Based Capacity (c_{IW}), pc/h	3366
Volume Ratio (VR)	0.713	Weaving Segment Capacity (c_W), veh/h	3147
Minimum Lane Change Rate (LC_{MIN}), lc/h	2318	Adjusted Weaving Area Capacity, pc/h	3410
Maximum Weaving Length (L_{MAX}), ft	10420	Volume-to-Capacity Ratio (v/c)	0.95

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	303	Average Weaving Speed (S_W), mi/h	58.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1898	Average Non-Weaving Speed (S_{NW}), mi/h	45.4
Weaving Lane Change Rate (LC_W), lc/h	2675	Average Speed (S), mi/h	53.8
Total Lane Change Rate (LC_{All}), lc/h	4573	Density (D), pc/mi/ln	20.2
Weaving Intensity Factor (W)	0.214	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	2275	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	670	125	80	345
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	796	158	101	437

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	897	Density-Based Capacity (c_{IWL}), pc/h/ln	2037
Total Flow Rate (v), pc/h	1492	Demand Flow-Based Capacity (c_{IW}), pc/h	6015
Volume Ratio (VR)	0.399	Weaving Segment Capacity (c_W), veh/h	5624
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	5992
Maximum Weaving Length (L_{MAX}), ft	6670	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	135	Average Weaving Speed (S_W), mi/h	59.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	840	Average Non-Weaving Speed (S_{NW}), mi/h	60.6
Weaving Lane Change Rate (LC_W), lc/h	829	Average Speed (S), mi/h	60.1
Total Lane Change Rate (LC_{All}), lc/h	1669	Density (D), pc/mi/ln	8.3
Weaving Intensity Factor (W)	0.177	Level of Service (LOS)	A

Option 4A

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	800	350	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	951	443	19	152

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	970	Density-Based Capacity (c_{IWL}), pc/h/ln	2254
Total Flow Rate (v), pc/h	1565	Demand Flow-Based Capacity (c_{IW}), pc/h	6316
Volume Ratio (VR)	0.380	Weaving Segment Capacity (c_W), veh/h	5905
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	6265
Maximum Weaving Length (L_{MAX}), ft	6458	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	314	Average Weaving Speed (S_W), mi/h	60.6
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1905	Average Non-Weaving Speed (S_{NW}), mi/h	60.5
Weaving Lane Change Rate (LC_W), lc/h	952	Average Speed (S), mi/h	60.5
Total Lane Change Rate (LC_{All}), lc/h	2857	Density (D), pc/mi/ln	8.6
Weaving Intensity Factor (W)	0.148	Level of Service (LOS)	A

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	510	185	125	1625
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	606	234	158	2059

Weaving Flow Rate (v_w), pc/h	2293	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	764	Density-Based Capacity (c_{IWL}), pc/h/ln	1908
Total Flow Rate (v), pc/h	3057	Demand Flow-Based Capacity (c_{IW}), pc/h	3200
Volume Ratio (VR)	0.750	Weaving Segment Capacity (c_W), veh/h	2992
Minimum Lane Change Rate (LC_{MIN}), lc/h	2293	Adjusted Weaving Area Capacity, pc/h	3259
Maximum Weaving Length (L_{MAX}), ft	10892	Volume-to-Capacity Ratio (v/c)	0.94

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	243	Average Weaving Speed (S_W), mi/h	58.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1859	Average Non-Weaving Speed (S_{NW}), mi/h	45.9
Weaving Lane Change Rate (LC_W), lc/h	2647	Average Speed (S), mi/h	54.5
Total Lane Change Rate (LC_{All}), lc/h	4506	Density (D), pc/mi/ln	18.7
Weaving Intensity Factor (W)	0.214	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	755	1555	30	275
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	897	1970	38	348

Weaving Flow Rate (v_w), pc/h	2318	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	935	Density-Based Capacity (c_{IWL}), pc/h/ln	1951
Total Flow Rate (v), pc/h	3253	Demand Flow-Based Capacity (c_{IW}), pc/h	3366
Volume Ratio (VR)	0.713	Weaving Segment Capacity (c_W), veh/h	3147
Minimum Lane Change Rate (LC_{MIN}), lc/h	2318	Adjusted Weaving Area Capacity, pc/h	3410
Maximum Weaving Length (L_{MAX}), ft	10420	Volume-to-Capacity Ratio (v/c)	0.95

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	303	Average Weaving Speed (S_W), mi/h	58.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1898	Average Non-Weaving Speed (S_{NW}), mi/h	45.4
Weaving Lane Change Rate (LC_W), lc/h	2675	Average Speed (S), mi/h	53.8
Total Lane Change Rate (LC_{All}), lc/h	4573	Density (D), pc/mi/ln	20.2
Weaving Intensity Factor (W)	0.214	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	670	125	80	345
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	796	158	101	437

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	897	Density-Based Capacity (c_{IWL}), pc/h/ln	2231
Total Flow Rate (v), pc/h	1492	Demand Flow-Based Capacity (c_{IW}), pc/h	6015
Volume Ratio (VR)	0.399	Weaving Segment Capacity (c_W), veh/h	5624
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	5992
Maximum Weaving Length (L_{MAX}), ft	6670	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	285	Average Weaving Speed (S_W), mi/h	60.5
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1889	Average Non-Weaving Speed (S_{NW}), mi/h	60.6
Weaving Lane Change Rate (LC_W), lc/h	949	Average Speed (S), mi/h	60.6
Total Lane Change Rate (LC_{All}), lc/h	2838	Density (D), pc/mi/ln	8.2
Weaving Intensity Factor (W)	0.149	Level of Service (LOS)	A

Option 4B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	800	350	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	951	443	19	152

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	970	Density-Based Capacity (c_{IWL}), pc/h/ln	2254
Total Flow Rate (v), pc/h	1565	Demand Flow-Based Capacity (c_{IW}), pc/h	6316
Volume Ratio (VR)	0.380	Weaving Segment Capacity (c_W), veh/h	5905
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	6265
Maximum Weaving Length (L_{MAX}), ft	6458	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	314	Average Weaving Speed (S_W), mi/h	60.6
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1905	Average Non-Weaving Speed (S_{NW}), mi/h	60.5
Weaving Lane Change Rate (LC_W), lc/h	952	Average Speed (S), mi/h	60.5
Total Lane Change Rate (LC_{All}), lc/h	2857	Density (D), pc/mi/ln	8.6
Weaving Intensity Factor (W)	0.148	Level of Service (LOS)	A

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	510	185	125	1625
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	606	234	158	2059

Weaving Flow Rate (v_w), pc/h	2293	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	764	Density-Based Capacity (c_{IWL}), pc/h/ln	1908
Total Flow Rate (v), pc/h	3057	Demand Flow-Based Capacity (c_{IW}), pc/h	3200
Volume Ratio (VR)	0.750	Weaving Segment Capacity (c_W), veh/h	2992
Minimum Lane Change Rate (LC_{MIN}), lc/h	2293	Adjusted Weaving Area Capacity, pc/h	3259
Maximum Weaving Length (L_{MAX}), ft	10892	Volume-to-Capacity Ratio (v/c)	0.94

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	243	Average Weaving Speed (S_W), mi/h	58.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1859	Average Non-Weaving Speed (S_{NW}), mi/h	45.9
Weaving Lane Change Rate (LC_W), lc/h	2647	Average Speed (S), mi/h	54.5
Total Lane Change Rate (LC_{All}), lc/h	4506	Density (D), pc/mi/ln	18.7
Weaving Intensity Factor (W)	0.214	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	755	1555	30	275
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	897	1970	38	348

Weaving Flow Rate (v_w), pc/h	2318	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	935	Density-Based Capacity (c_{IWL}), pc/h/ln	1951
Total Flow Rate (v), pc/h	3253	Demand Flow-Based Capacity (c_{IW}), pc/h	3366
Volume Ratio (VR)	0.713	Weaving Segment Capacity (c_W), veh/h	3147
Minimum Lane Change Rate (LC_{MIN}), lc/h	2318	Adjusted Weaving Area Capacity, pc/h	3410
Maximum Weaving Length (L_{MAX}), ft	10420	Volume-to-Capacity Ratio (v/c)	0.95

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	303	Average Weaving Speed (S_W), mi/h	58.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1898	Average Non-Weaving Speed (S_{NW}), mi/h	45.4
Weaving Lane Change Rate (LC_W), lc/h	2675	Average Speed (S), mi/h	53.8
Total Lane Change Rate (LC_{All}), lc/h	4573	Density (D), pc/mi/ln	20.2
Weaving Intensity Factor (W)	0.214	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	670	125	80	345
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	796	158	101	437

Weaving Flow Rate (v_w), pc/h	595	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	897	Density-Based Capacity (c_{IWL}), pc/h/ln	2231
Total Flow Rate (v), pc/h	1492	Demand Flow-Based Capacity (c_{IW}), pc/h	6015
Volume Ratio (VR)	0.399	Weaving Segment Capacity (c_W), veh/h	5624
Minimum Lane Change Rate (LC_{MIN}), lc/h	595	Adjusted Weaving Area Capacity, pc/h	5992
Maximum Weaving Length (L_{MAX}), ft	6670	Volume-to-Capacity Ratio (v/c)	0.25

Speed and Density

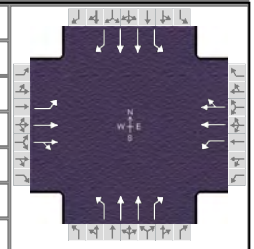
Non-Weaving Vehicle Index (I_{NW})	285	Average Weaving Speed (S_W), mi/h	60.5
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1889	Average Non-Weaving Speed (S_{NW}), mi/h	60.6
Weaving Lane Change Rate (LC_W), lc/h	949	Average Speed (S), mi/h	60.6
Total Lane Change Rate (LC_{All}), lc/h	2838	Density (D), pc/mi/ln	8.2
Weaving Intensity Factor (W)	0.149	Level of Service (LOS)	A

III. 2023 Arterial Analysis

Option 1A

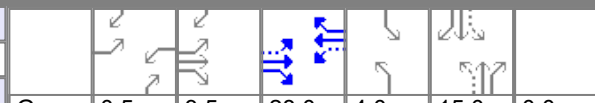
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1A_BENSON _AM.xus		
Project Description	I-229/BENSON IMJR				

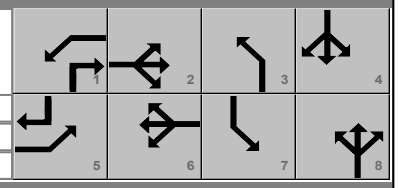


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	95	320	80	60	575	290	100	255	65	100	290	160

Signal Information			
Cycle, s	70.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	0.5	3.5	28.0	4.0	15.0	0.0						
Yellow	3.0	0.0	3.5	3.0	3.5	0.0						
Red	1.0	0.0	2.0	1.0	2.0	0.0						



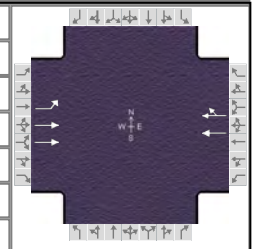
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	8.0	37.0	4.5	33.5	8.0	20.5	8.0	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	4.5		2.2		5.7	7.2	5.7	8.0
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.87		0.14		0.88	1.00	0.88	1.00
Max Out Probability	1.00		0.14		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	106	209	202	7	47	46	111	283	44	111	322	106
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1648	1647	1730	1595	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	2.5	5.3	5.4	0.2	1.1	1.0	3.7	5.2	1.7	3.7	6.0	4.0
Cycle Queue Clearance Time (g_c), s	2.5	5.3	5.4	0.2	1.1	1.0	3.7	5.2	1.7	3.7	6.0	4.0
Green Ratio (*g/C*)	0.48	0.45	0.45	0.41	0.40	0.40	0.27	0.21	0.22	0.27	0.21	0.27
Capacity (*c*), veh/h	686	777	741	443	691	637	301	706	325	317	706	399
Volume-to-Capacity Ratio (*X*)	0.154	0.269	0.273	0.017	0.068	0.073	0.369	0.401	0.137	0.351	0.457	0.265
Back of Queue (*Q*), ft/ln (95 th percentile)	37	90.3	85	3	19.2	15.7	64.3	87.2	25.5	64	100.5	58.2
Back of Queue (*Q*), veh/ln (95 th percentile)	1.4	3.5	3.4	0.1	0.7	0.6	2.5	3.4	1.0	2.5	3.9	2.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.19	0.00	0.00	0.02	0.00	0.00	0.21	0.00	0.11	0.17	0.00	0.18
Uniform Delay (d_1), s/veh	10.2	12.1	12.1	12.6	12.1	10.2	20.4	23.6	21.8	20.3	24.0	20.0
Incremental Delay (d_2), s/veh	0.1	0.8	0.9	0.0	0.2	0.2	1.1	0.1	0.1	0.9	0.2	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	0.0	0.0
Control Delay (*d*), s/veh	10.4	12.9	13.0	12.6	12.3	10.4	21.5	23.8	21.9	21.3	24.1	20.1
Level of Service (LOS)	B	B	B	B	B	B	C	C	C	C	C	C
Approach Delay, s/veh / LOS	12.4	B		11.4	B		23.0	C		22.8	C	
Intersection Delay, s/veh / LOS	18.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.70	C	2.85	C	2.88	C	2.75	C
Bicycle LOS Score / LOS	2.69	C	3.01	C	2.75	C	2.83	C

HCS7 Signalized Intersection Results Summary

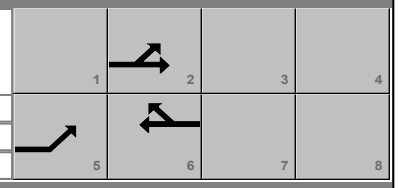
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1A_BENSON _AM.xus		
Project Description	I-229/BENSON 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	60	220			210	0						

Signal Information			
Cycle, s	70.0	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	1.7	58.8	0.0	0.0	0.0	0.0	
Yellow	4.0	3.5	0.0	0.0	0.0	0.0	
Red	0.0	2.0	0.0	0.0	0.0	0.0	



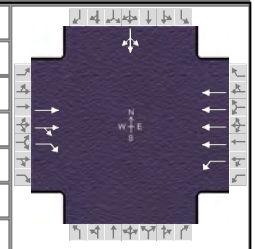
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	1.0	4.0		8.3				
Phase Duration, s	5.7	70.0		64.3				
Change Period, (*Y+R c*), s	4.0	5.5		5.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (*g s*), s	2.1							
Green Extension Time (*g e*), s	0.0	0.0		0.0				
Phase Call Probability	0.28							
Max Out Probability	0.00							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16						
Adjusted Flow Rate (*v*), veh/h	17	61			233	0						
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1543			1633	0						
Queue Service Time (*g s*), s	0.1	0.5			0.9	0.0						
Cycle Queue Clearance Time (*g c*), s	0.1	0.5			0.9	0.0						
Green Ratio (*g/C*)	0.89	0.73			0.84							
Capacity (*c*), veh/h	1069	2243			2746							
Volume-to-Capacity Ratio (*X*)	0.015	0.027			0.085	0.000						
Back of Queue (*Q*), ft/ln (95 th percentile)	0	3.8			1.1	0						
Back of Queue (*Q*), veh/ln (95 th percentile)	0.0	0.1			0.0	0.0						
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00	0.00						
Uniform Delay (*d 1*), s/veh	0.5	1.0			1.0							
Incremental Delay (*d 2*), s/veh	0.0	0.0			0.1	0.0						
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0						
Control Delay (*d*), s/veh	0.5	1.0			1.0							
Level of Service (LOS)	A	A			A							
Approach Delay, s/veh / LOS	0.9	A		1.0	A		0.0			0.0		
Intersection Delay, s/veh / LOS	1.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.55	A	1.29	A	2.29	B	2.48	B
Bicycle LOS Score / LOS	2.73	C	2.67	C		A		

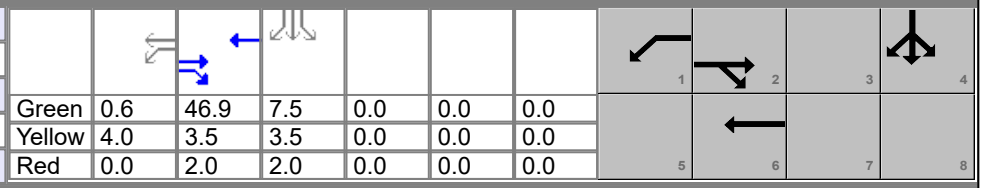
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1A_BENSON _AM.xus		
Project Description	I-229/BENSON 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		165	320	45	1805					5	0	110

Signal Information			
Cycle, s	70.0	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	0.6	46.9	7.5	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

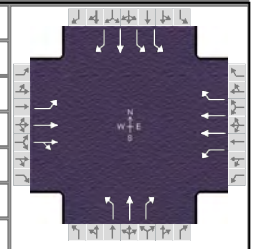
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		52.4	4.6	57.0				13.0
Change Period, (*Y+R c*), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (*g s*), s			2.2					8.0
Green Extension Time (*g e*), s		0.0	0.0	0.0				0.2
Phase Call Probability			0.10					0.92
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		66	128	6	228						128	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1621	1442	1714	1475						1458	
Queue Service Time (*g s*), s		0.5	2.1	0.2	0.8						6.0	
Cycle Queue Clearance Time (*g c*), s		0.5	2.1	0.2	0.8						6.0	
Green Ratio (*g/C*)		0.67	0.67	0.01	0.74						0.11	
Capacity (*c*), veh/h		2171	966	15	4342						156	
Volume-to-Capacity Ratio (*X*)		0.030	0.133	0.369	0.052						0.818	
Back of Queue (*Q*), ft/ln (95 th percentile)		5.2	21.7	5.1	5.8						96.2	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.2	0.9	0.2	0.2						3.8	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.05	0.00						0.00	
Uniform Delay (*d 1*), s/veh		3.9	4.0	34.6	2.8						30.6	
Incremental Delay (*d 2*), s/veh		0.0	0.3	5.4	0.0						4.0	
Initial Queue Delay (*d 3*), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		3.9	4.2	40.0	2.9						34.6	
Level of Service (LOS)		A	A	D	A						C	
Approach Delay, s/veh / LOS	4.1	A		3.8	A		0.0			34.6	C	
Intersection Delay, s/veh / LOS	11.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.93	B	1.33	A	3.02	C	3.12	C
Bicycle LOS Score / LOS	2.92	C	3.33	C		A	0.70	A

HCS7 Signalized Intersection Results Summary

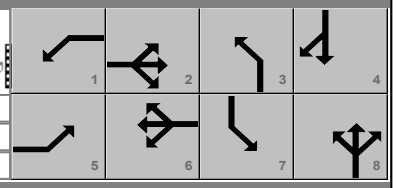
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1A_BENSON _AM.xus		
Project Description	I-229/BENSON 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	315	30	60	955	430	25	20	30	115	25	85

Signal Information			
Cycle, s	70.0	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	0.6	3.9	35.7	1.7	2.7	3.8						
Yellow	3.9	0.0	3.9	3.6	0.0	3.6						
Red	1.0	0.0	2.2	1.0	0.0	2.3						



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	9.4	45.8	5.5	41.8	6.3	9.7	9.0	12.4
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.2	5.1	1.2
Queue Clearance Time (g_s), s	4.5		2.2		3.1	3.0	4.7	4.5
Green Extension Time (g_e), s	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Phase Call Probability	0.93		0.16		0.42	0.95	0.92	0.99
Max Out Probability	0.02		0.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	133	187	185	9	141	41	28	22	22	128	28	56
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1693	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	2.5	3.0	2.9	0.2	1.7		1.1	0.9	1.0	2.7	1.0	2.5
Cycle Queue Clearance Time (g_c), s	2.5	3.0	2.9	0.2	1.7		1.1	0.9	1.0	2.7	1.0	2.5
Green Ratio (*g/C*)	0.59	0.57	0.57	0.52	0.51		0.08	0.05	0.05	0.06	0.09	0.09
Capacity (*c*), veh/h	803	980	959	606	1682		210	94	83	201	162	137
Volume-to-Capacity Ratio (*X*)	0.166	0.191	0.193	0.015	0.084		0.132	0.236	0.268	0.634	0.172	0.405
Back of Queue (*Q*), ft/ln (95 th percentile)	34.8	44.4	40.1	2.6	24.3		20.6	16.7	16.1	53.1	19.6	40.4
Back of Queue (*Q*), veh/ln (95 th percentile)	1.3	1.7	1.6	0.1	0.9		0.8	0.6	0.6	2.0	0.8	1.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.17	0.00	0.00	0.04	0.00		0.52	0.00	0.00	0.20	0.00	0.00
Uniform Delay (d_1), s/veh	6.9	5.8	5.5	8.2	9.6		30.2	31.7	31.8	32.0	29.2	29.9
Incremental Delay (d_2), s/veh	0.1	0.4	0.4	0.0	0.1		0.4	0.5	0.6	4.6	0.2	0.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	7.0	6.2	5.9	8.2	9.7	0.0	30.7	32.2	32.4	36.7	29.4	30.6
Level of Service (LOS)	A	A	A	A	A	A	C	C	C	D	C	C
Approach Delay, s/veh / LOS	6.3	A		7.5	A		31.7	C		34.1	C	
Intersection Delay, s/veh / LOS	14.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.15	B	2.60	C	3.14	C	2.75	C
Bicycle LOS Score / LOS	2.68	C	3.45	C	2.05	B	2.43	B

HCS7 Two-Way Stop-Control Report

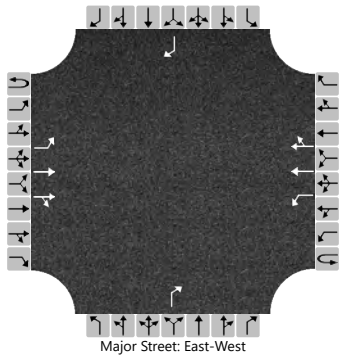
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2023
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	0	1		0	0	1
Configuration		L	T	TR		L	T	TR				R				R
Volume (veh/h)	0	15	405	40	0	135	1490	290				80				10
Percent Heavy Vehicles (%)	5	5			5	5						5				5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized									No				No			
Median Type | Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1						6.9				6.9
Critical Headway (sec)		4.20				4.20						7.00				7.00
Base Follow-Up Headway (sec)		2.2				2.2						3.3				3.3
Follow-Up Headway (sec)		2.25				2.25						3.35				3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		17				150						89				11
Capacity, c (veh/h)		277				1045						744				240
v/c Ratio		0.06				0.14						0.12				0.05
95% Queue Length, Q_{95} (veh)		0.2				0.5						0.4				0.1
Control Delay (s/veh)		18.8				9.0						10.5				20.7
Level of Service (LOS)		C				A						B				C
Approach Delay (s/veh)	0.6				0.6				10.5				20.7			
Approach LOS									B				C			

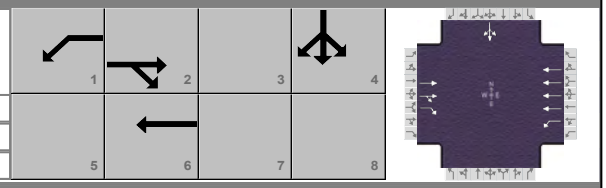
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 SB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1A_BENSON _AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		165	320	45	1805					5	0	110
Intersection Two Demand (*v*), veh/h	60	220			210	0						

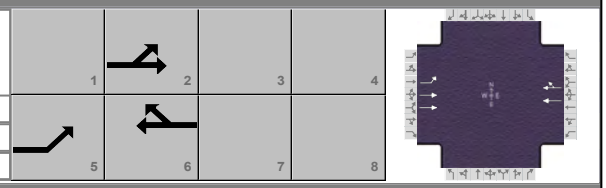
Signal One Information	
Cycle, s	70.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	0.6	46.9	7.5	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



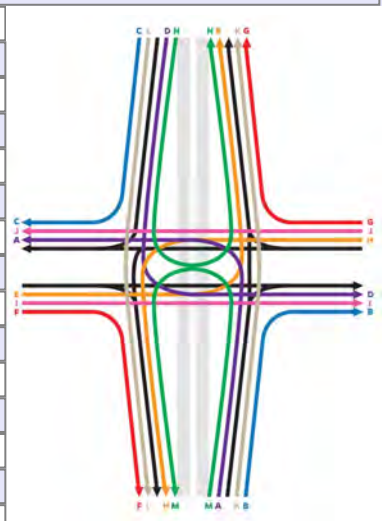
Signal Two Information	
Cycle, s	70.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	1.7	58.8	0.0	0.0	0.0	0.0
Yellow	4.0	3.5	0.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0



Interchange Results

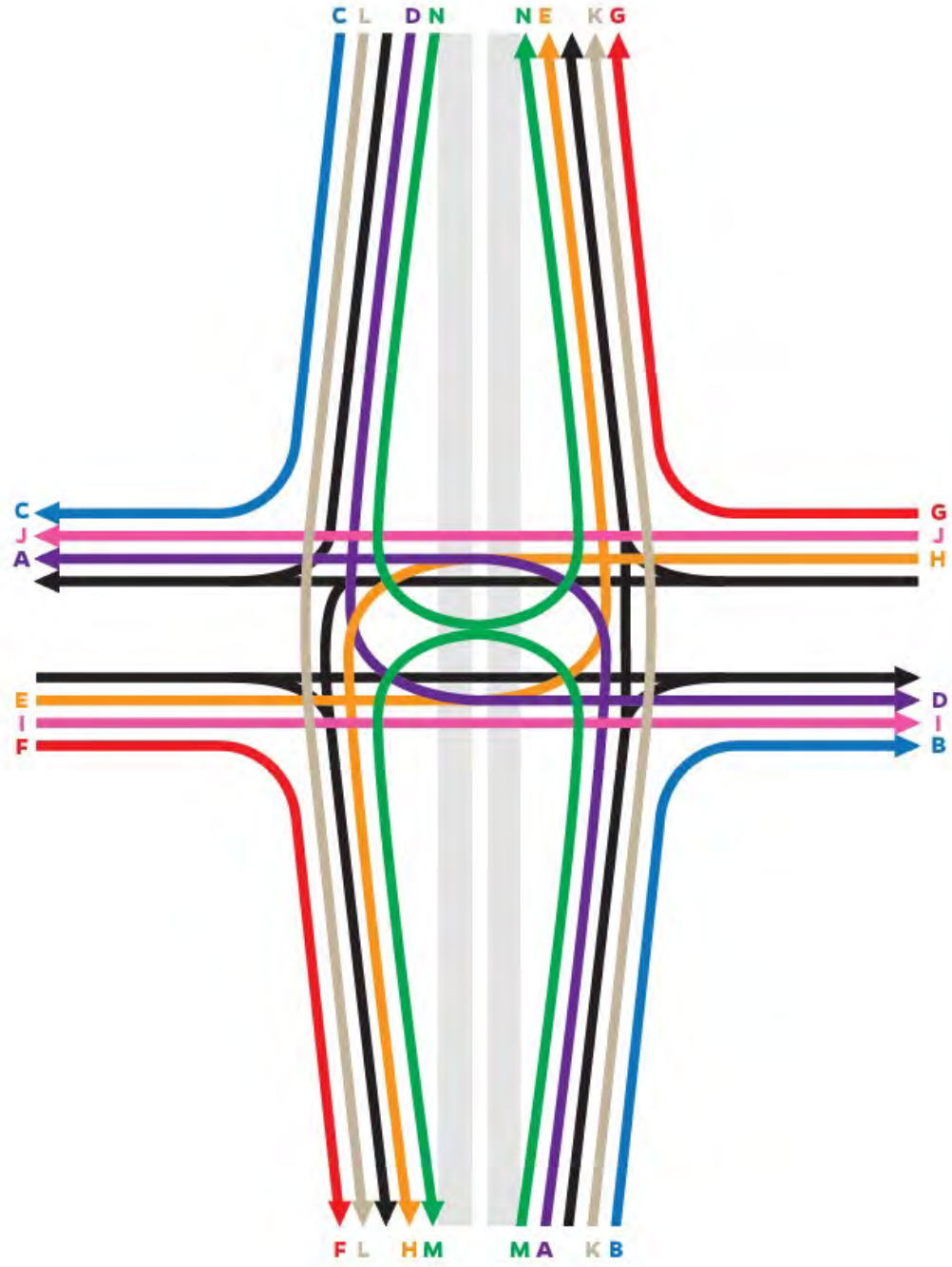
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	2.9	0.0	2.9	No	No	A
B	0	0.0	0.0	0.0	No	No	A
C	122	0.0	0.0	0.0	No	No	A
D	6	35.5	0.0	35.5	No	No	C
E	17	4.4	0.0	4.4	No	No	A
F	128	3.9	0.0	3.9	No	No	A
G	0	0.0	0.0	0.0	No	No	A
H	6	41.0	0.0	41.0	No	No	C
I	55	4.9	0.0	4.9	No	No	A
J	228	3.9	0.0	3.9	No	No	A
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		3.9	4.2	40.0	2.9						34.6	
Level of Service (LOS)		A	A	D	A						C	
Approach Delay, s/veh / LOS	4.1	A		3.8	A		0.0			34.6	C	
Intersection Delay, s/veh / LOS	11.0						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	0.5	1.0			1.0							
Level of Service (LOS)	A	A			A							
Approach Delay, s/veh / LOS	0.9	A		1.0	A		0.0			0.0		
Intersection Delay, s/veh / LOS	1.0						A					

Interchange Graphic



HCS7 Streets Text Report

File Name:	BUILD_1A_BENSON _AM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Mar 7, 2018
Time Period:	AM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2023
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	70
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	4	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											

1: Peak Hour Factor 1

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.09			42.8	
1	Running Speed, mph		41.85			42.14	
1	Through Delay, s/veh		6.07			11.74	
1	Travel Speed, mph		36.69			33.07	
1	Stop Rate, stops/veh		0.25			0.43	
1	Spatial Stop Rate, stops/mi		0.51			0.86	
1	Through vol/cap ratio		0.19			0.07	
1	Percent of Base FFS		83.24			75.03	
1	Level of Service		A			B	
1	Automobile Perception Score		2.22			2.27	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		62.95			62.72	
2	Running Speed, mph		42.83			42.99	
2	Through Delay, s/veh		3.92			9.67	
2	Travel Speed, mph		40.32			37.25	
2	Stop Rate, stops/veh		0.17			0.38	
2	Spatial Stop Rate, stops/mi		0.23			0.51	
2	Through vol/cap ratio		0.03			0.08	
2	Percent of Base FFS		91.5			84.53	
2	Level of Service		A			A	
2	Automobile Perception Score		2.28			2.27	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.68			18.7	
3	Running Speed, mph		36.5			36.47	
3	Through Delay, s/veh		0.99			2.85	
3	Travel Speed, mph		34.66			31.64	
3	Stop Rate, stops/veh		0.14			0.11	
3	Spatial Stop Rate, stops/mi		0.72			0.59	
3	Through vol/cap ratio		0.03			0.05	
3	Percent of Base FFS		78.64			71.79	
3	Level of Service		B			B	
3	Automobile Perception Score		2.25			2.44	
Facility Travel Time, s			135.7			148.48	
Facility Travel Speed, mph			38.18			34.9	
Facility Spatial Stop Rate, stops/mi			0.39			0.64	
Facility Base Free Flow Speed, mph			44.07			44.07	
Facility Percent Base Free Flow Speed			86.64			79.19	

Facility Level of Service	A	B
Facility Automobile Perception Score	2.25	2.29
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.3	4.3
Facility Pedestrian LOS Score	2.8	2.86
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	14.14	14.51
Facility Bicycle LOS Score	2.47	2.41
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	36.57	32.67
Facility Transit LOS Score	0.41	0.57
Facility Transit LOS	A	A
SPILLBACK TIME, h	999	

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.18	4.18
1	Ped LOS Score for Intersection	2.15	2.85
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.61	0.3
1	Speed Adjustment Factor	0.7	0.71
1	Ped LOS Score for Link	2.62	2.32
1	Ped Link LOS	C	B
1	Roadway Crossing Difficulty Factor	1.01	1
1	Ped LOS Score for Segment	2.84	2.62
1	Ped Segment LOS	C	B
1	Bicycle Travel Speed	13.78	14.02
1	Bicycle LOS Score for Intersection	2.68	3.01
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.13	1.77
1	Speed Adjustment Factor	0.85	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.04	2.68
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.65	2.42
1	Bicycle Segment LOS	B	B
1	Transit Running Speed, mi/h	41.85	42.14
1	g/C Ratio	0.57	0.4
1	Transit Running Time, s	43.09	42.8
1	Delay at Intersection, s/veh	6.22	12.39
1	Transit Travel Speed, mi/h	36.57	32.67
1	Transit Wait-Ride Score	3.92	3.77
1	Ped LOS Score for Link	2.62	2.32
1	Transit LOS Score for Segment	0.52	0.69
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.37	4.36
2	Ped LOS Score for Intersection	1.93	2.6
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.58	0.4
2	Speed Adjustment Factor	0.73	0.74
2	Ped LOS Score for Link	2.62	2.44
2	Ped Link LOS	C	B
2	Roadway Crossing Difficulty Factor	1.03	1.2
2	Ped LOS Score for Segment	2.89	3.07
2	Ped Segment LOS	C	C
2	Bicycle Travel Speed	14.47	14.8
2	Bicycle LOS Score for Intersection	2.92	3.45
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.11	1.92
2	Speed Adjustment Factor	0.86	0.86
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.02	2.83
2	Bicycle Link LOS	C	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.63	2.49

2	Bicycle Segment LOS	B	B
2	Transit Running Speed, mi/h	42.83	42.99
2	g/C Ratio	0.67	0.51
2	Transit Running Time, s	62.95	62.72
2	Delay at Intersection, s/veh	3.92	9.67
2	Transit Travel Speed, mi/h	40.32	37.25
2	Transit Wait-Ride Score	4.05	3.94
2	Ped LOS Score for Link	2.62	2.44
2	Transit LOS Score for Segment	0.32	0.45
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.33	4.35
3	Ped LOS Score for Intersection	0.55	1.33
3	Cross-section Adjustment Factor	-5.01	-4.74
3	Volume Adjustment Factor	0.09	0.13
3	Speed Adjustment Factor	0.53	0.53
3	Ped LOS Score for Link	1.66	1.97
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.19	1.2
3	Ped LOS Score for Segment	2.35	2.64
3	Ped Segment LOS	B	B
3	Bicycle Travel Speed	13.84	14.71
3	Bicycle LOS Score for Intersection	2.73	3.33
3	Cross-section Adjustment Factor	-3.85	-1.28
3	Volume Adjustment Factor	1.14	1.36
3	Speed Adjustment Factor	0.79	0.79
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	-0.59	2.2
3	Bicycle Link LOS	A	B
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.32	2.05
3	Bicycle Segment LOS	A	B
3	Transit Running Speed, mi/h	36.5	36.47
3	g/C Ratio	0.92	0.74
3	Transit Running Time, s	18.68	18.7
3	Delay at Intersection, s/veh	0.99	2.85
3	Transit Travel Speed, mi/h	34.66	31.64
3	Transit Wait-Ride Score	3.85	3.73
3	Ped LOS Score for Link	1.66	1.97
3	Transit LOS Score for Segment	0.48	0.71
3	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	517	22.2	0	229	34.6	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0	0	0	0.01	0	0	0.01	0.01	0.01	0.01	0.01	0
1: Thru veh delay		0.02			0.02							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

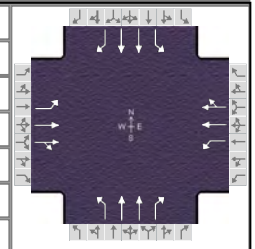
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	511	0	0	363	13.7	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.03	0	0	0.03	0.03	0.03	0.03	0.03	0
1: Thru veh delay		0			0.01							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	17.7	466	47.2	32.3	356	69.4	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0	0	0	0	0	0	0	0	0	0	0	0
2: Thru veh delay		0.03			0.04							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											

3: Volume, veh/h	0	189	367	1.93	348	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0	0	0	0	0	0	0	0	0	0	0	0
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

This Urban Streets text report was created in HCS™ Streets Version 7.5 on May 31, 2018 at 09:48:47

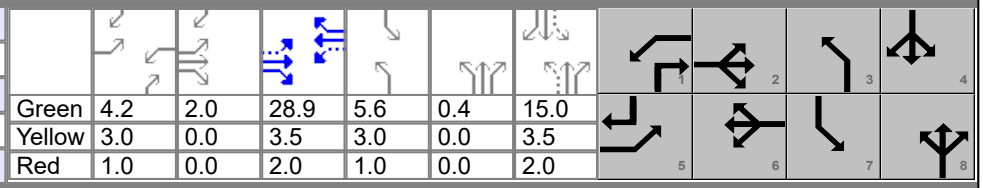
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1A_BENSON_PM.xus		
Project Description	I-229/BENSON 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	135	615	170	170	340	145	135	375	50	105	395	235

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	4.2	2.0	28.9	5.6	0.4	15.0	
Yellow	3.0	0.0	3.5	3.0	0.0	3.5	
Red	1.0	0.0	2.0	1.0	0.0	2.0	

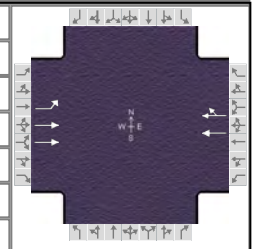
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	10.1	36.3	8.2	34.4	10.0	20.9	9.6	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	6.0		4.6		7.4	10.6	6.1	11.2
Green Extension Time (g_e), s	0.4	0.0	0.2	0.0	0.0	0.2	0.0	0.2
Phase Call Probability	0.96		0.87		0.96	1.00	0.91	1.00
Max Out Probability	0.12		0.12		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	150	433	406	97	106	105	150	417	28	117	439	189
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1618	1647	1730	1680	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	4.0	14.8	14.8	2.6	3.0	3.0	5.4	8.6	1.1	4.1	9.2	8.0
Cycle Queue Clearance Time (g_c), s	4.0	14.8	14.8	2.6	3.0	3.0	5.4	8.6	1.1	4.1	9.2	8.0
Green Ratio (*g/C*)	0.47	0.41	0.41	0.44	0.38	0.38	0.28	0.20	0.26	0.28	0.20	0.28
Capacity (*c*), veh/h	624	711	665	307	666	647	299	675	382	280	659	413
Volume-to-Capacity Ratio (*X*)	0.240	0.609	0.610	0.315	0.159	0.162	0.501	0.618	0.073	0.417	0.666	0.457
Back of Queue (*Q*), ft/ln (95 th percentile)	61.9	257.4	237	44.1	54.9	50.8	96.7	149.4	16.1	74	159.6	119.4
Back of Queue (*Q*), veh/ln (95 th percentile)	2.4	9.9	9.5	1.7	2.1	2.0	3.7	5.7	0.6	2.8	6.1	4.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.32	0.00	0.00	0.31	0.00	0.00	0.32	0.00	0.07	0.20	0.00	0.37
Uniform Delay (d_1), s/veh	11.8	17.4	17.4	14.5	15.3	14.8	22.1	27.1	20.9	22.0	27.7	22.2
Incremental Delay (d_2), s/veh	0.3	3.9	4.1	0.8	0.5	0.5	1.9	0.3	0.0	1.4	0.4	0.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	12.1	21.2	21.5	15.3	15.8	15.3	23.9	27.5	20.9	23.4	28.1	22.5
Level of Service (LOS)	B	C	C	B	B	B	C	C	C	C	C	C
Approach Delay, s/veh / LOS	20.0	B		15.5	B		26.3	C		26.0	C	
Intersection Delay, s/veh / LOS	22.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.81	C	2.90	C	2.89	C	2.84	C
Bicycle LOS Score / LOS	3.08	C	2.76	C	2.88	C	3.00	C

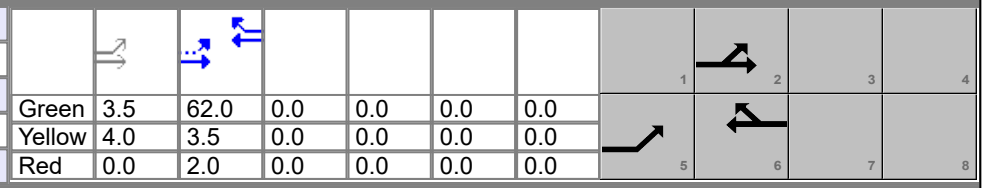
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1A_BENSON_PM.xus		
Project Description	I-229/BENSON 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	150	300			395	115						

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.5	62.0	0.0	0.0	0.0	0.0	
Yellow	4.0	3.5	0.0	0.0	0.0	0.0	
Red	0.0	2.0	0.0	0.0	0.0	0.0	

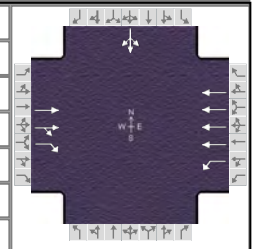
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	1.0	4.0		8.3				
Phase Duration, s	7.5	75.0		67.5				
Change Period, (*Y+R c*), s	4.0	5.5		5.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (*g s*), s	2.2							
Green Extension Time (*g e*), s	0.0	0.0		0.0				
Phase Call Probability	0.59							
Max Out Probability	0.00							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16						
Adjusted Flow Rate (*v*), veh/h	43	85			293	274						
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1545			1663	1531						
Queue Service Time (*g s*), s	0.2	0.7			7.2	2.8						
Cycle Queue Clearance Time (*g c*), s	0.2	0.7			7.2	2.8						
Green Ratio (*g/C*)	0.90	0.74			0.83	0.83						
Capacity (*c*), veh/h	776	2279			1374	1265						
Volume-to-Capacity Ratio (*X*)	0.055	0.038			0.213	0.216						
Back of Queue (*Q*), ft/ln (95 th percentile)	0.1	6			10.9	10.7						
Back of Queue (*Q*), veh/ln (95 th percentile)	0.0	0.2			0.4	0.4						
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00	0.00						
Uniform Delay (*d 1*), s/veh	1.0	1.0			1.4	1.4						
Incremental Delay (*d 2*), s/veh	0.0	0.0			0.4	0.4						
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0						
Control Delay (*d*), s/veh	1.0	1.0			1.7	1.8						
Level of Service (LOS)	A	A			A	A						
Approach Delay, s/veh / LOS	1.0	A		1.8	A		0.0			0.0		
Intersection Delay, s/veh / LOS	1.6						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.54	A	1.30	A	2.43	B	2.58	C
Bicycle LOS Score / LOS	2.89	C	2.95	C		A		

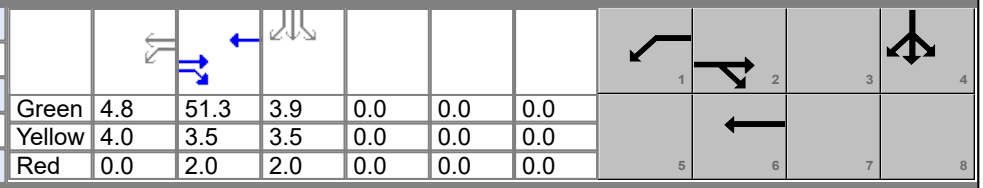
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1A_BENSON_PM.xus		
Project Description	I-229/BENSON 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		385	1450	135	625					5	0	40

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.8	51.3	3.9	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

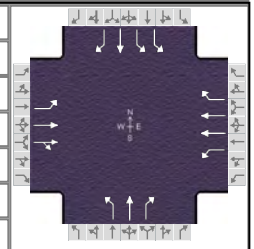
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		56.8	8.8	65.6				9.4
Change Period, (*Y+R c*), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (*g s*), s			5.4					4.5
Green Extension Time (*g e*), s		0.0	0.1	0.0				0.0
Phase Call Probability			0.80					0.65
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		117	441	78	361						50	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1626	1488	1714	1481						1461	
Queue Service Time (*g s*), s		1.0	8.9	3.4	1.2						2.5	
Cycle Queue Clearance Time (*g c*), s		1.0	8.9	3.4	1.2						2.5	
Green Ratio (*g/C*)		0.68	0.68	0.06	0.80						0.05	
Capacity (*c*), veh/h		2224	1018	110	4747						76	
Volume-to-Capacity Ratio (*X*)		0.053	0.433	0.708	0.076						0.661	
Back of Queue (*Q*), ft/ln (95 th percentile)		10.9	83	64.6	4.9						41.7	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.4	3.3	2.6	0.2						1.7	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.65	0.00						0.00	
Uniform Delay (*d 1*), s/veh		4.4	4.5	35.0	1.9						34.9	
Incremental Delay (*d 2*), s/veh		0.0	0.6	3.1	0.0						3.6	
Initial Queue Delay (*d 3*), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		4.4	5.1	38.0	2.0						38.5	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	5.0	A		8.4	A		0.0			38.5	D	
Intersection Delay, s/veh / LOS	8.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.92	D	1.31	A	2.84	C	3.15	C
Bicycle LOS Score / LOS	4.16	D	2.83	C		A	0.57	A

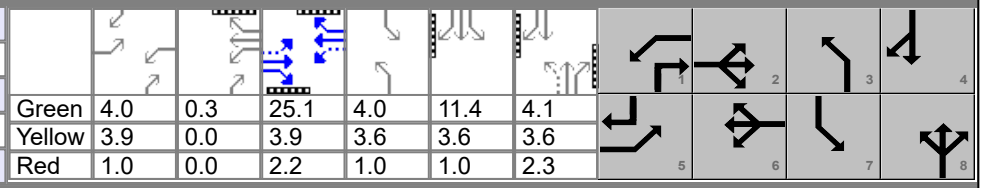
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1A_BENSON_PM.xus		
Project Description	I-229/BENSON 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	50	900	15	60	410	80	40	30	125	745	25	140

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.0	0.3	25.1	4.0	11.4	4.1
Yellow	3.9	0.0	3.9	3.6	3.6	3.6
Red	1.0	0.0	2.2	1.0	1.0	2.3

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	8.9	31.2	9.2	31.5	8.6	10.0	24.6	26.0
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	3.1		3.3		3.9	6.1	21.2	6.4
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	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	384	383	44	301	59	44	33	128	828	28	117
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1726	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	1.1	14.4	14.4	1.3	5.2		1.9	1.4	4.1	19.2	0.9	4.4
Cycle Queue Clearance Time (g_c), s	1.1	14.4	14.4	1.3	5.2		1.9	1.4	4.1	19.2	0.9	4.4
Green Ratio (*g/C*)	0.39	0.33	0.33	0.39	0.34		0.11	0.05	0.11	0.27	0.27	0.32
Capacity (*c*), veh/h	440	579	578	288	1115		258	95	171	853	464	471
Volume-to-Capacity Ratio (*X*)	0.096	0.663	0.663	0.153	0.270		0.173	0.353	0.748	0.970	0.060	0.248
Back of Queue (*Q*), ft/ln (95 th percentile)	17.4	252.2	242.9	24.1	89.5		34.4	27.4	128	381.7	16.2	65.8
Back of Queue (*Q*), veh/ln (95 th percentile)	0.7	9.7	9.7	0.9	3.4		1.3	1.1	5.1	14.7	0.6	2.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.09	0.00	0.00	0.34	0.00		0.86	0.00	0.00	0.95	0.00	0.00
Uniform Delay (d_1), s/veh	13.0	21.8	21.8	15.8	19.0		30.7	34.2	32.3	27.2	20.4	18.8
Incremental Delay (d_2), s/veh	0.1	4.8	4.8	1.1	0.6		0.4	0.8	14.8	23.8	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	0.0
Control Delay (*d*), s/veh	13.1	26.6	26.6	16.9	19.6	0.0	31.1	35.0	47.1	51.0	20.4	18.9
Level of Service (LOS)	B	C	C	B	B	A	C	C	D	D	C	B
Approach Delay, s/veh / LOS	25.9	C		16.4	B		41.7	D		46.3	D	
Intersection Delay, s/veh / LOS	33.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.22	B	2.65	C	3.02	C	2.75	C
Bicycle LOS Score / LOS	3.14	C	2.77	C	2.27	B	3.68	D

HCS7 Two-Way Stop-Control Report

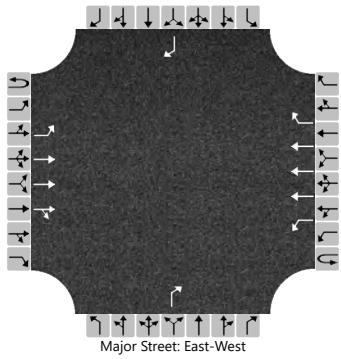
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2023
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes


Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	3	0	0	1	3	1		0	0	1		0	0	1
Configuration		L	T	TR		L	T	R				R				R
Volume (veh/h)	0	5	1735	30	0	60	555	50				100				40
Percent Heavy Vehicles (%)	5	5			5	5						5				5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized					No				No				No			
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		5.3				5.3						7.1				7.1
Critical Headway (sec)		5.40				5.40						7.20				7.20
Base Follow-Up Headway (sec)		3.1				3.1						3.9				3.9
Follow-Up Headway (sec)		3.15				3.15						3.95				3.95

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		6				67						111				44
Capacity, c (veh/h)		552				126						209				580
v/c Ratio		0.01				0.53						0.53				0.08
95% Queue Length, Q_{95} (veh)		0.0				2.5						2.8				0.2
Control Delay (s/veh)		11.6				61.7						40.1				11.7
Level of Service (LOS)		B				F						E				B
Approach Delay (s/veh)	0.0				5.6				40.1				11.7			
Approach LOS									E				B			

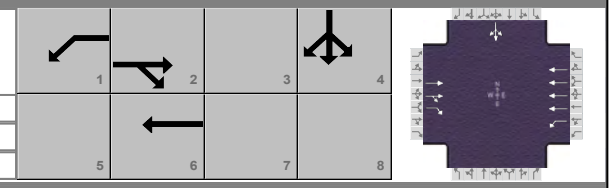
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 SB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1A_BENSON_PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		385	1450	135	625					5	0	40
Intersection Two Demand (*v*), veh/h	150	300			395	115						

Signal One Information	
Cycle, s	75.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	4.8	51.3	3.9	0.0	0.0	0.0	
Yellow	4.0	3.5	3.5	0.0	0.0	0.0	
Red	0.0	2.0	2.0	0.0	0.0	0.0	

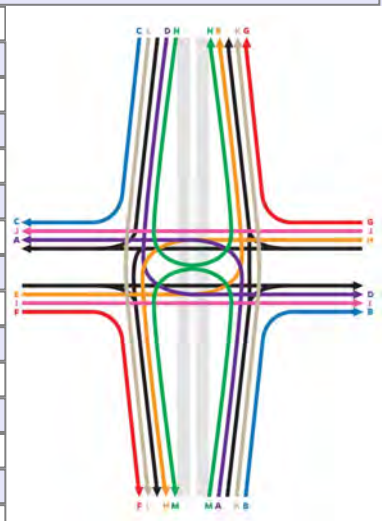


Signal Two Information	
Cycle, s	75.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	3.5	62.0	0.0	0.0	0.0	0.0	
Yellow	4.0	3.5	0.0	0.0	0.0	0.0	
Red	0.0	2.0	0.0	0.0	0.0	0.0	

Interchange Results

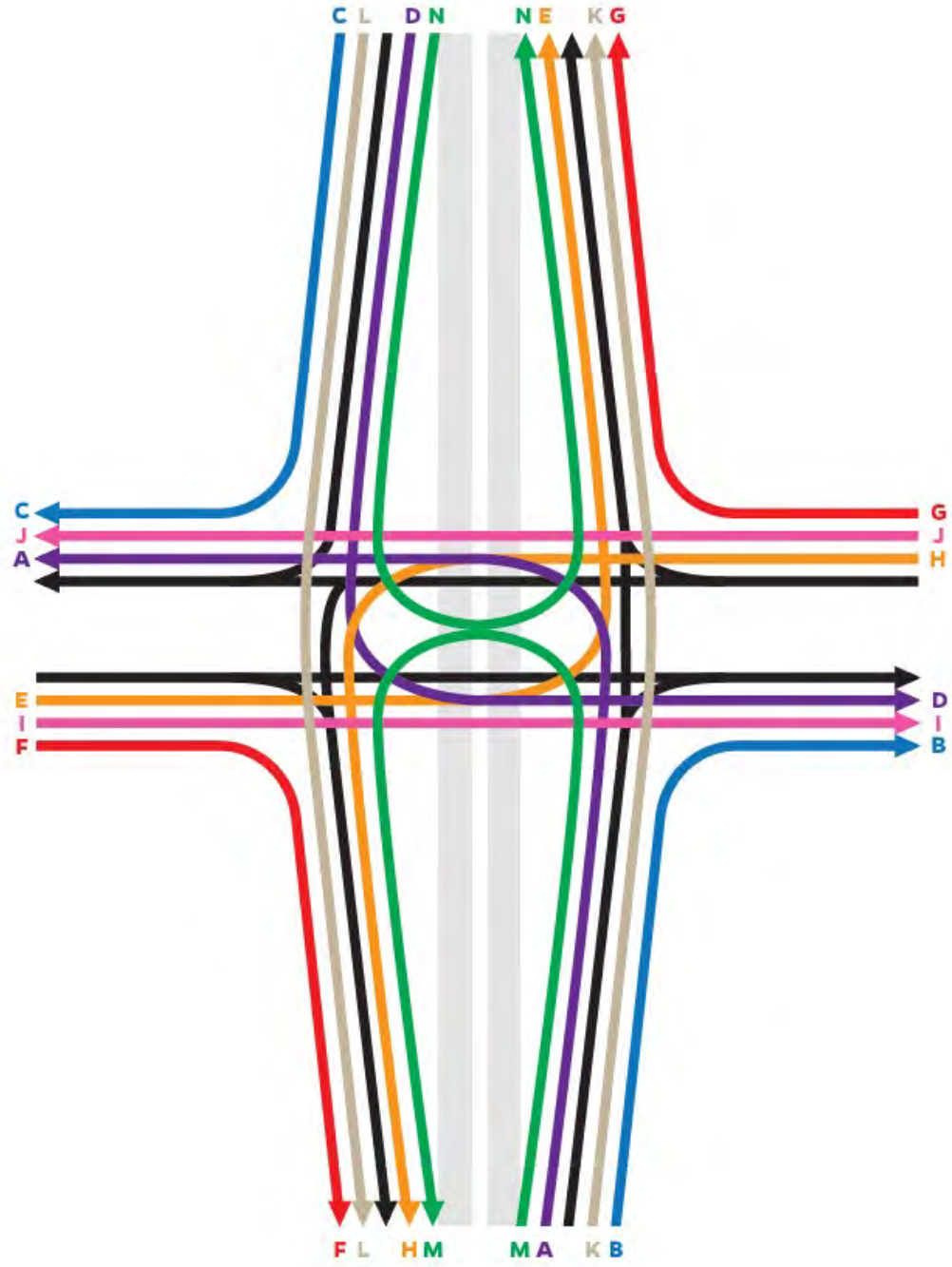
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	2.0	0.0	2.0	No	No	A
B	0	0.0	0.0	0.0	No	No	A
C	44	0.0	0.0	0.0	No	No	A
D	6	39.6	0.0	39.6	No	No	C
E	43	5.4	0.0	5.4	No	No	A
F	441	4.4	0.0	4.4	No	No	A
G	128	1.8	0.0	1.8	No	No	A
H	78	39.8	0.0	39.8	No	No	C
I	80	5.5	0.0	5.5	No	No	A
J	361	3.7	0.0	3.7	No	No	A
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		4.4	5.1	38.0	2.0						38.5	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	5.0		A	8.4		A	0.0			38.5		D
Intersection Delay, s/veh / LOS	8.0						A					

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	1.0	1.0			1.7	1.8						
Level of Service (LOS)	A	A			A	A						
Approach Delay, s/veh / LOS	1.0		A	1.8		A	0.0			0.0		
Intersection Delay, s/veh / LOS	1.6						A					

Interchange Graphic



File Name: BUILD_1A_BENSON_PM.xus
Analyst: RL
Agency/Co.: HDR
Analysis Date: Mar 7, 2018
Time Period: PM PEAK
Jurisdiction: CITY OF SIOUX FALLS
Analysis Year: 2023
Project Description: I-229/BENSON IMJR
Urban Street: BENSON ROAD
Analysis Period: 1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	75
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	4	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											

1: Peak Hour Factor 1

Number of access points: 1

SEGMENT 2

Movement	EB LT 1	EB TH 2	EB RT 3	WB LT 4	WB TH 5	WB RT 6	NB LT 7	NB TH 8	NB RT 9	SB LT 10	SB TH 11	SB RT 12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.46			43.07	
1	Running Speed, mph		41.49			41.87	
1	Through Delay, s/veh		26.59			15.57	
1	Travel Speed, mph		25.74			30.76	
1	Stop Rate, stops/veh		0.76			0.53	
1	Spatial Stop Rate, stops/mi		1.52			1.05	
1	Through vol/cap ratio		0.66			0.16	
1	Percent of Base FFS		58.41			69.79	
1	Level of Service		C			B	
1	Automobile Perception Score		2.37			2.3	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		65.36			62.81	
2	Running Speed, mph		41.26			42.93	
2	Through Delay, s/veh		4.43			19.56	
2	Travel Speed, mph		38.64			32.74	
2	Stop Rate, stops/veh		0.19			0.61	
2	Spatial Stop Rate, stops/mi		0.25			0.81	
2	Through vol/cap ratio		0.05			0.27	
2	Percent of Base FFS		87.68			74.29	
2	Level of Service		A			B	
2	Automobile Perception Score		2.28			2.31	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.7			18.74	
3	Running Speed, mph		36.46			36.38	
3	Through Delay, s/veh		1.04			1.97	
3	Travel Speed, mph		34.54			32.92	
3	Stop Rate, stops/veh		0.14			0.06	
3	Spatial Stop Rate, stops/mi		0.75			0.29	
3	Through vol/cap ratio		0.04			0.08	
3	Percent of Base FFS		78.37			74.69	
3	Level of Service		B			B	
3	Automobile Perception Score		2.25			2.39	

Facility Travel Time, s	159.58	161.72
Facility Travel Speed, mph	32.47	32.04
Facility Spatial Stop Rate, stops/mi	0.76	0.83
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	73.68	72.71

Facility Level of Service	B	B
Facility Automobile Perception Score	2.31	2.32
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.27	4.27
Facility Pedestrian LOS Score	3.41	2.88
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	13.68	14.22
Facility Bicycle LOS Score	2.84	2.54
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	25.75	30.65
Facility Transit LOS Score	0.82	0.76
Facility Transit LOS	A	A
SPILLBACK TIME, h	999	

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.17	4.17
1	Ped LOS Score for Intersection	2.22	2.9
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.97	0.57
1	Speed Adjustment Factor	0.69	0.7
1	Ped LOS Score for Link	2.97	2.58
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.03	0.87
1	Ped LOS Score for Segment	3.13	2.58
1	Ped Segment LOS	C	B
1	Bicycle Travel Speed	13.54	13.2
1	Bicycle LOS Score for Intersection	3.14	2.76
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.37	2.1
1	Speed Adjustment Factor	0.84	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.27	3
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.85	2.65
1	Bicycle Segment LOS	C	B
1	Transit Running Speed, mi/h	41.49	41.87
1	g/C Ratio	0.33	0.38
1	Transit Running Time, s	43.46	43.07
1	Delay at Intersection, s/veh	26.58	15.77
1	Transit Travel Speed, mi/h	25.75	30.65
1	Transit Wait-Ride Score	3.45	3.68
1	Ped LOS Score for Link	2.97	2.58
1	Transit LOS Score for Segment	1.26	0.86
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.32	4.32
2	Ped LOS Score for Intersection	3.92	2.65
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	1.97	0.46
2	Speed Adjustment Factor	0.68	0.74
2	Ped LOS Score for Link	3.96	2.51
2	Ped Link LOS	D	C
2	Roadway Crossing Difficulty Factor	1	1.2
2	Ped LOS Score for Segment	3.83	3.12
2	Ped Segment LOS	D	C
2	Bicycle Travel Speed	13.73	14.88
2	Bicycle LOS Score for Intersection	4.16	2.77
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.73	1.99
2	Speed Adjustment Factor	0.84	0.86
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.62	2.91
2	Bicycle Link LOS	D	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	3.17	2.53

2	Bicycle Segment LOS	C	B
2	Transit Running Speed, mi/h	41.26	42.93
2	g/C Ratio	0.68	0.34
2	Transit Running Time, s	65.36	62.81
2	Delay at Intersection, s/veh	4.43	19.56
2	Transit Travel Speed, mi/h	38.64	32.74
2	Transit Wait-Ride Score	3.99	3.77
2	Ped LOS Score for Link	3.96	2.51
2	Transit LOS Score for Segment	0.61	0.72
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.33	4.37
3	Ped LOS Score for Intersection	0.54	1.31
3	Cross-section Adjustment Factor	-4.91	-4.74
3	Volume Adjustment Factor	0.14	0.25
3	Speed Adjustment Factor	0.53	0.53
3	Ped LOS Score for Link	1.82	2.09
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.16	1.2
3	Ped LOS Score for Segment	2.45	2.75
3	Ped Segment LOS	B	B
3	Bicycle Travel Speed	13.86	14.64
3	Bicycle LOS Score for Intersection	2.89	2.83
3	Cross-section Adjustment Factor	-2.63	-1.28
3	Volume Adjustment Factor	1.4	1.68
3	Speed Adjustment Factor	0.79	0.78
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	0.9	2.52
3	Bicycle Link LOS	A	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.49	2.26
3	Bicycle Segment LOS	A	B
3	Transit Running Speed, mi/h	36.46	36.38
3	g/C Ratio	0.93	0.8
3	Transit Running Time, s	18.7	18.74
3	Delay at Intersection, s/veh	1.04	1.97
3	Transit Travel Speed, mi/h	34.54	32.92
3	Transit Wait-Ride Score	3.84	3.78
3	Ped LOS Score for Link	1.82	2.09
3	Transit LOS Score for Segment	0.51	0.65
3	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	820	35.3	0	435	65.9	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.03	0	0	0.13	0	0	0.16	0.16	0.13	0.16	0.16	0.03
1: Thru veh delay		0.03			0.04							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1729	0	0	404	15.3	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.43	0	0	0.43	0.43	0.43	0.43	0.43	0
1: Thru veh delay		0			0.01							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	58.3	1535	155	36.2	399	77.7	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0	0	0	0.41	0	0	0.41	0.41	0.41	0.41	0.41	0
2: Thru veh delay		0.15			0.04							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											

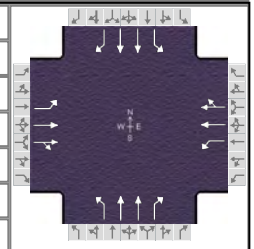
3: Volume, veh/h	0	553	1072	2.23	403	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0	0	0	0.39	0	0	0.39	0.39	0.39	0.39	0.39	0
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

This Urban Streets text report was created in HCS™ Streets Version 7.5 on May 31, 2018 at 11:18:29

Option 1B

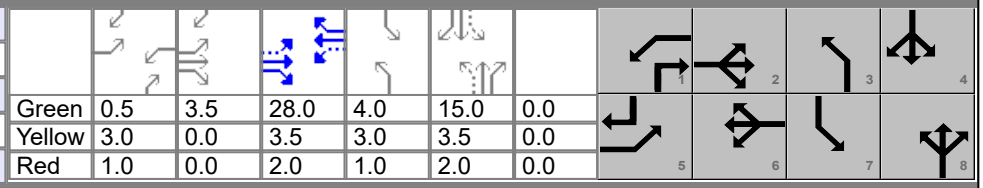
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1B_BENSON _AM.xus		
Project Description	I-229/BENSON 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	95	320	80	60	575	290	100	255	65	100	290	160

Signal Information			
Cycle, s	70.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	0.5	3.5	28.0	4.0	15.0	0.0
Yellow	3.0	0.0	3.5	3.0	3.5	0.0
Red	1.0	0.0	2.0	1.0	2.0	0.0

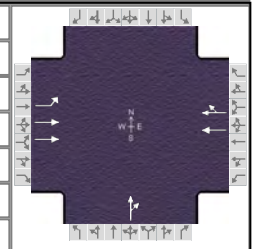
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	8.0	37.0	4.5	33.5	8.0	20.5	8.0	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	4.5		2.2		5.7	7.2	5.7	8.0
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.87		0.14		0.88	1.00	0.88	1.00
Max Out Probability	1.00		0.14		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	106	209	202	7	47	46	111	283	44	111	322	106
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1648	1647	1730	1595	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	2.5	5.3	5.4	0.2	1.1	1.0	3.7	5.2	1.7	3.7	6.0	4.0
Cycle Queue Clearance Time (g_c), s	2.5	5.3	5.4	0.2	1.1	1.0	3.7	5.2	1.7	3.7	6.0	4.0
Green Ratio (*g/C*)	0.48	0.45	0.45	0.41	0.40	0.40	0.27	0.21	0.22	0.27	0.21	0.27
Capacity (*c*), veh/h	686	777	741	443	691	637	301	706	325	317	706	399
Volume-to-Capacity Ratio (*X*)	0.154	0.269	0.273	0.017	0.068	0.073	0.369	0.401	0.137	0.351	0.457	0.265
Back of Queue (*Q*), ft/ln (95 th percentile)	37	90.3	85	3	19.3	15.7	64.3	87.2	25.5	64	100.5	58.2
Back of Queue (*Q*), veh/ln (95 th percentile)	1.4	3.5	3.4	0.1	0.7	0.6	2.5	3.4	1.0	2.5	3.9	2.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.19	0.00	0.00	0.02	0.00	0.00	0.21	0.00	0.11	0.17	0.00	0.18
Uniform Delay (d_1), s/veh	10.2	12.1	12.1	12.6	12.2	10.1	20.4	23.6	21.8	20.3	24.0	20.0
Incremental Delay (d_2), s/veh	0.1	0.8	0.9	0.0	0.2	0.2	1.1	0.1	0.1	0.9	0.2	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	0.0	0.0
Control Delay (*d*), s/veh	10.4	12.9	13.0	12.6	12.3	10.4	21.5	23.8	21.9	21.3	24.1	20.1
Level of Service (LOS)	B	B	B	B	B	B	C	C	C	C	C	C
Approach Delay, s/veh / LOS	12.4	B		11.4	B		23.0	C		22.8	C	
Intersection Delay, s/veh / LOS	18.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.70	C	2.85	C	2.88	C	2.75	C
Bicycle LOS Score / LOS	2.69	C	3.01	C	2.75	C	2.83	C

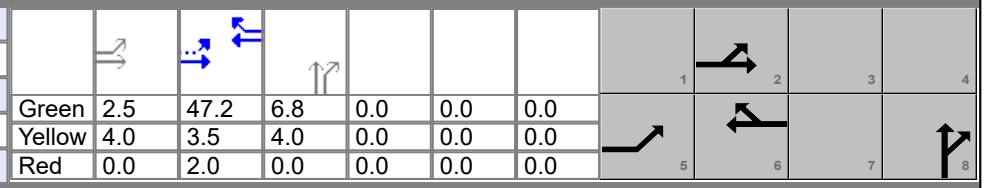
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1B_BENSON _AM.xus		
Project Description	I-229/BENSON 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	60	110			210	0		0	110			

Signal Information			
Cycle, s	70.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4		
Green	2.5	47.2	6.8	0.0	0.0	0.0	5	6	7	8		
Yellow	4.0	3.5	4.0	0.0	0.0	0.0						
Red	0.0	2.0	0.0	0.0	0.0	0.0						

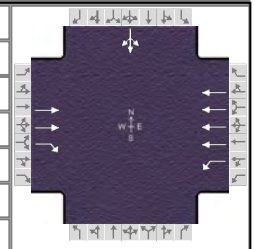
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		8.3		12.0		
Phase Duration, s	6.5	59.2		52.7		10.8		
Change Period, ($Y+R_c$), s	4.0	5.5		5.5		4.0		
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		3.3		
Queue Clearance Time (g_s), s	2.3					7.5		
Green Extension Time (g_e), s	0.0	0.0		0.0		0.2		
Phase Call Probability	0.41					0.90		
Max Out Probability	0.00					0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16		8	18			
Adjusted Flow Rate (*v*), veh/h	27	50			233	0		117				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1542			1633	0		1466				
Queue Service Time (g_s), s	0.3	0.4			1.8	0.0		5.5				
Cycle Queue Clearance Time (g_c), s	0.3	0.4			1.8	0.0		5.5				
Green Ratio (*g/C*)	0.74	0.73			0.67			0.10				
Capacity (*c*), veh/h	888	2242			2203			143				
Volume-to-Capacity Ratio (*X*)	0.031	0.022			0.106	0.000		0.815				
Back of Queue (*Q*), ft/ln (95 th percentile)	2.3	3			19	0		90.8				
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	0.1			0.7	0.0		3.5				
Queue Storage Ratio (*RQ*) (95 th percentile)	0.02	0.00			0.00	0.00		0.00				
Uniform Delay (d_1), s/veh	2.5	2.7			4.0			31.0				
Incremental Delay (d_2), s/veh	0.0	0.0			0.1	0.0		4.2				
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0		0.0				
Control Delay (*d*), s/veh	2.5	2.7			4.1			35.2				
Level of Service (LOS)	A	A			A			D				
Approach Delay, s/veh / LOS	2.6	A		4.1	A		35.2	D		0.0		
Intersection Delay, s/veh / LOS	12.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.49	A	1.35	A	2.29	B	2.44	B
Bicycle LOS Score / LOS	2.63	C	2.67	C	2.36	B		

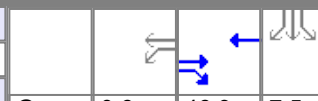
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1B_BENSON _AM.xus		
Project Description	I-229/BENSON IMJR				

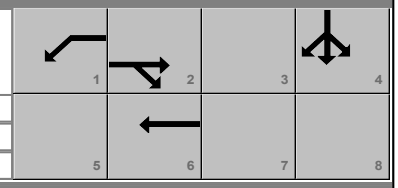


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		165	320	45	1805					5	0	110

Signal Information			
Cycle, s	70.0	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	0.6	46.9	7.5	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



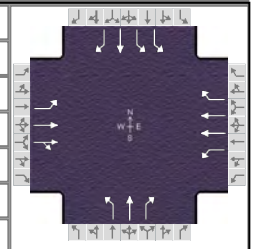
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		52.4	4.6	57.0				13.0
Change Period, ($Y+R_c$), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (g_s), s			2.2					8.0
Green Extension Time (g_e), s		0.0	0.0	0.0				0.2
Phase Call Probability			0.10					0.92
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		66	128	6	228						128	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1544	1442	1714	1475						1458	
Queue Service Time (g_s), s		0.5	2.1	0.2	1.0						6.0	
Cycle Queue Clearance Time (g_c), s		0.5	2.1	0.2	1.0						6.0	
Green Ratio (*g/C*)		0.67	0.67	0.01	0.74						0.11	
Capacity (*c*), veh/h		2067	966	15	4342						156	
Volume-to-Capacity Ratio (*X*)		0.032	0.133	0.369	0.052						0.818	
Back of Queue (*Q*), ft/ln (95 th percentile)		5.3	21.7	5.1	7.3						96.2	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.2	0.9	0.2	0.3						3.8	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.05	0.00						0.00	
Uniform Delay (d_1), s/veh		3.9	4.0	34.5	3.6						30.6	
Incremental Delay (d_2), s/veh		0.0	0.3	5.4	0.0						4.0	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		3.9	4.2	39.9	3.6						34.6	
Level of Service (LOS)		A	A	D	A						C	
Approach Delay, s/veh / LOS	4.1	A		4.5	A		0.0			34.6	C	
Intersection Delay, s/veh / LOS	11.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.93	B	1.33	A	3.02	C	3.12	C
Bicycle LOS Score / LOS	2.92	C	3.33	C		A	0.70	A

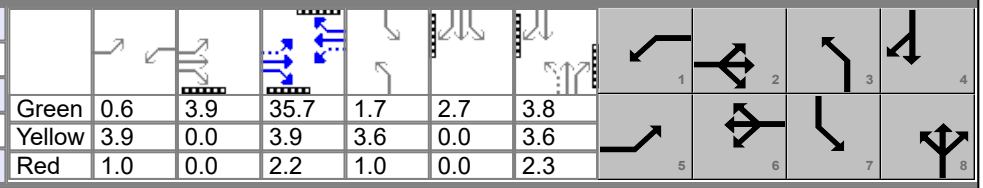
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1B_BENSON _AM.xus		
Project Description	I-229/BENSON 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	315	30	60	955	430	25	20	30	115	25	85

Signal Information			
Cycle, s	70.0	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	0.6	3.9	35.7	1.7	2.7	3.8
Yellow	3.9	0.0	3.9	3.6	0.0	3.6
Red	1.0	0.0	2.2	1.0	0.0	2.3

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	9.4	45.8	5.5	41.8	6.3	9.7	9.0	12.4
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.2	5.1	1.2
Queue Clearance Time (g_s), s	4.5		2.2		3.1	3.0	4.7	4.5
Green Extension Time (g_e), s	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Phase Call Probability	0.93		0.16		0.42	0.95	0.92	0.99
Max Out Probability	0.02		0.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	133	187	185	9	141	41	28	22	22	128	28	56
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1693	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	2.5	3.0	2.9	0.2	1.8		1.1	0.9	1.0	2.7	1.0	2.5
Cycle Queue Clearance Time (g_c), s	2.5	3.0	2.9	0.2	1.8		1.1	0.9	1.0	2.7	1.0	2.5
Green Ratio (*g/C*)	0.59	0.57	0.57	0.52	0.51		0.08	0.05	0.05	0.06	0.09	0.09
Capacity (*c*), veh/h	801	980	959	606	1682		210	94	83	201	162	137
Volume-to-Capacity Ratio (*X*)	0.166	0.191	0.193	0.015	0.084		0.132	0.236	0.268	0.634	0.172	0.405
Back of Queue (*Q*), ft/ln (95 th percentile)	34.8	44.4	40.1	2.6	26.2		20.6	16.7	16.1	53.1	19.6	40.4
Back of Queue (*Q*), veh/ln (95 th percentile)	1.3	1.7	1.6	0.1	1.0		0.8	0.6	0.6	2.0	0.8	1.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.17	0.00	0.00	0.04	0.00		0.52	0.00	0.00	0.20	0.00	0.00
Uniform Delay (d_1), s/veh	6.9	5.8	5.5	8.2	10.4		30.2	31.7	31.8	32.0	29.2	29.9
Incremental Delay (d_2), s/veh	0.1	0.4	0.4	0.0	0.1		0.4	0.5	0.6	4.6	0.2	0.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	7.0	6.2	5.9	8.2	10.5	0.0	30.7	32.2	32.4	36.7	29.4	30.6
Level of Service (LOS)	A	A	A	A	B	A	C	C	C	D	C	C
Approach Delay, s/veh / LOS	6.3	A		8.1	A		31.7	C		34.1	C	
Intersection Delay, s/veh / LOS	14.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.15	B	2.60	C	3.14	C	2.75	C
Bicycle LOS Score / LOS	2.68	C	3.45	C	2.05	B	2.43	B

HCS7 Two-Way Stop-Control Report

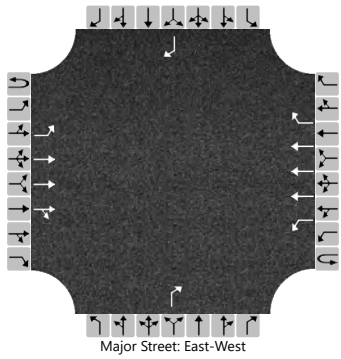
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2023
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes


Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	3	0	0	1	3	1		0	0	1		0	0	1
Configuration		L	T	TR		L	T	R				R				R
Volume (veh/h)	0	15	405	40	0	135	1490	290				80				10
Percent Heavy Vehicles (%)	5	5			5	5						5				5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized					No				No				No			
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		5.3				5.3						7.1				7.1
Critical Headway (sec)		5.40				5.40						7.20				7.20
Base Follow-Up Headway (sec)		3.1				3.1						3.9				3.9
Follow-Up Headway (sec)		3.15				3.15						3.95				3.95

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		17				150						89				11
Capacity, c (veh/h)		124				671						635				265
v/c Ratio		0.13				0.22						0.14				0.04
95% Queue Length, Q_{95} (veh)		0.5				0.9						0.5				0.1
Control Delay (s/veh)		38.6				11.9						11.6				19.2
Level of Service (LOS)		E				B						B				C
Approach Delay (s/veh)	1.3				0.8				11.6				19.2			
Approach LOS									B				C			

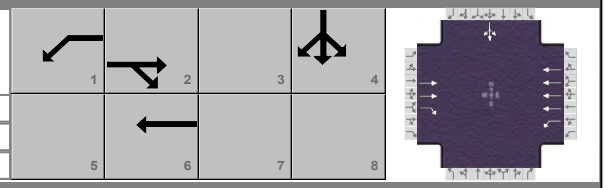
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1B_BENSON _AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		165	320	45	1805					5	0	110
Intersection Two Demand (*v*), veh/h	60	110			210	0		0	110			

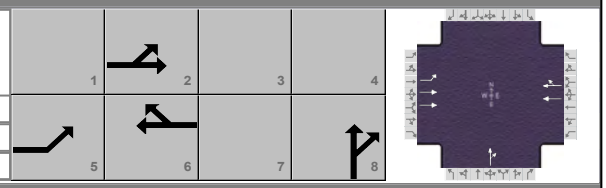
Signal One Information	
Cycle, s	70.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	0.6	46.9	7.5	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



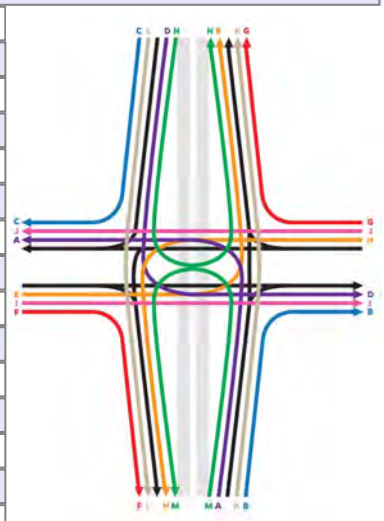
Signal Two Information	
Cycle, s	70.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	2.5	47.2	6.8	0.0	0.0	0.0
Yellow	4.0	3.5	4.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0



Interchange Results

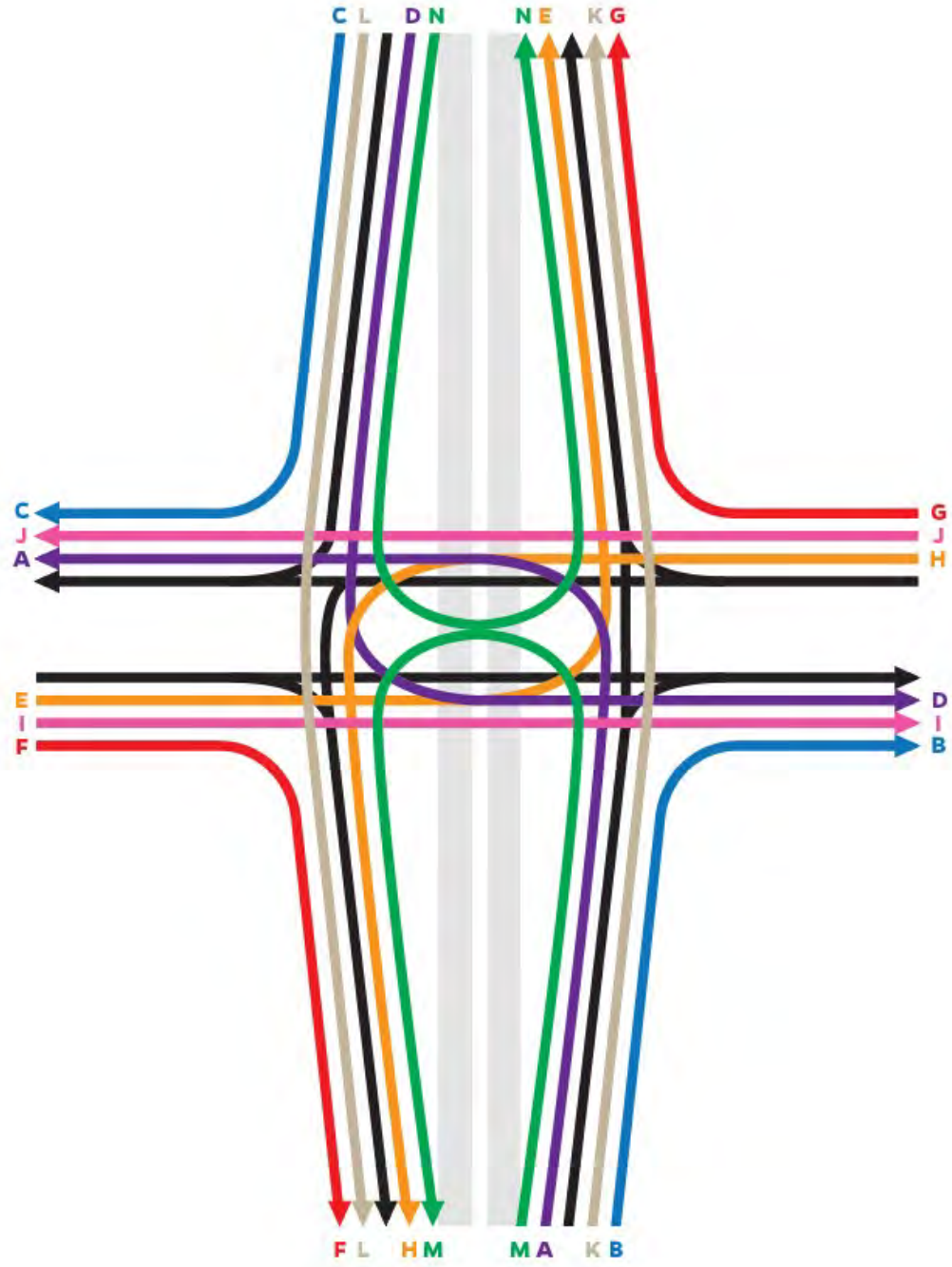
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	3.6	0.0	3.6	No	No	A
B	117	35.2	0.0	35.2	No	No	C
C	122	0.0	0.0	0.0	No	No	A
D	6	37.2	0.0	37.2	No	No	C
E	27	6.5	0.0	6.5	No	No	A
F	128	3.9	0.0	3.9	No	No	A
G	0	0.0	0.0	0.0	No	No	A
H	6	44.0	0.0	44.0	No	No	C
I	44	6.6	0.0	6.6	No	No	A
J	228	7.7	0.0	7.7	No	No	A
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		3.9	4.2	39.9	3.6						34.6	
Level of Service (LOS)		A	A	D	A						C	
Approach Delay, s/veh / LOS	4.1	A		4.5	A		0.0			34.6	C	
Intersection Delay, s/veh / LOS	11.3						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	2.5	2.7			4.1			35.2				
Level of Service (LOS)	A	A			A			D				
Approach Delay, s/veh / LOS	2.6	A		4.1	A		35.2	D		0.0		
Intersection Delay, s/veh / LOS	12.3						B					

Interchange Graphic



HCS7 Streets Text Report

File Name:	BUILD_1B_BENSON _AM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Mar 7, 2018
Time Period:	AM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2023
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	70
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	4	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											

1: Peak Hour Factor 1

Number of access points: 1

SEGMENT 2

Movement	EB LT 1	EB TH 2	EB RT 3	WB LT 4	WB TH 5	WB RT 6	NB LT 7	NB TH 8	NB RT 9	SB LT 10	SB TH 11	SB RT 12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.09			42.8	
1	Running Speed, mph		41.85			42.14	
1	Through Delay, s/veh		6.07			11.72	
1	Travel Speed, mph		36.69			33.08	
1	Stop Rate, stops/veh		0.25			0.43	
1	Spatial Stop Rate, stops/mi		0.51			0.86	
1	Through vol/cap ratio		0.19			0.07	
1	Percent of Base FFS		83.24			75.05	
1	Level of Service		A			B	
1	Automobile Perception Score		2.22			2.27	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		62.95			62.72	
2	Running Speed, mph		42.83			42.99	
2	Through Delay, s/veh		3.92			10.45	
2	Travel Speed, mph		40.32			36.85	
2	Stop Rate, stops/veh		0.17			0.41	
2	Spatial Stop Rate, stops/mi		0.23			0.55	
2	Through vol/cap ratio		0.03			0.08	
2	Percent of Base FFS		91.49			83.62	
2	Level of Service		A			A	
2	Automobile Perception Score		2.28			2.27	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.68			18.7	
3	Running Speed, mph		36.5			36.47	
3	Through Delay, s/veh		2.68			3.62	
3	Travel Speed, mph		31.92			30.56	
3	Stop Rate, stops/veh		0.13			0.14	
3	Spatial Stop Rate, stops/mi		0.7			0.75	
3	Through vol/cap ratio		0.02			0.05	
3	Percent of Base FFS		72.44			69.34	
3	Level of Service		B			B	
3	Automobile Perception Score		2.24			2.46	

Facility Travel Time, s	137.39	150.01
Facility Travel Speed, mph	37.71	34.54
Facility Spatial Stop Rate, stops/mi	0.39	0.68
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	85.58	78.38

Facility Level of Service	A	B
Facility Automobile Perception Score	2.25	2.29
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.3	4.3
Facility Pedestrian LOS Score	2.8	2.86
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	14.14	14.39
Facility Bicycle LOS Score	2.46	2.43
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	36.57	32.67
Facility Transit LOS Score	0.43	0.59
Facility Transit LOS	A	A
SPILLBACK TIME, h	999	

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.18	4.18
1	Ped LOS Score for Intersection	2.15	2.85
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.61	0.3
1	Speed Adjustment Factor	0.7	0.71
1	Ped LOS Score for Link	2.62	2.32
1	Ped Link LOS	C	B
1	Roadway Crossing Difficulty Factor	1.01	1
1	Ped LOS Score for Segment	2.84	2.62
1	Ped Segment LOS	C	B
1	Bicycle Travel Speed	13.78	14.02
1	Bicycle LOS Score for Intersection	2.68	3.01
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.13	1.77
1	Speed Adjustment Factor	0.85	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.04	2.68
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.65	2.42
1	Bicycle Segment LOS	B	B
1	Transit Running Speed, mi/h	41.85	42.14
1	g/C Ratio	0.57	0.4
1	Transit Running Time, s	43.09	42.8
1	Delay at Intersection, s/veh	6.22	12.4
1	Transit Travel Speed, mi/h	36.57	32.67
1	Transit Wait-Ride Score	3.92	3.77
1	Ped LOS Score for Link	2.62	2.32
1	Transit LOS Score for Segment	0.52	0.7
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.37	4.36
2	Ped LOS Score for Intersection	1.93	2.6
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.58	0.4
2	Speed Adjustment Factor	0.73	0.74
2	Ped LOS Score for Link	2.62	2.44
2	Ped Link LOS	C	B
2	Roadway Crossing Difficulty Factor	1.03	1.2
2	Ped LOS Score for Segment	2.89	3.07
2	Ped Segment LOS	C	C
2	Bicycle Travel Speed	14.47	14.8
2	Bicycle LOS Score for Intersection	2.92	3.45
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.11	1.92
2	Speed Adjustment Factor	0.86	0.86
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.02	2.83
2	Bicycle Link LOS	C	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.63	2.49

2	Bicycle Segment LOS	B	B
2	Transit Running Speed, mi/h	42.83	42.99
2	g/C Ratio	0.67	0.51
2	Transit Running Time, s	62.95	62.72
2	Delay at Intersection, s/veh	3.92	10.45
2	Transit Travel Speed, mi/h	40.32	36.85
2	Transit Wait-Ride Score	4.05	3.93
2	Ped LOS Score for Link	2.62	2.44
2	Transit LOS Score for Segment	0.32	0.47
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.33	4.35
3	Ped LOS Score for Intersection	1.49	1.33
3	Cross-section Adjustment Factor	-5.01	-4.74
3	Volume Adjustment Factor	0.09	0.13
3	Speed Adjustment Factor	0.53	0.53
3	Ped LOS Score for Link	1.66	1.97
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.19	1.2
3	Ped LOS Score for Segment	2.35	2.64
3	Ped Segment LOS	B	B
3	Bicycle Travel Speed	13.84	13.87
3	Bicycle LOS Score for Intersection	2.63	3.33
3	Cross-section Adjustment Factor	-3.85	-1.28
3	Volume Adjustment Factor	1.14	1.36
3	Speed Adjustment Factor	0.79	0.79
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	-0.59	2.2
3	Bicycle Link LOS	A	B
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.28	2.18
3	Bicycle Segment LOS	A	B
3	Transit Running Speed, mi/h	36.5	36.47
3	g/C Ratio	0.77	0.74
3	Transit Running Time, s	18.68	18.7
3	Delay at Intersection, s/veh	2.68	3.62
3	Transit Travel Speed, mi/h	31.92	30.56
3	Transit Wait-Ride Score	3.74	3.68
3	Ped LOS Score for Link	1.66	1.97
3	Transit LOS Score for Segment	0.64	0.78
3	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	517	22.2	0	229	34.6	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0	0	0	0.01	0	0	0.01	0.01	0.01	0.01	0.01	0
1: Thru veh delay		0.02			0.02							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

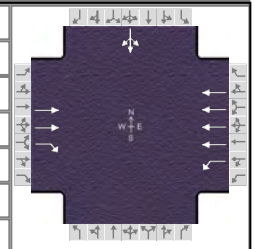
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	511	0	0	363	13.7	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.03	0	0	0.03	0.03	0.03	0.03	0.03	0
1: Thru veh delay		0			0.01							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	17.7	466	47.2	32.3	356	69.4	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0	0	0	0	0	0	0	0	0	0	0	0
2: Thru veh delay		0.03			0.04							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											

3: Volume, veh/h	0	189	367	1.93	348	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0	0	0	0	0	0	0	0	0	0	0	0
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

This Urban Streets text report was created in HCS™ Streets Version 7.5 on May 31, 2018 at 09:59:24

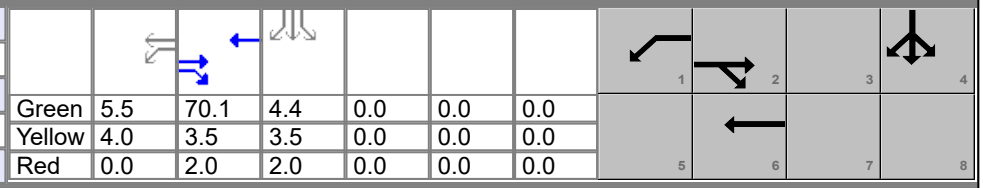
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1B_BENSON_PM.xus		
Project Description	I-229/BENSON 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		385	1450	135	625					5	0	40

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.5	70.1	4.4	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

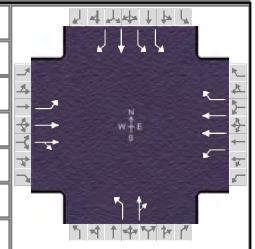
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		75.6	9.5	85.1				9.9
Change Period, (*Y+R c*), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (*g s*), s			6.3					5.2
Green Extension Time (*g e*), s		0.0	0.1	0.0				0.0
Phase Call Probability			0.87					0.73
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		117	441	78	361						50	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1550	1505	1714	1484						1464	
Queue Service Time (*g s*), s		0.9	5.8	4.3	1.5						3.2	
Cycle Queue Clearance Time (*g c*), s		0.9	5.8	4.3	1.5						3.2	
Green Ratio (*g/C*)		0.74	0.74	0.06	0.80						0.05	
Capacity (*c*), veh/h		2286	1110	100	4769						68	
Volume-to-Capacity Ratio (*X*)		0.051	0.397	0.780	0.076						0.738	
Back of Queue (*Q*), ft/ln (95 th percentile)		9.7	51.8	86.2	11						55.7	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.4	2.1	3.4	0.4						2.2	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.86	0.00						0.00	
Uniform Delay (*d 1*), s/veh		3.1	2.1	44.8	2.1						44.7	
Incremental Delay (*d 2*), s/veh		0.0	0.6	4.8	0.0						5.7	
Initial Queue Delay (*d 3*), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		3.1	2.7	49.6	2.1						50.5	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	2.8	A		10.5	B		0.0			50.5	D	
Intersection Delay, s/veh / LOS	8.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.91	D	1.30	A	2.85	C	3.16	C
Bicycle LOS Score / LOS	4.16	D	2.83	C		A	0.57	A

HCS7 Signalized Intersection Results Summary

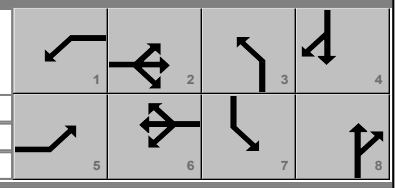
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1B_BENSON_PM.xus		
Project Description	I-229/BENSON 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	50	900	15	60	410	80	40	30	125	745	25	140

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.7	36.3	3.2	18.9	7.8	0.0
Yellow	3.9	3.9	3.6	3.6	3.6	0.0
Red	1.0	2.2	1.0	1.0	2.3	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	2.0	4.0	2.0	3.0
Phase Duration, s	7.6	42.4	7.6	42.4	7.8	13.7	31.3	37.2
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	3.5		3.5		4.5	9.8	25.8	7.5
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0
Phase Call Probability	0.67		0.69		0.69	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	42	384	383	44	301	59	44	161		828	28	117
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1726	1647	1647		1647	1514		1600	1730	1466
Queue Service Time (g_s), s	1.5	18.0	18.0	1.5	5.9		2.5	7.8		23.8	1.0	5.5
Cycle Queue Clearance Time (g_c), s	1.5	18.0	18.0	1.5	5.9		2.5	7.8		23.8	1.0	5.5
Green Ratio (*g/C*)	0.41	0.38	0.38	0.41	0.38		0.03	0.08		0.28	0.33	0.33
Capacity (*c*), veh/h	437	660	659	255	1259		55	124		899	571	484
Volume-to-Capacity Ratio (*X*)	0.097	0.581	0.581	0.173	0.239		0.812	1.294		0.921	0.049	0.241
Back of Queue (*Q*), ft/ln (95 th percentile)	25.3	322.4	309.8	27.3	105.1		70.6	395.1		416	19.3	86.9
Back of Queue (*Q*), veh/ln (95 th percentile)	1.0	12.4	12.4	1.0	4.0		2.7	15.2		16.0	0.7	3.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.13	0.00	0.00	0.39	0.00		0.94	0.00		0.98	0.00	0.00
Uniform Delay (d_1), s/veh	17.2	27.2	27.3	18.7	20.1		45.6	43.6		33.1	21.7	23.2
Incremental Delay (d_2), s/veh	0.1	3.2	3.2	0.5	0.4		31.9	179.4		14.3	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	17.3	30.4	30.5	19.2	20.6	0.0	77.5	223.0		47.4	21.7	23.3
Level of Service (LOS)	B	C	C	B	C	A	E	F		D	C	C
Approach Delay, s/veh / LOS	29.8	C		17.4	B		191.5	F		43.8	D	
Intersection Delay, s/veh / LOS	47.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.07	B	2.66	C	3.03	C	2.75	C
Bicycle LOS Score / LOS	3.14	C	2.77	C	2.27	B	3.68	D

HCS7 Two-Way Stop-Control Report

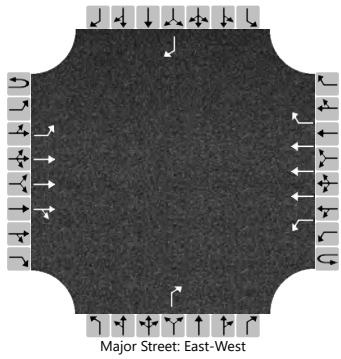
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2023
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes


Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	3	0	0	1	3	1		0	0	1		0	0	1
Configuration		L	T	TR		L	T	R				R				R
Volume (veh/h)	0	5	1735	30	0	60	555	50				100				40
Percent Heavy Vehicles (%)	5	5			5	5						5				5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized					No				No				No			
Median Type | Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)		5.3				5.3						7.1				7.1
Critical Headway (sec)		5.40				5.40						7.20				7.20
Base Follow-Up Headway (sec)		3.1				3.1						3.9				3.9
Follow-Up Headway (sec)		3.15				3.15						3.95				3.95

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		6				67						111				44
Capacity, c (veh/h)		552				126						209				580
v/c Ratio		0.01				0.53						0.53				0.08
95% Queue Length, Q_{95} (veh)		0.0				2.5						2.8				0.2
Control Delay (s/veh)		11.6				61.7						40.1				11.7
Level of Service (LOS)		B				F						E				B
Approach Delay (s/veh)	0.0				5.6				40.1				11.7			
Approach LOS									E				B			

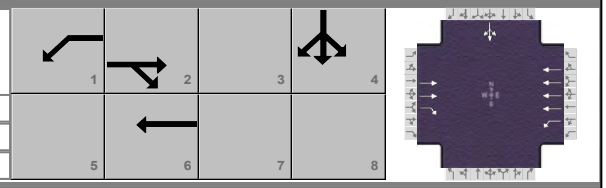
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1B_BENSON_PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		385	1450	135	625					5	0	40
Intersection Two Demand (*v*), veh/h	150	240			395	115		0	60			

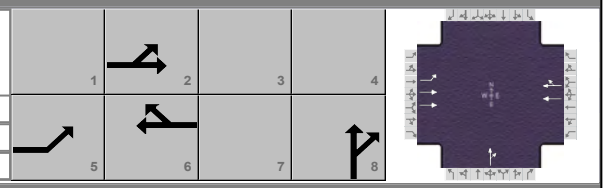
Signal One Information	
Cycle, s	95.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	5.5	70.1	4.4	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



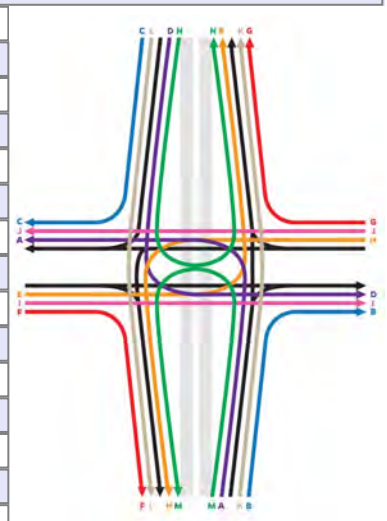
Signal Two Information	
Cycle, s	95.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	4.4	72.3	4.8	0.0	0.0	0.0
Yellow	4.0	3.5	4.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0



Interchange Results

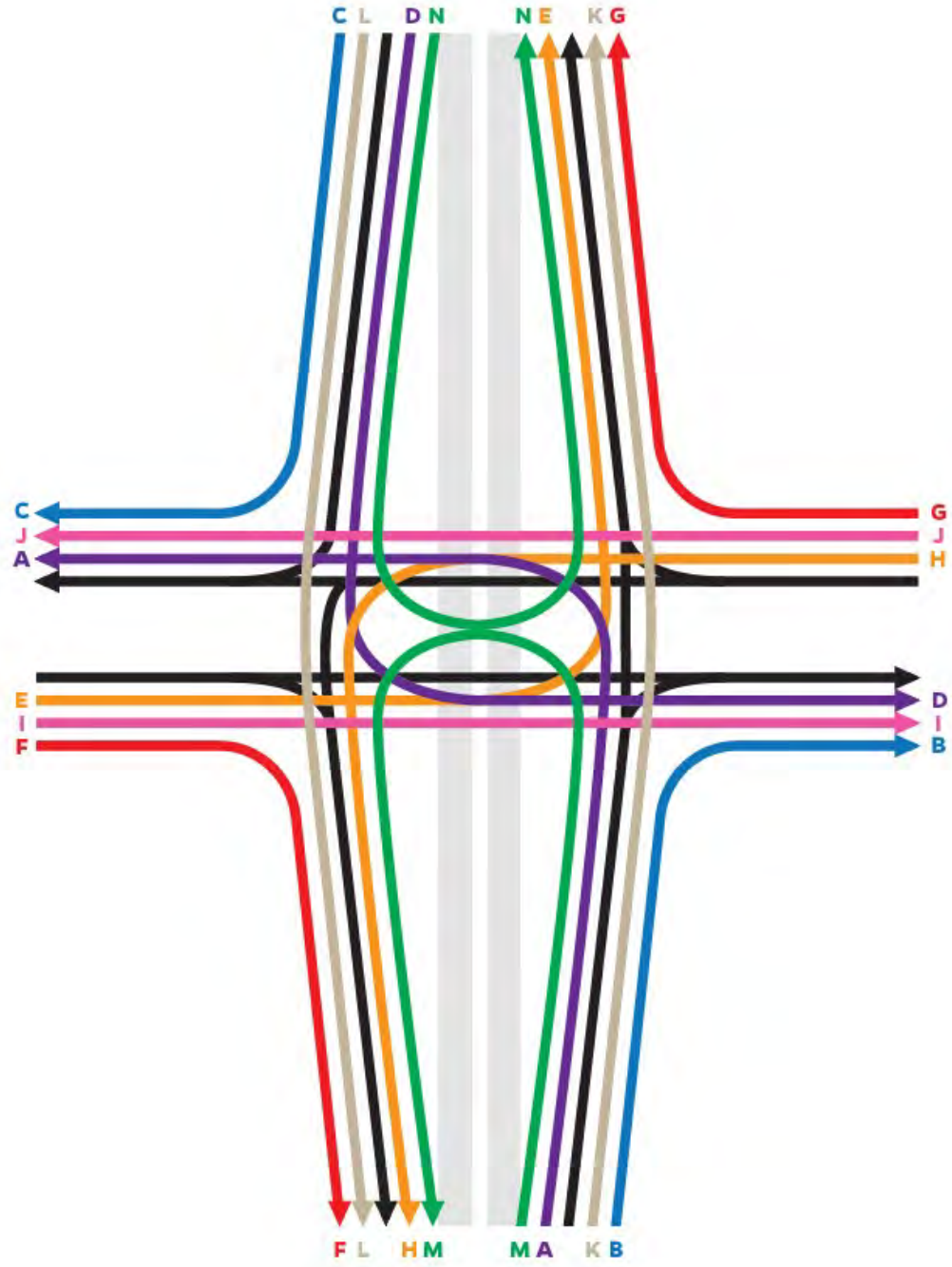
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	2.1	0.0	2.1	No	No	A
B	61	52.9	0.0	52.9	No	No	C
C	44	0.0	0.0	0.0	No	No	A
D	6	52.3	0.0	52.3	No	No	C
E	49	5.6	0.0	5.6	No	No	A
F	441	3.1	0.0	3.1	No	No	A
G	128	3.8	0.0	3.8	No	No	A
H	78	53.3	0.0	53.3	No	No	C
I	73	5.0	0.0	5.0	No	No	A
J	361	5.8	0.0	5.8	No	No	A
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		3.1	2.7	49.6	2.1						50.5	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	2.8	A		10.5	B		0.0			50.5	D	
Intersection Delay, s/veh / LOS	8.3						A					

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	2.5	1.8			3.7	3.8		52.9				
Level of Service (LOS)	A	A			A	A		D				
Approach Delay, s/veh / LOS	2.1	A		3.7	A		52.9	D		0.0		
Intersection Delay, s/veh / LOS	7.4						A					

Interchange Graphic



File Name: BUILD_1B_BENSON_PM.xus
Analyst: RL
Agency/Co.: HDR
Analysis Date: Mar 7, 2018
Time Period: PM PEAK
Jurisdiction: CITY OF SIOUX FALLS
Analysis Year: 2023
Project Description: I-229/BENSON IMJR
Urban Street: BENSON ROAD
Analysis Period: 1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	95
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	4	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											

1: Peak Hour Factor	1											

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.46			43.07	
1	Running Speed, mph		41.49			41.87	
1	Through Delay, s/veh		31.85			12.21	
1	Travel Speed, mph		23.94			32.62	
1	Stop Rate, stops/veh		0.81			0.39	
1	Spatial Stop Rate, stops/mi		1.63			0.77	
1	Through vol/cap ratio		0.6			0.13	
1	Percent of Base FFS		54.33			74.02	
1	Level of Service		C			B	
1	Automobile Perception Score		2.39			2.26	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		65.36			62.81	
2	Running Speed, mph		41.26			42.93	
2	Through Delay, s/veh		3.14			21.32	
2	Travel Speed, mph		39.37			32.05	
2	Stop Rate, stops/veh		0.13			0.57	
2	Spatial Stop Rate, stops/mi		0.18			0.77	
2	Through vol/cap ratio		0.05			0.25	
2	Percent of Base FFS		89.33			72.73	
2	Level of Service		A			B	
2	Automobile Perception Score		2.27			2.31	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.7			18.74	
3	Running Speed, mph		36.46			36.38	
3	Through Delay, s/veh		1.81			2.11	
3	Travel Speed, mph		33.24			32.7	
3	Stop Rate, stops/veh		0.11			0.1	
3	Spatial Stop Rate, stops/mi		0.6			0.52	
3	Through vol/cap ratio		0.03			0.08	
3	Percent of Base FFS		75.43			74.2	
3	Level of Service		B			B	
3	Automobile Perception Score		2.23			2.43	

Facility Travel Time, s	164.32	160.26
Facility Travel Speed, mph	31.53	32.33
Facility Spatial Stop Rate, stops/mi	0.74	0.74
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	71.55	73.37

Facility Level of Service	B	B
Facility Automobile Perception Score	2.3	2.3
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.24	4.24
Facility Pedestrian LOS Score	3.64	2.9
Facility Pedestrian LOS	D	C
Facility Bicycle Travel Speed	13.65	14.07
Facility Bicycle LOS Score	2.83	2.54
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	23.95	32.4
Facility Transit LOS Score	0.86	0.74
Facility Transit LOS	A	A
SPILLBACK TIME, h	999	

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.1	4.1
1	Ped LOS Score for Intersection	2.23	2.91
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.97	0.57
1	Speed Adjustment Factor	0.69	0.7
1	Ped LOS Score for Link	2.97	2.58
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.16	0.89
1	Ped LOS Score for Segment	3.4	2.64
1	Ped Segment LOS	C	B
1	Bicycle Travel Speed	13.64	12.96
1	Bicycle LOS Score for Intersection	3.14	2.76
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.37	2.1
1	Speed Adjustment Factor	0.84	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.27	3
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.84	2.65
1	Bicycle Segment LOS	C	B
1	Transit Running Speed, mi/h	41.49	41.87
1	g/C Ratio	0.37	0.48
1	Transit Running Time, s	43.46	43.07
1	Delay at Intersection, s/veh	31.83	12.59
1	Transit Travel Speed, mi/h	23.95	32.4
1	Transit Wait-Ride Score	3.36	3.76
1	Ped LOS Score for Link	2.97	2.58
1	Transit LOS Score for Segment	1.4	0.75
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.31	4.31
2	Ped LOS Score for Intersection	3.91	2.66
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	1.97	0.46
2	Speed Adjustment Factor	0.68	0.74
2	Ped LOS Score for Link	3.96	2.51
2	Ped Link LOS	D	C
2	Roadway Crossing Difficulty Factor	1.09	1.2
2	Ped LOS Score for Segment	4.09	3.12
2	Ped Segment LOS	D	C
2	Bicycle Travel Speed	13.57	14.9
2	Bicycle LOS Score for Intersection	4.16	2.77
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.73	1.99
2	Speed Adjustment Factor	0.84	0.86
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.62	2.91
2	Bicycle Link LOS	D	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	3.18	2.53

2	Bicycle Segment LOS	C	B
2	Transit Running Speed, mi/h	41.26	42.93
2	g/C Ratio	0.74	0.37
2	Transit Running Time, s	65.36	62.81
2	Delay at Intersection, s/veh	3.14	21.32
2	Transit Travel Speed, mi/h	39.37	32.05
2	Transit Wait-Ride Score	4.02	3.74
2	Ped LOS Score for Link	3.96	2.51
2	Transit LOS Score for Segment	0.57	0.76
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.34	4.38
3	Ped LOS Score for Intersection	1.39	1.3
3	Cross-section Adjustment Factor	-4.91	-4.74
3	Volume Adjustment Factor	0.14	0.25
3	Speed Adjustment Factor	0.53	0.53
3	Ped LOS Score for Link	1.82	2.09
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.2	1.2
3	Ped LOS Score for Segment	2.5	2.75
3	Ped Segment LOS	B	B
3	Bicycle Travel Speed	13.99	14.16
3	Bicycle LOS Score for Intersection	2.84	2.83
3	Cross-section Adjustment Factor	-2.63	-1.28
3	Volume Adjustment Factor	1.4	1.68
3	Speed Adjustment Factor	0.79	0.78
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	0.9	2.52
3	Bicycle Link LOS	A	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.44	2.3
3	Bicycle Segment LOS	A	B
3	Transit Running Speed, mi/h	36.46	36.38
3	g/C Ratio	0.85	0.84
3	Transit Running Time, s	18.7	18.74
3	Delay at Intersection, s/veh	1.81	2.11
3	Transit Travel Speed, mi/h	33.24	32.7
3	Transit Wait-Ride Score	3.79	3.77
3	Ped LOS Score for Link	1.82	2.09
3	Transit LOS Score for Segment	0.59	0.66
3	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	820	35.3	0	435	65.9	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.04	0	0	0.13	0	0	0.17	0.17	0.13	0.17	0.17	0.04
1: Thru veh delay		0.03			0.04							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

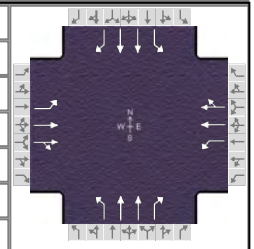
SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1729	0	0	404	15.3	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.43	0	0	0.43	0.43	0.43	0.43	0.43	0
1: Thru veh delay		0			0.01							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	58.3	1535	155	36.2	399	77.7	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0	0	0	0.42	0	0	0.42	0.42	0.42	0.42	0.42	0
2: Thru veh delay		0.15			0.04							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											

3: Volume, veh/h	0	553	1072	2.23	403	0	0	0	0	5	0	110	
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0	
3: Prop blocked	0	0	0	0.4	0	0	0.4	0.4	0.4	0.4	0.4	0	
3: Thru veh delay		0			0								
3: Prob inside blk		0			0								
3: Dist to upstream signal	1910												

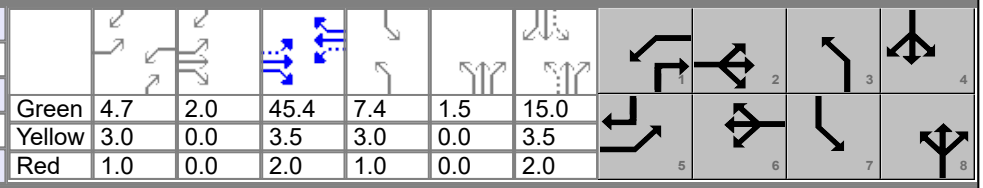
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1B_BENSON_PM.xus		
Project Description	I-229/BENSON 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	135	615	170	170	340	145	135	375	50	105	395	235

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



	EB		WB			NB			SB		
Green	4.7	2.0	45.4	7.4	1.5	15.0					
Yellow	3.0	0.0	3.5	3.0	0.0	3.5					
Red	1.0	0.0	2.0	1.0	0.0	2.0					

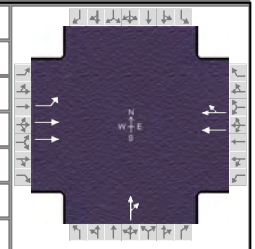
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	10.7	52.8	8.7	50.9	12.9	22.0	11.4	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	6.3		4.8		9.1	13.4	7.5	14.3
Green Extension Time (g_e), s	0.5	0.0	0.3	0.0	0.0	0.2	0.2	0.2
Phase Call Probability	0.98		0.92		0.98	1.00	0.95	1.00
Max Out Probability	0.01		0.00		1.00	0.00	0.38	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	150	433	406	97	106	105	150	417	28	117	439	189
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1618	1647	1730	1680	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	4.3	15.9	16.0	2.8	2.9	2.8	7.1	11.4	1.4	5.5	12.3	10.8
Cycle Queue Clearance Time (g_c), s	4.3	15.9	16.0	2.8	2.9	2.8	7.1	11.4	1.4	5.5	12.3	10.8
Green Ratio (*g/C*)	0.55	0.50	0.50	0.53	0.48	0.48	0.25	0.17	0.22	0.24	0.16	0.23
Capacity (*c*), veh/h	702	862	806	356	826	803	257	573	328	236	520	335
Volume-to-Capacity Ratio (*X*)	0.214	0.503	0.503	0.272	0.128	0.131	0.583	0.727	0.085	0.495	0.844	0.564
Back of Queue (*Q*), ft/ln (95 th percentile)	68.1	267.9	246	47.9	52.3	46.6	139.8	205.9	22.9	105.6	222.6	175.1
Back of Queue (*Q*), veh/ln (95 th percentile)	2.6	10.3	9.8	1.8	2.0	1.9	5.4	7.9	0.9	4.1	8.6	6.7
Queue Storage Ratio (*RQ*) (95 th percentile)	0.35	0.00	0.00	0.34	0.00	0.00	0.47	0.00	0.10	0.29	0.00	0.55
Uniform Delay (d_1), s/veh	10.7	16.0	16.0	13.3	12.3	11.4	30.2	37.1	29.2	30.7	38.9	32.5
Incremental Delay (d_2), s/veh	0.2	2.1	2.2	0.6	0.3	0.3	4.0	0.7	0.0	2.3	2.0	0.6
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	10.9	18.1	18.2	13.8	12.6	11.8	34.2	37.8	29.2	33.0	40.8	33.0
Level of Service (LOS)	B	B	B	B	B	B	C	D	C	C	D	C
Approach Delay, s/veh / LOS	17.0	B		12.7	B		36.5	D		37.6	D	
Intersection Delay, s/veh / LOS	26.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.82	C	2.91	C	2.90	C	2.85	C
Bicycle LOS Score / LOS	3.08	C	2.76	C	2.88	C	3.00	C

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1B_BENSON_PM.xus		
Project Description	I-229/BENSON 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	150	240			395	115		0	60			

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4
Green	4.4	72.3	4.8	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	3.5	4.0	0.0	0.0	0.0				
Red	0.0	2.0	0.0	0.0	0.0	0.0				

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		8.3		12.0		
Phase Duration, s	8.4	86.2		77.8		8.8		
Change Period, ($Y+R_c$), s	4.0	5.5		5.5		4.0		
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		3.3		
Queue Clearance Time (g_s), s	2.5					5.9		
Green Extension Time (g_e), s	0.1	0.0		0.0		0.1		
Phase Call Probability	0.73					0.80		
Max Out Probability	0.00					0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16		8	18			
Adjusted Flow Rate (*v*), veh/h	49	79			293	274		61				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1546			1675	1542		1466				
Queue Service Time (g_s), s	0.5	0.6			11.4	4.9		3.9				
Cycle Queue Clearance Time (g_c), s	0.5	0.6			11.4	4.9		3.9				
Green Ratio (*g/C*)	0.83	0.78			0.76	0.76		0.05				
Capacity (*c*), veh/h	680	2411			1276	1174		74				
Volume-to-Capacity Ratio (*X*)	0.073	0.033			0.230	0.233		0.824				
Back of Queue (*Q*), ft/ln (95 th percentile)	2.9	5.5			55.7	51.3		72.1				
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	0.2			2.1	2.1		2.8				
Queue Storage Ratio (*RQ*) (95 th percentile)	0.03	0.00			0.00	0.00		0.00				
Uniform Delay (d_1), s/veh	2.4	1.8			3.3	3.3		44.7				
Incremental Delay (d_2), s/veh	0.0	0.0			0.4	0.5		8.3				
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0		0.0				
Control Delay (*d*), s/veh	2.5	1.8			3.7	3.8		52.9				
Level of Service (LOS)	A	A			A	A		D				
Approach Delay, s/veh / LOS	2.1	A		3.7	A		52.9	D		0.0		
Intersection Delay, s/veh / LOS	7.4						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.39	A	1.33	A	2.44	B	2.57	C
Bicycle LOS Score / LOS	2.84	C	2.95	C	2.27	B		

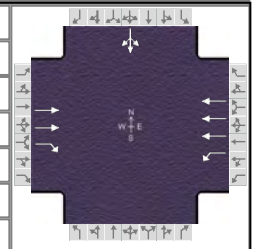
Option 1C

Scenario is Same as Option 1A - See Option 1A

Option 1D

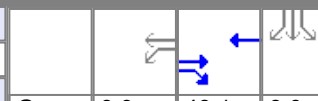
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1D_BENSON _AM.xus		
Project Description	I-229/BENSON IMJR				

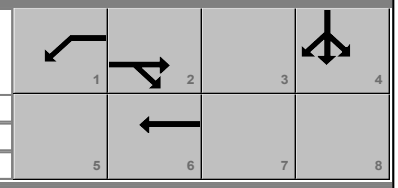


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		165	320	45	1805					5	0	110

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.9	48.1	8.0	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	0.5	2.0	2.0	0.0	0.0	0.0



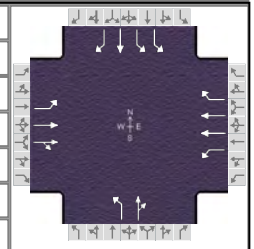
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		53.6	7.9	61.5				13.5
Change Period, (*Y+R c*), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (*g s*), s			4.2					8.4
Green Extension Time (*g e*), s		0.0	0.0	0.0				0.2
Phase Call Probability			0.65					0.93
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		66	128	50	2006						128	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1544	1443	1714	1567						1460	
Queue Service Time (*g s*), s		0.6	2.7	2.2	14.5						6.4	
Cycle Queue Clearance Time (*g c*), s		0.6	2.7	2.2	14.5						6.4	
Green Ratio (*g/C*)		0.64	0.64	0.05	0.19						0.11	
Capacity (*c*), veh/h		1982	926	89	908						155	
Volume-to-Capacity Ratio (*X*)		0.033	0.138	0.563	2.209						0.822	
Back of Queue (*Q*), ft/ln (95 th percentile)		6.9	30.5	40.3	2188.4						104.3	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.3	1.2	1.6	84.2						4.2	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.40	0.00						0.00	
Uniform Delay (*d 1*), s/veh		4.9	5.5	36.5	18.2						32.8	
Incremental Delay (*d 2*), s/veh		0.0	0.3	0.4	545.0						4.1	
Initial Queue Delay (*d 3*), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		5.0	5.8	36.9	563.2						36.9	
Level of Service (LOS)		A	A	D	F						D	
Approach Delay, s/veh / LOS	5.5	A		550.4	F		0.0			36.9	D	
Intersection Delay, s/veh / LOS	478.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.94	B	1.33	A	2.95	C	3.07	C
Bicycle LOS Score / LOS	2.92	C	3.61	D		A	0.70	A

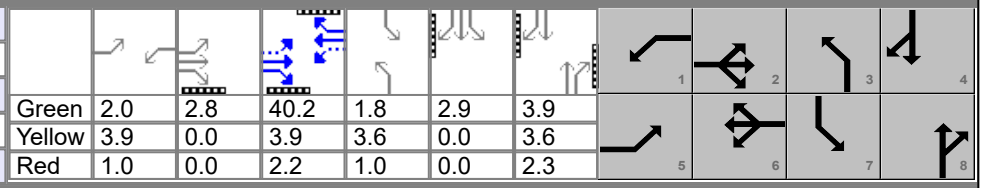
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1D_BENSON _AM.xus		
Project Description	I-229/BENSON 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	315	30	60	955	430	25	20	30	115	25	85

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.0	2.8	40.2	1.8	2.9	3.9	
Yellow	3.9	0.0	3.9	3.6	0.0	3.6	
Red	1.0	0.0	2.2	1.0	0.0	2.3	

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	9.6	49.0	6.9	46.3	6.4	9.8	9.3	12.7
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.2	5.1	1.2
Queue Clearance Time (g_s), s	4.6		2.7		3.3	4.0	4.9	4.7
Green Extension Time (g_e), s	0.4	0.0	0.1	0.0	0.0	0.0	0.1	0.0
Phase Call Probability	0.94		0.49		0.44	0.96	0.93	1.00
Max Out Probability	0.01		0.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	133	187	185	32	516	149	28	44		128	28	56
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1693	1647	1647		1647	1587		1600	1730	1466
Queue Service Time (g_s), s	2.6	3.1	3.0	0.7	2.5		1.3	2.0		2.9	1.1	2.7
Cycle Queue Clearance Time (g_c), s	2.6	3.1	3.0	0.7	2.5		1.3	2.0		2.9	1.1	2.7
Green Ratio (*g/C*)	0.60	0.57	0.57	0.56	0.54		0.02	0.05		0.06	0.09	0.09
Capacity (*c*), veh/h	634	991	970	636	1765		39	83		200	157	133
Volume-to-Capacity Ratio (*X*)	0.210	0.189	0.191	0.051	0.293		0.719	0.538		0.640	0.176	0.416
Back of Queue (*Q*), ft/ln (95 th percentile)	37.5	46.9	42.6	9.2	25.7		37.7	37.8		57.4	21.3	44
Back of Queue (*Q*), veh/ln (95 th percentile)	1.4	1.8	1.7	0.4	1.0		1.5	1.5		2.2	0.8	1.7
Queue Storage Ratio (*RQ*) (95 th percentile)	0.19	0.00	0.00	0.13	0.00		0.94	0.00		0.21	0.00	0.00
Uniform Delay (d_1), s/veh	6.9	5.9	5.6	7.6	3.0		36.4	34.7		34.3	31.5	32.2
Incremental Delay (d_2), s/veh	0.2	0.4	0.4	0.0	0.0		29.8	2.0		4.8	0.2	0.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	7.2	6.3	6.0	7.6	3.0	0.0	66.2	36.7		39.1	31.7	33.0
Level of Service (LOS)	A	A	A	A	A	A	E	D		D	C	C
Approach Delay, s/veh / LOS	6.4	A		2.6	A		48.0	D		36.5	D	
Intersection Delay, s/veh / LOS	10.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.98	B	2.59	C	3.14	C	2.76	C
Bicycle LOS Score / LOS	2.68	C	3.45	C	2.05	B	2.43	B

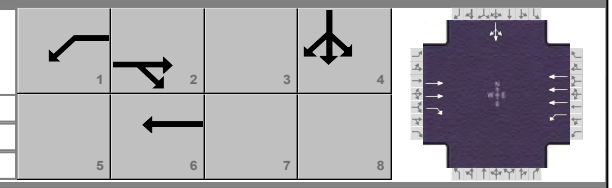
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 SB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1D_BENSON _AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		165	320	45	1805					5	0	110
Intersection Two Demand (*v*), veh/h	60	110			210	0		0	110		0	1640

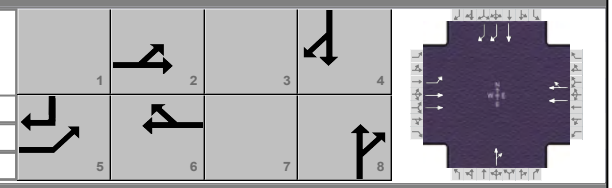
Signal One Information	
Cycle, s	75.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	3.9	48.1	8.0	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	0.5	2.0	2.0	0.0	0.0	0.0



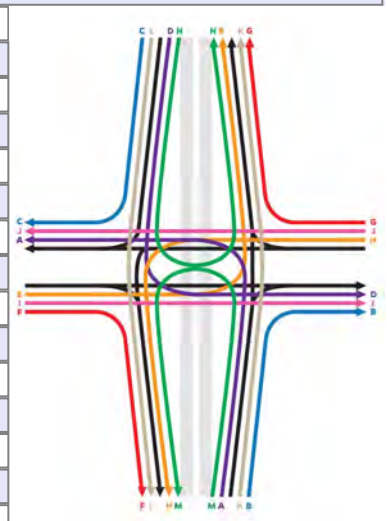
Signal Two Information	
Cycle, s	75.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	2.5	8.5	47.5	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Interchange Results

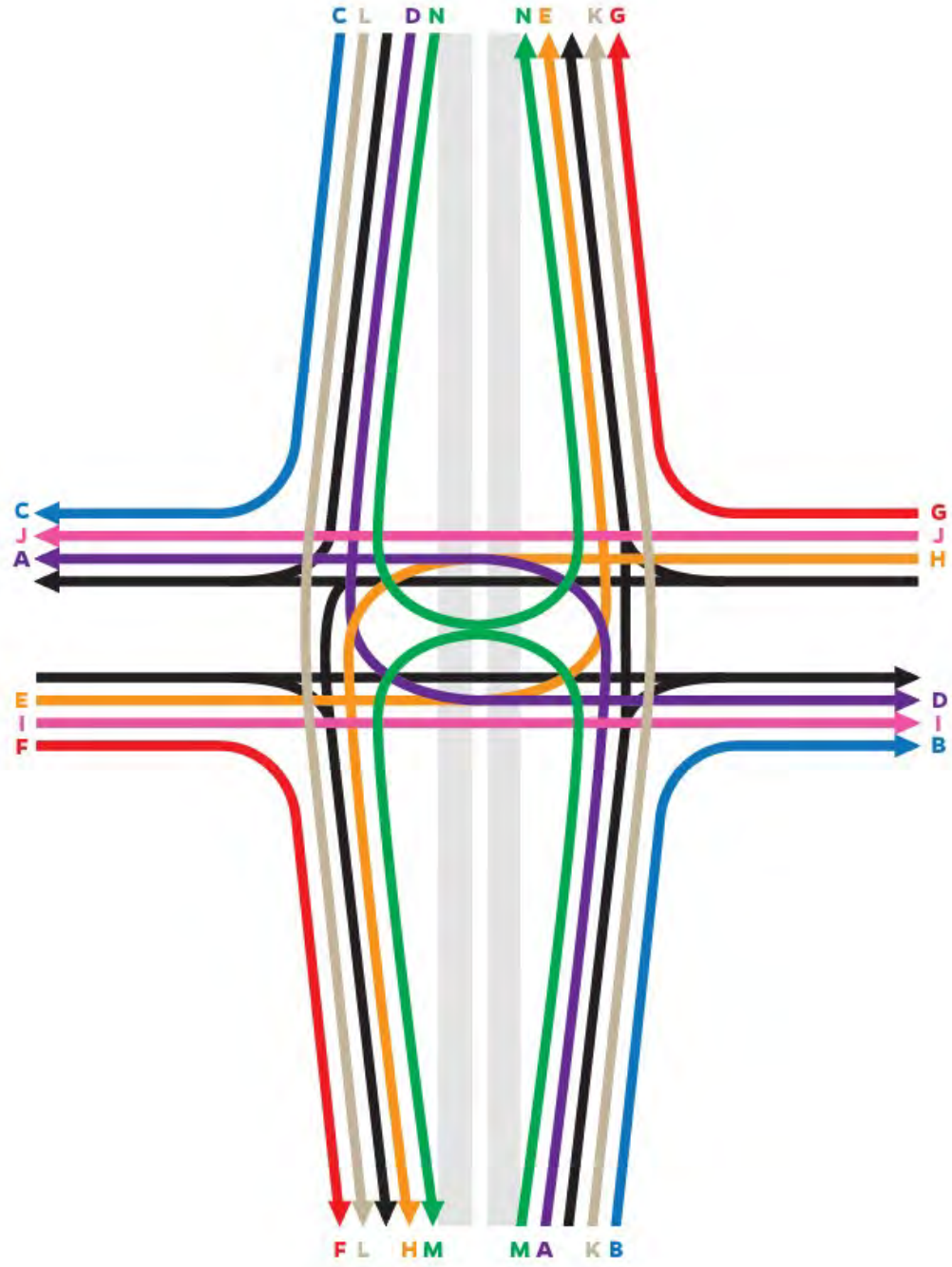
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	563.2	0.0	563.2	Yes	No	F
B	117	5.5	0.0	5.5	No	No	A
C	122	0.0	0.0	0.0	No	No	A
D	6	58.4	0.0	58.4	No	No	D
E	27	31.3	0.0	31.3	No	No	C
F	128	5.0	0.0	5.0	No	No	A
G	0	0.0	0.0	0.0	No	No	A
H	50	76.6	0.0	76.6	Yes	No	F
I	44	26.5	0.0	26.5	No	No	B
J	2006	602.8	0.0	602.8	Yes	No	F
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		5.0	5.8	36.9	563.2						36.9	
Level of Service (LOS)		A	A	D	F						D	
Approach Delay, s/veh / LOS	5.5	A		550.4	F		0.0			36.9	D	
Intersection Delay, s/veh / LOS	478.3						F					

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	26.3	21.5			39.6			5.5			0.0	30.8
Level of Service (LOS)	C	C			D			A				C
Approach Delay, s/veh / LOS	23.2	C		39.6	D		5.5	A		30.8	C	
Intersection Delay, s/veh / LOS	30.1						C					

Interchange Graphic



File Name: BUILD_1D_BENSON _AM.xus
Analyst: RL
Agency/Co.: HDR
Analysis Date: Mar 7, 2018
Time Period: AM PEAK
Jurisdiction: CITY OF SIOUX FALLS
Analysis Year: 2023
Project Description: I-229/BENSON IMJR
Urban Street: BENSON ROAD
Analysis Period: 1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	75
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	3	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											

1: Peak Hour Factor 1

Number of access points: 1

SEGMENT 2

Movement	EB LT 1	EB TH 2	EB RT 3	WB LT 4	WB TH 5	WB RT 6	NB LT 7	NB TH 8	NB RT 9	SB LT 10	SB TH 11	SB RT 12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.09			43.23	
1	Running Speed, mph		41.85			41.72	
1	Through Delay, s/veh		6.18			10.96	
1	Travel Speed, mph		36.61			33.28	
1	Stop Rate, stops/veh		0.25			0.38	
1	Spatial Stop Rate, stops/mi		0.5			0.76	
1	Through vol/cap ratio		0.19			0.27	
1	Percent of Base FFS		83.06			75.52	
1	Level of Service		A			B	
1	Automobile Perception Score		2.21			2.25	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		62.95			63.92	
2	Running Speed, mph		42.83			42.19	
2	Through Delay, s/veh		4.96			3.02	
2	Travel Speed, mph		39.71			40.28	
2	Stop Rate, stops/veh		0.22			0.11	
2	Spatial Stop Rate, stops/mi		0.29			0.15	
2	Through vol/cap ratio		0.03			0.29	
2	Percent of Base FFS		90.1			91.41	
2	Level of Service		A			A	
2	Automobile Perception Score		2.28			2.21	
3	Bay/Lane Spillback Time, h	999	999	999	999	0.1	999
3	ShrdLane Spillback Time, h	999			999.09		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.68			19.35	
3	Running Speed, mph		36.5			35.24	
3	Through Delay, s/veh		21.52			563.21	
3	Travel Speed, mph		16.96			1.17	
3	Stop Rate, stops/veh		0.62			4.04	
3	Spatial Stop Rate, stops/mi		3.26			21.35	
3	Through vol/cap ratio		0.07			2.21	
3	Percent of Base FFS		38.48			2.66	
3	Level of Service		E			F	
3	Automobile Perception Score		2.66			5.73	

Facility Travel Time, s	157.38	703.69
Facility Travel Speed, mph	32.93	7.36
Facility Spatial Stop Rate, stops/mi	0.75	3.15
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	74.71	16.71

Facility Level of Service	B	F
Facility Automobile Perception Score	2.3	2.42
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.29	4.29
Facility Pedestrian LOS Score	2.86	3.35
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	14.09	13.44
Facility Bicycle LOS Score	2.47	2.87
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	16.96	1.17
Facility Transit LOS Score	0.61	1.05
Facility Transit LOS	A	A
SPILLBACK TIME, h	0.1	

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.17	4.17
1	Ped LOS Score for Intersection	1.98	2.85
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.61	0.73
1	Speed Adjustment Factor	0.7	0.7
1	Ped LOS Score for Link	2.62	2.73
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.04	1.01
1	Ped LOS Score for Segment	2.9	2.94
1	Ped Segment LOS	C	C
1	Bicycle Travel Speed	13.78	14.06
1	Bicycle LOS Score for Intersection	2.68	3.01
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.13	2.22
1	Speed Adjustment Factor	0.85	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.04	3.12
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.65	2.72
1	Bicycle Segment LOS	B	B
1	Transit Running Speed, mi/h	41.85	41.72
1	g/C Ratio	0.57	0.44
1	Transit Running Time, s	43.09	43.23
1	Delay at Intersection, s/veh	6.3	11.23
1	Transit Travel Speed, mi/h	36.51	33.11
1	Transit Wait-Ride Score	3.92	3.79
1	Ped LOS Score for Link	2.62	2.73
1	Transit LOS Score for Segment	0.52	0.73
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.37	4.36
2	Ped LOS Score for Intersection	1.94	2.59
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.58	1.17
2	Speed Adjustment Factor	0.73	0.71
2	Ped LOS Score for Link	2.62	3.19
2	Ped Link LOS	C	C
2	Roadway Crossing Difficulty Factor	1.07	1.2
2	Ped LOS Score for Segment	2.96	3.73
2	Ped Segment LOS	C	D
2	Bicycle Travel Speed	14.45	14.8
2	Bicycle LOS Score for Intersection	2.92	3.45
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.11	2.46
2	Speed Adjustment Factor	0.86	0.85
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.02	3.37
2	Bicycle Link LOS	C	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.63	2.88

2	Bicycle Segment LOS	B	C
2	Transit Running Speed, mi/h	42.83	42.19
2	g/C Ratio	0.64	0.54
2	Transit Running Time, s	62.95	63.92
2	Delay at Intersection, s/veh	4.96	3.02
2	Transit Travel Speed, mi/h	39.71	40.28
2	Transit Wait-Ride Score	4.03	4.05
2	Ped LOS Score for Link	2.62	3.19
2	Transit LOS Score for Segment	0.35	0.41
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.31	4.35
3	Ped LOS Score for Intersection	1.79	1.33
3	Cross-section Adjustment Factor	-5.01	-4.74
3	Volume Adjustment Factor	0.09	1.56
3	Speed Adjustment Factor	0.53	0.5
3	Ped LOS Score for Link	1.66	3.36
3	Ped Link LOS	B	C
3	Roadway Crossing Difficulty Factor	1.2	0.8
3	Ped LOS Score for Segment	2.36	2.88
3	Ped Segment LOS	B	C
3	Bicycle Travel Speed	13.56	9.1
3	Bicycle LOS Score for Intersection	2.63	3.61
3	Cross-section Adjustment Factor	-3.85	-1.28
3	Volume Adjustment Factor	1.14	2.61
3	Speed Adjustment Factor	0.79	0.77
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	-0.59	3.43
3	Bicycle Link LOS	A	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.37	3.21
3	Bicycle Segment LOS	A	C
3	Transit Running Speed, mi/h	36.5	35.24
3	g/C Ratio	0.22	0.75
3	Transit Running Time, s	18.68	19.35
3	Delay at Intersection, s/veh	21.52	563.21
3	Transit Travel Speed, mi/h	16.96	1.17
3	Transit Wait-Ride Score	2.94	1.37
3	Ped LOS Score for Link	1.66	3.36
3	Transit LOS Score for Segment	1.84	4.45
3	Transit Segment LOS	A	E

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	517	22.2	0	555	84	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0	0	0	0.03	0	0	0.03	0.03	0.03	0.03	0.03	0
1: Thru veh delay		0.02			0.05							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

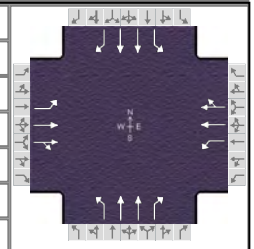
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	511	0	0	870	32.9	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0.16	0	0	0.03	0	0	0.17	0.17	0.03	0.17	0.17	0.16
1: Thru veh delay		0			0.03							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	17.7	466	47.2	80	883	172	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0.2	0	0	0	0	0	0.2	0.2	0	0.2	0.2	0.2
2: Thru veh delay		0.03			0.09							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											

3: Volume, veh/h	0	189	367	5.67	1024	0	0	0	0	5	0	110	
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0	
3: Prop blocked	0.21	0	0	0	0	0	0.21	0.21	0	0.21	0.21	0.21	
3: Thru veh delay		0			0								
3: Prob inside blk		0			0								
3: Dist to upstream signal	1910												

This Urban Streets text report was created in HCS™ Streets Version 7.5 on June 4, 2018 at 06:13:04

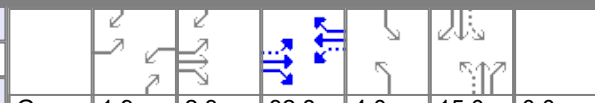
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1D_BENSON _AM.xus		
Project Description	I-229/BENSON IMJR				

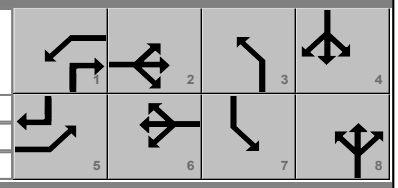


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	95	320	80	60	575	290	100	255	65	100	290	160

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	1.9	2.3		32.8	4.0	15.0	0.0					
Yellow	3.0	0.0		3.5	3.0	3.5	0.0					
Red	1.0	0.0		2.0	1.0	2.0	0.0					



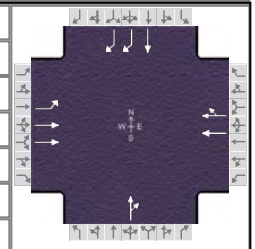
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	8.2	40.6	5.9	38.3	8.0	20.5	8.0	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	4.6		2.8		6.0	7.6	6.0	8.5
Green Extension Time (g_e), s	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.89		0.48		0.90	1.00	0.90	1.00
Max Out Probability	0.54		0.16		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	106	209	202	32	203	192	111	283	44	111	322	106
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1648	1647	1730	1592	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	2.6	5.5	5.6	0.8	4.6	4.4	4.0	5.6	1.8	4.0	6.5	4.3
Cycle Queue Clearance Time (g_c), s	2.6	5.5	5.6	0.8	4.6	4.4	4.0	5.6	1.8	4.0	6.5	4.3
Green Ratio (*g/C*)	0.50	0.47	0.47	0.46	0.44	0.44	0.25	0.20	0.23	0.25	0.20	0.26
Capacity (*c*), veh/h	551	809	771	487	756	696	273	659	331	289	659	376
Volume-to-Capacity Ratio (*X*)	0.191	0.258	0.262	0.065	0.269	0.276	0.407	0.430	0.134	0.385	0.489	0.281
Back of Queue (*Q*), ft/ln (95 th percentile)	39.2	94.2	88.6	12.6	77.3	65.3	72.7	97.4	27.7	72.2	112.3	65.2
Back of Queue (*Q*), veh/ln (95 th percentile)	1.5	3.6	3.5	0.5	3.0	2.6	2.8	3.7	1.1	2.8	4.3	2.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.20	0.00	0.00	0.09	0.00	0.00	0.24	0.00	0.12	0.20	0.00	0.20
Uniform Delay (d_1), s/veh	10.3	12.1	12.1	11.5	10.4	9.5	23.0	26.3	23.2	22.9	26.6	22.3
Incremental Delay (d_2), s/veh	0.2	0.8	0.8	0.1	0.8	0.9	1.4	0.2	0.1	1.2	0.2	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	0.0	0.0
Control Delay (*d*), s/veh	10.5	12.9	12.9	11.6	11.2	10.4	24.4	26.4	23.2	24.1	26.8	22.5
Level of Service (LOS)	B	B	B	B	B	B	C	C	C	C	C	C
Approach Delay, s/veh / LOS	12.4	B		10.9	B		25.6	C		25.4	C	
Intersection Delay, s/veh / LOS	18.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.70	C	2.85	C	2.89	C	2.75	C
Bicycle LOS Score / LOS	2.69	C	3.01	C	2.75	C	2.83	C

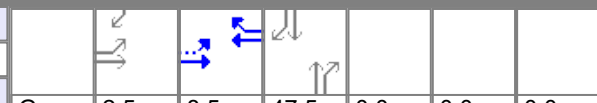
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1D_BENSON _AM.xus		
Project Description	I-229/BENSON IMJR				

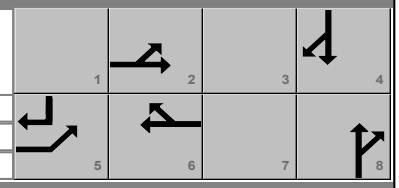


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	110			210	0		0	110		0	1640

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.5	8.5	47.5	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



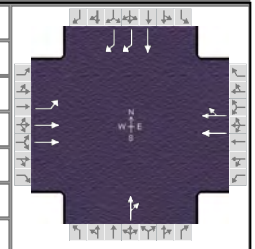
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		8.3		8.0		7.0
Phase Duration, s	8.0	22.0		14.0		53.0		53.0
Change Period, ($Y+R_c$), s	5.5	5.5		5.5		5.5		5.5
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		3.3		3.3
Queue Clearance Time (g_s), s	3.0					4.4		49.5
Green Extension Time (g_e), s	0.0	0.0		0.0		8.8		0.0
Phase Call Probability	1.00					1.00		1.00
Max Out Probability	1.00					0.01		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16		8	18		4	14
Adjusted Flow Rate (*v*), veh/h	27	50			233	0		117			0	1822
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1543			1635	0		1466			1682	1381
Queue Service Time (g_s), s	1.0	0.9			5.1	0.0		2.4			0.0	47.5
Cycle Queue Clearance Time (g_c), s	1.0	0.9			5.1	0.0		2.4			0.0	47.5
Green Ratio (*g/C*)	0.17	0.22			0.11			0.63			0.63	0.67
Capacity (*c*), veh/h	202	679			371			928			1065	1841
Volume-to-Capacity Ratio (*X*)	0.135	0.074			0.630	0.000		0.126			0.000	0.990
Back of Queue (*Q*), ft/ln (95 th percentile)	18.1	15			107.7	0		24.4			0	515.6
Back of Queue (*Q*), veh/ln (95 th percentile)	0.7	0.6			4.1	0.0		0.9			0.0	20.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.18	0.00			0.00	0.00		0.00			0.00	0.00
Uniform Delay (d_1), s/veh	26.2	21.3			31.7			5.5			0.0	12.3
Incremental Delay (d_2), s/veh	0.1	0.2			7.9	0.0		0.0			0.0	18.5
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0		0.0			0.0	0.0
Control Delay (*d*), s/veh	26.3	21.5			39.6			5.5			0.0	30.8
Level of Service (LOS)	C	C			D			A				C
Approach Delay, s/veh / LOS	23.2	C		39.6	D		5.5	A		30.8	C	
Intersection Delay, s/veh / LOS	30.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.79	B	2.14	B	2.21	B	2.83	C
Bicycle LOS Score / LOS	2.63	C	2.67	C	2.36	B	3.49	C

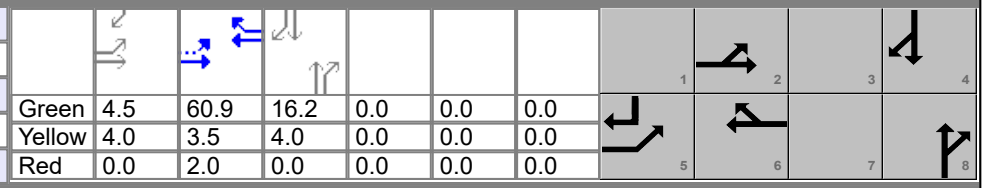
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1D_BENSON_PM.xus		
Project Description	I-229/BENSON 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	150	240			395	115		0	60		0	365

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.5	60.9	16.2	0.0	0.0	0.0
Yellow	4.0	3.5	4.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0

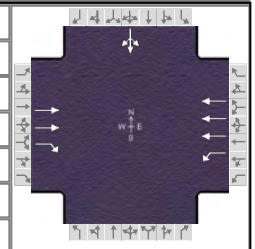
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		8.3		8.0		7.0
Phase Duration, s	8.5	74.8		66.4		20.2		20.2
Change Period, ($Y+R_c$), s	4.0	5.5		5.5		4.0		4.0
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		3.3		3.3
Queue Clearance Time (g_s), s	2.9					5.4		15.8
Green Extension Time (g_e), s	0.1	0.0		0.0		1.1		0.3
Phase Call Probability	0.74					1.00		1.00
Max Out Probability	0.00					0.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16		8	18		4	14
Adjusted Flow Rate (*v*), veh/h	52	83			293	274		61			0	406
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1547			1675	1542		1466			1682	1293
Queue Service Time (g_s), s	0.9	0.8			11.4	7.4		3.4			0.0	13.8
Cycle Queue Clearance Time (g_c), s	0.9	0.8			11.4	7.4		3.4			0.0	13.8
Green Ratio (*g/C*)	0.71	0.73			0.64	0.64		0.17			0.17	0.22
Capacity (*c*), veh/h	582	2258			1073	988		249			286	562
Volume-to-Capacity Ratio (*X*)	0.089	0.037			0.273	0.277		0.245			0.000	0.722
Back of Queue (*Q*), ft/ln (95 th percentile)	11.5	9.2			110.8	100.7		55.3			0	196
Back of Queue (*Q*), veh/ln (95 th percentile)	0.4	0.4			4.3	4.0		2.1			0.0	7.8
Queue Storage Ratio (*RQ*) (95 th percentile)	0.11	0.00			0.00	0.00		0.00			0.00	0.00
Uniform Delay (d_1), s/veh	5.4	4.1			7.4	7.5		34.1			0.0	34.5
Incremental Delay (d_2), s/veh	0.0	0.0			0.6	0.7		0.2			0.0	3.1
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	5.4	4.2			8.1	8.2		34.3			0.0	37.6
Level of Service (LOS)	A	A			A	A		C				D
Approach Delay, s/veh / LOS	4.6	A		8.1	A		34.3	C		37.6	D	
Intersection Delay, s/veh / LOS	19.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.68	B	2.08	B	2.42	B	2.66	C
Bicycle LOS Score / LOS	2.84	C	2.95	C	2.27	B	1.16	A

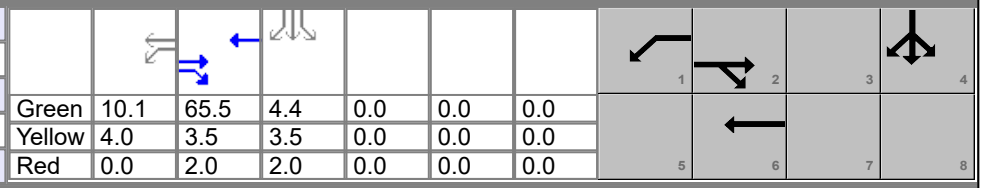
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1D_BENSON_PM.xus		
Project Description	I-229/BENSON 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		385	1450	135	625					5	0	40

Signal Information			
Cycle, s	95.0	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	10.1	65.5	4.4	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

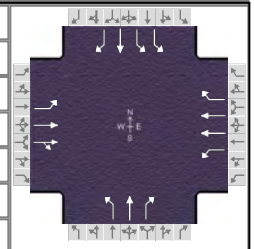
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		71.0	14.1	85.1				9.9
Change Period, ($Y+R_c$), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (g_s), s			10.2					5.2
Green Extension Time (g_e), s		0.0	0.2	0.0				0.0
Phase Call Probability			0.98					0.73
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		125	472	150	694						50	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1551	1511	1714	1510						1464	
Queue Service Time (g_s), s		1.1	8.5	8.2	6.0						3.2	
Cycle Queue Clearance Time (g_c), s		1.1	8.5	8.2	6.0						3.2	
Green Ratio (*g/C*)		0.69	0.69	0.11	0.68						0.05	
Capacity (*c*), veh/h		2138	1042	183	3091						68	
Volume-to-Capacity Ratio (*X*)		0.059	0.453	0.822	0.225						0.738	
Back of Queue (*Q*), ft/ln (95 th percentile)		13.8	82.2	159.2	75.1						55.7	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.5	3.3	6.4	2.9						2.2	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.91	0.00						0.00	
Uniform Delay (d_1), s/veh		4.3	3.4	42.2	3.7						44.7	
Incremental Delay (d_2), s/veh		0.0	0.7	3.0	0.1						5.7	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		4.4	4.1	45.2	3.9						50.5	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	4.2	A		11.2	B		0.0			50.5	D	
Intersection Delay, s/veh / LOS	9.7						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.92	D	1.30	A	2.75	C	3.10	C
Bicycle LOS Score / LOS	4.16	D	2.94	C		A	0.57	A

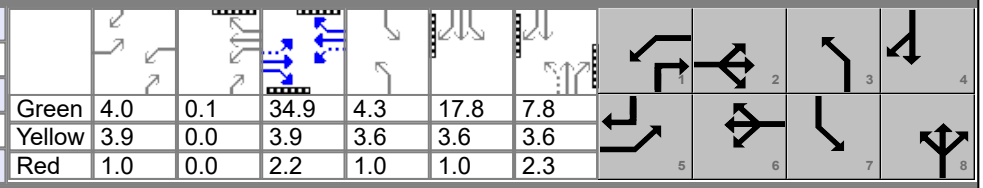
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1D_BENSON_PM.xus		
Project Description	I-229/BENSON 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	50	900	15	60	410	80	40	30	125	745	25	140

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.0	0.1	34.9	4.3	17.8	7.8
Yellow	3.9	0.0	3.9	3.6	3.6	3.6
Red	1.0	0.0	2.2	1.0	1.0	2.3

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	8.9	41.0	9.0	41.1	8.9	13.7	31.3	36.1
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	3.7		4.5		4.3	9.6	25.8	7.3
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	50	449	449	71	487	95	44	33	128	828	28	117
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1726	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	1.7	21.4	21.4	2.5	11.1		2.3	1.7	7.6	23.8	1.1	5.3
Cycle Queue Clearance Time (g_c), s	1.7	21.4	21.4	2.5	11.1		2.3	1.7	7.6	23.8	1.1	5.3
Green Ratio (*g/C*)	0.41	0.37	0.37	0.41	0.37		0.13	0.08	0.13	0.28	0.32	0.36
Capacity (*c*), veh/h	350	635	634	233	1213		262	142	191	899	549	527
Volume-to-Capacity Ratio (*X*)	0.142	0.707	0.707	0.306	0.401		0.170	0.234	0.668	0.921	0.051	0.221
Back of Queue (*Q*), ft/ln (95 th percentile)	29	355.8	341.8	52.6	202.7		43.9	34.1	142	416	19.8	82.1
Back of Queue (*Q*), veh/ln (95 th percentile)	1.1	13.7	13.7	2.0	7.8		1.7	1.3	5.7	16.0	0.8	3.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.14	0.00	0.00	0.75	0.00		0.59	0.00	0.00	0.98	0.00	0.00
Uniform Delay (d_1), s/veh	17.3	26.9	26.9	20.1	24.5		37.1	40.8	39.7	33.1	22.5	21.2
Incremental Delay (d_2), s/veh	0.2	4.9	4.9	3.3	1.0		0.4	0.3	7.0	14.3	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	0.0
Control Delay (*d*), s/veh	17.5	31.8	31.8	23.4	25.5	0.0	37.6	41.1	46.7	47.4	22.5	21.2
Level of Service (LOS)	B	C	C	C	C	A	D	D	D	D	C	C
Approach Delay, s/veh / LOS	31.1	C		21.6	C		43.8	D		43.6	D	
Intersection Delay, s/veh / LOS	34.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.23	B	2.66	C	3.03	C	2.75	C
Bicycle LOS Score / LOS	3.14	C	2.77	C	2.27	B	3.68	D

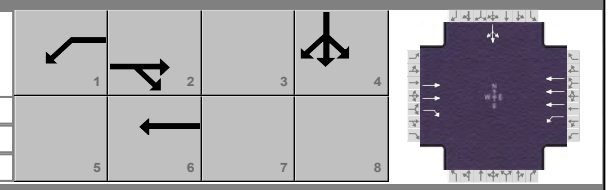
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1D_BENSON_PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		385	1450	135	625					5	0	40
Intersection Two Demand (*v*), veh/h	150	240			395	115		0	60		0	365

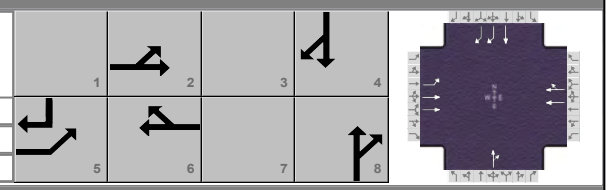
Signal One Information	
Cycle, s	95.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	10.1	65.5	4.4	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



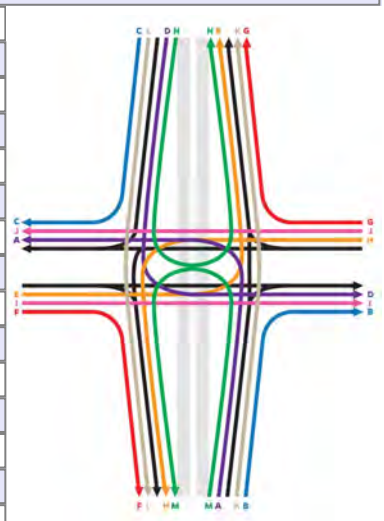
Signal Two Information	
Cycle, s	95.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	4.5	60.9	16.2	0.0	0.0	0.0
Yellow	4.0	3.5	4.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0



Interchange Results

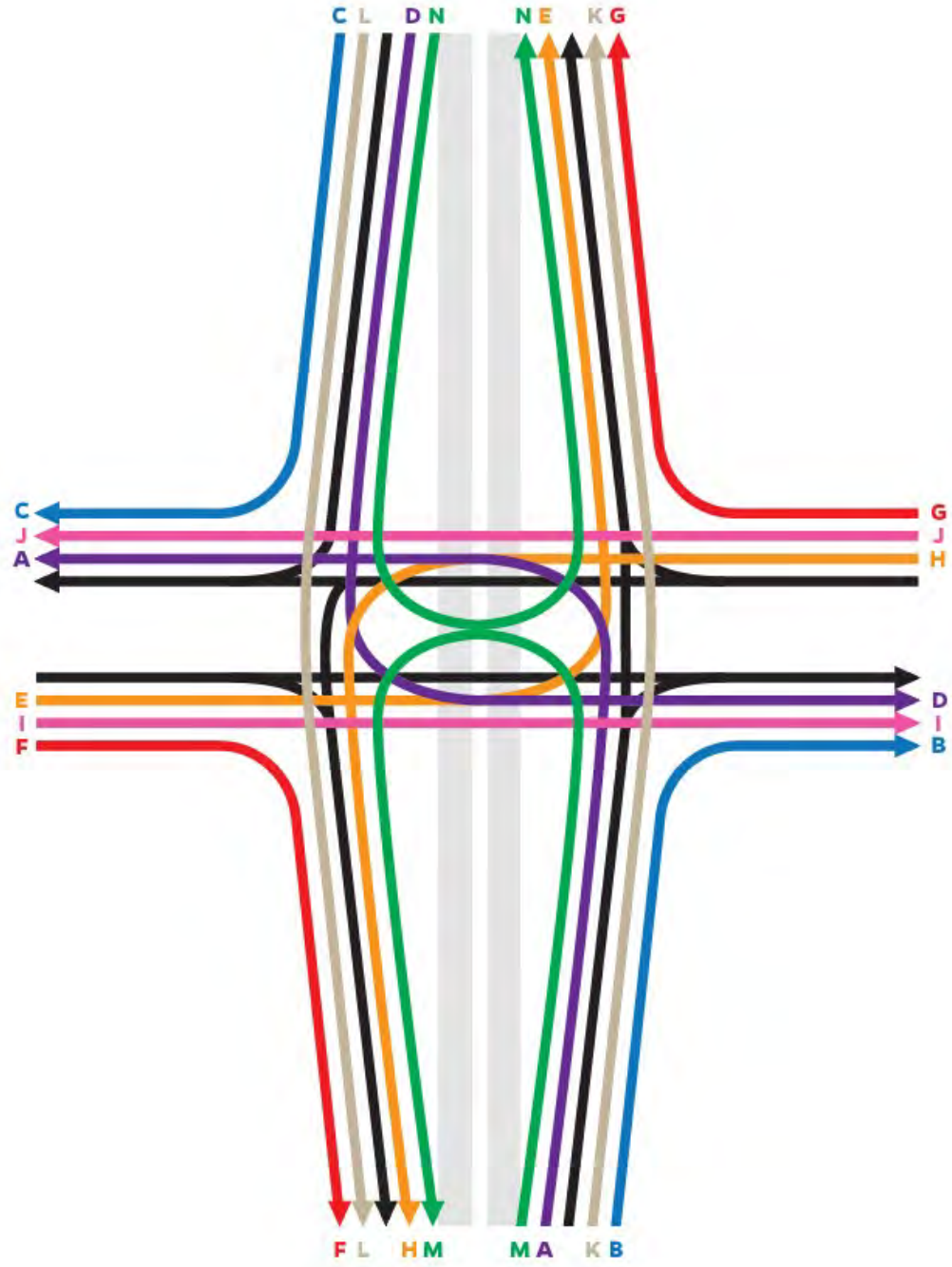
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	3.9	0.0	3.9	No	No	A
B	61	34.3	0.0	34.3	No	No	C
C	44	0.0	0.0	0.0	No	No	A
D	6	54.6	0.0	54.6	No	No	C
E	52	9.6	0.0	9.6	No	No	A
F	465	4.2	0.0	4.2	No	No	A
G	128	8.2	0.0	8.2	No	No	A
H	150	53.3	0.0	53.3	No	No	C
I	77	8.4	0.0	8.4	No	No	A
J	694	11.9	0.0	11.9	No	No	A
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		4.2	4.1	45.2	3.9						50.5	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	4.1	A		11.2	B		0.0			50.5	D	
Intersection Delay, s/veh / LOS	9.7						A					

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	5.4	4.2			8.1	8.2		34.3			0.0	37.6
Level of Service (LOS)	A	A			A	A		C				D
Approach Delay, s/veh / LOS	4.6	A		8.1	A		34.3	C		37.6	D	
Intersection Delay, s/veh / LOS	19.3						B					

Interchange Graphic



File Name: BUILD_1D_BENSON_PM.xus
Analyst: RL
Agency/Co.: HDR
Analysis Date: Mar 7, 2018
Time Period: PM PEAK
Jurisdiction: CITY OF SIOUX FALLS
Analysis Year: 2023
Project Description: I-229/BENSON IMJR
Urban Street: BENSON ROAD
Analysis Period: 1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	95
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	3	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											

1: Peak Hour Factor 1

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.64			43.29	
1	Running Speed, mph		41.32			41.66	
1	Through Delay, s/veh		31.56			12.33	
1	Travel Speed, mph		23.98			32.42	
1	Stop Rate, stops/veh		0.79			0.36	
1	Spatial Stop Rate, stops/mi		1.57			0.72	
1	Through vol/cap ratio		0.7			0.22	
1	Percent of Base FFS		54.41			73.57	
1	Level of Service		C			B	
1	Automobile Perception Score		2.38			2.25	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		65.61			63.38	
2	Running Speed, mph		41.1			42.55	
2	Through Delay, s/veh		4.21			24.76	
2	Travel Speed, mph		38.63			30.6	
2	Stop Rate, stops/veh		0.17			0.67	
2	Spatial Stop Rate, stops/mi		0.23			0.9	
2	Through vol/cap ratio		0.06			0.39	
2	Percent of Base FFS		87.64			69.43	
2	Level of Service		A			B	
2	Automobile Perception Score		2.28			2.33	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.7			18.9	
3	Running Speed, mph		36.46			36.07	
3	Through Delay, s/veh		4.15			3.89	
3	Travel Speed, mph		29.83			29.92	
3	Stop Rate, stops/veh		0.18			0.26	
3	Spatial Stop Rate, stops/mi		0.95			1.39	
3	Through vol/cap ratio		0.04			0.22	
3	Percent of Base FFS		67.69			67.89	
3	Level of Service		B			B	
3	Automobile Perception Score		2.28			2.57	
Facility Travel Time, s			167.88			166.54	
Facility Travel Speed, mph			30.87			31.11	
Facility Spatial Stop Rate, stops/mi			0.79			0.9	
Facility Base Free Flow Speed, mph			44.07			44.07	
Facility Percent Base Free Flow Speed			70.04			70.6	

Facility Level of Service	B	B
Facility Automobile Perception Score	2.31	2.33
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.24	4.24
Facility Pedestrian LOS Score	3.73	3.11
Facility Pedestrian LOS	D	C
Facility Bicycle Travel Speed	13.47	13.96
Facility Bicycle LOS Score	2.88	2.74
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	29.83	29.92
Facility Transit LOS Score	0.93	0.87
Facility Transit LOS	A	A
SPILLBACK TIME, h	999	

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.1	4.1
1	Ped LOS Score for Intersection	2.07	2.91
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	1.14	0.78
1	Speed Adjustment Factor	0.68	0.69
1	Ped LOS Score for Link	3.13	2.78
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.15	0.87
1	Ped LOS Score for Segment	3.52	2.72
1	Ped Segment LOS	D	B
1	Bicycle Travel Speed	13.25	13.02
1	Bicycle LOS Score for Intersection	3.14	2.76
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.45	2.26
1	Speed Adjustment Factor	0.84	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.35	3.16
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.91	2.75
1	Bicycle Segment LOS	C	B
1	Transit Running Speed, mi/h	41.32	41.66
1	g/C Ratio	0.37	0.42
1	Transit Running Time, s	43.64	43.29
1	Delay at Intersection, s/veh	31.54	12.73
1	Transit Travel Speed, mi/h	23.99	32.19
1	Transit Wait-Ride Score	3.36	3.75
1	Ped LOS Score for Link	3.13	2.78
1	Transit LOS Score for Segment	1.42	0.79
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.31	4.31
2	Ped LOS Score for Intersection	3.92	2.66
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	2.08	0.84
2	Speed Adjustment Factor	0.68	0.72
2	Ped LOS Score for Link	4.07	2.87
2	Ped Link LOS	D	C
2	Roadway Crossing Difficulty Factor	1.09	1.2
2	Ped LOS Score for Segment	4.17	3.44
2	Ped Segment LOS	D	C
2	Bicycle Travel Speed	13.58	14.9
2	Bicycle LOS Score for Intersection	4.16	2.77
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.75	2.29
2	Speed Adjustment Factor	0.84	0.86
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.65	3.21
2	Bicycle Link LOS	D	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	3.2	2.75

2	Bicycle Segment LOS	C	C
2	Transit Running Speed, mi/h	41.1	42.55
2	g/C Ratio	0.69	0.38
2	Transit Running Time, s	65.61	63.38
2	Delay at Intersection, s/veh	4.21	24.76
2	Transit Travel Speed, mi/h	38.63	30.6
2	Transit Wait-Ride Score	3.99	3.68
2	Ped LOS Score for Link	4.07	2.87
2	Transit LOS Score for Segment	0.62	0.91
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.31	4.38
3	Ped LOS Score for Intersection	1.68	1.3
3	Cross-section Adjustment Factor	-4.89	-4.74
3	Volume Adjustment Factor	0.15	0.64
3	Speed Adjustment Factor	0.53	0.52
3	Ped LOS Score for Link	1.84	2.47
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.2	1.06
3	Ped LOS Score for Segment	2.52	2.82
3	Ped Segment LOS	B	C
3	Bicycle Travel Speed	13.63	13.22
3	Bicycle LOS Score for Intersection	2.84	2.94
3	Cross-section Adjustment Factor	-2.49	-1.28
3	Volume Adjustment Factor	1.43	2.16
3	Speed Adjustment Factor	0.79	0.78
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	1.06	2.99
3	Bicycle Link LOS	A	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.59	2.66
3	Bicycle Segment LOS	A	B
3	Transit Running Speed, mi/h	36.46	36.07
3	g/C Ratio	0.73	0.84
3	Transit Running Time, s	18.7	18.9
3	Delay at Intersection, s/veh	4.15	3.89
3	Transit Travel Speed, mi/h	29.83	29.92
3	Transit Wait-Ride Score	3.65	3.65
3	Ped LOS Score for Link	1.84	2.47
3	Transit LOS Score for Segment	0.8	0.89
3	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	959	41.2	0	596	90.2	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.11	0	0	0.16	0	0	0.26	0.26	0.16	0.26	0.26	0.11
1: Thru veh delay		0.03			0.05							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

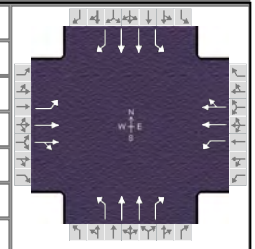
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1831	0	0	653	24.7	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.46	0	0	0.46	0.46	0.46	0.46	0.46	0
1: Thru veh delay		0			0.02							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	61.7	1624	165	59.6	657	128	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0.05	0	0	0.46	0	0	0.52	0.52	0.46	0.52	0.52	0.05
2: Thru veh delay		0.17			0.06							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											

3: Volume, veh/h	0	583	1131	4.07	735	0	0	0	0	5	0	110	
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0	
3: Prop blocked	0.06	0	0	0.43	0	0	0.49	0.49	0.43	0.49	0.49	0.06	
3: Thru veh delay		0			0								
3: Prob inside blk		0			0								
3: Dist to upstream signal	1910												

This Urban Streets text report was created in HCS™ Streets Version 7.5 on June 4, 2018 at 11:46:39

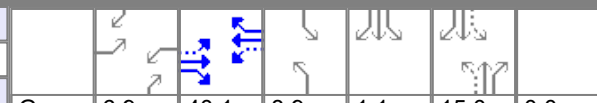
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1D_BENSON_PM.xus		
Project Description	I-229/BENSON IMJR				

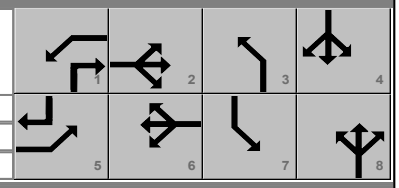


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	135	615	170	170	340	145	135	375	50	235	395	105

Signal Information			
Cycle, s	95.0	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	6.9	40.1	8.9	1.1	15.0	0.0						
Yellow	3.0	3.5	3.0	3.0	3.5	0.0						
Red	1.0	2.0	1.0	1.0	2.0	0.0						



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	11.0	45.6	10.9	45.5	12.9	20.5	18.0	25.6
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	6.8		6.7		9.1	13.6	14.1	13.5
Green Extension Time (g_e), s	0.3	0.0	0.4	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.98		0.98		0.98	1.00	1.00	1.00
Max Out Probability	0.37		0.05		1.00	0.00	1.00	0.00

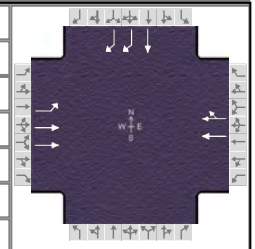
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	150	433	406	147	162	159	150	417	28	261	439	44
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1618	1647	1730	1680	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	4.8	18.4	18.4	4.7	4.2	4.0	7.1	11.6	1.4	12.1	11.5	2.1
Cycle Queue Clearance Time (g_c), s	4.8	18.4	18.4	4.7	4.2	4.0	7.1	11.6	1.4	12.1	11.5	2.1
Green Ratio (*g/C*)	0.49	0.42	0.42	0.49	0.42	0.42	0.25	0.16	0.23	0.33	0.21	0.28
Capacity (*c*), veh/h	587	729	682	329	728	707	295	520	339	353	695	418
Volume-to-Capacity Ratio (*X*)	0.256	0.594	0.595	0.449	0.222	0.225	0.509	0.801	0.082	0.741	0.631	0.106
Back of Queue (*Q*), ft/ln (95 th percentile)	79.3	315.2	289.2	86.6	74.4	65.6	134	217.7	22.6	236.6	206.4	33.5
Back of Queue (*Q*), veh/ln (95 th percentile)	3.1	12.1	11.6	3.3	2.9	2.6	5.2	8.4	0.9	9.1	7.9	1.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.41	0.00	0.00	0.62	0.00	0.00	0.45	0.00	0.09	0.64	0.00	0.10
Uniform Delay (d_1), s/veh	13.4	21.2	21.2	17.3	12.1	11.2	29.7	38.6	28.6	26.9	34.1	25.0
Incremental Delay (d_2), s/veh	0.3	3.5	3.8	1.3	0.7	0.7	2.0	3.9	0.0	8.7	0.5	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	13.8	24.7	25.0	18.6	12.7	11.8	31.7	42.5	28.7	35.6	34.6	25.1
Level of Service (LOS)	B	C	C	B	B	B	C	D	C	D	C	C
Approach Delay, s/veh / LOS	23.2	C		14.3	B		39.1	D		34.4	C	
Intersection Delay, s/veh / LOS	28.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.82	C	2.91	C	2.94	C	2.81	C
Bicycle LOS Score / LOS	3.08	C	2.76	C	2.88	C	3.00	C

Option 1E

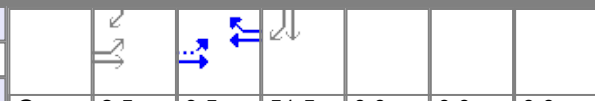
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1E_BENSON _AM.xus		
Project Description	I-229/BENSON 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	60	220			210	0					0	1640

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4		
Green	2.5	9.5	51.5	0.0	0.0	0.0	5	6	7	8		
Yellow	3.5	3.5	3.5	0.0	0.0	0.0						
Red	2.0	2.0	2.0	0.0	0.0	0.0						

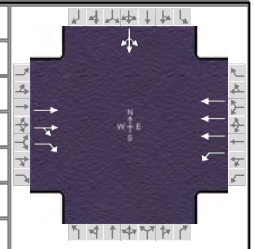
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				11.0
Phase Duration, s	8.0	23.0		15.0				57.0
Change Period, ($Y+R_c$), s	5.5	5.5		5.5				5.5
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				3.3
Queue Clearance Time (g_s), s	2.7							51.5
Green Extension 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	5	2			6	16					4	14
Adjusted Flow Rate (*v*), veh/h	17	61			233	0					0	1822
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1544			1636	0					1682	1389
Queue Service Time (g_s), s	0.7	1.1			5.4	0.0					0.0	49.5
Cycle Queue Clearance Time (g_c), s	0.7	1.1			5.4	0.0					0.0	49.5
Green Ratio (*g/C*)	0.18	0.22			0.12						0.64	0.68
Capacity (*c*), veh/h	199	675			389						1083	1876
Volume-to-Capacity Ratio (*X*)	0.083	0.090			0.601	0.000					0.000	0.971
Back of Queue (*Q*), ft/ln (95 th percentile)	11.8	19.5			112.2	0					0	505.2
Back of Queue (*Q*), veh/ln (95 th percentile)	0.5	0.7			4.3	0.0					0.0	20.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.12	0.00			0.00	0.00					0.00	0.00
Uniform Delay (d_1), s/veh	27.6	22.5			33.4						0.0	12.3
Incremental Delay (d_2), s/veh	0.1	0.3			6.7	0.0					0.0	14.5
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0					0.0	0.0
Control Delay (*d*), s/veh	27.7	22.8			40.2						0.0	26.8
Level of Service (LOS)	C	C			D							C
Approach Delay, s/veh / LOS	23.9	C		40.2	D		0.0			26.8	C	
Intersection Delay, s/veh / LOS	28.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.42	A	2.14	B	2.30	B	2.96	C
Bicycle LOS Score / LOS	2.73	C	2.67	C		A	3.49	C

HCS7 Signalized Intersection Results Summary

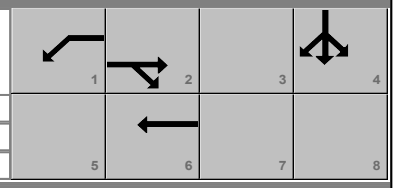
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1E_BENSON _AM.xus		
Project Description	I-229/BENSON 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		165	320	45	1805					5	0	110

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	4.4	50.7	8.5	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



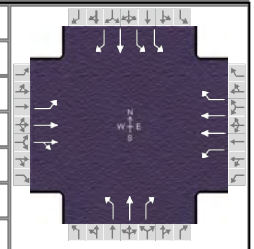
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		56.2	9.9	66.0				14.0
Change Period, ($Y+R_c$), s		5.5	5.5	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (g_s), s			4.3					8.9
Green Extension Time (g_e), s		0.0	0.0	0.0				0.2
Phase Call Probability			1.00					0.94
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		66	128	50	2006						128	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1622	1444	1714	1574						1461	
Queue Service Time (g_s), s		0.6	2.7	2.3	15.0						6.9	
Cycle Queue Clearance Time (g_c), s		0.6	2.7	2.3	15.0						6.9	
Green Ratio (*g/C*)		0.63	0.63	0.05	0.19						0.11	
Capacity (*c*), veh/h		2054	915	93	885						155	
Volume-to-Capacity Ratio (*X*)		0.032	0.140	0.535	2.265						0.824	
Back of Queue (*Q*), ft/ln (95 th percentile)		7.7	31.3	43.6	2269.8						112.3	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.3	1.3	1.7	87.3						4.5	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.44	0.00						0.00	
Uniform Delay (d_1), s/veh		5.3	5.4	38.6	19.8						35.0	
Incremental Delay (d_2), s/veh		0.0	0.3	0.4	570.2						4.2	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		5.3	5.7	39.1	590.0						39.2	
Level of Service (LOS)		A	A	D	F						D	
Approach Delay, s/veh / LOS	5.6	A		576.6	F		0.0			39.2	D	
Intersection Delay, s/veh / LOS	501.0						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.95	B	1.33	A	2.95	C	3.07	C
Bicycle LOS Score / LOS	2.92	C	3.61	D		A	0.70	A

HCS7 Signalized Intersection Results Summary

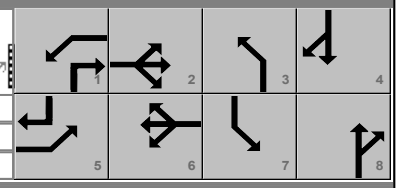
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1E_BENSON _AM.xus		
Project Description	I-229/BENSON 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	315	30	60	955	430	25	20	30	115	25	85

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.9	4.4	34.0	4.0	1.2	4.0
Yellow	3.9	3.9	3.9	3.6	0.0	3.6
Red	1.0	1.0	2.2	1.0	0.0	2.3



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	10.8	40.1	20.2	49.4	8.6	9.9	9.8	11.1
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.2	5.1	1.2
Queue Clearance Time (g_s), s	5.5		2.7		3.3	3.0	5.1	4.7
Green Extension Time (g_e), s	0.4	0.0	0.1	0.0	0.0	0.0	0.1	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.01		0.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	133	187	185	32	504	145	28	22	22	128	28	56
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1693	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	3.5	6.2	6.2	0.7	2.2		1.3	1.0	0.9	3.1	1.2	2.7
Cycle Queue Clearance Time (g_c), s	3.5	6.2	6.2	0.7	2.2		1.3	1.0	0.9	3.1	1.2	2.7
Green Ratio (*g/C*)	0.50	0.43	0.43	0.64	0.54		0.05	0.05	0.24	0.07	0.07	0.14
Capacity (*c*), veh/h	584	735	720	748	1784		82	87	367	209	113	205
Volume-to-Capacity Ratio (*X*)	0.228	0.255	0.257	0.042	0.283		0.337	0.257	0.060	0.612	0.246	0.272
Back of Queue (*Q*), ft/ln (95 th percentile)	56.8	114.2	108	8.5	23.8		27.4	19.6	14.1	60.5	23.9	43.9
Back of Queue (*Q*), veh/ln (95 th percentile)	2.2	4.4	4.3	0.3	0.9		1.1	0.8	0.6	2.3	0.9	1.7
Queue Storage Ratio (*RQ*) (95 th percentile)	0.28	0.00	0.00	0.12	0.00		0.69	0.00	0.00	0.22	0.00	0.00
Uniform Delay (d_1), s/veh	11.3	16.9	16.9	6.9	2.7		36.7	36.6	23.4	36.4	35.5	30.8
Incremental Delay (d_2), s/veh	0.3	0.8	0.8	0.0	0.0		3.4	0.6	0.0	4.1	0.4	0.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	11.6	17.7	17.7	6.9	2.7	0.0	40.1	37.1	23.4	40.5	35.9	31.0
Level of Service (LOS)	B	B	B	A	A	A	D	D	C	D	D	C
Approach Delay, s/veh / LOS	16.1	B		2.3	A		34.1	C		37.4	D	
Intersection Delay, s/veh / LOS	13.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.18	B	2.60	C	3.14	C	2.76	C
Bicycle LOS Score / LOS	2.68	C	3.45	C	2.05	B	2.43	B

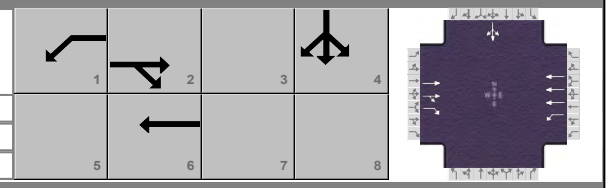
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1E_BENSON _AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		165	320	45	1805					5	0	110
Intersection Two Demand (*v*), veh/h	60	220			210	0					0	1640

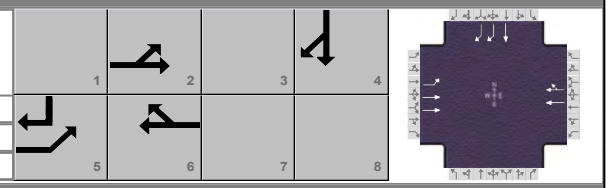
Signal One Information	
Cycle, s	80.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	4.4	50.7	8.5	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



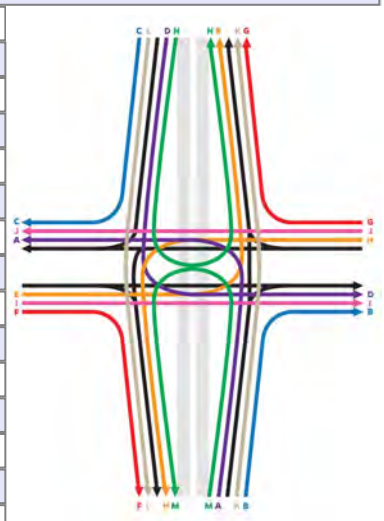
Signal Two Information	
Cycle, s	80.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	2.5	9.5	51.5	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Interchange Results

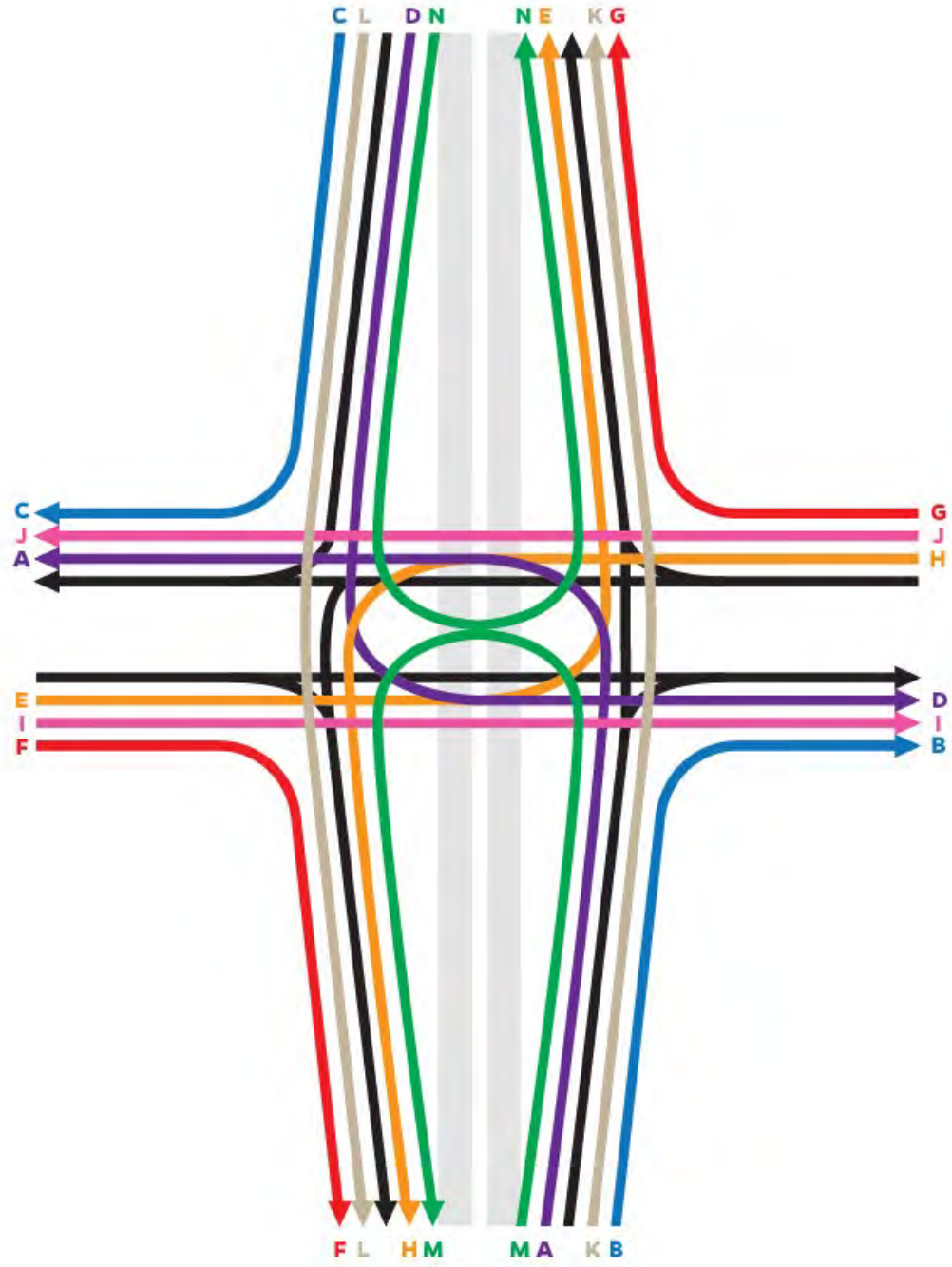
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	590.0	0.0	590.0	Yes	No	F
B	0	0.0	0.0	0.0	No	No	A
C	122	0.0	0.0	0.0	No	No	A
D	6	62.0	0.0	62.0	No	No	D
E	17	33.0	0.0	33.0	No	No	C
F	128	5.3	0.0	5.3	No	No	A
G	0	0.0	0.0	0.0	No	No	A
H	50	79.2	0.0	79.2	Yes	No	F
I	55	28.1	0.0	28.1	No	No	B
J	2006	630.1	0.0	630.1	Yes	No	F
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		5.3	5.7	39.1	590.0						39.2	
Level of Service (LOS)		A	A	D	F						D	
Approach Delay, s/veh / LOS	5.6	A		576.6	F		0.0			39.2	D	
Intersection Delay, s/veh / LOS	501.0						F					

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	27.7	22.8			40.2						0.0	26.8
Level of Service (LOS)	C	C			D							C
Approach Delay, s/veh / LOS	23.9	C		40.2	D		0.0			26.8	C	
Intersection Delay, s/veh / LOS	28.2						C					

Interchange Graphic



HCS7 Streets Text Report

File Name:	BUILD_1E_BENSON _AM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Mar 7, 2018
Time Period:	AM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2023
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	80
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	3	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											

1: Peak Hour Factor 1

Number of access points: 1

SEGMENT 2

Movement	EB LT 1	EB TH 2	EB RT 3	WB LT 4	WB TH 5	WB RT 6	NB LT 7	NB TH 8	NB RT 9	SB LT 10	SB TH 11	SB RT 12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.09			43.22	
1	Running Speed, mph		41.85			41.73	
1	Through Delay, s/veh		17.72			7.98	
1	Travel Speed, mph		29.66			35.23	
1	Stop Rate, stops/veh		0.59			0.28	
1	Spatial Stop Rate, stops/mi		1.17			0.56	
1	Through vol/cap ratio		0.26			0.25	
1	Percent of Base FFS		67.29			79.93	
1	Level of Service		B			B	
1	Automobile Perception Score		2.32			2.22	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		62.95			63.87	
2	Running Speed, mph		42.83			42.22	
2	Through Delay, s/veh		5.33			2.71	
2	Travel Speed, mph		39.49			40.5	
2	Stop Rate, stops/veh		0.22			0.1	
2	Spatial Stop Rate, stops/mi		0.3			0.13	
2	Through vol/cap ratio		0.03			0.28	
2	Percent of Base FFS		89.61			91.89	
2	Level of Service		A			A	
2	Automobile Perception Score		2.29			2.21	
3	Bay/Lane Spillback Time, h	999	999	999	999	0.1	999
3	ShrdLane Spillback Time, h	999			999.08		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.68			19.35	
3	Running Speed, mph		36.5			35.24	
3	Through Delay, s/veh		22.8			589.97	
3	Travel Speed, mph		16.44			1.12	
3	Stop Rate, stops/veh		0.62			3.94	
3	Spatial Stop Rate, stops/mi		3.26			20.78	
3	Through vol/cap ratio		0.09			2.26	
3	Percent of Base FFS		37.3			2.54	
3	Level of Service		E			F	
3	Automobile Perception Score		2.66			5.7	

Facility Travel Time, s	170.57	727.1
Facility Travel Speed, mph	30.38	7.13
Facility Spatial Stop Rate, stops/mi	0.99	3
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	68.93	16.17

Facility Level of Service	B	F
Facility Automobile Perception Score	2.34	2.41
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.26	4.28
Facility Pedestrian LOS Score	2.91	3.5
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	13.85	13.38
Facility Bicycle LOS Score	2.49	2.87
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	16.44	1.12
Facility Transit LOS Score	0.76	1.01
Facility Transit LOS	A	A
SPILLBACK TIME, h	0.1	

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.15	4.15
1	Ped LOS Score for Intersection	2.18	2.86
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.61	0.71
1	Speed Adjustment Factor	0.7	0.7
1	Ped LOS Score for Link	2.62	2.72
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.08	1.06
1	Ped LOS Score for Segment	2.96	3.03
1	Ped Segment LOS	C	C
1	Bicycle Travel Speed	13.85	14.02
1	Bicycle LOS Score for Intersection	2.68	3.01
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.13	2.21
1	Speed Adjustment Factor	0.85	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.04	3.11
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.65	2.72
1	Bicycle Segment LOS	B	B
1	Transit Running Speed, mi/h	41.85	41.73
1	g/C Ratio	0.43	0.47
1	Transit Running Time, s	43.09	43.22
1	Delay at Intersection, s/veh	17.75	8.24
1	Transit Travel Speed, mi/h	29.64	35.05
1	Transit Wait-Ride Score	3.64	3.86
1	Ped LOS Score for Link	2.62	2.72
1	Transit LOS Score for Segment	0.93	0.61
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.34	4.36
2	Ped LOS Score for Intersection	1.95	2.6
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.58	1.15
2	Speed Adjustment Factor	0.73	0.71
2	Ped LOS Score for Link	2.62	3.17
2	Ped Link LOS	C	C
2	Roadway Crossing Difficulty Factor	1.09	1.2
2	Ped LOS Score for Segment	3.01	3.71
2	Ped Segment LOS	C	D
2	Bicycle Travel Speed	13.97	14.8
2	Bicycle LOS Score for Intersection	2.92	3.45
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.11	2.45
2	Speed Adjustment Factor	0.86	0.85
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.02	3.36
2	Bicycle Link LOS	C	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.65	2.88

2	Bicycle Segment LOS	B	C
2	Transit Running Speed, mi/h	42.83	42.22
2	g/C Ratio	0.63	0.54
2	Transit Running Time, s	62.95	63.87
2	Delay at Intersection, s/veh	5.33	2.71
2	Transit Travel Speed, mi/h	39.49	40.5
2	Transit Wait-Ride Score	4.02	4.05
2	Ped LOS Score for Link	2.62	3.17
2	Transit LOS Score for Segment	0.36	0.39
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.3	4.35
3	Ped LOS Score for Intersection	1.42	1.33
3	Cross-section Adjustment Factor	-5.01	-4.74
3	Volume Adjustment Factor	0.09	1.56
3	Speed Adjustment Factor	0.53	0.5
3	Ped LOS Score for Link	1.66	3.36
3	Ped Link LOS	B	C
3	Roadway Crossing Difficulty Factor	1.2	1.2
3	Ped LOS Score for Segment	2.35	3.88
3	Ped Segment LOS	B	D
3	Bicycle Travel Speed	13.41	8.91
3	Bicycle LOS Score for Intersection	2.73	3.61
3	Cross-section Adjustment Factor	-3.85	-1.28
3	Volume Adjustment Factor	1.14	2.61
3	Speed Adjustment Factor	0.79	0.77
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	-0.59	3.43
3	Bicycle Link LOS	A	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.45	3.22
3	Bicycle Segment LOS	A	C
3	Transit Running Speed, mi/h	36.5	35.24
3	g/C Ratio	0.22	0.76
3	Transit Running Time, s	18.68	19.35
3	Delay at Intersection, s/veh	22.8	589.97
3	Transit Travel Speed, mi/h	16.44	1.12
3	Transit Wait-Ride Score	2.9	1.36
3	Ped LOS Score for Link	1.66	3.36
3	Transit LOS Score for Segment	1.9	4.46
3	Transit Segment LOS	A	E

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	517	22.2	0	544	82.3	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0	0	0	0.02	0	0	0.02	0.02	0.02	0.02	0.02	0
1: Thru veh delay		0.02			0.05							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

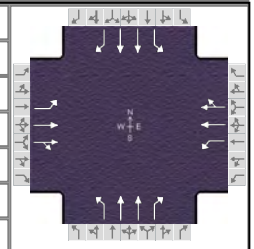
SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	511	0	0	853	32.2	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0.16	0	0	0.08	0	0	0.24	0.24	0.08	0.24	0.24	0.16
1: Thru veh delay		0			0.03							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	17.7	466	47.2	78.4	865	168	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0.2	0	0	0.02	0	0	0.22	0.22	0.02	0.22	0.22	0.2
2: Thru veh delay		0.03			0.09							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											

3: Volume, veh/h	0	189	367	5.55	1002	0	0	0	0	5	0	110	
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0	
3: Prop blocked	0.21	0	0	0.01	0	0	0.22	0.22	0.01	0.22	0.22	0.21	
3: Thru veh delay		0			0								
3: Prob inside blk		0			0								
3: Dist to upstream signal	1910												

HCS7 Signalized Intersection Results Summary

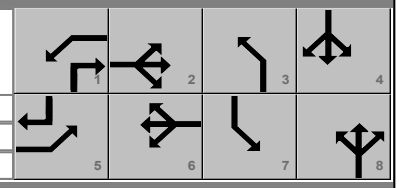
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1E_BENSON _AM.xus		
Project Description	I-229/BENSON 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	95	320	80	60	575	290	100	255	65	100	290	160

Signal Information			
Cycle, s	80.0	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	2.0	2.4		37.7	4.0	15.0	0.0					
Yellow	3.0	0.0		3.5	3.0	3.5	0.0					
Red	1.0	0.0		2.0	1.0	2.0	0.0					



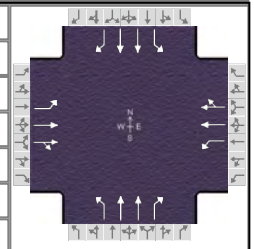
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	8.3	45.5	6.0	43.2	8.0	20.5	8.0	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	4.6		2.8		6.0	8.1	6.0	9.0
Green Extension Time (g_e), s	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.90		0.50		0.92	1.00	0.92	1.00
Max Out Probability	0.20		0.31		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	106	209	202	31	198	188	111	283	44	111	322	106
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1648	1647	1730	1592	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	2.6	5.5	5.6	0.8	3.6	3.3	4.0	6.1	2.0	4.0	7.0	4.7
Cycle Queue Clearance Time (g_c), s	2.6	5.5	5.6	0.8	3.6	3.3	4.0	6.1	2.0	4.0	7.0	4.7
Green Ratio (*g/C*)	0.53	0.50	0.50	0.50	0.47	0.47	0.24	0.19	0.21	0.24	0.19	0.24
Capacity (*c*), veh/h	594	865	824	516	814	750	249	618	311	264	618	354
Volume-to-Capacity Ratio (*X*)	0.178	0.241	0.245	0.060	0.243	0.250	0.446	0.459	0.143	0.420	0.522	0.298
Back of Queue (*Q*), ft/ln (95 th percentile)	38.9	93.5	87.9	12.2	59.3	49.2	81.3	107.4	30.6	80.7	124	72.6
Back of Queue (*Q*), veh/ln (95 th percentile)	1.5	3.6	3.5	0.5	2.3	2.0	3.1	4.1	1.2	3.1	4.8	2.8
Queue Storage Ratio (*RQ*) (95 th percentile)	0.20	0.00	0.00	0.09	0.00	0.00	0.27	0.00	0.13	0.22	0.00	0.23
Uniform Delay (d_1), s/veh	9.6	11.4	11.4	10.8	7.6	6.7	26.2	28.9	25.6	26.1	29.3	24.8
Incremental Delay (d_2), s/veh	0.2	0.7	0.7	0.1	0.7	0.8	1.8	0.2	0.1	1.5	0.3	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	9.8	12.0	12.1	10.8	8.2	7.5	28.0	29.1	25.7	27.6	29.5	25.0
Level of Service (LOS)	A	B	B	B	A	A	C	C	C	C	C	C
Approach Delay, s/veh / LOS	11.6	B		8.1	A		28.5	C		28.2	C	
Intersection Delay, s/veh / LOS	19.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.71	C	2.86	C	2.89	C	2.75	C
Bicycle LOS Score / LOS	2.69	C	3.01	C	2.75	C	2.83	C

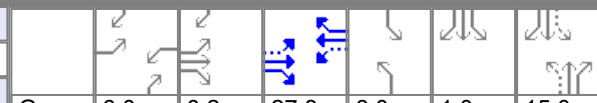
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1E_BENSON_PM.xus		
Project Description	I-229/BENSON IMJR				

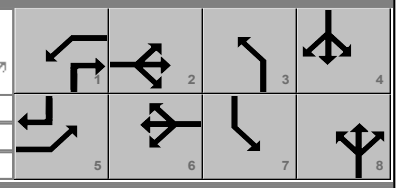


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	135	615	170	170	340	145	135	375	50	235	395	105

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	6.0	0.2	27.8	6.0	1.0	15.0						
Yellow	3.0	0.0	3.5	3.0	0.0	3.5						
Red	1.0	0.0	2.0	1.0	0.0	2.0						



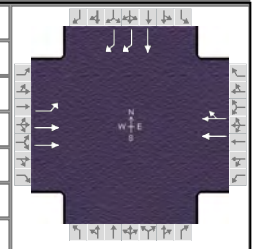
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	10.2	33.5	10.0	33.3	10.0	20.5	11.0	21.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	6.1		6.0		7.4	10.7	9.0	11.1
Green Extension Time (g_e), s	0.4	0.0	0.3	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.96		0.95		0.96	1.00	1.00	1.00
Max Out Probability	0.24		0.78		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	150	433	406	147	162	159	150	417	28	261	439	44
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1618	1647	1730	1680	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	4.1	15.7	15.7	4.0	4.8	4.7	5.4	8.7	1.0	7.0	9.1	1.7
Cycle Queue Clearance Time (g_c), s	4.1	15.7	15.7	4.0	4.8	4.7	5.4	8.7	1.0	7.0	9.1	1.7
Green Ratio (*g/C*)	0.45	0.37	0.37	0.45	0.37	0.37	0.28	0.20	0.28	0.29	0.21	0.30
Capacity (*c*), veh/h	549	645	604	316	641	623	289	659	411	329	703	434
Volume-to-Capacity Ratio (*X*)	0.273	0.671	0.672	0.467	0.252	0.255	0.519	0.633	0.068	0.793	0.625	0.102
Back of Queue (*Q*), ft/ln (95 th percentile)	64.5	281.2	259	70.4	86.4	80.1	97.9	150.3	15.6	114.4	156.2	24.5
Back of Queue (*Q*), veh/ln (95 th percentile)	2.5	10.8	10.4	2.7	3.3	3.2	3.8	5.8	0.6	4.4	6.0	0.9
Queue Storage Ratio (*RQ*) (95 th percentile)	0.33	0.00	0.00	0.50	0.00	0.00	0.33	0.00	0.06	0.31	0.00	0.08
Uniform Delay (d_1), s/veh	12.5	19.7	19.7	15.9	15.9	15.5	22.2	27.5	19.8	25.6	26.8	19.2
Incremental Delay (d_2), s/veh	0.4	5.5	5.9	1.4	0.9	0.9	2.2	0.4	0.0	13.1	0.3	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	12.9	25.1	25.5	17.3	16.8	16.5	24.4	27.9	19.8	38.7	27.1	19.2
Level of Service (LOS)	B	C	C	B	B	B	C	C	B	D	C	B
Approach Delay, s/veh / LOS	23.4	C		16.9	B		26.6	C		30.7	C	
Intersection Delay, s/veh / LOS	24.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.81	C	2.90	C	2.93	C	2.80	C
Bicycle LOS Score / LOS	3.08	C	2.76	C	2.88	C	3.00	C

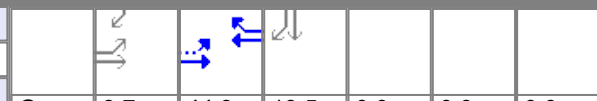
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1E_BENSON_PM.xus		
Project Description	I-229/BENSON IMJR				

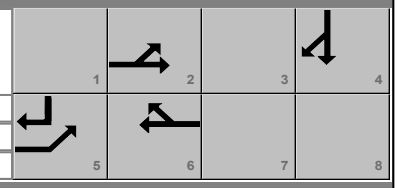


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	150	300			395	115					0	365

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.7	44.3	13.5	0.0	0.0	0.0
Yellow	4.0	3.5	4.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0



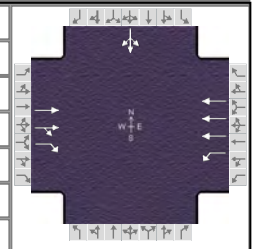
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				11.0
Phase Duration, s	7.7	57.5		49.8				17.5
Change Period, (*Y+R c*), s	4.0	5.5		5.5				4.0
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				3.3
Queue Clearance Time (*g s*), s	2.7							12.8
Green Extension Time (*g e*), s	0.0	0.0		0.0				0.7
Phase Call Probability	0.61							1.00
Max Out Probability	0.00							0.07

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16					4	14
Adjusted Flow Rate (*v*), veh/h	45	91			293	274					0	406
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1546			1663	1531					1682	1286
Queue Service Time (*g s*), s	0.7	0.8			9.6	6.7					0.0	10.8
Cycle Queue Clearance Time (*g c*), s	0.7	0.8			9.6	6.7					0.0	10.8
Green Ratio (*g/C*)	0.67	0.69			0.59	0.59					0.18	0.23
Capacity (*c*), veh/h	558	2142			982	904					303	590
Volume-to-Capacity Ratio (*X*)	0.081	0.042			0.298	0.303					0.000	0.687
Back of Queue (*Q*), ft/ln (95 th percentile)	8.3	8.6			95.6	87.4					0	139.6
Back of Queue (*Q*), veh/ln (95 th percentile)	0.3	0.3			3.7	3.5					0.0	5.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.08	0.00			0.00	0.00					0.00	0.00
Uniform Delay (*d 1*), s/veh	5.4	4.4			7.6	7.7					0.0	26.4
Incremental Delay (*d 2*), s/veh	0.0	0.0			0.8	0.9					0.0	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	5.5	4.4			8.4	8.5					0.0	27.0
Level of Service (LOS)	A	A			A	A						C
Approach Delay, s/veh / LOS	4.8	A		8.5	A		0.0			27.0	C	
Intersection Delay, s/veh / LOS	14.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.34	A	2.08	B	2.43	B	2.69	C
Bicycle LOS Score / LOS	2.89	C	2.95	C		A	1.16	A

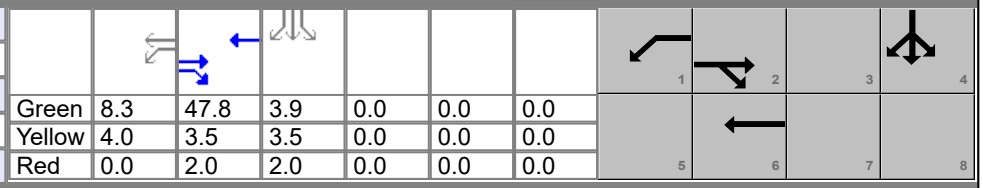
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1E_BENSON_PM.xus		
Project Description	I-229/BENSON 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		385	1450	135	625					5	0	40

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.3	47.8	3.9	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

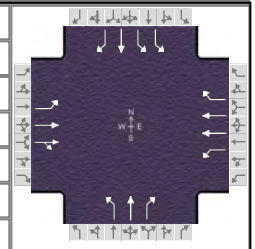
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		53.3	12.3	65.6				9.4
Change Period, (*Y+R c*), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (*g s*), s			8.5					4.5
Green Extension Time (*g e*), s		0.0	0.2	0.0				0.0
Phase Call Probability			0.96					0.65
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		125	472	150	694						50	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1626	1492	1714	1501						1461	
Queue Service Time (*g s*), s		1.2	10.4	6.5	4.3						2.5	
Cycle Queue Clearance Time (*g c*), s		1.2	10.4	6.5	4.3						2.5	
Green Ratio (*g/C*)		0.64	0.64	0.11	0.64						0.05	
Capacity (*c*), veh/h		2074	951	190	2900						76	
Volume-to-Capacity Ratio (*X*)		0.060	0.496	0.790	0.239						0.661	
Back of Queue (*Q*), ft/ln (95 th percentile)		14.1	94.5	125.5	47						41.7	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.5	3.8	5.0	1.8						1.7	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.84	0.00						0.00	
Uniform Delay (*d 1*), s/veh		5.5	5.3	34.5	3.0						34.9	
Incremental Delay (*d 2*), s/veh		0.0	0.7	2.4	0.2						3.6	
Initial Queue Delay (*d 3*), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		5.5	6.0	37.0	3.2						38.5	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	5.9	A		9.2	A		0.0			38.5	D	
Intersection Delay, s/veh / LOS	8.9						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.93	D	1.31	A	2.74	C	3.09	C
Bicycle LOS Score / LOS	4.16	D	2.94	C		A	0.57	A

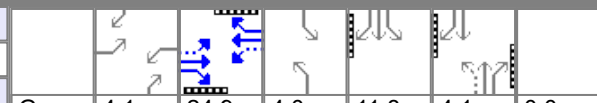
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1E_BENSON_PM.xus		
Project Description	I-229/BENSON IMJR				

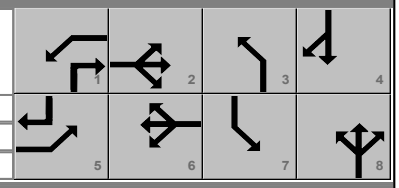


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	900	15	60	410	80	40	30	125	745	25	140

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.1	24.9	4.0	11.8	4.1	0.0
Yellow	3.9	3.9	3.6	3.6	3.6	0.0
Red	1.0	2.2	1.0	1.0	2.3	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	3.0	2.0	3.0
Phase Duration, s	8.9	31.0	9.0	31.1	8.6	10.0	25.0	26.4
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	3.4		4.1		3.9	6.1	21.1	6.4
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	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	50	449	449	71	487	95	44	33	128	828	28	117
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1726	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	1.4	17.2	17.2	2.1	9.5		1.9	1.4	4.1	19.1	0.9	4.4
Cycle Queue Clearance Time (g_c), s	1.4	17.2	17.2	2.1	9.5		1.9	1.4	4.1	19.1	0.9	4.4
Green Ratio (*g/C*)	0.39	0.33	0.33	0.39	0.33		0.11	0.05	0.11	0.27	0.27	0.33
Capacity (*c*), veh/h	344	574	573	248	1098		258	95	167	870	473	479
Volume-to-Capacity Ratio (*X*)	0.144	0.783	0.783	0.287	0.443		0.173	0.353	0.766	0.951	0.059	0.244
Back of Queue (*Q*), ft/ln (95 th percentile)	20.8	273.6	262.7	41.7	176.5		34.4	27.4	132.7	366.2	16	65.2
Back of Queue (*Q*), veh/ln (95 th percentile)	0.8	10.5	10.5	1.6	6.8		1.3	1.1	5.3	14.1	0.6	2.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.10	0.00	0.00	0.60	0.00		0.86	0.00	0.00	0.98	0.00	0.00
Uniform Delay (d_1), s/veh	13.8	21.0	21.0	16.9	22.9		30.7	34.2	32.5	26.8	20.1	18.5
Incremental Delay (d_2), s/veh	0.2	7.0	7.0	2.8	1.3		0.4	0.8	17.3	19.8	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	0.0
Control Delay (*d*), s/veh	14.0	28.0	28.0	19.7	24.2	0.0	31.1	35.0	49.8	46.6	20.1	18.6
Level of Service (LOS)	B	C	C	B	C	A	C	C	D	D	C	B
Approach Delay, s/veh / LOS	27.3	C		20.2	C		43.3	D		42.5	D	
Intersection Delay, s/veh / LOS	32.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.22	B	2.65	C	3.02	C	2.75	C
Bicycle LOS Score / LOS	3.14	C	2.77	C	2.27	B	3.68	D

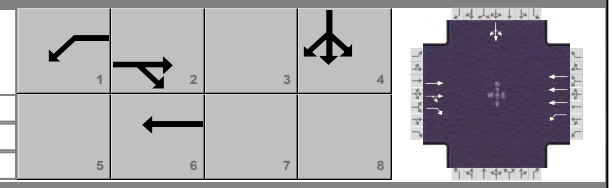
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1E_BENSON_PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		385	1450	135	625					5	0	40
Intersection Two Demand (*v*), veh/h	150	300			395	115					0	365

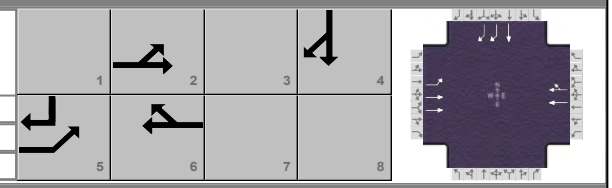
Signal One Information	
Cycle, s	75.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	8.3	47.8	3.9	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



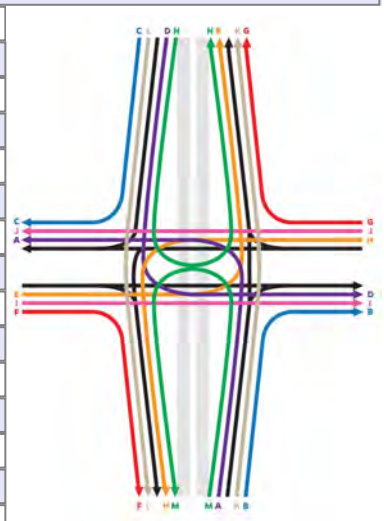
Signal Two Information	
Cycle, s	75.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	3.7	44.3	13.5	0.0	0.0	0.0
Yellow	4.0	3.5	4.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0



Interchange Results

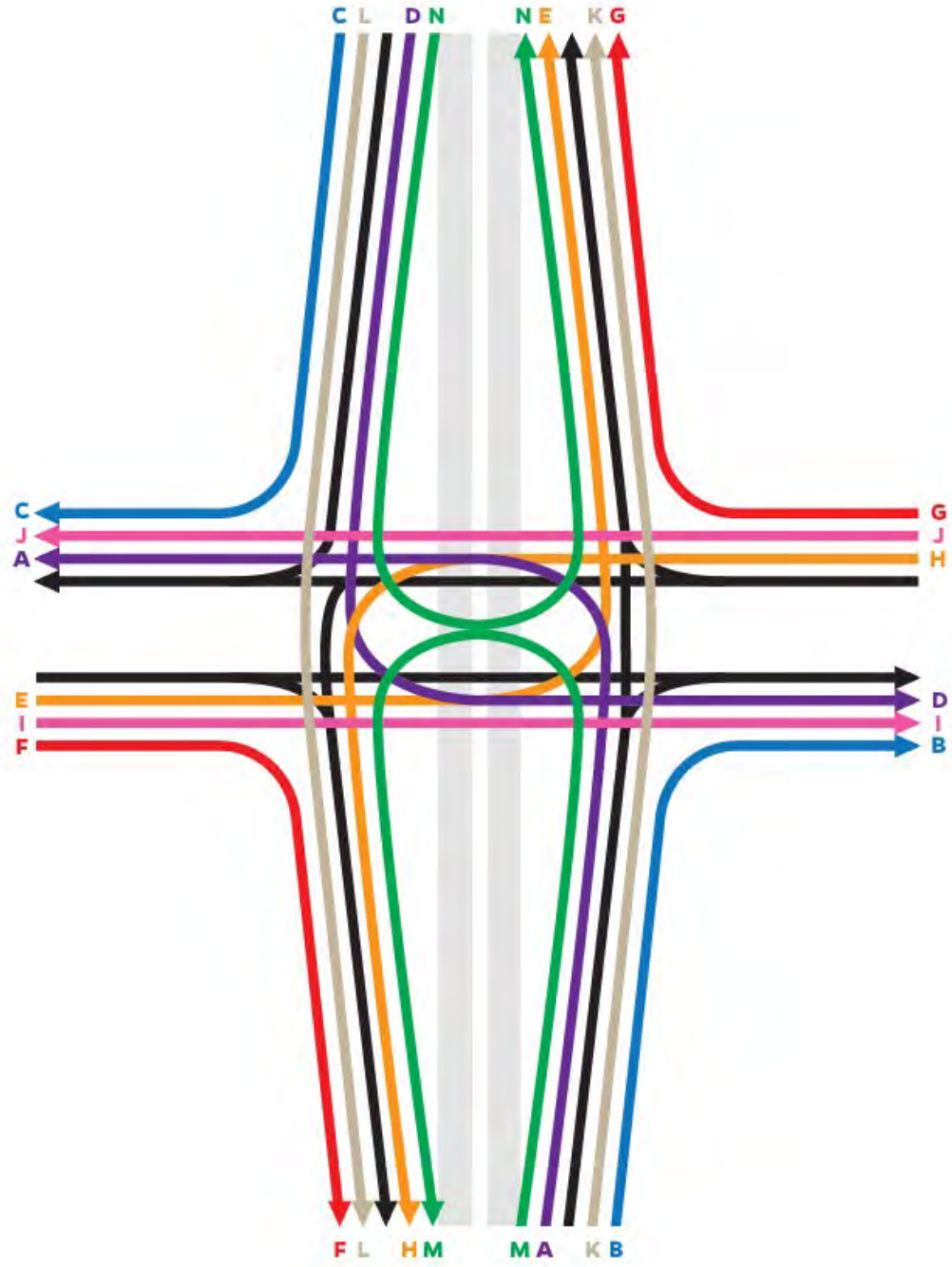
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	3.2	0.0	3.2	No	No	A
B	0	0.0	0.0	0.0	No	No	A
C	44	0.0	0.0	0.0	No	No	A
D	6	43.0	0.0	43.0	No	No	C
E	45	11.0	0.0	11.0	No	No	A
F	472	5.5	0.0	5.5	No	No	A
G	128	8.5	0.0	8.5	No	No	A
H	150	45.4	0.0	45.4	No	No	C
I	85	9.9	0.0	9.9	No	No	A
J	694	11.6	0.0	11.6	No	No	A
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		5.5	6.0	37.0	3.2						38.5	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	5.9	A		9.2	A		0.0			38.5	D	
Intersection Delay, s/veh / LOS	8.9						A					

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	5.5	4.4			8.4	8.5					0.0	27.0
Level of Service (LOS)	A	A			A	A						C
Approach Delay, s/veh / LOS	4.8	A		8.5	A		0.0			27.0	C	
Intersection Delay, s/veh / LOS	14.8						B					

Interchange Graphic



File Name: BUILD_1E_BENSON_PM.xus
Analyst: RL
Agency/Co.: HDR
Analysis Date: Mar 7, 2018
Time Period: PM PEAK
Jurisdiction: CITY OF SIOUX FALLS
Analysis Year: 2023
Project Description: I-229/BENSON IMJR
Urban Street: BENSON ROAD
Analysis Period: 1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	75
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	3	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											

1: Peak Hour Factor 1

Number of access points: 1

SEGMENT 2

Movement	EB LT 1	EB TH 2	EB RT 3	WB LT 4	WB TH 5	WB RT 6	NB LT 7	NB TH 8	NB RT 9	SB LT 10	SB TH 11	SB RT 12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.64			43.29	
1	Running Speed, mph		41.32			41.66	
1	Through Delay, s/veh		28			16.65	
1	Travel Speed, mph		25.17			30.09	
1	Stop Rate, stops/veh		0.75			0.54	
1	Spatial Stop Rate, stops/mi		1.49			1.08	
1	Through vol/cap ratio		0.78			0.25	
1	Percent of Base FFS		57.12			68.27	
1	Level of Service		C			B	
1	Automobile Perception Score		2.37			2.3	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		65.68			63.38	
2	Running Speed, mph		41.06			42.55	
2	Through Delay, s/veh		5.52			24.16	
2	Travel Speed, mph		37.87			30.8	
2	Stop Rate, stops/veh		0.23			0.74	
2	Spatial Stop Rate, stops/mi		0.31			0.99	
2	Through vol/cap ratio		0.06			0.44	
2	Percent of Base FFS		85.94			69.9	
2	Level of Service		A			B	
2	Automobile Perception Score		2.29			2.34	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.7			18.9	
3	Running Speed, mph		36.45			36.07	
3	Through Delay, s/veh		4.41			3.16	
3	Travel Speed, mph		29.5			30.9	
3	Stop Rate, stops/veh		0.19			0.21	
3	Spatial Stop Rate, stops/mi		1.03			1.1	
3	Through vol/cap ratio		0.04			0.24	
3	Percent of Base FFS		66.93			70.12	
3	Level of Service		C			B	
3	Automobile Perception Score		2.29			2.52	
Facility Travel Time, s			165.96			169.54	
Facility Travel Speed, mph			31.22			30.56	
Facility Spatial Stop Rate, stops/mi			0.81			1.04	
Facility Base Free Flow Speed, mph			44.07			44.07	
Facility Percent Base Free Flow Speed			70.85			69.35	

Facility Level of Service	B	B
Facility Automobile Perception Score	2.31	2.35
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.26	4.27
Facility Pedestrian LOS Score	3.49	3.13
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	13.57	14.01
Facility Bicycle LOS Score	2.89	2.74
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	29.5	30.9
Facility Transit LOS Score	0.92	0.9
Facility Transit LOS	A	A
SPILLBACK TIME, h	999	

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.17	4.17
1	Ped LOS Score for Intersection	2.22	2.9
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	1.14	0.78
1	Speed Adjustment Factor	0.68	0.69
1	Ped LOS Score for Link	3.13	2.78
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.02	0.85
1	Ped LOS Score for Segment	3.23	2.68
1	Ped Segment LOS	C	B
1	Bicycle Travel Speed	13.36	13.17
1	Bicycle LOS Score for Intersection	3.14	2.76
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.45	2.26
1	Speed Adjustment Factor	0.84	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.35	3.16
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.9	2.75
1	Bicycle Segment LOS	C	B
1	Transit Running Speed, mi/h	41.32	41.66
1	g/C Ratio	0.33	0.37
1	Transit Running Time, s	43.64	43.29
1	Delay at Intersection, s/veh	27.99	16.81
1	Transit Travel Speed, mi/h	25.17	30.01
1	Transit Wait-Ride Score	3.43	3.66
1	Ped LOS Score for Link	3.13	2.78
1	Transit LOS Score for Segment	1.33	0.93
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.32	4.32
2	Ped LOS Score for Intersection	3.93	2.65
2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	2.12	0.84
2	Speed Adjustment Factor	0.67	0.72
2	Ped LOS Score for Link	4.1	2.87
2	Ped Link LOS	D	C
2	Roadway Crossing Difficulty Factor	0.99	1.2
2	Ped LOS Score for Segment	3.92	3.45
2	Ped Segment LOS	D	C
2	Bicycle Travel Speed	13.72	14.88
2	Bicycle LOS Score for Intersection	4.16	2.77
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.76	2.29
2	Speed Adjustment Factor	0.84	0.86
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.66	3.21
2	Bicycle Link LOS	D	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	3.19	2.75

2	Bicycle Segment LOS	C	C
2	Transit Running Speed, mi/h	41.06	42.55
2	g/C Ratio	0.64	0.33
2	Transit Running Time, s	65.68	63.38
2	Delay at Intersection, s/veh	5.52	24.16
2	Transit Travel Speed, mi/h	37.87	30.8
2	Transit Wait-Ride Score	3.96	3.69
2	Ped LOS Score for Link	4.1	2.87
2	Transit LOS Score for Segment	0.67	0.9
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.31	4.37
3	Ped LOS Score for Intersection	1.34	1.31
3	Cross-section Adjustment Factor	-4.89	-4.74
3	Volume Adjustment Factor	0.15	0.64
3	Speed Adjustment Factor	0.53	0.52
3	Ped LOS Score for Link	1.84	2.47
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.16	1.19
3	Ped LOS Score for Segment	2.47	3.07
3	Ped Segment LOS	B	C
3	Bicycle Travel Speed	13.53	13.18
3	Bicycle LOS Score for Intersection	2.89	2.94
3	Cross-section Adjustment Factor	-2.45	-1.28
3	Volume Adjustment Factor	1.43	2.16
3	Speed Adjustment Factor	0.79	0.78
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	1.11	2.99
3	Bicycle Link LOS	A	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.64	2.66
3	Bicycle Segment LOS	A	B
3	Transit Running Speed, mi/h	36.45	36.07
3	g/C Ratio	0.69	0.8
3	Transit Running Time, s	18.7	18.9
3	Delay at Intersection, s/veh	4.41	3.16
3	Transit Travel Speed, mi/h	29.5	30.9
3	Transit Wait-Ride Score	3.63	3.69
3	Ped LOS Score for Link	1.84	2.47
3	Transit LOS Score for Segment	0.83	0.83
3	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	959	41.2	0	596	90.2	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.09	0	0	0.15	0	0	0.24	0.24	0.15	0.24	0.24	0.09
1: Thru veh delay		0.03			0.05							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

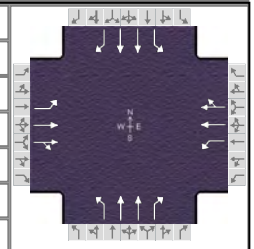
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1860	0	0	653	24.7	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.47	0	0	0.47	0.47	0.47	0.47	0.47	0
1: Thru veh delay		0			0.02							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	62.7	1650	167	59.6	657	128	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0.01	0	0	0.47	0	0	0.48	0.48	0.47	0.48	0.48	0.01
2: Thru veh delay		0.18			0.06							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											

3: Volume, veh/h	0	592	1148	4.07	735	0	0	0	0	5	0	110	
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0	
3: Prop blocked	0.03	0	0	0.44	0	0	0.47	0.47	0.44	0.47	0.47	0.03	
3: Thru veh delay		0			0								
3: Prob inside blk		0			0								
3: Dist to upstream signal	1910												

Option 4A

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 30, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023 DDI Build	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	95	320	80	60	575	290	100	255	65	100	290	160

Signal Information			
Cycle, s	85.0	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	2.1	1.1	42.8	5.0	15.0	0.0	1	2	3	4	5	6	7	8
Yellow	3.0	0.0	3.5	3.0	3.5	0.0								
Red	1.0	0.0	2.0	1.0	2.0	0.0								

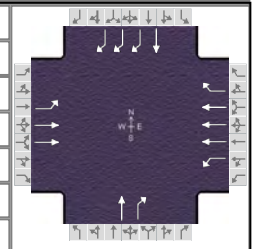
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	6.1	48.3	7.2	49.4	9.0	20.5	9.0	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	2.8		3.6		6.7	8.6	6.7	9.6
Green Extension Time (g_e), s	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.53		0.79		0.93	1.00	0.93	1.00
Max Out Probability	0.00		0.51		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	32	62	61	67	411	384	111	283	39	111	322	111
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1656	1647	1730	1612	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	0.8	2.4	2.4	1.6	12.8	12.8	4.7	6.6	1.8	4.7	7.6	5.6
Cycle Queue Clearance Time (g_c), s	0.8	2.4	2.4	1.6	12.8	12.8	4.7	6.6	1.8	4.7	7.6	5.6
Green Ratio (*g/C*)	0.53	0.50	0.50	0.54	0.52	0.52	0.24	0.18	0.21	0.24	0.18	0.20
Capacity (*c*), veh/h	354	872	834	735	893	832	247	581	313	262	581	295
Volume-to-Capacity Ratio (*X*)	0.090	0.071	0.073	0.091	0.460	0.461	0.449	0.487	0.124	0.424	0.554	0.376
Back of Queue (*Q*), ft/ln (95 th percentile)	12.7	42.4	39.1	25	217.6	199.7	87.6	117.7	28.7	87	135.6	88.2
Back of Queue (*Q*), veh/ln (95 th percentile)	0.5	1.6	1.6	1.0	8.4	8.0	3.4	4.5	1.1	3.3	5.2	3.4
Queue Storage Ratio (*RQ*) (95 th percentile)	0.06	0.00	0.00	0.18	0.00	0.00	0.29	0.00	0.12	0.24	0.00	0.28
Uniform Delay (d_1), s/veh	11.0	17.6	17.0	9.4	13.0	13.1	27.3	31.5	27.0	27.1	31.9	29.3
Incremental Delay (d_2), s/veh	0.1	0.1	0.2	0.1	1.7	1.8	1.8	0.2	0.1	1.5	0.3	0.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	11.1	17.8	17.1	9.4	14.7	14.9	29.1	31.8	27.1	28.7	32.3	29.6
Level of Service (LOS)	B	B	B	A	B	B	C	C	C	C	C	C
Approach Delay, s/veh / LOS	16.1	B		14.4	B		30.7	C		31.0	C	
Intersection Delay, s/veh / LOS	22.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.72	C	2.85	C	2.94	C	2.76	C
Bicycle LOS Score / LOS	2.68	C	2.97	C	2.74	C	2.83	C

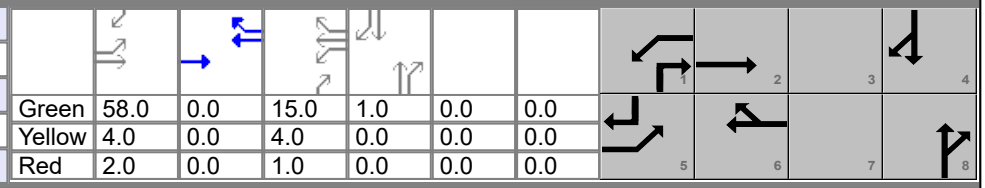
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 30, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023 DDI Build	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	60	110		1	210	0		0	110		1	1640

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off



Green	58.0	0.0	15.0	1.0	0.0	0.0
Yellow	4.0	0.0	4.0	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	0.0	0.0

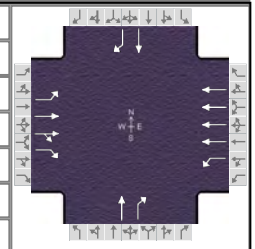
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	4.0	2.0	3.0		7.0		7.0
Phase Duration, s	64.0	64.0	20.0	20.0		1.0		1.0
Change Period, ($Y+R_c$), s	6.0	0.0	5.0	5.0		0.0		0.0
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		5.3		3.3
Queue Clearance Time (g_s), s	2.7		2.2			3.0		3.0
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		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		1	6	16		8	18		4	14
Adjusted Flow Rate (*v*), veh/h	40	74		3	697	0		0	122		1	1822
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1406		1714	1514			1617	1445		1682	1525
Queue Service Time (g_s), s		0.5		0.2	13.0			0.0	1.0		0.1	1.0
Cycle Queue Clearance Time (g_c), s		0.5		0.2	13.0			0.0	1.0		0.1	1.0
Green Ratio (*g/C*)		0.75		0.18	0.18			0.01	0.19		0.01	0.69
Capacity (*c*), veh/h		2117		303	801			19	272		20	3176
Volume-to-Capacity Ratio (*X*)		0.035		0.011	0.869			0.000	0.449		0.056	0.574
Back of Queue (*Q*), ft/ln (95 th percentile)		4.3		3.1	267.3			0	99.3		1.1	178.3
Back of Queue (*Q*), veh/ln (95 th percentile)		0.2		0.1	10.3			0.0	4.0		0.0	7.1
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00		0.00	0.00			0.00	0.00		0.00	0.00
Uniform Delay (d_1), s/veh		2.4		34.6	40.3			0.0	30.6		41.5	6.6
Incremental Delay (d_2), s/veh		0.0		0.1	12.1			0.0	1.7		0.4	0.2
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	0.0	2.4		34.7	52.4	0.0		0.0	32.2		42.0	6.8
Level of Service (LOS)	A	A		C	D				C		D	A
Approach Delay, s/veh / LOS	1.5	A		52.3	D		32.2	C		6.8	A	
Intersection Delay, s/veh / LOS	19.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.99	B	2.30	B	2.69	C	2.97	C
Bicycle LOS Score / LOS	2.63	C	2.61	C	2.37	B	3.50	C

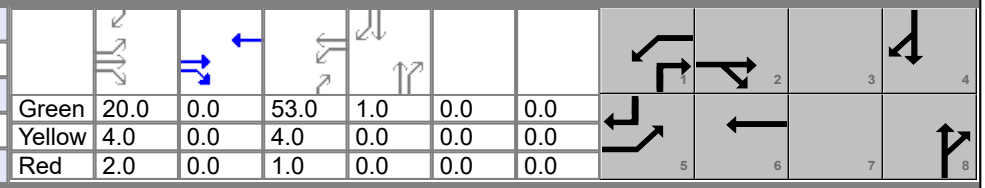
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 30, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023 DDI Build	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	1	165	320	45	1805			1	5		0	110

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off



Green	20.0	0.0		53.0	1.0	0.0	0.0					
Yellow	4.0	0.0		4.0	0.0	0.0	0.0					
Red	2.0	0.0		1.0	0.0	0.0	0.0					

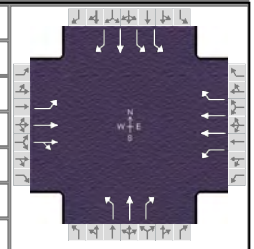
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		7.0		7.0
Phase Duration, s	26.0	26.0	58.0	58.0		1.0		1.0
Change Period, ($Y+R_c$), s	6.0	0.0	5.0	5.0		0.0		0.0
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		3.3		3.4
Queue Clearance Time (g_s), s	2.0		2.3			2.1		3.0
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			0.95		0.95
Max Out Probability	0.00		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			8	18		4	14
Adjusted Flow Rate (*v*), veh/h	0	67	129	14	578			1	6		0	122
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1810	1627			1066			1776	1506		1706	1465
Queue Service Time (g_s), s	0.0	1.6			6.0			0.1	0.1		0.0	1.0
Cycle Queue Clearance Time (g_c), s	0.0	1.6			6.0			0.1	0.1		0.0	1.0
Green Ratio (*g/C*)	0.24	0.31			0.62			0.01	0.64		0.01	0.25
Capacity (*c*), veh/h	426	995			2659			21	957		20	362
Volume-to-Capacity Ratio (*X*)	0.001	0.067			0.217			0.053	0.006		0.000	0.338
Back of Queue (*Q*), ft/ln (95 th percentile)	0.3	27.1			55.8			1.1	1.4		0	92.5
Back of Queue (*Q*), veh/ln (95 th percentile)	0.0	1.1			2.2			0.0	0.1		0.0	3.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.01	0.00			0.00			0.00	0.00		0.00	0.00
Uniform Delay (d_1), s/veh	28.5	27.2			8.7			41.5	5.7		0.0	26.3
Incremental Delay (d_2), s/veh	0.0	0.1			0.2			0.4	0.0		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
Control Delay (*d*), s/veh	28.6	27.3	0.0	0.0	8.8			41.9	5.7		0.0	26.5
Level of Service (LOS)	C	C	A	A	A			D	A			C
Approach Delay, s/veh / LOS	9.3	A		8.6	A		11.7	B		26.5	C	
Intersection Delay, s/veh / LOS	11.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.86	B	1.86	B	2.60	C	2.73	C
Bicycle LOS Score / LOS	0.93	A	1.34	A	0.50	A	0.69	A

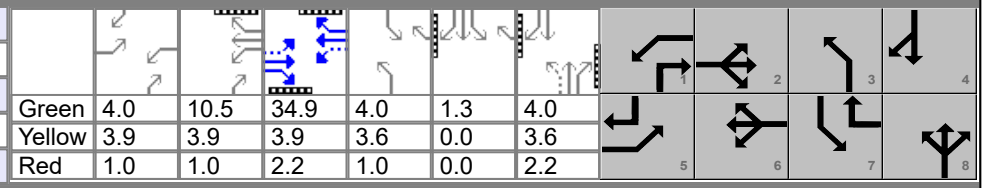
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 30, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023 DDI Build	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	315	30	60	955	430	25	20	30	115	25	85

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.0	10.5	34.9	4.0	1.3	4.0
Yellow	3.9	3.9	3.9	3.6	0.0	3.6
Red	1.0	1.0	2.2	1.0	0.0	2.2

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	3.0	2.0	3.0
Phase Duration, s	8.9	41.0	24.3	56.4	8.6	9.8	9.9	11.1
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.8	4.6	5.8
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.2	5.1	1.2
Queue Clearance Time (g_s), s	2.4		2.4		3.3	3.1	5.3	4.1
Green Extension Time (g_e), s	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.00		0.00		1.00	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	15	20	20	30	470	135	28	22	17	128	28	39
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1702	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	0.4	1.0	1.0	0.4	4.7		1.3	1.1	0.7	3.3	1.3	2.1
Cycle Queue Clearance Time (g_c), s	0.4	1.0	1.0	0.4	4.7		1.3	1.1	0.7	3.3	1.3	2.1
Green Ratio (*g/C*)	0.46	0.41	0.41	0.66	0.59		0.09	0.05	0.27	0.06	0.06	0.11
Capacity (*c*), veh/h	532	710	699	993	1948		194	81	419	200	108	161
Volume-to-Capacity Ratio (*X*)	0.028	0.029	0.029	0.030	0.241		0.143	0.273	0.040	0.638	0.256	0.242
Back of Queue (*Q*), ft/ln (95 th percentile)	7	17.6	16.9	5.8	65.2		25.3	21.1	10.7	68.5	25.8	34
Back of Queue (*Q*), veh/ln (95 th percentile)	0.3	0.7	0.7	0.2	2.5		1.0	0.8	0.4	2.6	1.0	1.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.04	0.00	0.00	0.08	0.00		0.63	0.00	0.00	0.25	0.00	0.00
Uniform Delay (d_1), s/veh	13.0	24.7	24.8	4.0	6.4		35.5	39.1	22.6	38.9	38.0	34.6
Incremental Delay (d_2), s/veh	0.0	0.1	0.1	0.0	0.3		0.5	0.7	0.0	7.1	0.5	0.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	13.1	24.8	24.9	4.1	6.6	0.0	36.0	39.8	22.6	46.0	38.4	34.9
Level of Service (LOS)	B	C	C	A	A	A	D	D	C	D	D	C
Approach Delay, s/veh / LOS	21.7	C		5.1	A		33.9	C		42.7	D	
Intersection Delay, s/veh / LOS	15.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.19	B	2.61	C	3.15	C	2.77	C
Bicycle LOS Score / LOS	2.68	C	3.45	C	2.04	B	2.40	B

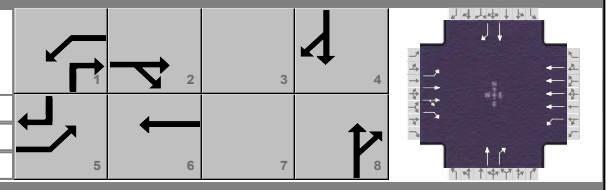
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diverging Diamond
Analyst	SS	Analysis Date	May 30, 2018	Segment Distance, ft	
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	BENSON AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	1	165	320	45	1805			1	5		0	110
Intersection Two Demand (*v*), veh/h	60	110		1	210	0		0	110		1	1640

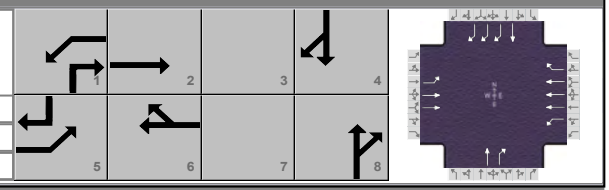
Signal One Information	
Cycle, s	85.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	20.0	0.0	53.0	1.0	0.0	0.0
Yellow	4.0	0.0	4.0	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	0.0	0.0



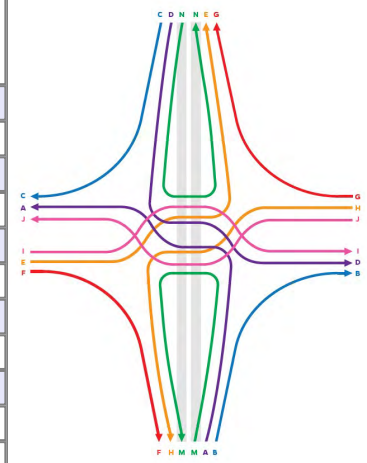
Signal Two Information	
Cycle, s	85.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	58.0	0.0	15.0	1.0	0.0	0.0
Yellow	4.0	0.0	4.0	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	0.0	0.0



Interchange Results

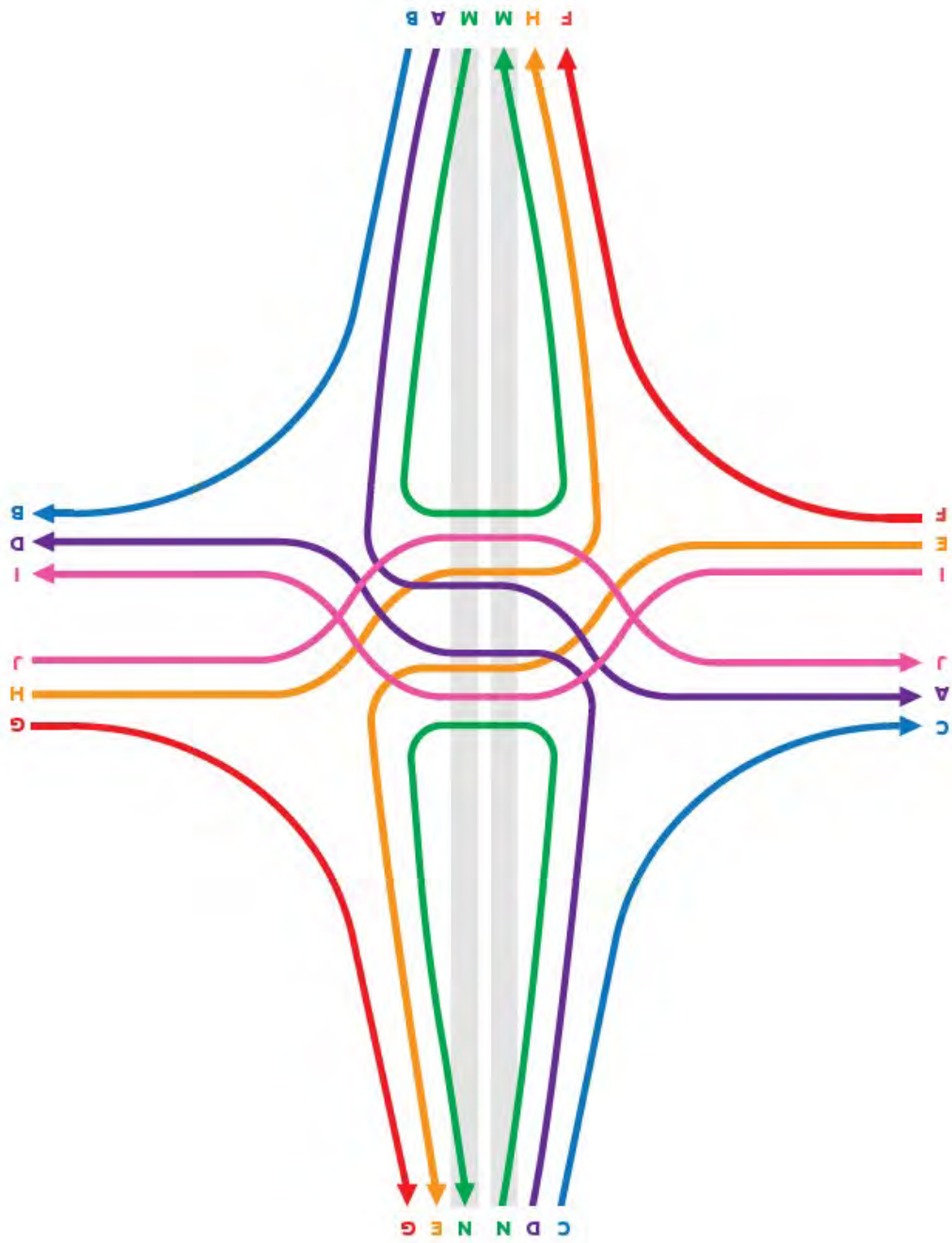
O-D	PHF-Adjusted Demand (veh/h)	Movement	Control Delay Components	Total Control Delay (s/veh)	Extra Distance (ft)	EDTT (s/veh)	ETT (s/veh)	LOS
A	122		M3 + M5	78.9	0	0.0	78.9	D
B	6		M4	5.7	0	0.0	5.7	A
C	1822		M8	6.8	0	0.0	6.8	A
D	122		M7 + M1	59.5	0	0.0	59.5	D
E	1		M6	2.4	0	0.0	2.4	A
F	0		N/A	0.0	0	0.0	0.0	A
G	0		N/A	0.0	0	0.0	0.0	A
H	1		M2	8.8	0	0.0	8.8	A
I	121		M6 + M1	29.7	30	0.6	30.3	C
J	2004		M2 + M5	61.3	30	0.6	61.8	D
M	--	--	--	--	--	--	--	--
N	--	--	--	--	--	--	--	--



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	28.6	27.3	0.0	0.0	8.8			41.9	5.7		0.0	26.5
Level of Service (LOS)	C	C	A	A	A			D	A			C
Approach Delay, s/veh / LOS	9.3	A		8.6	A		11.7	B		26.5	C	
Intersection Delay, s/veh / LOS	11.2						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	0.0	2.4		34.7	52.4	0.0		0.0	32.2		42.0	6.8
Level of Service (LOS)	A	A		C	D				C		D	A
Approach Delay, s/veh / LOS	1.5	A		52.3	D		32.2	C		6.8	A	
Intersection Delay, s/veh / LOS	19.3						B					

Interchange Graphic



HCS7 Streets Text Report

File Name:	BENSON AM.xus
Analyst:	SS
Agency/Co.:	HDR
Analysis Date:	May 30, 2018
Time Period:	AM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2023 DDI Build
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	85
Urban street forward direction	WB
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	95
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	0.51
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

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB
1	40	40	2	2	2586	2586	50	50	0	0	70	70	0	0
2	35	40	4	2	1905	1905	50	50	0	0	70	70	0	0
3	40	35	3	2	1088	1088	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h	0	615	20	0	1170	175	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											

1: Peak Hour Factor 1

Number of access points: 1

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	WB LT 5	WB TH 2	WB RT 12	EB LT 1	EB TH 6	EB RT 16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h	999			999		999
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		42.69			41.85	
1	Running Speed, mph		41.3			42.13	
1	Through Delay, s/veh		6.49			17.49	
1	Travel Speed, mph		35.85			29.71	
1	Stop Rate, stops/veh		0.25			0.61	
1	Spatial Stop Rate, stops/mi		0.5			1.25	
1	Through vol/cap ratio		0.24			0.08	
1	Percent of Base FFS		81.34			67.42	
1	Level of Service		A			B	
1	Automobile Perception Score		2.21			2.33	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999					
2	Base Free-Flow Speed, mph		41.72			44.07	
2	Running Time, s		33.34			31.62	
2	Running Speed, mph		38.96			41.07	
2	Through Delay, s/veh		8.82			25.06	
2	Travel Speed, mph		30.81			22.91	
2	Stop Rate, stops/veh		0.36			0.79	
2	Spatial Stop Rate, stops/mi		1.01			2.18	
2	Through vol/cap ratio		0.22			0.04	
2	Percent of Base FFS		73.84			51.99	
2	Level of Service		B			C	
2	Automobile Perception Score		2.29			2.48	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999					
3	Base Free-Flow Speed, mph		44.07			41.72	
3	Running Time, s		20.11			20.84	
3	Running Speed, mph		36.88			35.6	
3	Through Delay, s/veh		52.41			26.06	
3	Travel Speed, mph		10.23			15.82	
3	Stop Rate, stops/veh		1.13			0.73	
3	Spatial Stop Rate, stops/mi		5.51			3.56	
3	Through vol/cap ratio		0.87			0.08	
3	Percent of Base FFS		23.21			37.91	
3	Level of Service		F			E	
3	Automobile Perception Score		3.06			2.71	

Facility Travel Time, s	163.87	162.93
Facility Travel Speed, mph	23.21	23.35
Facility Spatial Stop Rate, stops/mi	1.65	2.02
Facility Base Free Flow Speed, mph	43.24	43.59
Facility Percent Base Free Flow Speed	53.68	53.56
Facility Level of Service	C	C
Facility Automobile Perception Score	2.37	2.45
Facility Pedestrian Space	Infinity	Infinity
Facility Pedestrian Travel Speed	4.28	4.25
Facility Pedestrian LOS Score	3.07	2.69
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	13.83	12.79
Facility Bicycle LOS Score	2.64	1.88
Facility Bicycle LOS	C	A
Facility Transit Travel Speed	35.85	29.58

Facility Transit LOS Score		1.1	0.96
Facility Transit LOS		A	A
SPILLBACK TIME, h		999	

Multimodal Results

1	Average Pedestrian Space, ft2/p	Infinity	Infinity
1	Pedestrian Travel Speed, ft/s	4.35	4.29
1	Ped LOS Score for Intersection	2.61	2.72
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	1.06	0.24
1	Speed Adjustment Factor	0.68	0.71
1	Ped LOS Score for Link	3.05	2.26
1	Ped Link LOS	C	B
1	Roadway Crossing Difficulty Factor	1.09	1.14
1	Ped LOS Score for Segment	3.35	2.81
1	Ped Segment LOS	C	C
1	Bicycle Travel Speed	13.82	13.33
1	Bicycle LOS Score for Intersection	3.45	2.68
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.41	1.66
1	Speed Adjustment Factor	0.84	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.31	2.57
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2586	2586
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.89	2.36
1	Bicycle Segment LOS	C	B
1	Transit Running Speed, mi/h	41.3	42.13
1	g/C Ratio	0.59	0.5
1	Transit Running Time, s	42.69	41.85
1	Delay at Intersection, s/veh	6.49	17.76
1	Transit Travel Speed, mi/h	35.85	29.58
1	Transit Wait-Ride Score	3.89	3.64
1	Ped LOS Score for Link	3.05	2.26
1	Transit LOS Score for Segment	0.62	0.88
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	Infinity	Infinity
2	Pedestrian Travel Speed, ft/s	4.36	4.36
2	Ped LOS Score for Intersection	1.86	2.19
2	Cross-section Adjustment Factor	-4.74	-4.99
2	Volume Adjustment Factor	0.34	0.1
2	Speed Adjustment Factor	0.61	0.67
2	Ped LOS Score for Link	2.25	1.84
2	Ped Link LOS	B	B
2	Roadway Crossing Difficulty Factor	1.11	1.2
2	Ped LOS Score for Segment	2.74	2.52
2	Ped Segment LOS	B	B
2	Bicycle Travel Speed	13.86	14.29
2	Bicycle LOS Score for Intersection	1.34	2.68
2	Cross-section Adjustment Factor	-1.28	-3.53
2	Volume Adjustment Factor	1.83	1.22
2	Speed Adjustment Factor	0.82	0.84
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	2.7	-0.14
2	Bicycle Link LOS	C	A
2	Number of access point approaches	0	0
2	Segment Length, ft	1905	1905
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.35	1.12
2	Bicycle Segment LOS	B	A
2	Transit Running Speed, mi/h	38.96	41.07
2	g/C Ratio	0.68	0.41
2	Transit Running Time, s	33.34	31.62
2	Delay at Intersection, s/veh	8.82	25.03
2	Transit Travel Speed, mi/h	30.81	22.93
2	Transit Wait-Ride Score	3.69	3.31
2	Ped LOS Score for Link	2.25	1.84
2	Transit LOS Score for Segment	0.8	1.32
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	Infinity	Infinity

3	Pedestrian Travel Speed, ft/s	3.99	4
3	Ped LOS Score for Intersection	2.3	1.86
3	Cross-section Adjustment Factor	-4.74	-4.74
3	Volume Adjustment Factor	0.53	0.28
3	Speed Adjustment Factor	0.54	0.51
3	Ped LOS Score for Link	2.38	2.09
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.18	1.19
3	Ped LOS Score for Segment	2.95	2.71
3	Ped Segment LOS	C	B
3	Bicycle Travel Speed	13.8	9.98
3	Bicycle LOS Score for Intersection	2.61	0.93
3	Cross-section Adjustment Factor	-1.28	-1.28
3	Volume Adjustment Factor	2.06	1.73
3	Speed Adjustment Factor	0.79	0.77
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	2.91	2.56
3	Bicycle Link LOS	C	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1088	1088
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	2.56	2.09
3	Bicycle Segment LOS	B	B
3	Transit Running Speed, mi/h	36.88	35.6
3	g/C Ratio	0.22	0.68
3	Transit Running Time, s	20.11	20.84
3	Delay at Intersection, s/veh	52.41	0
3	Transit Travel Speed, mi/h	10.23	35.6
3	Transit Wait-Ride Score	2.4	3.88
3	Ped LOS Score for Link	2.38	2.09
3	Transit LOS Score for Segment	2.75	0.49
3	Transit Segment LOS	C	A

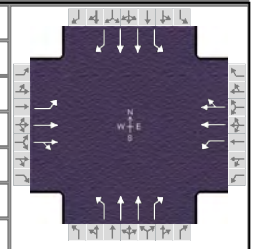
ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h	0	205	6.66	0	807	121	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.11	0	0	0	0	0	0.11	0.11	0	0.11	0.11	0.11
1: Thru veh delay		0			0.07							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

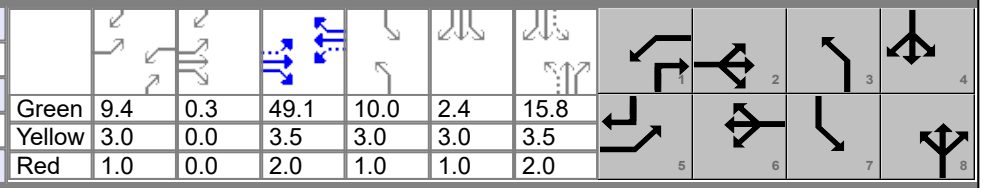
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 30, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023 Build DDI	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	135	615	170	170	340	145	135	375	50	235	395	105

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	9.4	0.3	49.1	10.0	2.4	15.8						
Yellow	3.0	0.0	3.5	3.0	3.0	3.5						
Red	1.0	0.0	2.0	1.0	1.0	2.0						

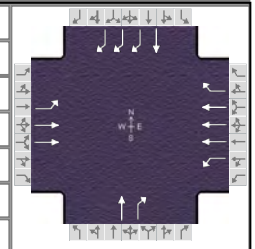
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	13.7	55.0	13.4	54.6	14.0	21.3	20.4	27.7
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	9.2		8.7		10.4	15.6	16.3	15.5
Green Extension Time (g_e), s	0.5	0.0	0.7	0.0	0.0	0.1	0.1	0.1
Phase Call Probability	1.00		1.00		0.99	1.00	1.00	1.00
Max Out Probability	0.34		0.01		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	203	546	521	189	239	227	150	417	39	261	439	72
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1648	1647	1730	1616	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	7.2	26.6	27.3	6.7	9.8	10.0	8.4	13.6	2.3	14.3	13.5	4.0
Cycle Queue Clearance Time (g_c), s	7.2	26.6	27.3	6.7	9.8	10.0	8.4	13.6	2.3	14.3	13.5	4.0
Green Ratio (*g/C*)	0.53	0.45	0.45	0.53	0.45	0.45	0.23	0.14	0.23	0.31	0.20	0.29
Capacity (*c*), veh/h	533	778	741	300	773	722	271	473	335	329	664	425
Volume-to-Capacity Ratio (*X*)	0.381	0.702	0.702	0.629	0.310	0.315	0.553	0.881	0.116	0.793	0.661	0.170
Back of Queue (*Q*), ft/ln (95 th percentile)	119.4	373.2	363.2	121.3	186.7	172.1	165.7	256.7	38	282.9	238.5	65.6
Back of Queue (*Q*), veh/ln (95 th percentile)	4.6	14.4	14.5	4.7	7.2	6.9	6.4	9.9	1.5	10.9	9.2	2.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.61	0.00	0.00	0.87	0.00	0.00	0.55	0.00	0.16	0.76	0.00	0.21
Uniform Delay (d_1), s/veh	14.2	21.5	23.0	19.6	19.5	19.6	35.9	46.2	33.6	32.4	40.5	29.2
Incremental Delay (d_2), s/veh	0.4	3.2	3.3	3.1	1.0	1.1	3.1	6.7	0.1	12.6	0.4	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	0.0	0.0
Control Delay (*d*), s/veh	14.5	24.7	26.4	22.7	20.6	20.7	39.0	52.9	33.7	45.1	40.9	29.3
Level of Service (LOS)	B	C	C	C	C	C	D	D	C	D	D	C
Approach Delay, s/veh / LOS	23.8	C		21.3	C		48.2	D		41.2	D	
Intersection Delay, s/veh / LOS	31.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.84	C	2.90	C	2.93	C	2.90	C
Bicycle LOS Score / LOS	3.04	C	2.80	C	2.89	C	3.02	C

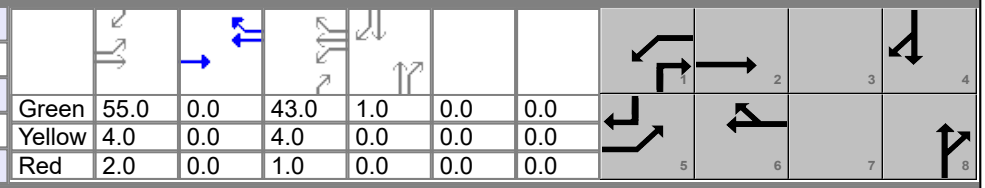
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 30, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023 Build DDI	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	150	240		1	395	115		0	60		1	365

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off



Green	55.0	0.0	43.0	1.0	0.0	0.0
Yellow	4.0	0.0	4.0	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	0.0	0.0

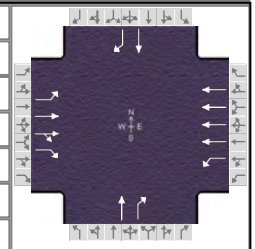
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	4.0	2.0	3.0		7.0		7.0
Phase Duration, s	61.0	61.0	48.0	48.0		1.0		1.0
Change Period, ($Y+R_c$), s	6.0	0.0	5.0	5.0		0.0		0.0
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		5.3		3.3
Queue Clearance Time (g_s), s	6.6		2.0			3.0		3.0
Green Extension Time (g_e), s	0.2	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		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		1	6	16		8	18		4	14
Adjusted Flow Rate (*v*), veh/h	100	161		1	371	47		0	67		1	406
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1419		1714	1502			1617	1439		1683	1453
Queue Service Time (g_s), s		3.9		0.0	5.3			0.0	1.0		0.1	1.0
Cycle Queue Clearance Time (g_c), s		3.9		0.0	5.3			0.0	1.0		0.1	1.0
Green Ratio (*g/C*)		0.55		0.39	0.39			0.01	0.40		0.01	0.51
Capacity (*c*), veh/h		1574		670	1761			15	576		15	2219
Volume-to-Capacity Ratio (*X*)		0.102		0.001	0.211			0.000	0.116		0.073	0.183
Back of Queue (*Q*), ft/ln (95 th percentile)		57.2		0.6	83.6			0	47.3		1.5	78.4
Back of Queue (*Q*), veh/ln (95 th percentile)		2.2		0.0	3.2			0.0	1.9		0.1	3.1
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00		0.00	0.00			0.00	0.00		0.00	0.00
Uniform Delay (d_1), s/veh		15.8		17.1	18.9			0.0	20.8		54.0	14.6
Incremental Delay (d_2), s/veh		0.1		0.0	0.3			0.0	0.1		0.7	0.0
Initial Queue Delay (d_3), s/veh		0.0		0.0	0.0			0.0	0.0		0.0	0.0
Control Delay (*d*), s/veh	0.0	15.9		17.1	19.2	0.0		0.0	20.9		54.8	14.6
Level of Service (LOS)	A	B		B	B	A			C		D	B
Approach Delay, s/veh / LOS	9.8	A		17.0	B		20.9	C		14.7	B	
Intersection Delay, s/veh / LOS	14.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.95	B	2.32	B	2.87	C	2.82	C
Bicycle LOS Score / LOS	2.84	C	2.75	C	2.28	B	1.16	A

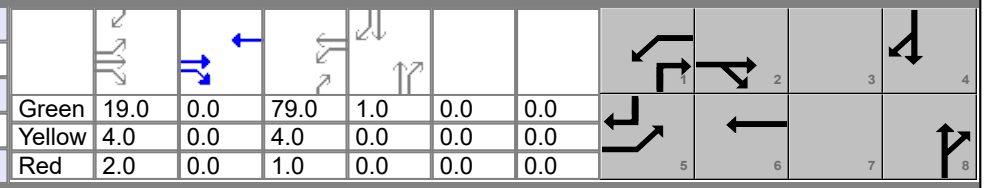
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 30, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023 Build DDI	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	1	385	1450	135	625			1	5		0	40

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off



Green	19.0	0.0	79.0	1.0	0.0	0.0						
Yellow	4.0	0.0	4.0	0.0	0.0	0.0						
Red	2.0	0.0	1.0	0.0	0.0	0.0						

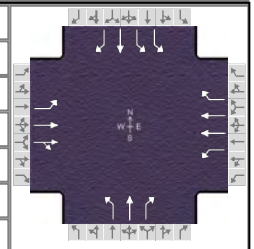
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		7.0		7.0
Phase Duration, s	25.0	25.0	84.0	84.0		1.0		1.0
Change Period, ($Y+R_c$), s	6.0	5.0	5.0	5.0		0.0		0.0
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		3.2		3.3
Queue Clearance Time (g_s), s	2.0		2.3			2.1		3.0
Green Extension Time (g_e), s	0.0	0.0	0.2	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			0.79		0.79
Max Out Probability	0.00		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			8	18		4	14
Adjusted Flow Rate (*v*), veh/h	0	48	179	96	447			1	6		0	44
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1481			971			1617	1427		1682	1434
Queue Service Time (g_s), s	0.0	1.3			1.4			0.1	0.1		0.0	1.0
Cycle Queue Clearance Time (g_c), s	0.0	1.3			1.4			0.1	0.1		0.0	1.0
Green Ratio (*g/C*)	0.17	0.18			0.72			0.01	0.73		0.01	0.18
Capacity (*c*), veh/h	285	539			2789			15	1038		15	261
Volume-to-Capacity Ratio (*X*)	0.000	0.088			0.160			0.076	0.005		0.000	0.170
Back of Queue (*Q*), ft/ln (95 th percentile)	0.1	21.7			10.6			1.5	1.2		0	45
Back of Queue (*Q*), veh/ln (95 th percentile)	0.0	0.8			0.4			0.1	0.0		0.0	1.8
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00			0.00	0.00		0.00	0.00
Uniform Delay (d_1), s/veh	36.9	31.4			1.5			54.0	4.1		0.0	38.0
Incremental Delay (d_2), s/veh	0.0	0.3			0.1			0.8	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
Control Delay (*d*), s/veh	36.9	31.7	0.0	0.0	1.6			54.8	4.1		0.0	38.1
Level of Service (LOS)	D	C	A	A	A			D	A			D
Approach Delay, s/veh / LOS	6.7	A		1.3	A		12.6	B		38.1	D	
Intersection Delay, s/veh / LOS	4.9						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.72	C	1.91	B	2.94	C	3.27	C
Bicycle LOS Score / LOS	4.16	D	2.80	C	2.18	B	0.56	A

HCS7 Signalized Intersection Results Summary

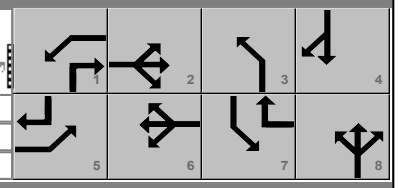
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 30, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2023 Build DDI	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	50	900	15	60	410	80	40	230	125	745	25	140

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	4.0	0.5	36.7	4.5	20.3	18.0
Yellow	3.9	0.0	3.9	3.6	3.6	3.6
Red	1.0	0.0	2.2	1.0	1.0	2.2



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	3.0	2.0	3.0
Phase Duration, s	8.9	42.8	9.4	43.3	9.1	23.8	34.0	48.7
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.8	4.6	5.8
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.2	5.1	1.2
Queue Clearance Time (g_s), s	2.8		5.4		4.4	18.0	30.1	4.7
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	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	177	177	78	532	78	44	256	94	828	28	61
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1726	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	0.8	7.7	7.7	3.4	14.4		2.4	16.0	5.8	28.1	1.1	2.7
Cycle Queue Clearance Time (g_c), s	0.8	7.7	7.7	3.4	14.4		2.4	16.0	5.8	28.1	1.1	2.7
Green Ratio (*g/C*)	0.37	0.33	0.33	0.37	0.34		0.20	0.16	0.20	0.27	0.39	0.43
Capacity (*c*), veh/h	287	577	576	398	1115		352	282	312	855	675	625
Volume-to-Capacity Ratio (*X*)	0.068	0.306	0.306	0.196	0.477		0.126	0.905	0.303	0.968	0.041	0.098
Back of Queue (*Q*), ft/ln (95 th percentile)	15.5	151	144.5	67	252.5		46.3	362.4	96.8	508.9	20.6	43.1
Back of Queue (*Q*), veh/ln (95 th percentile)	0.6	5.8	5.8	2.6	9.7		1.8	13.9	3.9	19.6	0.8	1.7
Queue Storage Ratio (*RQ*) (95 th percentile)	0.08	0.00	0.00	0.19	0.00		0.46	0.00	0.00	0.97	0.00	0.00
Uniform Delay (d_1), s/veh	23.7	24.5	24.4	23.4	30.2		35.8	45.2	37.1	39.8	20.8	18.9
Incremental Delay (d_2), s/veh	0.1	1.4	1.4	1.0	1.4		0.2	29.0	0.2	23.3	0.0	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	23.9	25.9	25.8	24.5	31.5	0.0	36.1	74.2	37.3	63.1	20.8	18.9
Level of Service (LOS)	C	C	C	C	C	A	D	E	D	E	C	B
Approach Delay, s/veh / LOS	25.8	C		27.2	C		61.1	E		58.9	E	
Intersection Delay, s/veh / LOS	44.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.34	B	2.74	C	3.16	C	2.75	C
Bicycle LOS Score / LOS	3.14	C	2.75	C	2.58	C	3.59	D

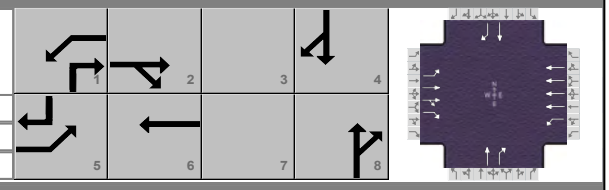
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diverging Diamond
Analyst	SS	Analysis Date	May 30, 2018	Segment Distance, ft	
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	BENSON PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	1	385	1450	135	625			1	5		0	40
Intersection Two Demand (*v*), veh/h	150	240		1	395	115		0	60		1	365

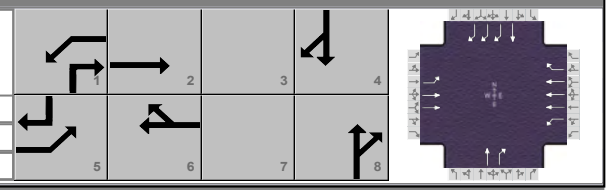
Signal One Information	
Cycle, s	110.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	19.0	0.0	79.0	1.0	0.0	0.0
Yellow	4.0	0.0	4.0	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	0.0	0.0



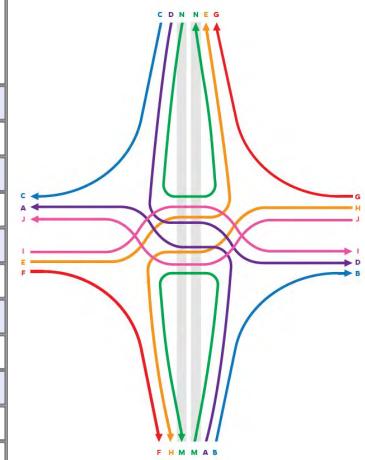
Signal Two Information	
Cycle, s	110.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	55.0	0.0	43.0	1.0	0.0	0.0
Yellow	4.0	0.0	4.0	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	0.0	0.0



Interchange Results

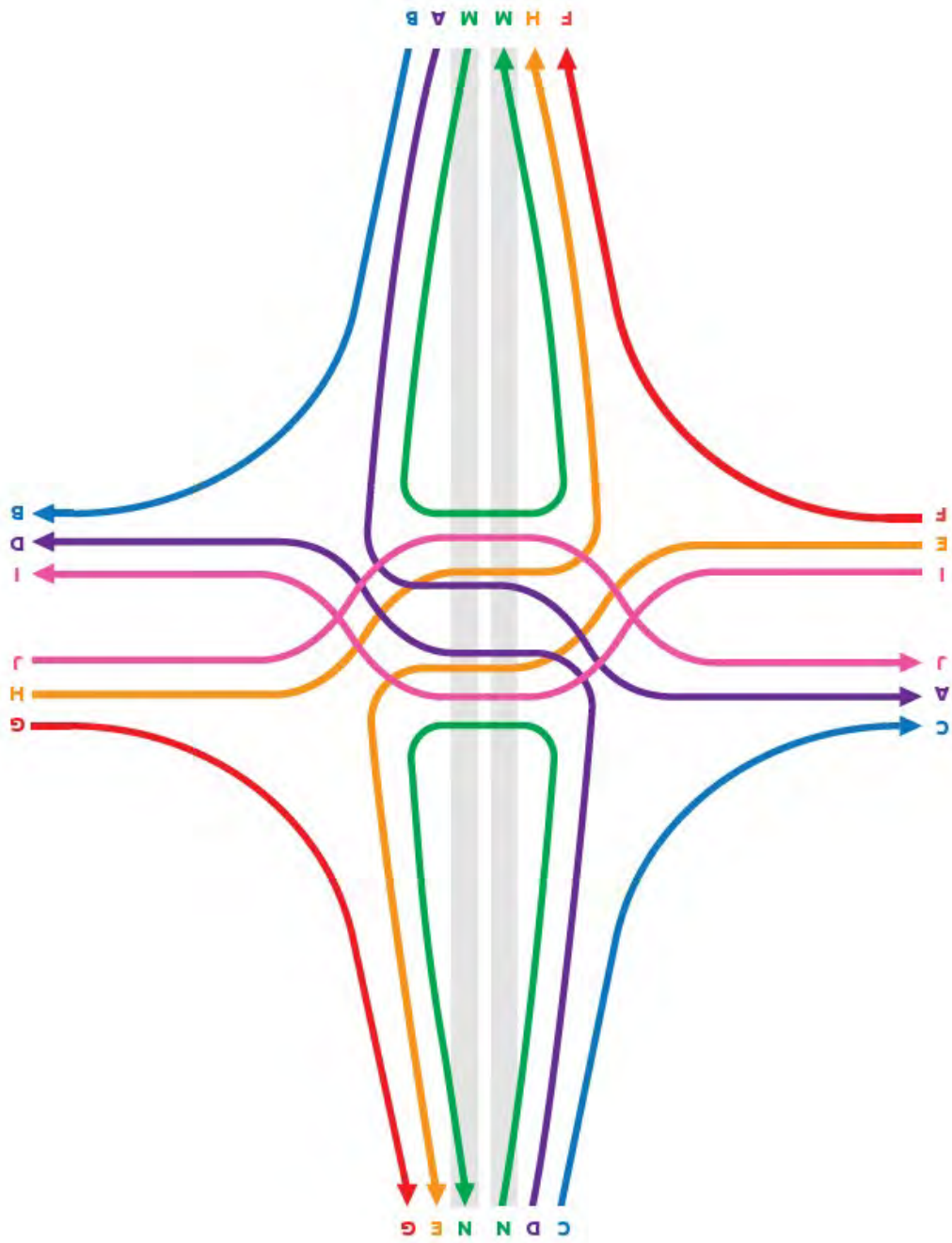
O-D	PHF-Adjusted Demand (veh/h)	Movement	Control Delay Components	Total Control Delay (s/veh)	Extra Distance (ft)	EDTT (s/veh)	ETT (s/veh)	LOS
A	44		M3 + M5	57.3	0	0.0	57.3	D
B	6		M4	4.1	0	0.0	4.1	A
C	406		M8	14.6	0	0.0	14.6	A
D	67		M7 + M1	52.6	0	0.0	52.6	C
E	1		M6	15.9	0	0.0	15.9	B
F	0		N/A	0.0	0	0.0	0.0	A
G	0		N/A	0.0	0	0.0	0.0	A
H	1		M2	1.6	0	0.0	1.6	A
I	266		M6 + M1	47.6	30	0.6	48.2	C
J	693		M2 + M5	20.8	30	0.6	21.4	B
M	--	--	--	--	--	--	--	--
N	--	--	--	--	--	--	--	--



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	36.9	31.7	0.0	0.0	1.6			54.8	4.1		0.0	38.1
Level of Service (LOS)	D	C	A	A	A			D	A			D
Approach Delay, s/veh / LOS	6.7	A		1.3	A		12.6	B		38.1	D	
Intersection Delay, s/veh / LOS	4.9						A					

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	0.0	15.9		17.1	19.2	0.0		0.0	20.9		54.8	14.6
Level of Service (LOS)	A	B		B	B	A			C		D	B
Approach Delay, s/veh / LOS	9.8	A		17.0	B		20.9	C		14.7	B	
Intersection Delay, s/veh / LOS	14.8						B					

Interchange Graphic



HCS7 Streets Text Report

File Name: BENSON PM.xus
Analyst: SS
Agency/Co.: HDR
Analysis Date: May 30, 2018
Time Period: PM PEAK
Jurisdiction: CITY OF SIOUX FALLS
Analysis Year: 2023 Build DDI
Project Description: I-229/BENSON IMJR
Urban Street: BENSON ROAD
Analysis Period: 1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	110
Urban street forward direction	WB
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	95
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	0.51
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

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB
1	40	40	2	2	2598	2598	50	50	0	0	70	70	0	0
2	40	40	4	2	1891	1891	50	50	0	0	70	70	0	0
3	40	40	3	2	1084	1084	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h	0	850	20	0	665	0	30	0	45	40	0	35
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Location, ft	1320											

1: Peak Hour Factor	1

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h	0	1510	0	0	545	40	0	0	0	145	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	5	1435	25	40	340	30	10	5	95	70	0	40
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1410											
2: Peak Hour Factor	1											

Number of access points: 2

SEGMENT 3

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	WB LT 5	WB TH 2	WB RT 12	EB LT 1	EB TH 6	EB RT 16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h	999			999		999
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		42.48			43.33	
1	Running Speed, mph		41.7			40.88	
1	Through Delay, s/veh		31.53			26.32	
1	Travel Speed, mph		23.93			25.43	
1	Stop Rate, stops/veh		0.72			0.65	
1	Spatial Stop Rate, stops/mi		1.47			1.33	
1	Through vol/cap ratio		0.48			0.71	
1	Percent of Base FFS		54.31			57.71	
1	Level of Service		C			C	
1	Automobile Perception Score		2.36			2.34	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999					
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		31.69			31.41	
2	Running Speed, mph		40.68			41.05	
2	Through Delay, s/veh		1.64			25.86	
2	Travel Speed, mph		38.68			22.51	
2	Stop Rate, stops/veh		0.07			0.6	
2	Spatial Stop Rate, stops/mi		0.19			1.67	
2	Through vol/cap ratio		0.16			0.31	
2	Percent of Base FFS		87.76			51.08	
2	Level of Service		A			C	
2	Automobile Perception Score		2.23			2.47	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h						
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		19.99			19.99	
3	Running Speed, mph		36.97			36.97	
3	Through Delay, s/veh		19.2			35.92	
3	Travel Speed, mph		18.86			13.22	
3	Stop Rate, stops/veh		0.47			0.72	
3	Spatial Stop Rate, stops/mi		2.3			3.49	
3	Through vol/cap ratio		0.21			0.13	
3	Percent of Base FFS		42.79			29.99	
3	Level of Service		D			F	
3	Automobile Perception Score		2.5			2.7	

Facility Travel Time, s	146.53	182.83
Facility Travel Speed, mph	25.93	20.78
Facility Spatial Stop Rate, stops/mi	1.19	1.86
Facility Base Free Flow Speed, mph	44.07	44.07
Facility Percent Base Free Flow Speed	58.84	47.16
Facility Level of Service	C	D
Facility Automobile Perception Score	2.34	2.44

Facility Pedestrian Space	Infinity	Infinity
Facility Pedestrian Travel Speed	4.25	4.24
Facility Pedestrian LOS Score	2.93	3.12
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	12.72	12.68
Facility Bicycle LOS Score	2.63	2.4
Facility Bicycle LOS	C	C
Facility Transit Travel Speed	23.93	25.7
Facility Transit LOS Score	1.1	1.17
Facility Transit LOS	A	A
SPILLBACK TIME, h	999	

Multimodal Results

1	Average Pedestrian Space, ft2/p	Infinity	Infinity
1	Pedestrian Travel Speed, ft/s	4.23	4.23
1	Ped LOS Score for Intersection	2.74	2.84
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.73	1.5
1	Speed Adjustment Factor	0.7	0.67
1	Ped LOS Score for Link	2.74	3.48
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.2	1.08
1	Ped LOS Score for Segment	3.32	3.67
1	Ped Segment LOS	C	D
1	Bicycle Travel Speed	13.12	12.43
1	Bicycle LOS Score for Intersection	2.75	3.04
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.23	2.59
1	Speed Adjustment Factor	0.85	0.84
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.13	3.48
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2598	2598
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.73	2.99
1	Bicycle Segment LOS	B	C
1	Transit Running Speed, mi/h	41.7	40.88
1	g/C Ratio	0.34	0.45
1	Transit Running Time, s	42.48	43.33
1	Delay at Intersection, s/veh	31.53	25.59
1	Transit Travel Speed, mi/h	23.93	25.7
1	Transit Wait-Ride Score	3.36	3.45
1	Ped LOS Score for Link	2.74	3.48
1	Transit LOS Score for Segment	1.37	1.34
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	Infinity	Infinity
2	Pedestrian Travel Speed, ft/s	4.36	4.36
2	Ped LOS Score for Intersection	1.91	2.34
2	Cross-section Adjustment Factor	-4.74	-5.01
2	Volume Adjustment Factor	0.42	0.09
2	Speed Adjustment Factor	0.66	0.67
2	Ped LOS Score for Link	2.39	1.79
2	Ped Link LOS	B	B
2	Roadway Crossing Difficulty Factor	0.88	1.2
2	Ped LOS Score for Segment	2.44	2.49
2	Ped Segment LOS	B	B
2	Bicycle Travel Speed	11.72	14.27
2	Bicycle LOS Score for Intersection	2.8	3.14
2	Cross-section Adjustment Factor	-1.28	-3.87
2	Volume Adjustment Factor	1.94	1.14
2	Speed Adjustment Factor	0.84	0.84
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	2.83	-0.56
2	Bicycle Link LOS	C	A
2	Number of access point approaches	0	0
2	Segment Length, ft	1891	1891
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.6	1.25
2	Bicycle Segment LOS	B	A
2	Transit Running Speed, mi/h	40.68	41.05

2	g/C Ratio	0.72	0.33
2	Transit Running Time, s	31.69	31.41
2	Delay at Intersection, s/veh	1.64	25.91
2	Transit Travel Speed, mi/h	38.68	22.5
2	Transit Wait-Ride Score	3.99	3.28
2	Ped LOS Score for Link	2.39	1.79
2	Transit LOS Score for Segment	0.37	1.35
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	Infinity	Infinity
3	Pedestrian Travel Speed, ft/s	4.11	4.11
3	Ped LOS Score for Intersection	2.32	2.72
3	Cross-section Adjustment Factor	-4.74	-4.74
3	Volume Adjustment Factor	0.37	0.38
3	Speed Adjustment Factor	0.55	0.55
3	Ped LOS Score for Link	2.23	2.23
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.2	1.2
3	Ped LOS Score for Segment	2.86	2.88
3	Ped Segment LOS	C	C
3	Bicycle Travel Speed	13.78	11.07
3	Bicycle LOS Score for Intersection	2.75	4.16
3	Cross-section Adjustment Factor	-1.28	-1.28
3	Volume Adjustment Factor	1.88	1.89
3	Speed Adjustment Factor	0.79	0.79
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	2.73	2.74
3	Bicycle Link LOS	C	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1084	1084
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	2.45	3
3	Bicycle Segment LOS	B	C
3	Transit Running Speed, mi/h	36.97	36.97
3	g/C Ratio	0.44	0.72
3	Transit Running Time, s	19.99	19.99
3	Delay at Intersection, s/veh	19.2	0
3	Transit Travel Speed, mi/h	18.86	36.97
3	Transit Wait-Ride Score	3.06	3.93
3	Ped LOS Score for Link	2.23	2.23
3	Transit LOS Score for Segment	1.74	0.44
3	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h	0	1288	30.3	0	644	0	30	0	45	40	0	35
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.05	0	0	0.31	0	0	0.35	0.35	0.31	0.35	0.35	0.05
1: Thru veh delay		0.03			0							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h	0	239	0	0	682	50	0	0	0	145	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0.13	0	0	0	0	0	0.13	0.13	0	0.13	0.13	0.13
1: Thru veh delay		0			0.03							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	0.26	73.9	1.29	66.5	565	49.9	10	5	95	70	0	40
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0.1	0	0	0	0	0	0.1	0.1	0	0.1	0.1	0.1
2: Thru veh delay		0			0.03							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1410											

Option 4B

Option 4B Model Replicates Option 4A - See 4A

IV. 2045 Freeway Analysis – Ramps

Option 1A

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1430	180
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1748	220
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.38	0.11

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	16.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.332
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	58.9
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1748	Ramp Junction Speed (S), mi/h	58.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	14.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	860	95
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1051	116
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.26	0.06

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.241
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1051	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1167	Average Density (D), pc/mi/ln	9.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1510	140
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1846	171
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.41	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	17.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.328
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1846	Ramp Junction Speed (S), mi/h	59.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	15.6
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	925	285
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1131	348
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.33	0.17

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.246
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1131	Ramp Junction Speed (S), mi/h	61.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1479	Average Density (D), pc/mi/ln	12.1
Level of Service (LOS)	B		

Option 1B

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1430	180
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1748	220
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.38	0.11

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	16.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.332
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	58.9
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1748	Ramp Junction Speed (S), mi/h	58.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	14.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	860	95
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1051	116
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.26	0.06

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.241
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1051	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1167	Average Density (D), pc/mi/ln	9.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1510	140
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1846	171
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.41	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	17.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.328
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1846	Ramp Junction Speed (S), mi/h	59.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	15.6
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	925	285
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1131	348
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.33	0.17

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.246
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1131	Ramp Junction Speed (S), mi/h	61.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1479	Average Density (D), pc/mi/ln	12.1
Level of Service (LOS)	B		

Option 1C

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1430	180
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1748	220
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.38	0.11

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	16.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.332
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	58.9
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1748	Ramp Junction Speed (S), mi/h	58.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	14.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	860	95
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1051	116
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.26	0.06

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.241
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1051	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1167	Average Density (D), pc/mi/ln	9.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1510	140
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1846	171
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.41	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	17.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.328
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1846	Ramp Junction Speed (S), mi/h	59.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	15.6
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	925	285
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1131	348
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.33	0.17

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.246
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1131	Ramp Junction Speed (S), mi/h	61.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1479	Average Density (D), pc/mi/ln	12.1
Level of Service (LOS)	B		

Option 1D

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1430	180
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1748	220
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.38	0.11

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	16.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.332
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	58.9
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1748	Ramp Junction Speed (S), mi/h	58.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	14.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/28/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	860	95
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1051	116
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.26	0.06

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.241
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1051	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1167	Average Density (D), pc/mi/ln	9.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1510	140
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1846	171
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.41	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	17.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.328
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1846	Ramp Junction Speed (S), mi/h	59.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	15.6
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	925	285
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1131	348
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.33	0.17

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.246
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1131	Ramp Junction Speed (S), mi/h	61.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1479	Average Density (D), pc/mi/ln	12.1
Level of Service (LOS)	B		

Option 1E

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1430	180
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1748	220
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.38	0.11

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	16.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.332
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	58.9
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1748	Ramp Junction Speed (S), mi/h	58.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	14.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	860	95
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1051	116
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.26	0.06

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.241
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1051	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1167	Average Density (D), pc/mi/ln	9.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1510	140
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1846	171
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.41	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	17.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.328
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1846	Ramp Junction Speed (S), mi/h	59.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	15.6
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3215	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	925	285
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1131	348
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.33	0.17

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.246
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1131	Ramp Junction Speed (S), mi/h	61.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1479	Average Density (D), pc/mi/ln	12.1
Level of Service (LOS)	B		

Option 4A

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1430	180
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1748	220
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.38	0.11

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	16.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.332
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	58.9
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1748	Ramp Junction Speed (S), mi/h	58.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	14.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	860	95
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1051	116
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.26	0.06

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.241
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1051	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1167	Average Density (D), pc/mi/ln	9.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1510	140
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1846	171
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.41	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	17.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.328
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1846	Ramp Junction Speed (S), mi/h	59.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	15.6
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	925	285
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1131	348
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.33	0.17

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.246
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1131	Ramp Junction Speed (S), mi/h	61.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1479	Average Density (D), pc/mi/ln	12.1
Level of Service (LOS)	B		

Option 4B

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1430	180
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1748	220
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.38	0.11

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	16.8
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.332
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	58.9
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1748	Ramp Junction Speed (S), mi/h	58.9
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	14.8
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	860	95
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1051	116
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.26	0.06

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	8.0
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.241
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.2
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1051	Ramp Junction Speed (S), mi/h	61.2
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1167	Average Density (D), pc/mi/ln	9.5
Level of Service (LOS)	A		

HCS7 Freeway Diverge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Deceleration Length (L_D), ft	3620	280
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	1510	140
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1846	171
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.41	0.08

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	17.6
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.328
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	59.0
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1846	Ramp Junction Speed (S), mi/h	59.0
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	15.6
Level of Service (LOS)	B		

HCS7 Freeway Merge Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

	Freeway	Ramp
Number of Lanes (N)	2	1
Free-Flow Speed (FFS), mi/h	69.0	45.0
Segment Length (L) / Acceleration Length (L_A), ft	3445	1050
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (V_i), veh/h	925	285
Peak Hour Factor (PHF)	0.90	0.90
Total Trucks, %	10.00	10.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.909	0.909
Flow Rate (v_i), pc/h	1131	348
Capacity (c), pc/h	4550	2033
Volume-to-Capacity Ratio (v/c)	0.33	0.17

Speed and Density

Upstream Equilibrium Distance (L_{EQ}), ft	-	Density in Ramp Influence Area (D_R), pc/mi/ln	10.3
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (M_S)	0.246
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	-
Distance to Downstream Ramp (L_{DOWN}), ft	-	On-Ramp Influence Area Speed (S_R), mi/h	61.1
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FM})	1.000	Outer Lanes Freeway Speed (S_O), mi/h	-
Flow in Lanes 1 and 2 (v_{12}), pc/h	1131	Ramp Junction Speed (S), mi/h	61.1
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	1479	Average Density (D), pc/mi/ln	12.1
Level of Service (LOS)	B		

V. 2045 Freeway Analysis – Weaving

Option 1A

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1130	395	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1343	500	19	152

Weaving Flow Rate (v_w), pc/h	652	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1362	Density-Based Capacity (c_{IWL}), pc/h/ln	2301
Total Flow Rate (v), pc/h	2014	Demand Flow-Based Capacity (c_{IW}), pc/h	7407
Volume Ratio (VR)	0.324	Weaving Segment Capacity (c_W), veh/h	6454
Minimum Lane Change Rate (LC_{MIN}), lc/h	652	Adjusted Weaving Area Capacity, pc/h	6821
Maximum Weaving Length (L_{MAX}), ft	5843	Volume-to-Capacity Ratio (v/c)	0.30

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	441	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1993	Average Non-Weaving Speed (S_{NW}), mi/h	59.4
Weaving Lane Change Rate (LC_W), lc/h	1009	Average Speed (S), mi/h	59.7
Total Lane Change Rate (LC_{All}), lc/h	3002	Density (D), pc/mi/ln	11.2
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	605	255	175	1635
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	719	323	222	2071

Weaving Flow Rate (v_w), pc/h	2394	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	941	Density-Based Capacity (c_{IWL}), pc/h/ln	1870
Total Flow Rate (v), pc/h	3335	Demand Flow-Based Capacity (c_{IW}), pc/h	3343
Volume Ratio (VR)	0.718	Weaving Segment Capacity (c_W), veh/h	3125
Minimum Lane Change Rate (LC_{MIN}), lc/h	323	Adjusted Weaving Area Capacity, pc/h	3401
Maximum Weaving Length (L_{MAX}), ft	10484	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	243	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1733	Average Non-Weaving Speed (S_{NW}), mi/h	59.6
Weaving Lane Change Rate (LC_W), lc/h	639	Average Speed (S), mi/h	60.2
Total Lane Change Rate (LC_{All}), lc/h	2372	Density (D), pc/mi/ln	18.5
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.33	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1100	1610	30	270
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1307	2040	38	342

Weaving Flow Rate (v_w), pc/h	2382	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1345	Density-Based Capacity (c_{IWL}), pc/h/ln	2022
Total Flow Rate (v), pc/h	3727	Demand Flow-Based Capacity (c_{IW}), pc/h	3756
Volume Ratio (VR)	0.639	Weaving Segment Capacity (c_W), veh/h	3512
Minimum Lane Change Rate (LC_{MIN}), lc/h	2382	Adjusted Weaving Area Capacity, pc/h	3789
Maximum Weaving Length (L_{MAX}), ft	9496	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	220	Average Weaving Speed (S_W), mi/h	58.0
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1989	Average Non-Weaving Speed (S_{NW}), mi/h	44.2
Weaving Lane Change Rate (LC_W), lc/h	2682	Average Speed (S), mi/h	52.1
Total Lane Change Rate (LC_{All}), lc/h	4671	Density (D), pc/mi/ln	23.8
Weaving Intensity Factor (W)	0.217	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	750	175	120	355
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	891	222	152	450

Weaving Flow Rate (v_w), pc/h	672	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1043	Density-Based Capacity (c_{IWL}), pc/h/ln	2167
Total Flow Rate (v), pc/h	1715	Demand Flow-Based Capacity (c_{IW}), pc/h	6122
Volume Ratio (VR)	0.392	Weaving Segment Capacity (c_W), veh/h	5724
Minimum Lane Change Rate (LC_{MIN}), lc/h	672	Adjusted Weaving Area Capacity, pc/h	6109
Maximum Weaving Length (L_{MAX}), ft	6592	Volume-to-Capacity Ratio (v/c)	0.28

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	269	Average Weaving Speed (S_W), mi/h	59.7
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1754	Average Non-Weaving Speed (S_{NW}), mi/h	59.7
Weaving Lane Change Rate (LC_W), lc/h	988	Average Speed (S), mi/h	59.7
Total Lane Change Rate (LC_{All}), lc/h	2742	Density (D), pc/mi/ln	9.6
Weaving Intensity Factor (W)	0.171	Level of Service (LOS)	A

Option 1B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1130	395	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1343	500	19	152

Weaving Flow Rate (v_w), pc/h	652	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1362	Density-Based Capacity (c_{IWL}), pc/h/ln	2301
Total Flow Rate (v), pc/h	2014	Demand Flow-Based Capacity (c_{IW}), pc/h	7407
Volume Ratio (VR)	0.324	Weaving Segment Capacity (c_W), veh/h	6454
Minimum Lane Change Rate (LC_{MIN}), lc/h	652	Adjusted Weaving Area Capacity, pc/h	6821
Maximum Weaving Length (L_{MAX}), ft	5843	Volume-to-Capacity Ratio (v/c)	0.30

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	441	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1993	Average Non-Weaving Speed (S_{NW}), mi/h	59.4
Weaving Lane Change Rate (LC_W), lc/h	1009	Average Speed (S), mi/h	59.7
Total Lane Change Rate (LC_{All}), lc/h	3002	Density (D), pc/mi/ln	11.2
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	605	255	175	1635
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	719	323	222	2071

Weaving Flow Rate (v_w), pc/h	2394	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	941	Density-Based Capacity (c_{IWL}), pc/h/ln	1870
Total Flow Rate (v), pc/h	3335	Demand Flow-Based Capacity (c_{IW}), pc/h	3343
Volume Ratio (VR)	0.718	Weaving Segment Capacity (c_W), veh/h	3125
Minimum Lane Change Rate (LC_{MIN}), lc/h	323	Adjusted Weaving Area Capacity, pc/h	3401
Maximum Weaving Length (L_{MAX}), ft	10484	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	243	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1733	Average Non-Weaving Speed (S_{NW}), mi/h	59.6
Weaving Lane Change Rate (LC_W), lc/h	639	Average Speed (S), mi/h	60.2
Total Lane Change Rate (LC_{All}), lc/h	2372	Density (D), pc/mi/ln	18.5
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1100	1610	30	270
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1307	2040	38	342

Weaving Flow Rate (v_w), pc/h	2382	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1345	Density-Based Capacity (c_{IWL}), pc/h/ln	2022
Total Flow Rate (v), pc/h	3727	Demand Flow-Based Capacity (c_{IW}), pc/h	3756
Volume Ratio (VR)	0.639	Weaving Segment Capacity (c_W), veh/h	3512
Minimum Lane Change Rate (LC_{MIN}), lc/h	2382	Adjusted Weaving Area Capacity, pc/h	3789
Maximum Weaving Length (L_{MAX}), ft	9496	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	435	Average Weaving Speed (S_W), mi/h	57.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1989	Average Non-Weaving Speed (S_{NW}), mi/h	44.2
Weaving Lane Change Rate (LC_W), lc/h	2739	Average Speed (S), mi/h	52.1
Total Lane Change Rate (LC_{All}), lc/h	4728	Density (D), pc/mi/ln	23.8
Weaving Intensity Factor (W)	0.220	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	750	175	120	355
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	891	222	152	450

Weaving Flow Rate (v_w), pc/h	672	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1043	Density-Based Capacity (c_{IWL}), pc/h/ln	2167
Total Flow Rate (v), pc/h	1715	Demand Flow-Based Capacity (c_{IW}), pc/h	6122
Volume Ratio (VR)	0.392	Weaving Segment Capacity (c_W), veh/h	5724
Minimum Lane Change Rate (LC_{MIN}), lc/h	672	Adjusted Weaving Area Capacity, pc/h	6109
Maximum Weaving Length (L_{MAX}), ft	6592	Volume-to-Capacity Ratio (v/c)	0.28

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	269	Average Weaving Speed (S_W), mi/h	59.7
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1754	Average Non-Weaving Speed (S_{NW}), mi/h	59.7
Weaving Lane Change Rate (LC_W), lc/h	988	Average Speed (S), mi/h	59.7
Total Lane Change Rate (LC_{All}), lc/h	2742	Density (D), pc/mi/ln	9.6
Weaving Intensity Factor (W)	0.171	Level of Service (LOS)	A

Option 1C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1130	395	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1343	500	19	152

Weaving Flow Rate (v_w), pc/h	652	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1362	Density-Based Capacity (c_{IWL}), pc/h/ln	2301
Total Flow Rate (v), pc/h	2014	Demand Flow-Based Capacity (c_{IW}), pc/h	7407
Volume Ratio (VR)	0.324	Weaving Segment Capacity (c_W), veh/h	6454
Minimum Lane Change Rate (LC_{MIN}), lc/h	652	Adjusted Weaving Area Capacity, pc/h	6821
Maximum Weaving Length (L_{MAX}), ft	5843	Volume-to-Capacity Ratio (v/c)	0.30

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	441	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1993	Average Non-Weaving Speed (S_{NW}), mi/h	59.4
Weaving Lane Change Rate (LC_W), lc/h	1009	Average Speed (S), mi/h	59.7
Total Lane Change Rate (LC_{All}), lc/h	3002	Density (D), pc/mi/ln	11.2
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	2275	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	605	255	175	1635
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	719	323	222	2071

Weaving Flow Rate (v_w), pc/h	2394	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	941	Density-Based Capacity (c_{IWL}), pc/h/ln	1745
Total Flow Rate (v), pc/h	3335	Demand Flow-Based Capacity (c_{IW}), pc/h	3343
Volume Ratio (VR)	0.718	Weaving Segment Capacity (c_W), veh/h	3125
Minimum Lane Change Rate (LC_{MIN}), lc/h	323	Adjusted Weaving Area Capacity, pc/h	3401
Maximum Weaving Length (L_{MAX}), ft	10484	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	141	Average Weaving Speed (S_W), mi/h	60.3
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	849	Average Non-Weaving Speed (S_{NW}), mi/h	59.6
Weaving Lane Change Rate (LC_W), lc/h	557	Average Speed (S), mi/h	60.1
Total Lane Change Rate (LC_{All}), lc/h	1406	Density (D), pc/mi/ln	18.5
Weaving Intensity Factor (W)	0.155	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1100	1610	30	270
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1307	2040	38	342

Weaving Flow Rate (v_w), pc/h	2382	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1345	Density-Based Capacity (c_{IWL}), pc/h/ln	2022
Total Flow Rate (v), pc/h	3727	Demand Flow-Based Capacity (c_{IW}), pc/h	3756
Volume Ratio (VR)	0.639	Weaving Segment Capacity (c_W), veh/h	3512
Minimum Lane Change Rate (LC_{MIN}), lc/h	2382	Adjusted Weaving Area Capacity, pc/h	3789
Maximum Weaving Length (L_{MAX}), ft	9496	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	435	Average Weaving Speed (S_W), mi/h	57.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1989	Average Non-Weaving Speed (S_{NW}), mi/h	44.2
Weaving Lane Change Rate (LC_W), lc/h	2739	Average Speed (S), mi/h	52.1
Total Lane Change Rate (LC_{All}), lc/h	4728	Density (D), pc/mi/ln	23.8
Weaving Intensity Factor (W)	0.220	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	2275	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	750	175	120	355
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	891	222	152	450

Weaving Flow Rate (v_w), pc/h	672	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1043	Density-Based Capacity (c_{IWL}), pc/h/ln	2043
Total Flow Rate (v), pc/h	1715	Demand Flow-Based Capacity (c_{IW}), pc/h	6122
Volume Ratio (VR)	0.392	Weaving Segment Capacity (c_W), veh/h	5724
Minimum Lane Change Rate (LC_{MIN}), lc/h	672	Adjusted Weaving Area Capacity, pc/h	6109
Maximum Weaving Length (L_{MAX}), ft	6592	Volume-to-Capacity Ratio (v/c)	0.28

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	157	Average Weaving Speed (S_W), mi/h	59.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	870	Average Non-Weaving Speed (S_{NW}), mi/h	59.7
Weaving Lane Change Rate (LC_W), lc/h	906	Average Speed (S), mi/h	59.5
Total Lane Change Rate (LC_{All}), lc/h	1776	Density (D), pc/mi/ln	9.6
Weaving Intensity Factor (W)	0.186	Level of Service (LOS)	A

Option 1D

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1130	395	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1343	500	19	152

Weaving Flow Rate (v_w), pc/h	652	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1362	Density-Based Capacity (c_{IWL}), pc/h/ln	2301
Total Flow Rate (v), pc/h	2014	Demand Flow-Based Capacity (c_{IW}), pc/h	7407
Volume Ratio (VR)	0.324	Weaving Segment Capacity (c_W), veh/h	6454
Minimum Lane Change Rate (LC_{MIN}), lc/h	652	Adjusted Weaving Area Capacity, pc/h	6821
Maximum Weaving Length (L_{MAX}), ft	5843	Volume-to-Capacity Ratio (v/c)	0.30

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	441	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1993	Average Non-Weaving Speed (S_{NW}), mi/h	59.4
Weaving Lane Change Rate (LC_W), lc/h	1009	Average Speed (S), mi/h	59.7
Total Lane Change Rate (LC_{All}), lc/h	3002	Density (D), pc/mi/ln	11.2
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	605	255	175	1635
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	719	323	222	2071

Weaving Flow Rate (v_w), pc/h	2394	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	941	Density-Based Capacity (c_{IWL}), pc/h/ln	1870
Total Flow Rate (v), pc/h	3335	Demand Flow-Based Capacity (c_{IW}), pc/h	3343
Volume Ratio (VR)	0.718	Weaving Segment Capacity (c_W), veh/h	3125
Minimum Lane Change Rate (LC_{MIN}), lc/h	323	Adjusted Weaving Area Capacity, pc/h	3401
Maximum Weaving Length (L_{MAX}), ft	10484	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	243	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1733	Average Non-Weaving Speed (S_{NW}), mi/h	59.6
Weaving Lane Change Rate (LC_W), lc/h	639	Average Speed (S), mi/h	60.2
Total Lane Change Rate (LC_{All}), lc/h	2372	Density (D), pc/mi/ln	18.5
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1100	1610	30	270
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1307	2040	38	342

Weaving Flow Rate (v_w), pc/h	2382	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1345	Density-Based Capacity (c_{IWL}), pc/h/ln	2022
Total Flow Rate (v), pc/h	3727	Demand Flow-Based Capacity (c_{IW}), pc/h	3756
Volume Ratio (VR)	0.639	Weaving Segment Capacity (c_W), veh/h	3512
Minimum Lane Change Rate (LC_{MIN}), lc/h	2382	Adjusted Weaving Area Capacity, pc/h	3789
Maximum Weaving Length (L_{MAX}), ft	9496	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	435	Average Weaving Speed (S_W), mi/h	57.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1989	Average Non-Weaving Speed (S_{NW}), mi/h	44.2
Weaving Lane Change Rate (LC_W), lc/h	2739	Average Speed (S), mi/h	52.1
Total Lane Change Rate (LC_{All}), lc/h	4728	Density (D), pc/mi/ln	23.8
Weaving Intensity Factor (W)	0.220	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/18/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	3905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	750	175	120	355
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	891	222	152	450

Weaving Flow Rate (v_w), pc/h	672	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1043	Density-Based Capacity (c_{IWL}), pc/h/ln	2167
Total Flow Rate (v), pc/h	1715	Demand Flow-Based Capacity (c_{IW}), pc/h	6122
Volume Ratio (VR)	0.392	Weaving Segment Capacity (c_W), veh/h	5724
Minimum Lane Change Rate (LC_{MIN}), lc/h	672	Adjusted Weaving Area Capacity, pc/h	6109
Maximum Weaving Length (L_{MAX}), ft	6592	Volume-to-Capacity Ratio (v/c)	0.28

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	269	Average Weaving Speed (S_W), mi/h	59.7
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1754	Average Non-Weaving Speed (S_{NW}), mi/h	59.7
Weaving Lane Change Rate (LC_W), lc/h	988	Average Speed (S), mi/h	59.7
Total Lane Change Rate (LC_{All}), lc/h	2742	Density (D), pc/mi/ln	9.6
Weaving Intensity Factor (W)	0.171	Level of Service (LOS)	A

Option 1E

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1130	395	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1343	500	19	152

Weaving Flow Rate (v_w), pc/h	652	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1362	Density-Based Capacity (c_{IWL}), pc/h/ln	2301
Total Flow Rate (v), pc/h	2014	Demand Flow-Based Capacity (c_{IW}), pc/h	7407
Volume Ratio (VR)	0.324	Weaving Segment Capacity (c_W), veh/h	6454
Minimum Lane Change Rate (LC_{MIN}), lc/h	652	Adjusted Weaving Area Capacity, pc/h	6821
Maximum Weaving Length (L_{MAX}), ft	5843	Volume-to-Capacity Ratio (v/c)	0.30

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	441	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1993	Average Non-Weaving Speed (S_{NW}), mi/h	59.4
Weaving Lane Change Rate (LC_W), lc/h	1009	Average Speed (S), mi/h	59.7
Total Lane Change Rate (LC_{All}), lc/h	3002	Density (D), pc/mi/ln	11.2
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	2275	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	605	255	175	1635
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	719	323	222	2071

Weaving Flow Rate (v_w), pc/h	2394	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	941	Density-Based Capacity (c_{IWL}), pc/h/ln	1745
Total Flow Rate (v), pc/h	3335	Demand Flow-Based Capacity (c_{IW}), pc/h	3343
Volume Ratio (VR)	0.718	Weaving Segment Capacity (c_W), veh/h	3125
Minimum Lane Change Rate (LC_{MIN}), lc/h	323	Adjusted Weaving Area Capacity, pc/h	3401
Maximum Weaving Length (L_{MAX}), ft	10484	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	141	Average Weaving Speed (S_W), mi/h	60.3
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	849	Average Non-Weaving Speed (S_{NW}), mi/h	59.6
Weaving Lane Change Rate (LC_W), lc/h	557	Average Speed (S), mi/h	60.1
Total Lane Change Rate (LC_{All}), lc/h	1406	Density (D), pc/mi/ln	18.5
Weaving Intensity Factor (W)	0.155	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1100	1610	30	270
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1307	2040	38	342

Weaving Flow Rate (v_w), pc/h	2382	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1345	Density-Based Capacity (c_{IWL}), pc/h/ln	2022
Total Flow Rate (v), pc/h	3727	Demand Flow-Based Capacity (c_{IW}), pc/h	3756
Volume Ratio (VR)	0.639	Weaving Segment Capacity (c_W), veh/h	3512
Minimum Lane Change Rate (LC_{MIN}), lc/h	2382	Adjusted Weaving Area Capacity, pc/h	3789
Maximum Weaving Length (L_{MAX}), ft	9496	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	435	Average Weaving Speed (S_W), mi/h	57.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1989	Average Non-Weaving Speed (S_{NW}), mi/h	44.2
Weaving Lane Change Rate (LC_W), lc/h	2739	Average Speed (S), mi/h	52.1
Total Lane Change Rate (LC_{All}), lc/h	4728	Density (D), pc/mi/ln	23.8
Weaving Intensity Factor (W)	0.220	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	2275	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	750	175	120	355
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	891	222	152	450

Weaving Flow Rate (v_w), pc/h	672	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1043	Density-Based Capacity (c_{IWL}), pc/h/ln	2043
Total Flow Rate (v), pc/h	1715	Demand Flow-Based Capacity (c_{IW}), pc/h	6122
Volume Ratio (VR)	0.392	Weaving Segment Capacity (c_W), veh/h	5724
Minimum Lane Change Rate (LC_{MIN}), lc/h	672	Adjusted Weaving Area Capacity, pc/h	6109
Maximum Weaving Length (L_{MAX}), ft	6592	Volume-to-Capacity Ratio (v/c)	0.28

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	157	Average Weaving Speed (S_W), mi/h	59.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	870	Average Non-Weaving Speed (S_{NW}), mi/h	59.7
Weaving Lane Change Rate (LC_W), lc/h	906	Average Speed (S), mi/h	59.5
Total Lane Change Rate (LC_{All}), lc/h	1776	Density (D), pc/mi/ln	9.6
Weaving Intensity Factor (W)	0.186	Level of Service (LOS)	A

Option 4A

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1130	395	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1343	500	19	152

Weaving Flow Rate (v_w), pc/h	652	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1362	Density-Based Capacity (c_{IWL}), pc/h/ln	2301
Total Flow Rate (v), pc/h	2014	Demand Flow-Based Capacity (c_{IW}), pc/h	7407
Volume Ratio (VR)	0.324	Weaving Segment Capacity (c_W), veh/h	6454
Minimum Lane Change Rate (LC_{MIN}), lc/h	652	Adjusted Weaving Area Capacity, pc/h	6821
Maximum Weaving Length (L_{MAX}), ft	5843	Volume-to-Capacity Ratio (v/c)	0.30

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	441	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1993	Average Non-Weaving Speed (S_{NW}), mi/h	59.4
Weaving Lane Change Rate (LC_W), lc/h	1009	Average Speed (S), mi/h	59.7
Total Lane Change Rate (LC_{All}), lc/h	3002	Density (D), pc/mi/ln	11.2
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	605	255	175	1635
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	719	323	222	2071

Weaving Flow Rate (v_w), pc/h	2394	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	941	Density-Based Capacity (c_{IWL}), pc/h/ln	1940
Total Flow Rate (v), pc/h	3335	Demand Flow-Based Capacity (c_{IW}), pc/h	3343
Volume Ratio (VR)	0.718	Weaving Segment Capacity (c_W), veh/h	3125
Minimum Lane Change Rate (LC_{MIN}), lc/h	323	Adjusted Weaving Area Capacity, pc/h	3401
Maximum Weaving Length (L_{MAX}), ft	10484	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	299	Average Weaving Speed (S_W), mi/h	61.0
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1899	Average Non-Weaving Speed (S_{NW}), mi/h	59.6
Weaving Lane Change Rate (LC_W), lc/h	677	Average Speed (S), mi/h	60.6
Total Lane Change Rate (LC_{All}), lc/h	2576	Density (D), pc/mi/ln	18.3
Weaving Intensity Factor (W)	0.138	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1100	1610	30	270
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1307	2040	38	342

Weaving Flow Rate (v_w), pc/h	2382	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1345	Density-Based Capacity (c_{IWL}), pc/h/ln	2022
Total Flow Rate (v), pc/h	3727	Demand Flow-Based Capacity (c_{IW}), pc/h	3756
Volume Ratio (VR)	0.639	Weaving Segment Capacity (c_W), veh/h	3512
Minimum Lane Change Rate (LC_{MIN}), lc/h	2382	Adjusted Weaving Area Capacity, pc/h	3789
Maximum Weaving Length (L_{MAX}), ft	9496	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	435	Average Weaving Speed (S_W), mi/h	57.9
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1989	Average Non-Weaving Speed (S_{NW}), mi/h	44.2
Weaving Lane Change Rate (LC_W), lc/h	2739	Average Speed (S), mi/h	52.1
Total Lane Change Rate (LC_{All}), lc/h	4728	Density (D), pc/mi/ln	23.8
Weaving Intensity Factor (W)	0.220	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	750	175	120	355
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	891	222	152	450

Weaving Flow Rate (v_w), pc/h	672	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1043	Density-Based Capacity (c_{IWL}), pc/h/ln	2237
Total Flow Rate (v), pc/h	1715	Demand Flow-Based Capacity (c_{IW}), pc/h	6122
Volume Ratio (VR)	0.392	Weaving Segment Capacity (c_W), veh/h	5724
Minimum Lane Change Rate (LC_{MIN}), lc/h	672	Adjusted Weaving Area Capacity, pc/h	6109
Maximum Weaving Length (L_{MAX}), ft	6592	Volume-to-Capacity Ratio (v/c)	0.28

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	332	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1922	Average Non-Weaving Speed (S_{NW}), mi/h	59.7
Weaving Lane Change Rate (LC_W), lc/h	1026	Average Speed (S), mi/h	60.0
Total Lane Change Rate (LC_{All}), lc/h	2948	Density (D), pc/mi/ln	9.5
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	A

Option 4B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1130	395	15	120
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1343	500	19	152

Weaving Flow Rate (v_w), pc/h	652	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1362	Density-Based Capacity (c_{IWL}), pc/h/ln	2301
Total Flow Rate (v), pc/h	2014	Demand Flow-Based Capacity (c_{IW}), pc/h	7407
Volume Ratio (VR)	0.324	Weaving Segment Capacity (c_W), veh/h	6454
Minimum Lane Change Rate (LC_{MIN}), lc/h	652	Adjusted Weaving Area Capacity, pc/h	6821
Maximum Weaving Length (L_{MAX}), ft	5843	Volume-to-Capacity Ratio (v/c)	0.30

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	441	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1993	Average Non-Weaving Speed (S_{NW}), mi/h	59.4
Weaving Lane Change Rate (LC_W), lc/h	1009	Average Speed (S), mi/h	59.7
Total Lane Change Rate (LC_{All}), lc/h	3002	Density (D), pc/mi/ln	11.2
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	AM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	605	255	175	1635
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	719	323	222	2071

Weaving Flow Rate (v_w), pc/h	2394	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	941	Density-Based Capacity (c_{IWL}), pc/h/ln	1940
Total Flow Rate (v), pc/h	3335	Demand Flow-Based Capacity (c_{IW}), pc/h	3343
Volume Ratio (VR)	0.718	Weaving Segment Capacity (c_W), veh/h	3125
Minimum Lane Change Rate (LC_{MIN}), lc/h	323	Adjusted Weaving Area Capacity, pc/h	3401
Maximum Weaving Length (L_{MAX}), ft	10484	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	299	Average Weaving Speed (S_W), mi/h	61.0
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1899	Average Non-Weaving Speed (S_{NW}), mi/h	59.6
Weaving Lane Change Rate (LC_W), lc/h	677	Average Speed (S), mi/h	60.6
Total Lane Change Rate (LC_{All}), lc/h	2576	Density (D), pc/mi/ln	18.3
Weaving Intensity Factor (W)	0.138	Level of Service (LOS)	B

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4905	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.33	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1100	1610	30	270
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	1307	2040	38	342

Weaving Flow Rate (v_w), pc/h	2382	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1345	Density-Based Capacity (c_{IWL}), pc/h/ln	2022
Total Flow Rate (v), pc/h	3727	Demand Flow-Based Capacity (c_{IW}), pc/h	3756
Volume Ratio (VR)	0.639	Weaving Segment Capacity (c_W), veh/h	3512
Minimum Lane Change Rate (LC_{MIN}), lc/h	2382	Adjusted Weaving Area Capacity, pc/h	3789
Maximum Weaving Length (L_{MAX}), ft	9496	Volume-to-Capacity Ratio (v/c)	0.98

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	220	Average Weaving Speed (S_W), mi/h	58.0
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1989	Average Non-Weaving Speed (S_{NW}), mi/h	44.2
Weaving Lane Change Rate (LC_W), lc/h	2682	Average Speed (S), mi/h	52.1
Total Lane Change Rate (LC_{All}), lc/h	4671	Density (D), pc/mi/ln	23.8
Weaving Intensity Factor (W)	0.217	Level of Service (LOS)	C

HCS7 Freeway Weaving Report

Project Information

Analyst	DH	Date	5/21/2018
Agency	HDR	Analysis Year	2045
Jurisdiction	SDDOT	Time Period Analyzed	PM PEAK
Project Description	I-229/BENSON IMJR		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Freeway
Short Length (L_S), ft	4820	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	750	175	120	355
Peak Hour Factor (PHF)	0.90	0.90	0.90	0.90
Total Trucks, %	7.00	7.00	7.00	7.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.935	0.877	0.877	0.877
Flow Rate (v_i), pc/h	891	222	152	450

Weaving Flow Rate (v_w), pc/h	672	Freeway Max Capacity (c_{IFL}), pc/h/ln	2373
Non-Weaving Flow Rate (v_{NW}), pc/h	1043	Density-Based Capacity (c_{IWL}), pc/h/ln	2237
Total Flow Rate (v), pc/h	1715	Demand Flow-Based Capacity (c_{IW}), pc/h	6122
Volume Ratio (VR)	0.392	Weaving Segment Capacity (c_W), veh/h	5724
Minimum Lane Change Rate (LC_{MIN}), lc/h	672	Adjusted Weaving Area Capacity, pc/h	6109
Maximum Weaving Length (L_{MAX}), ft	6592	Volume-to-Capacity Ratio (v/c)	0.28

Speed and Density

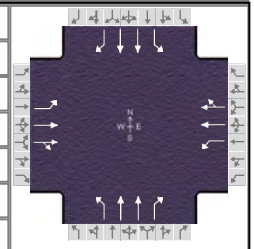
Non-Weaving Vehicle Index (I_{NW})	332	Average Weaving Speed (S_W), mi/h	60.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1922	Average Non-Weaving Speed (S_{NW}), mi/h	59.7
Weaving Lane Change Rate (LC_W), lc/h	1026	Average Speed (S), mi/h	60.0
Total Lane Change Rate (LC_{All}), lc/h	2948	Density (D), pc/mi/ln	9.5
Weaving Intensity Factor (W)	0.153	Level of Service (LOS)	A

VI. 2045 Arterial Analysis

Option 1A

HCS7 Signalized Intersection Results Summary

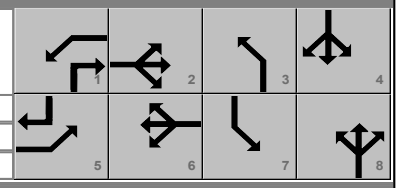
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1A_BENSON _AM.xus		
Project Description	I-229/BENSON 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	105	445	90	70	730	370	95	245	70	120	275	155

Signal Information			
Cycle, s	80.0	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	1.7	2.9	37.4	4.0	15.0	0.0	
Yellow	3.0	0.0	3.5	3.0	3.5	0.0	
Red	1.0	0.0	2.0	1.0	2.0	0.0	



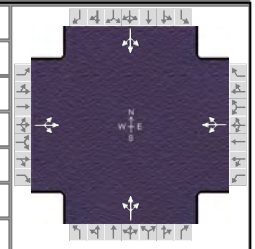
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	8.6	45.8	5.7	42.9	8.0	20.5	8.0	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	4.8		2.6		6.0	7.9	6.0	8.6
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.93		0.42		0.90	1.00	0.95	1.00
Max Out Probability	1.00		0.49		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	117	285	276	25	179	170	106	272	50	133	306	100
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1658	1647	1730	1579	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	2.8	7.8	7.9	0.6	3.7	3.0	4.0	5.9	2.2	4.0	6.6	4.4
Cycle Queue Clearance Time (g_c), s	2.8	7.8	7.9	0.6	3.7	3.0	4.0	5.9	2.2	4.0	6.6	4.4
Green Ratio (*g/C*)	0.54	0.50	0.50	0.49	0.47	0.47	0.24	0.19	0.21	0.24	0.19	0.24
Capacity (*c*), veh/h	612	871	835	440	809	738	256	618	306	269	618	359
Volume-to-Capacity Ratio (*X*)	0.191	0.328	0.330	0.056	0.222	0.230	0.413	0.441	0.163	0.496	0.495	0.279
Back of Queue (*Q*), ft/ln (95 th percentile)	42.5	134.2	125.4	10	61.5	43.3	76.5	102.7	34.9	29.7	116.7	68.2
Back of Queue (*Q*), veh/ln (95 th percentile)	1.6	5.2	5.0	0.4	2.4	1.7	2.9	3.9	1.3	1.1	4.5	2.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.22	0.00	0.00	0.07	0.00	0.00	0.26	0.00	0.15	0.08	0.00	0.21
Uniform Delay (d_1), s/veh	9.4	11.8	11.8	11.1	8.9	6.5	25.7	28.8	25.9	27.6	29.1	24.5
Incremental Delay (d_2), s/veh	0.2	1.0	1.1	0.1	0.6	0.7	1.5	0.2	0.1	2.0	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	0.0	0.0
Control Delay (*d*), s/veh	9.6	12.8	12.9	11.2	9.5	7.2	27.2	29.0	26.0	29.6	29.3	24.6
Level of Service (LOS)	A	B	B	B	A	A	C	C	C	C	C	C
Approach Delay, s/veh / LOS	12.3	B		8.6	A		28.2	C		28.5	C	
Intersection Delay, s/veh / LOS	19.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.71	C	2.88	C	3.00	C	2.84	C
Bicycle LOS Score / LOS	2.82	C	3.23	C	2.74	C	2.83	C

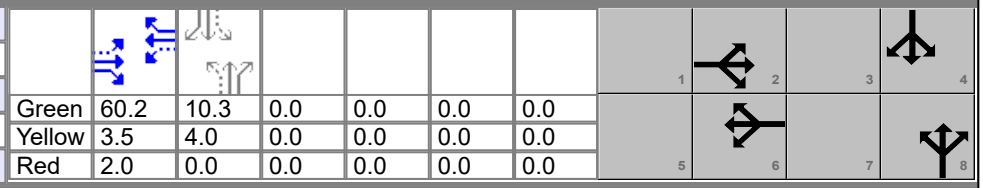
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	Hall	File Name	BUILD_1A_BENSON _AM.xus		
Project Description	I-229/BENSON 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	95	140	130	85	495	20	90	5	40	10	10	50

Signal Information			
Cycle, s	80.0	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	60.2	10.3	0.0	0.0	0.0	0.0						
Yellow	3.5	4.0	0.0	0.0	0.0	0.0						
Red	2.0	0.0	0.0	0.0	0.0	0.0						

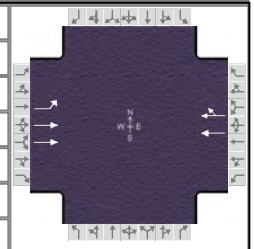
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		65.7		65.7		14.3		14.3
Change Period, ($Y+R_c$), s		5.5		5.5		4.0		4.0
Max Allow Headway (*MAH*), s		0.0		0.0		3.2		3.2
Queue Clearance Time (g_s), s						10.1		5.6
Green Extension Time (g_e), s		0.0		0.0		0.3		0.3
Phase Call Probability						0.99		0.99
Max Out Probability						0.00		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		115			667			144			78	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1319			1655			1386			1619	
Queue Service Time (g_s), s		0.0			0.6			4.5			0.0	
Cycle Queue Clearance Time (g_c), s		1.3			12.6			8.1			3.6	
Green Ratio (*g/C*)		0.75			0.75			0.13			0.13	
Capacity (*c*), veh/h		1050			1297			254			259	
Volume-to-Capacity Ratio (*X*)		0.110			0.514			0.569			0.300	
Back of Queue (*Q*), ft/ln (95 th percentile)		13			134.6			121.5			59.8	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.5			5.2			4.7			2.4	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		2.2			4.0			33.8			32.0	
Incremental Delay (d_2), s/veh		0.2			1.5			0.7			0.2	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		2.4			5.4			34.6			32.2	
Level of Service (LOS)		A			A			C			C	
Approach Delay, s/veh / LOS	2.4	A		5.4	A		34.6	C		32.2	C	
Intersection Delay, s/veh / LOS	11.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.91	B	1.62	B	2.28	B	2.46	B
Bicycle LOS Score / LOS	3.15	C	3.58	D	2.41	B	0.62	A

HCS7 Signalized Intersection Results Summary

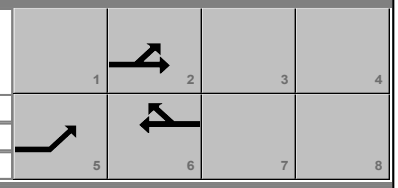
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1A_BENSON _AM.xus		
Project Description	I-229/BENSON 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	75	365			615	20						

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.4	68.1	0.0	0.0	0.0	0.0	
Yellow	4.0	3.5	0.0	0.0	0.0	0.0	
Red	0.0	2.0	0.0	0.0	0.0	0.0	



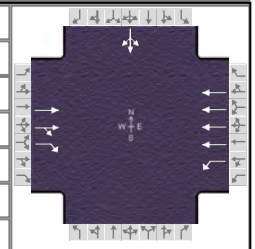
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	1.0	4.0		8.3				
Phase Duration, s	6.4	80.0		73.6				
Change Period, (*Y+R c*), s	4.0	5.5		5.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (*g s*), s	2.1							
Green Extension Time (*g e*), s	0.0	0.0		0.0				
Phase Call Probability	0.39							
Max Out Probability	0.00							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16						
Adjusted Flow Rate (*v*), veh/h	23	110			355	351						
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1548			1677	1657						
Queue Service Time (*g s*), s	0.1	1.0			7.4	3.0						
Cycle Queue Clearance Time (*g c*), s	0.1	1.0			7.4	3.0						
Green Ratio (*g/C*)	0.91	0.68			0.85	0.85						
Capacity (*c*), veh/h	689	2098			1428	1411						
Volume-to-Capacity Ratio (*X*)	0.033	0.052			0.248	0.249						
Back of Queue (*Q*), ft/ln (95 th percentile)	0.1	11.7			6.6	6.4						
Back of Queue (*Q*), veh/ln (95 th percentile)	0.0	0.4			0.3	0.3						
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00	0.00						
Uniform Delay (*d 1*), s/veh	0.9	1.1			1.0	1.0						
Incremental Delay (*d 2*), s/veh	0.0	0.0			0.4	0.4						
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0						
Control Delay (*d*), s/veh	0.9	1.2			1.4	1.4						
Level of Service (LOS)	A	A			A	A						
Approach Delay, s/veh / LOS	1.1	A		1.4	A		0.0			0.0		
Intersection Delay, s/veh / LOS	1.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.54	A	1.29	A	2.50	C	2.64	C
Bicycle LOS Score / LOS	2.88	C	3.06	C		A		

HCS7 Signalized Intersection Results Summary

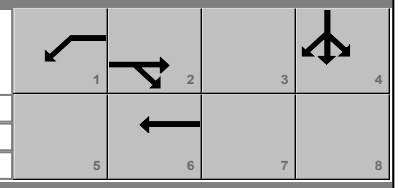
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1A_BENSON _AM.xus		
Project Description	I-229/BENSON 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		305	345	65	2235					10	0	170

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.1	50.2	12.7	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



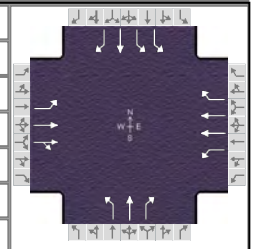
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		55.7	6.1	61.8				18.2
Change Period, ($Y+R_c$), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (g_s), s			2.9					12.5
Green Extension Time (g_e), s		0.0	0.0	0.0				0.3
Phase Call Probability			0.35					0.99
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		115	131	19	664						200	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1626	1445	1714	1493						1478	
Queue Service Time (g_s), s		1.0	2.4	0.9	2.8						10.5	
Cycle Queue Clearance Time (g_c), s		1.0	2.4	0.9	2.8						10.5	
Green Ratio (*g/C*)		0.63	0.63	0.03	0.70						0.16	
Capacity (*c*), veh/h		2042	907	45	4205						234	
Volume-to-Capacity Ratio (*X*)		0.056	0.144	0.430	0.158						0.854	
Back of Queue (*Q*), ft/ln (95 th percentile)		13.1	27.9	17.8	26.9						170.1	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.5	1.1	0.7	1.0						6.8	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.18	0.00						0.00	
Uniform Delay (d_1), s/veh		5.2	4.7	39.3	3.6						32.8	
Incremental Delay (d_2), s/veh		0.0	0.3	2.4	0.1						3.4	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		5.3	5.0	41.7	3.7						36.2	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	5.2	A		4.8	A		0.0			36.2	D	
Intersection Delay, s/veh / LOS	10.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.02	B	1.35	A	3.14	C	3.26	C
Bicycle LOS Score / LOS	3.07	C	3.53	D		A	0.82	A

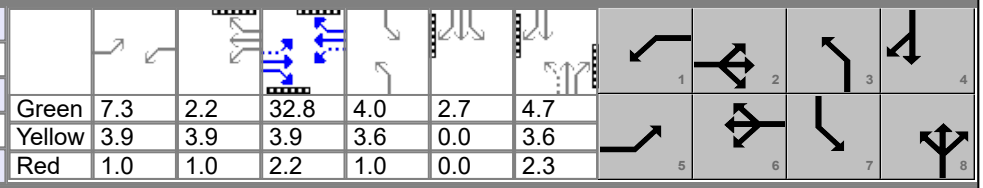
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1A_BENSON _AM.xus		
Project Description	I-229/BENSON 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	160	415	40	80	1190	545	30	25	40	165	40	125

Signal Information			
Cycle, s	80.0	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	7.3	2.2	32.8	4.0	2.7	4.7
Yellow	3.9	3.9	3.9	3.6	0.0	3.6
Red	1.0	1.0	2.2	1.0	0.0	2.3

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	12.2	38.9	19.3	46.0	8.6	10.6	11.3	13.2
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	6.8		2.5		3.5	3.7	6.5	7.3
Green Extension Time (g_e), s	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.26		0.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	176	247	242	27	405	133	33	28	33	183	44	100
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1688	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	4.8	8.5	8.5	0.5	6.4		1.5	1.2	1.7	4.5	1.9	5.3
Cycle Queue Clearance Time (g_c), s	4.8	8.5	8.5	0.5	6.4		1.5	1.2	1.7	4.5	1.9	5.3
Green Ratio (*g/C*)	0.50	0.41	0.41	0.61	0.50		0.11	0.06	0.06	0.08	0.09	0.09
Capacity (*c*), veh/h	616	709	692	655	1643		229	101	89	267	159	134
Volume-to-Capacity Ratio (*X*)	0.286	0.348	0.350	0.042	0.247		0.145	0.276	0.375	0.686	0.280	0.744
Back of Queue (*Q*), ft/ln (95 th percentile)	71.8	159.3	149.8	7.6	105.1		27.7	24.3	28.4	86.5	37.2	90.8
Back of Queue (*Q*), veh/ln (95 th percentile)	2.8	6.1	6.0	0.3	4.0		1.1	0.9	1.1	3.3	1.4	3.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.36	0.00	0.00	0.11	0.00		0.69	0.00	0.00	0.32	0.00	0.00
Uniform Delay (d_1), s/veh	10.9	18.1	18.0	6.6	13.7		32.5	36.1	36.3	35.6	33.9	35.4
Incremental Delay (d_2), s/veh	0.3	1.3	1.3	0.1	0.4		0.4	0.5	1.0	4.6	0.4	3.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	11.2	19.4	19.3	6.8	14.0	0.0	32.9	36.6	37.2	40.2	34.2	38.4
Level of Service (LOS)	B	B	B	A	B	A	C	D	D	D	C	D
Approach Delay, s/veh / LOS	17.2	B		10.4	B		35.5	D		38.9	D	
Intersection Delay, s/veh / LOS	20.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.20	B	2.63	C	3.27	C	2.88	C
Bicycle LOS Score / LOS	2.82	C	3.78	D	2.08	B	2.62	C

HCS7 Two-Way Stop-Control Report

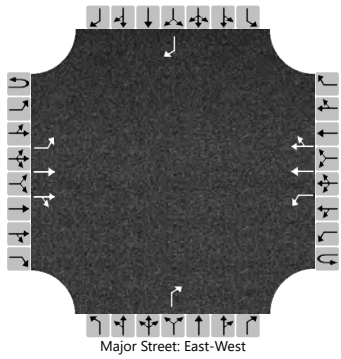
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2045
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes


Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	0	1		0	0	1
Configuration		L	T	TR		L	T	TR				R				R
Volume (veh/h)	0	25	540	55	0	165	1875	365				110				10
Percent Heavy Vehicles (%)	5	5			5	5						5				5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized									No				No			
Median Type | Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1						6.9				6.9
Critical Headway (sec)		4.20				4.20						7.00				7.00
Base Follow-Up Headway (sec)		2.2				2.2						3.3				3.3
Follow-Up Headway (sec)		2.25				2.25						3.35				3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		28				183						122				11
Capacity, c (veh/h)		173				903						656				161
v/c Ratio		0.16				0.20						0.19				0.07
95% Queue Length, Q_{95} (veh)		0.6				0.8						0.7				0.2
Control Delay (s/veh)		29.8				10.0						11.7				29.0
Level of Service (LOS)		D				A						B				D
Approach Delay (s/veh)	1.2				0.7				11.7				29.0			
Approach LOS									B				D			

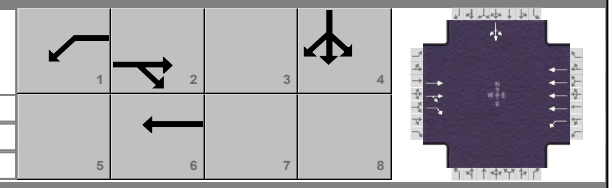
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1A_BENSON _AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		305	345	65	2235					10	0	170
Intersection Two Demand (*v*), veh/h	75	365			615	20						

Signal One Information	
Cycle, s	80.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	2.1	50.2	12.7	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

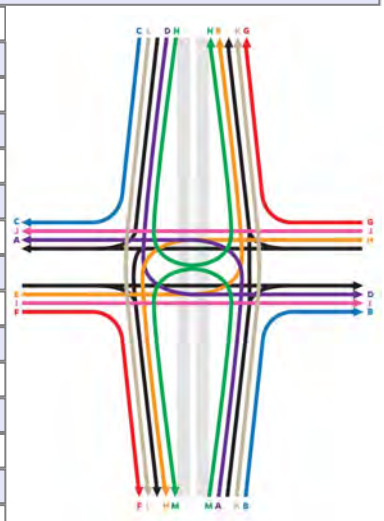


Signal Two Information	
Cycle, s	80.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	2.4	68.1	0.0	0.0	0.0	0.0
Yellow	4.0	3.5	0.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0

Interchange Results

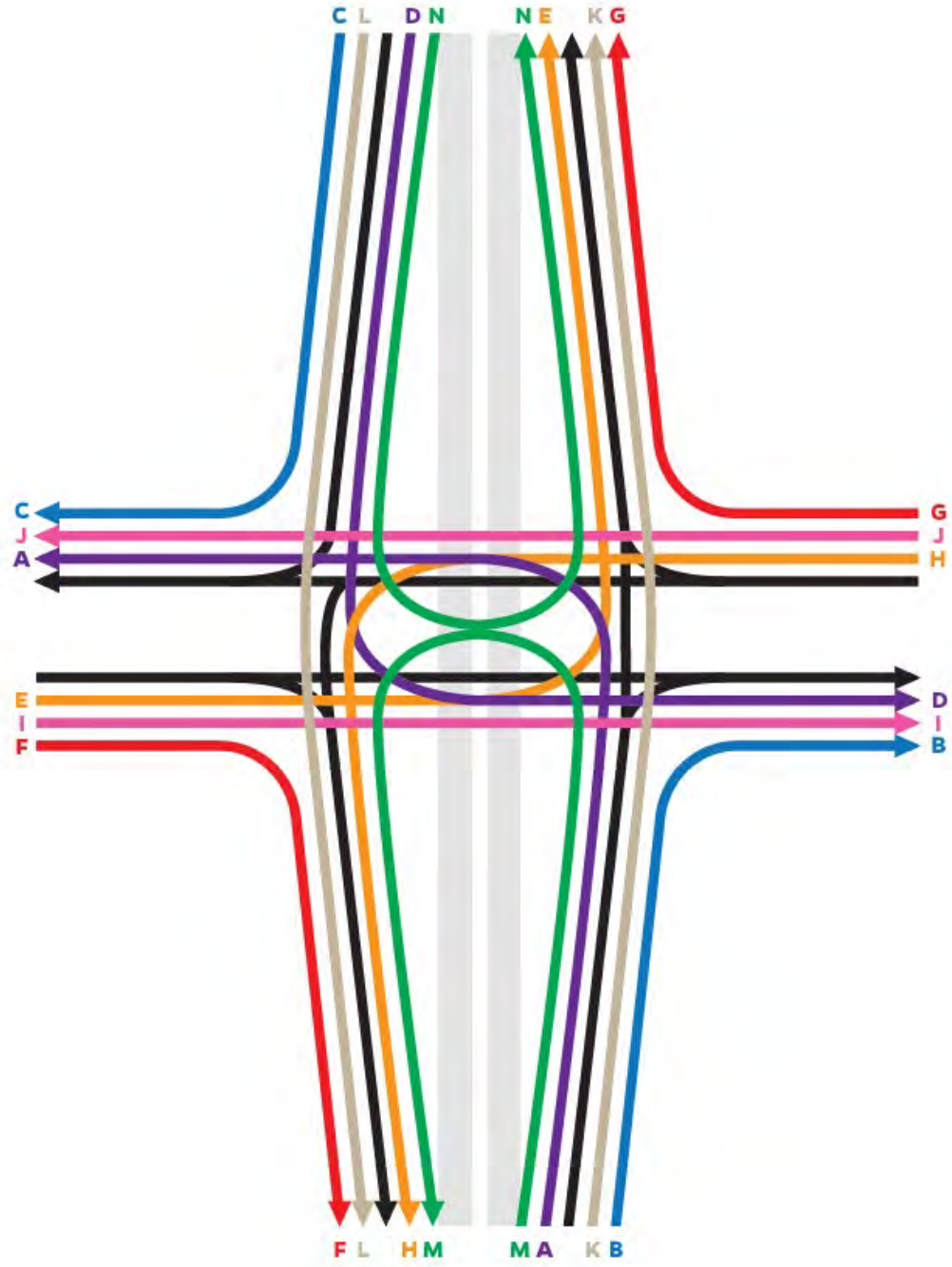
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	3.7	0.0	3.7	No	No	A
B	0	0.0	0.0	0.0	No	No	A
C	189	0.0	0.0	0.0	No	No	A
D	11	37.4	0.0	37.4	No	No	C
E	23	6.2	0.0	6.2	No	No	A
F	131	5.3	0.0	5.3	No	No	A
G	22	1.4	0.0	1.4	No	No	A
H	19	43.1	0.0	43.1	No	No	C
I	98	6.5	0.0	6.5	No	No	A
J	664	5.1	0.0	5.1	No	No	A
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		5.3	5.0	41.7	3.7						36.2	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	5.2	A		4.8	A		0.0			36.2	D	
Intersection Delay, s/veh / LOS	10.4						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	0.9	1.2			1.4	1.4						
Level of Service (LOS)	A	A			A	A						
Approach Delay, s/veh / LOS	1.1	A		1.4	A		0.0			0.0		
Intersection Delay, s/veh / LOS	1.3						A					

Interchange Graphic



File Name: BUILD_1A_BENSON _AM.xus
Analyst: RL
Agency/Co.: HDR
Analysis Date: Mar 7, 2018
Time Period: AM PEAK
Jurisdiction: CITY OF SIOUX FALLS
Analysis Year: 2045
Project Description: I-229/BENSON IMJR
Urban Street: BENSON ROAD
Analysis Period: 1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	5
Number of Segments	4
Analysis period duration, h	0.25
System cycle length, s	80
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	4	1000	1000	50	50	0	0	70	70	0	0
4	40	40	1	2	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0

1: Location, ft	1320
1: Peak Hour Factor	1

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

Number of access points: 0

SEGMENT 4

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.28			43.16	
1	Running Speed, mph		41.67			41.79	
1	Through Delay, s/veh		19.34			8.34	
1	Travel Speed, mph		28.8			35.02	
1	Stop Rate, stops/veh		0.62			0.29	
1	Spatial Stop Rate, stops/mi		1.24			0.58	
1	Through vol/cap ratio		0.35			0.22	
1	Percent of Base FFS		65.35			79.45	
1	Level of Service		C			B	
1	Automobile Perception Score		2.33			2.23	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		63.24			63.58	
2	Running Speed, mph		42.64			42.41	
2	Through Delay, s/veh		5.29			14.03	
2	Travel Speed, mph		39.35			34.74	
2	Stop Rate, stops/veh		0.22			0.5	
2	Spatial Stop Rate, stops/mi		0.29			0.67	
2	Through vol/cap ratio		0.06			0.25	
2	Percent of Base FFS		89.28			78.84	
2	Level of Service		A			B	
2	Automobile Perception Score		2.28			2.29	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.7			18.8	
3	Running Speed, mph		36.46			36.27	
3	Through Delay, s/veh		1.18			3.7	
3	Travel Speed, mph		34.29			30.31	
3	Stop Rate, stops/veh		0.21			0.16	
3	Spatial Stop Rate, stops/mi		1.08			0.82	
3	Through vol/cap ratio		0.05			0.16	
3	Percent of Base FFS		77.8			68.77	
3	Level of Service		B			B	
3	Automobile Perception Score		2.3			2.48	

4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999					
4	Base Free-Flow Speed, mph		44.07			44.07	
4	Running Time, s		17.14			18.97	
4	Running Speed, mph		39.77			35.94	
4	Through Delay, s/veh		2.38			1.39	
4	Travel Speed, mph		34.93			33.49	
4	Stop Rate, stops/veh		0.11			0.02	
4	Spatial Stop Rate, stops/mi		0.57			0.1	
4	Through vol/cap ratio		0.11			0.25	
4	Percent of Base FFS		79.25			75.98	
4	Level of Service		B			B	
4	Automobile Perception Score		2.44			2.36	
Facility Travel Time, s			170.56			171.97	
Facility Travel Speed, mph			34.38			34.1	
Facility Spatial Stop Rate, stops/mi			0.71			0.59	
Facility Base Free Flow Speed, mph			44.07			44.07	
Facility Percent Base Free Flow Speed			78.01			77.37	
Facility Level of Service			B			B	
Facility Automobile Perception Score			2.32			2.3	
Facility Pedestrian Space			∞			∞	
Facility Pedestrian Travel Speed			4.28			4.29	
Facility Pedestrian LOS Score			2.99			3.21	
Facility Pedestrian LOS			C			C	
Facility Bicycle Travel Speed			13.95			14.38	
Facility Bicycle LOS Score			2.43			2.73	
Facility Bicycle LOS			C			C	
Facility Transit Travel Speed			28.78			34.57	
Facility Transit LOS Score			0.59			0.68	
Facility Transit LOS			A			A	
SPILLBACK TIME, h			999				

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.15	4.15
1	Ped LOS Score for Intersection	2.2	2.88
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.8	0.66
1	Speed Adjustment Factor	0.69	0.7
1	Ped LOS Score for Link	2.8	2.66
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.07	1.04
1	Ped LOS Score for Segment	3.09	2.95
1	Ped Segment LOS	C	C
1	Bicycle Travel Speed	13.86	13.84
1	Bicycle LOS Score for Intersection	2.82	3.23
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.27	2.17
1	Speed Adjustment Factor	0.85	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.17	3.07
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.75	2.71
1	Bicycle Segment LOS	B	B
1	Transit Running Speed, mi/h	41.67	41.79
1	g/C Ratio	0.41	0.47
1	Transit Running Time, s	43.28	43.16
1	Delay at Intersection, s/veh	19.37	9.01
1	Transit Travel Speed, mi/h	28.78	34.57
1	Transit Wait-Ride Score	3.6	3.84
1	Ped LOS Score for Link	2.8	2.66
1	Transit LOS Score for Segment	1.02	0.63
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.33	4.35
2	Ped LOS Score for Intersection	2.02	2.63

2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.78	0.97
2	Speed Adjustment Factor	0.73	0.72
2	Ped LOS Score for Link	2.81	3
2	Ped Link LOS	C	C
2	Roadway Crossing Difficulty Factor	1.07	1.2
2	Ped LOS Score for Segment	3.13	3.56
2	Ped Segment LOS	C	D
2	Bicycle Travel Speed	13.92	14.71
2	Bicycle LOS Score for Intersection	3.07	3.78
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.26	2.37
2	Speed Adjustment Factor	0.86	0.85
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.17	3.28
2	Bicycle Link LOS	C	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.76	2.83
2	Bicycle Segment LOS	C	C
2	Transit Running Speed, mi/h	42.64	42.41
2	g/C Ratio	0.63	0.5
2	Transit Running Time, s	63.24	63.58
2	Delay at Intersection, s/veh	5.29	14.03
2	Transit Travel Speed, mi/h	39.35	34.74
2	Transit Wait-Ride Score	4.02	3.85
2	Ped LOS Score for Link	2.81	3
2	Transit LOS Score for Segment	0.4	0.67
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.3	4.33
3	Ped LOS Score for Intersection	0.54	1.35
3	Cross-section Adjustment Factor	-4.9	-4.74
3	Volume Adjustment Factor	0.15	0.39
3	Speed Adjustment Factor	0.53	0.53
3	Ped LOS Score for Link	1.83	2.22
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.2	1.2
3	Ped LOS Score for Segment	2.5	2.86
3	Ped Segment LOS	B	C
3	Bicycle Travel Speed	13.37	14.72
3	Bicycle LOS Score for Intersection	2.88	3.53
3	Cross-section Adjustment Factor	-2.54	-1.28
3	Volume Adjustment Factor	1.42	1.9
3	Speed Adjustment Factor	0.79	0.78
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	1	2.74
3	Bicycle Link LOS	A	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.64	2.44
3	Bicycle Segment LOS	A	B
3	Transit Running Speed, mi/h	36.46	36.27
3	g/C Ratio	0.93	0.7
3	Transit Running Time, s	18.7	18.8
3	Delay at Intersection, s/veh	1.18	3.7
3	Transit Travel Speed, mi/h	34.29	30.31
3	Transit Wait-Ride Score	3.83	3.67
3	Ped LOS Score for Link	1.83	2.22
3	Transit LOS Score for Segment	0.53	0.83
3	Transit Segment LOS	A	A
4	Average Pedestrian Space, ft2/p	∞	∞
4	Pedestrian Travel Speed, ft/s	4.4	4.38
4	Ped LOS Score for Intersection	1.91	1.29
4	Cross-section Adjustment Factor	-4.93	-4.74
4	Volume Adjustment Factor	0.26	0.8
4	Speed Adjustment Factor	0.63	0.52
4	Ped LOS Score for Link	2	2.63
4	Ped Link LOS	B	C
4	Roadway Crossing Difficulty Factor	1.2	1.03
4	Ped LOS Score for Segment	2.68	2.9
4	Ped Segment LOS	B	C
4	Bicycle Travel Speed	14.94	14.24
4	Bicycle LOS Score for Intersection	3.15	3.06
4	Cross-section Adjustment Factor	-2.92	-1.28

4	Volume Adjustment Factor	1.7	2.27
4	Speed Adjustment Factor	0.83	0.78
4	Pavement Adjustment Factor	0.58	0.58
4	Bicycle LOS Score for Link	0.94	3.11
4	Bicycle Link LOS	A	C
4	Number of access point approaches	0	0
4	Segment Length, ft	1000	1000
4	Unsignalized Conflicts Factor	-0.7	-0.7
4	Bicycle LOS Score for Segment	1.1	2.71
4	Bicycle Segment LOS	A	B
4	Transit Running Speed, mi/h	39.77	35.94
4	g/C Ratio	0.75	0.85
4	Transit Running Time, s	17.14	18.97
4	Delay at Intersection, s/veh	0	1.38
4	Transit Travel Speed, mi/h	39.77	33.49
4	Transit Wait-Ride Score	4.03	3.8
4	Ped LOS Score for Link	2	2.63
4	Transit LOS Score for Segment	0.26	0.69
4	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

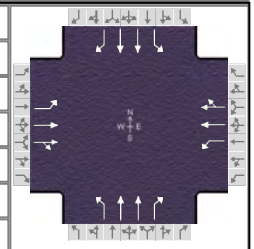
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	676	29.1	0	502	75.9	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.06	0	0	0.06	0	0	0.12	0.12	0.06	0.12	0.12	0.06
1: Thru veh delay		0.02			0.04							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	684	0	0	738	27.9	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.14	0	0	0.14	0.14	0.14	0.14	0.14	0
1: Thru veh delay		0			0.02							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	23.5	618	62.6	67.6	746	145	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0	0	0	0.1	0	0	0.1	0.1	0.1	0.1	0.1	0
2: Thru veh delay		0.04			0.07							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											
3: Volume, veh/h	0	241	467	4.7	848	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0	0	0	0.06	0	0	0.06	0.06	0.06	0.06	0.06	0
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

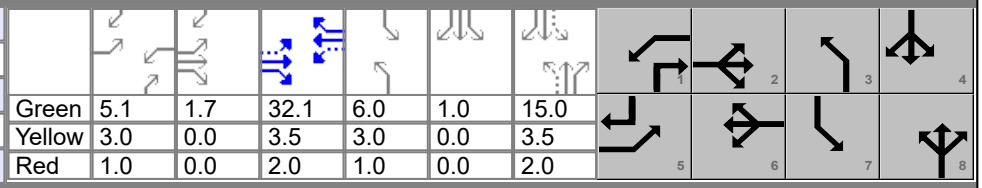
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1A_BENSON_PM.xus		
Project Description	I-229/BENSON 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	150	625	190	190	380	160	130	355	40	205	380	100

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



	EB		WB		NB	
Green	5.1	1.7	32.1	6.0	1.0	15.0
Yellow	3.0	0.0	3.5	3.0	0.0	3.5
Red	1.0	0.0	2.0	1.0	0.0	2.0

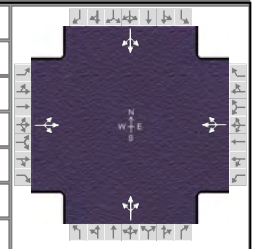
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	10.9	39.4	9.1	37.6	10.0	20.5	11.0	21.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	6.6		5.3		7.7	10.8	9.0	11.4
Green Extension Time (g_e), s	0.4	0.0	0.3	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.98		0.92		0.96	1.00	0.99	1.00
Max Out Probability	0.26		0.08		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	167	452	420	116	131	129	144	394	17	228	422	39
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1607	1647	1730	1666	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	4.6	16.3	16.3	3.3	4.2	4.0	5.7	8.8	0.7	7.0	9.4	1.6
Cycle Queue Clearance Time (g_c), s	4.6	16.3	16.3	3.3	4.2	4.0	5.7	8.8	0.7	7.0	9.4	1.6
Green Ratio (*g/C*)	0.49	0.42	0.42	0.47	0.40	0.40	0.26	0.19	0.25	0.28	0.20	0.29
Capacity (*c*), veh/h	613	732	681	316	695	669	268	618	369	309	659	419
Volume-to-Capacity Ratio (*X*)	0.272	0.617	0.617	0.369	0.189	0.193	0.540	0.639	0.045	0.738	0.641	0.093
Back of Queue (*Q*), ft/ln (95 th percentile)	72.2	280.7	256.9	53.8	76.6	68.4	106	155.7	10.6	82.3	165	23.6
Back of Queue (*Q*), veh/ln (95 th percentile)	2.8	10.8	10.3	2.1	2.9	2.7	4.1	6.0	0.4	3.2	6.3	0.9
Queue Storage Ratio (*RQ*) (95 th percentile)	0.37	0.00	0.00	0.38	0.00	0.00	0.35	0.00	0.04	0.22	0.00	0.07
Uniform Delay (d_1), s/veh	11.8	18.0	18.0	14.4	16.7	15.6	24.6	30.0	22.7	27.3	29.4	21.0
Incremental Delay (d_2), s/veh	0.3	3.9	4.2	1.0	0.6	0.6	2.8	0.4	0.0	9.7	0.4	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	12.2	21.9	22.2	15.4	17.2	16.3	27.5	30.4	22.7	37.0	29.8	21.0
Level of Service (LOS)	B	C	C	B	B	B	C	C	C	D	C	C
Approach Delay, s/veh / LOS	20.4	C		16.3	B		29.4	C		31.6	C	
Intersection Delay, s/veh / LOS	24.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.81	C	2.90	C	2.94	C	2.82	C
Bicycle LOS Score / LOS	3.12	C	2.83	C	2.84	C	2.95	C

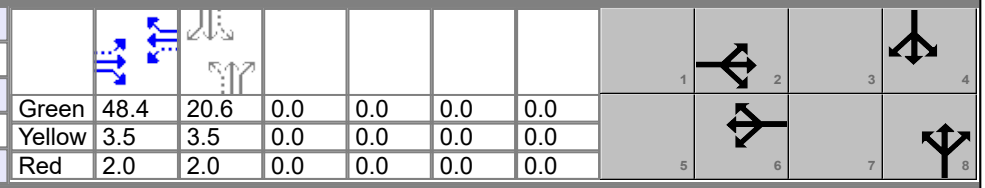
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	Hall	File Name	BUILD_1A_BENSON_PM.xus		
Project Description	I-229/BENSON 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	35	175	135	50	335	20	180	20	95	20	20	35

Signal Information			
Cycle, s	80.0	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	48.4	20.6	0.0	0.0	0.0	0.0						
Yellow	3.5	3.5	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						

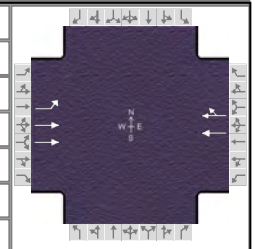
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		53.9		53.9		26.1		26.1
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		3.1		3.1
Queue Clearance Time (g_s), s						19.9		5.1
Green Extension Time (g_e), s		0.0		0.0		0.7		0.8
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		149			450			322			83	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1541			1656			1391			1584	
Queue Service Time (g_s), s		0.0			0.0			14.8			0.0	
Cycle Queue Clearance Time (g_c), s		2.0			11.2			17.9			3.1	
Green Ratio (*g/C*)		0.61			0.61			0.26			0.26	
Capacity (*c*), veh/h		983			1053			430			464	
Volume-to-Capacity Ratio (*X*)		0.151			0.427			0.749			0.180	
Back of Queue (*Q*), ft/ln (95 th percentile)		28			172.4			244.2			52.5	
Back of Queue (*Q*), veh/ln (95 th percentile)		1.1			6.6			9.4			2.1	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		4.0			8.4			28.6			23.2	
Incremental Delay (d_2), s/veh		0.3			1.3			1.1			0.1	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		4.3			9.7			29.8			23.3	
Level of Service (LOS)		A			A			C			C	
Approach Delay, s/veh / LOS	4.3	A		9.7	A		29.8	C		23.3	C	
Intersection Delay, s/veh / LOS	16.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.06	B	1.66	B	2.20	B	2.37	B
Bicycle LOS Score / LOS	3.11	C	3.22	C	2.70	C	0.63	A

HCS7 Signalized Intersection Results Summary

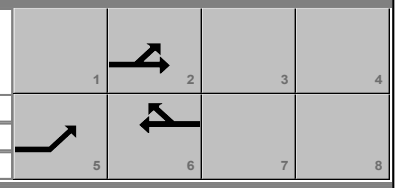
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1A_BENSON_PM.xus		
Project Description	I-229/BENSON 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	90	345			355	195						

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	3.4	67.1	0.0	0.0	0.0	0.0	
Yellow	4.0	3.5	0.0	0.0	0.0	0.0	
Red	0.0	2.0	0.0	0.0	0.0	0.0	



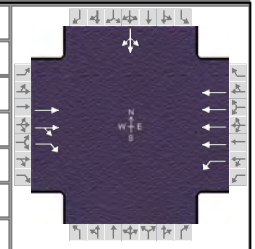
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				
Case Number	1.0	4.0		8.3				
Phase Duration, s	7.4	80.0		72.6				
Change Period, (*Y+R c*), s	4.0	5.5		5.5				
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				
Queue Clearance Time (*g s*), s	2.2							
Green Extension Time (*g e*), s	0.0	0.0		0.0				
Phase Call Probability	0.56							
Max Out Probability	0.00							

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16						
Adjusted Flow Rate (*v*), veh/h	37	143			322	289						
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1550			1671	1467						
Queue Service Time (*g s*), s	0.2	1.2			7.0	2.5						
Cycle Queue Clearance Time (*g c*), s	0.2	1.2			7.0	2.5						
Green Ratio (*g/C*)	0.91	0.68			0.84	0.84						
Capacity (*c*), veh/h	754	2110			1402	1231						
Volume-to-Capacity Ratio (*X*)	0.050	0.068			0.230	0.235						
Back of Queue (*Q*), ft/ln (95 th percentile)	0.1	13.4			8.4	8.5						
Back of Queue (*Q*), veh/ln (95 th percentile)	0.0	0.5			0.3	0.3						
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00	0.00						
Uniform Delay (*d 1*), s/veh	0.9	1.0			0.8	1.0						
Incremental Delay (*d 2*), s/veh	0.0	0.1			0.3	0.4						
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0						
Control Delay (*d*), s/veh	0.9	1.1			1.1	1.4						
Level of Service (LOS)	A	A			A	A						
Approach Delay, s/veh / LOS	1.0	A		1.2	A		0.0			0.0		
Intersection Delay, s/veh / LOS	1.2						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.54	A	1.30	A	2.46	B	2.57	C
Bicycle LOS Score / LOS	2.88	C	2.98	C		A		

HCS7 Signalized Intersection Results Summary

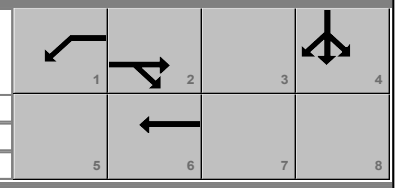
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1A_BENSON_PM.xus		
Project Description	I-229/BENSON 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		260	1485	155	580					80	0	60

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.1	50.5	9.5	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		56.0	9.1	65.0				15.0
Change Period, ($Y+R_c$), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.2
Queue Clearance Time (g_s), s			5.9					9.6
Green Extension Time (g_e), s		0.0	0.1	0.0				0.2
Phase Call Probability			0.84					0.97
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		86	492	83	311						156	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1624	1500	1714	1480						1594	
Queue Service Time (g_s), s		0.8	10.5	3.9	1.2						7.6	
Cycle Queue Clearance Time (g_c), s		0.8	10.5	3.9	1.2						7.6	
Green Ratio (*g/C*)		0.63	0.63	0.06	0.74						0.12	
Capacity (*c*), veh/h		2048	946	108	4402						189	
Volume-to-Capacity Ratio (*X*)		0.042	0.520	0.768	0.071						0.823	
Back of Queue (*Q*), ft/ln (95 th percentile)		10.2	98.7	78.5	9.9						134.2	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.4	3.9	3.1	0.4						5.4	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.79	0.00						0.00	
Uniform Delay (d_1), s/veh		5.5	4.9	39.0	2.9						34.4	
Incremental Delay (d_2), s/veh		0.0	1.0	4.2	0.0						3.4	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		5.6	5.8	43.1	2.9						37.8	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	5.8	A		11.4	B		0.0			37.8	D	
Intersection Delay, s/veh / LOS	12.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	4.02	D	1.33	A	2.83	C	3.13	C
Bicycle LOS Score / LOS	4.08	D	2.81	C		A	0.74	A

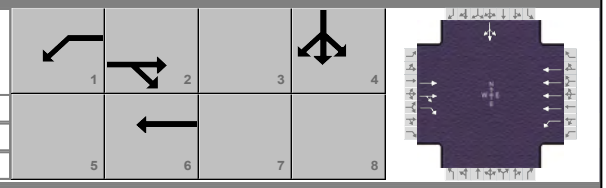
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 SB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1A_BENSON_PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		260	1485	155	580					80	0	60
Intersection Two Demand (*v*), veh/h	90	345			355	195						

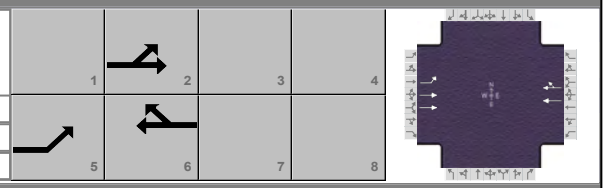
Signal One Information	
Cycle, s	80.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	5.1	50.5	9.5	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



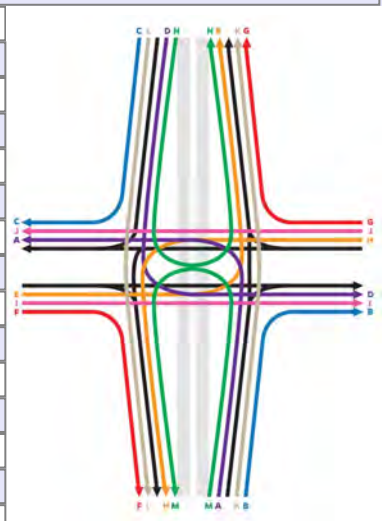
Signal Two Information	
Cycle, s	80.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	3.4	67.1	0.0	0.0	0.0	0.0
Yellow	4.0	3.5	0.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0



Interchange Results

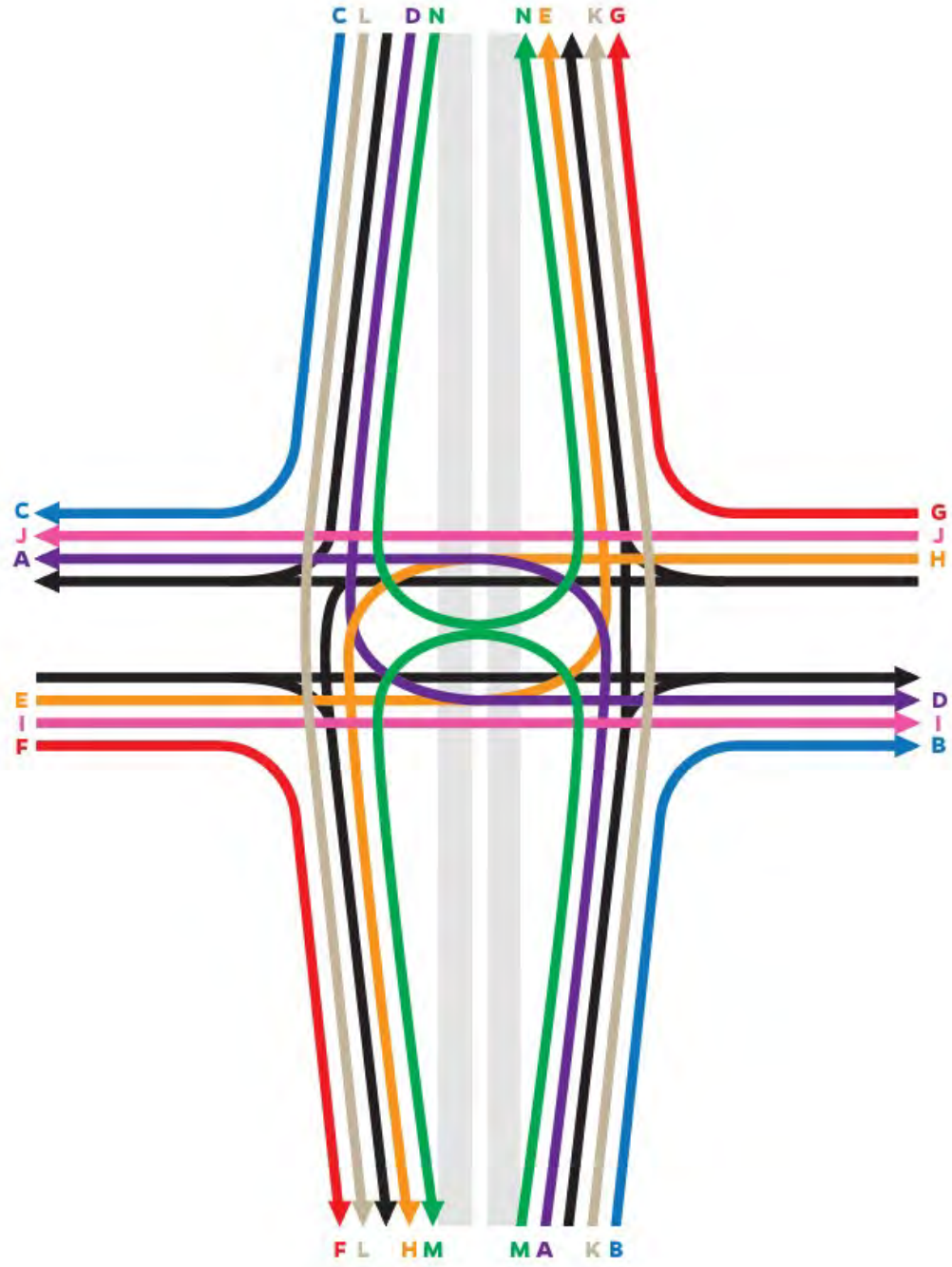
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	2.9	0.0	2.9	No	No	A
B	0	0.0	0.0	0.0	No	No	A
C	67	0.0	0.0	0.0	No	No	A
D	89	38.9	0.0	38.9	No	No	C
E	37	6.5	0.0	6.5	No	No	A
F	492	5.6	0.0	5.6	No	No	A
G	217	1.4	0.0	1.4	No	No	A
H	83	44.2	0.0	44.2	No	No	C
I	54	6.6	0.0	6.6	No	No	A
J	311	4.0	0.0	4.0	No	No	A
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		5.6	5.8	43.1	2.9						37.8	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	5.8	A		11.4	B		0.0			37.8	D	
Intersection Delay, s/veh / LOS	12.2						B					

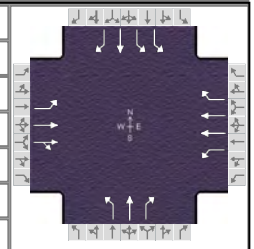
Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	0.9	1.1			1.1	1.4						
Level of Service (LOS)	A	A			A	A						
Approach Delay, s/veh / LOS	1.0	A		1.2	A		0.0			0.0		
Intersection Delay, s/veh / LOS	1.2						A					

Interchange Graphic



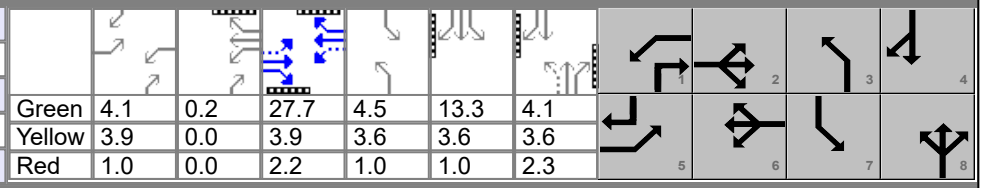
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1A_BENSON_PM.xus		
Project Description	I-229/BENSON 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	70	840	25	60	400	75	50	35	105	765	40	215

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.1	0.2	27.7	4.5	13.3	4.1						
Yellow	3.9	0.0	3.9	3.6	3.6	3.6						
Red	1.0	0.0	2.2	1.0	1.0	2.3						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	9.0	33.8	9.2	34.0	9.1	10.0	27.0	27.9
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	4.1		3.3		4.5	6.1	22.8	10.5
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	0.00

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	69	425	422	43	287	54	56	39	106	850	44	200
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1719	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	2.1	17.2	17.3	1.3	5.1		2.5	1.7	4.1	20.8	1.5	8.5
Cycle Queue Clearance Time (g_c), s	2.1	17.2	17.3	1.3	5.1		2.5	1.7	4.1	20.8	1.5	8.5
Green Ratio (*g/C*)	0.40	0.35	0.35	0.40	0.35		0.11	0.05	0.11	0.28	0.27	0.33
Capacity (*c*), veh/h	452	599	595	261	1147		251	89	160	896	476	479
Volume-to-Capacity Ratio (*X*)	0.153	0.709	0.709	0.164	0.250		0.221	0.439	0.659	0.949	0.093	0.418
Back of Queue (*Q*), ft/ln (95 th percentile)	31.1	292.9	280.5	25.4	88.6		46.8	34.9	100.8	389.4	28	129.7
Back of Queue (*Q*), veh/ln (95 th percentile)	1.2	11.3	11.2	1.0	3.4		1.8	1.3	4.0	15.0	1.1	5.0
Queue Storage Ratio (*RQ*) (95 th percentile)	0.16	0.00	0.00	0.36	0.00		0.47	0.00	0.00	0.97	0.00	0.00
Uniform Delay (d_1), s/veh	13.8	23.6	23.6	17.0	19.2		33.0	36.8	34.4	28.2	21.6	21.0
Incremental Delay (d_2), s/veh	0.2	5.1	5.2	1.3	0.5		0.6	1.3	7.7	19.0	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	0.0
Control Delay (*d*), s/veh	14.0	28.7	28.8	18.3	19.7	0.0	33.6	38.1	42.1	47.2	21.6	21.2
Level of Service (LOS)	B	C	C	B	B	A	C	D	D	D	C	C
Approach Delay, s/veh / LOS	27.6	C		16.8	B		39.0	D		41.4	D	
Intersection Delay, s/veh / LOS	32.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.23	B	2.67	C	3.01	C	2.76	C
Bicycle LOS Score / LOS	3.11	C	2.75	C	2.26	B	3.89	D

HCS7 Streets Text Report

File Name:	BUILD_1A_BENSON_PM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Mar 7, 2018
Time Period:	PM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2045
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	5
Number of Segments	4
Analysis period duration, h	0.25
System cycle length, s	80
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	4	1000	1000	50	50	0	0	70	70	0	0
4	40	40	1	2	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0

1: Location, ft	1320
1: Peak Hour Factor	1

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

Number of access points: 0

SEGMENT 4

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.6			43.16	
1	Running Speed, mph		41.36			41.78	
1	Through Delay, s/veh		28.73			16.82	
1	Travel Speed, mph		24.93			30.07	
1	Stop Rate, stops/veh		0.79			0.55	
1	Spatial Stop Rate, stops/mi		1.58			1.09	
1	Through vol/cap ratio		0.71			0.19	
1	Percent of Base FFS		56.58			68.22	
1	Level of Service		C			B	
1	Automobile Perception Score		2.38			2.3	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		65.53			62.77	
2	Running Speed, mph		41.15			42.96	
2	Through Delay, s/veh		5.56			19.74	
2	Travel Speed, mph		37.94			32.68	
2	Stop Rate, stops/veh		0.23			0.59	
2	Spatial Stop Rate, stops/mi		0.3			0.79	
2	Through vol/cap ratio		0.04			0.25	
2	Percent of Base FFS		86.08			74.16	
2	Level of Service		A			B	
2	Automobile Perception Score		2.29			2.31	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.72			18.73	
3	Running Speed, mph		36.42			36.4	
3	Through Delay, s/veh		1.08			2.95	
3	Travel Speed, mph		34.42			31.45	
3	Stop Rate, stops/veh		0.18			0.12	
3	Spatial Stop Rate, stops/mi		0.95			0.65	
3	Through vol/cap ratio		0.07			0.07	
3	Percent of Base FFS		78.1			71.37	
3	Level of Service		B			B	
3	Automobile Perception Score		2.28			2.45	

4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999					
4	Base Free-Flow Speed, mph		44.07			44.07	
4	Running Time, s		17.18			18.93	
4	Running Speed, mph		39.7			36.03	
4	Through Delay, s/veh		4.29			1.15	
4	Travel Speed, mph		31.77			33.97	
4	Stop Rate, stops/veh		0.18			0.03	
4	Spatial Stop Rate, stops/mi		0.96			0.14	
4	Through vol/cap ratio		0.15			0.23	
4	Percent of Base FFS		72.09			77.07	
4	Level of Service		B			B	
4	Automobile Perception Score		2.5			2.37	
	Facility Travel Time, s		184.68			184.23	
	Facility Travel Speed, mph		31.75			31.83	
	Facility Spatial Stop Rate, stops/mi		0.85			0.79	
	Facility Base Free Flow Speed, mph		44.07			44.07	
	Facility Percent Base Free Flow Speed		72.04			72.22	
	Facility Level of Service		B			B	
	Facility Automobile Perception Score		2.34			2.33	
	Facility Pedestrian Space		∞			∞	
	Facility Pedestrian Travel Speed		4.27			4.28	
	Facility Pedestrian LOS Score		3.48			2.86	
	Facility Pedestrian LOS		C			C	
	Facility Bicycle Travel Speed		13.73			14.03	
	Facility Bicycle LOS Score		2.81			2.56	
	Facility Bicycle LOS		C			C	
	Facility Transit Travel Speed		24.94			29.85	
	Facility Transit LOS Score		0.81			0.78	
	Facility Transit LOS		A			A	
	SPILLBACK TIME, h		999				

Multimodal Results

1	Average Pedestrian Space, ft2/p		∞			∞	
1	Pedestrian Travel Speed, ft/s		4.15			4.15	
1	Ped LOS Score for Intersection		2.23			2.9	
1	Cross-section Adjustment Factor		-4.74			-4.74	
1	Volume Adjustment Factor		1.1			0.66	
1	Speed Adjustment Factor		0.68			0.7	
1	Ped LOS Score for Link		3.09			2.67	
1	Ped Link LOS		C			C	
1	Roadway Crossing Difficulty Factor		1.05			0.87	
1	Ped LOS Score for Segment		3.28			2.65	
1	Ped Segment LOS		C			B	
1	Bicycle Travel Speed		13.51			13.14	
1	Bicycle LOS Score for Intersection		3.11			2.83	
1	Cross-section Adjustment Factor		-1.28			-1.28	
1	Volume Adjustment Factor		2.43			2.17	
1	Speed Adjustment Factor		0.84			0.85	
1	Pavement Adjustment Factor		0.58			0.58	
1	Bicycle LOS Score for Link		3.33			3.08	
1	Bicycle Link LOS		C			C	
1	Number of access point approaches		0			0	
1	Segment Length, ft		2645			2645	
1	Unsignalized Conflicts Factor		-0.7			-0.7	
1	Bicycle LOS Score for Segment		2.88			2.7	
1	Bicycle Segment LOS		C			B	
1	Transit Running Speed, mi/h		41.36			41.78	
1	g/C Ratio		0.35			0.4	
1	Transit Running Time, s		43.6			43.16	
1	Delay at Intersection, s/veh		28.7			17.25	
1	Transit Travel Speed, mi/h		24.94			29.85	
1	Transit Wait-Ride Score		3.41			3.65	
1	Ped LOS Score for Link		3.09			2.67	
1	Transit LOS Score for Segment		1.34			0.93	
1	Transit Segment LOS		A			A	
2	Average Pedestrian Space, ft2/p		∞			∞	
2	Pedestrian Travel Speed, ft/s		4.32			4.32	
2	Ped LOS Score for Intersection		4.02			2.67	

2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	2.05	0.43
2	Speed Adjustment Factor	0.68	0.74
2	Ped LOS Score for Link	4.03	2.48
2	Ped Link LOS	D	B
2	Roadway Crossing Difficulty Factor	1.03	1.2
2	Ped LOS Score for Segment	3.98	3.1
2	Ped Segment LOS	D	C
2	Bicycle Travel Speed	13.7	14.78
2	Bicycle LOS Score for Intersection	4.08	2.75
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.75	1.95
2	Speed Adjustment Factor	0.84	0.86
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.64	2.87
2	Bicycle Link LOS	D	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	3.17	2.51
2	Bicycle Segment LOS	C	B
2	Transit Running Speed, mi/h	41.15	42.96
2	g/C Ratio	0.63	0.35
2	Transit Running Time, s	65.53	62.77
2	Delay at Intersection, s/veh	5.56	19.74
2	Transit Travel Speed, mi/h	37.94	32.68
2	Transit Wait-Ride Score	3.97	3.77
2	Ped LOS Score for Link	4.03	2.48
2	Transit LOS Score for Segment	0.65	0.72
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.3	4.35
3	Ped LOS Score for Intersection	0.54	1.33
3	Cross-section Adjustment Factor	-4.74	-4.74
3	Volume Adjustment Factor	0.2	0.22
3	Speed Adjustment Factor	0.53	0.53
3	Ped LOS Score for Link	2.04	2.06
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.18	1.2
3	Ped LOS Score for Segment	2.67	2.72
3	Ped Segment LOS	B	B
3	Bicycle Travel Speed	13.39	14.67
3	Bicycle LOS Score for Intersection	2.88	2.81
3	Cross-section Adjustment Factor	-1.28	-1.28
3	Volume Adjustment Factor	1.58	1.62
3	Speed Adjustment Factor	0.78	0.78
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	2.42	2.47
3	Bicycle Link LOS	B	B
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	2.29	2.22
3	Bicycle Segment LOS	B	B
3	Transit Running Speed, mi/h	36.42	36.4
3	g/C Ratio	0.93	0.74
3	Transit Running Time, s	18.72	18.73
3	Delay at Intersection, s/veh	1.08	2.95
3	Transit Travel Speed, mi/h	34.42	31.45
3	Transit Wait-Ride Score	3.84	3.72
3	Ped LOS Score for Link	2.04	2.06
3	Transit LOS Score for Segment	0.55	0.73
3	Transit Segment LOS	A	A
4	Average Pedestrian Space, ft2/p	∞	∞
4	Pedestrian Travel Speed, ft/s	4.4	4.38
4	Ped LOS Score for Intersection	2.06	1.3
4	Cross-section Adjustment Factor	-4.86	-4.74
4	Volume Adjustment Factor	0.34	0.7
4	Speed Adjustment Factor	0.63	0.52
4	Ped LOS Score for Link	2.15	2.52
4	Ped Link LOS	B	C
4	Roadway Crossing Difficulty Factor	1.2	0.92
4	Ped LOS Score for Segment	2.81	2.62
4	Ped Segment LOS	C	B
4	Bicycle Travel Speed	14.94	13.19
4	Bicycle LOS Score for Intersection	3.11	2.98
4	Cross-section Adjustment Factor	-2.2	-1.28

4	Volume Adjustment Factor	1.83	2.2
4	Speed Adjustment Factor	0.83	0.78
4	Pavement Adjustment Factor	0.58	0.58
4	Bicycle LOS Score for Link	1.8	3.03
4	Bicycle Link LOS	B	C
4	Number of access point approaches	0	0
4	Segment Length, ft	1000	1000
4	Unsignalized Conflicts Factor	-0.7	-0.7
4	Bicycle LOS Score for Segment	1.71	2.69
4	Bicycle Segment LOS	A	B
4	Transit Running Speed, mi/h	39.7	36.03
4	g/C Ratio	0.61	0.84
4	Transit Running Time, s	17.18	18.93
4	Delay at Intersection, s/veh	0	1.1
4	Transit Travel Speed, mi/h	39.7	34.05
4	Transit Wait-Ride Score	4.03	3.82
4	Ped LOS Score for Link	2.15	2.52
4	Transit LOS Score for Segment	0.28	0.64
4	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	927	39.9	0	505	76.4	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.02	0	0	0.15	0	0	0.18	0.18	0.15	0.18	0.18	0.02
1: Thru veh delay		0.03			0.04							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1798	0	0	384	14.5	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.48	0	0	0.48	0.48	0.48	0.48	0.48	0
1: Thru veh delay		0			0.01							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	60.6	1596	162	34.3	378	73.6	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0	0	0	0.46	0	0	0.46	0.46	0.46	0.46	0.46	0
2: Thru veh delay		0.16			0.04							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											
3: Volume, veh/h	0	574	1112	2.08	376	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0	0	0	0.44	0	0	0.44	0.44	0.44	0.44	0.44	0
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

HCS7 Two-Way Stop-Control Report

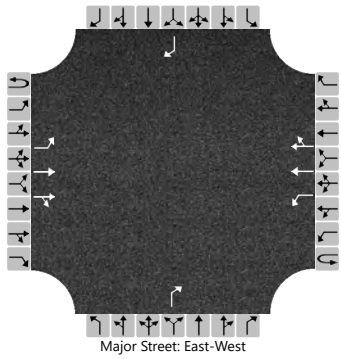
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2045
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes


Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	0	1		0	0	1
Configuration		L	T	TR		L	T	TR				R				R
Volume (veh/h)	0	10	1660	40	0	60	535	45				85				40
Percent Heavy Vehicles (%)	5	5			5	5						5				5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized									No				No			
Median Type | Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1						6.9				6.9
Critical Headway (sec)		4.20				4.20						7.00				7.00
Base Follow-Up Headway (sec)		2.2				2.2						3.3				3.3
Follow-Up Headway (sec)		2.25				2.25						3.35				3.35

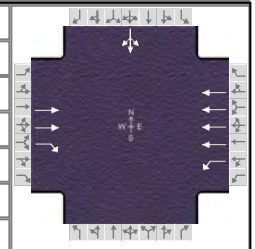
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		11				67						94				44
Capacity, c (veh/h)		916				301						257				665
v/c Ratio		0.01				0.22						0.37				0.07
95% Queue Length, Q_{95} (veh)		0.0				0.8						1.6				0.2
Control Delay (s/veh)		9.0				20.3						26.9				10.8
Level of Service (LOS)		A				C						D				B
Approach Delay (s/veh)	0.1				1.9				26.9				10.8			
Approach LOS									D				B			

Option 1B

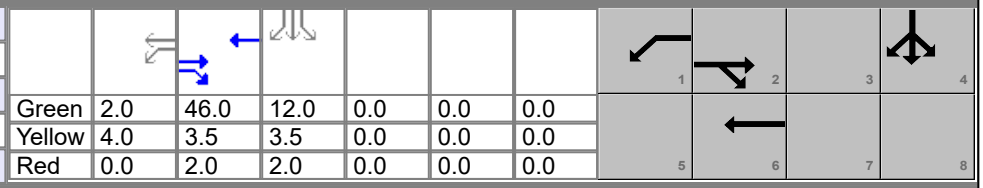
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1B_BENSON _AM.xus		
Project Description	I-229/BENSON 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		305	345	65	2235					10	0	170

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.0	46.0	12.0	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		51.5	6.0	57.5				17.5
Change Period, ($Y+R_c$), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (g_s), s			2.8					11.9
Green Extension Time (g_e), s		0.0	0.0	0.0				0.3
Phase Call Probability			0.33					0.98
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		115	131	19	664						200	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1547	1443	1714	1491						1476	
Queue Service Time (g_s), s		1.0	1.3	0.8	3.4						9.9	
Cycle Queue Clearance Time (g_c), s		1.0	1.3	0.8	3.4						9.9	
Green Ratio (*g/C*)		0.61	0.61	0.03	0.69						0.16	
Capacity (*c*), veh/h		1900	886	45	4138						236	
Volume-to-Capacity Ratio (*X*)		0.061	0.147	0.425	0.160						0.849	
Back of Queue (*Q*), ft/ln (95 th percentile)		11.9	16.3	16.5	34.2						157.4	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.5	0.7	0.7	1.3						6.3	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.17	0.00						0.00	
Uniform Delay (d_1), s/veh		5.0	2.6	36.8	4.9						30.6	
Incremental Delay (d_2), s/veh		0.1	0.3	2.2	0.1						3.3	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		5.0	2.9	39.0	5.0						33.9	
Level of Service (LOS)		A	A	D	A						C	
Approach Delay, s/veh / LOS	3.9	A		5.9	A		0.0			33.9	C	
Intersection Delay, s/veh / LOS	10.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.02	B	1.35	A	3.14	C	3.26	C
Bicycle LOS Score / LOS	3.07	C	3.53	D		A	0.82	A

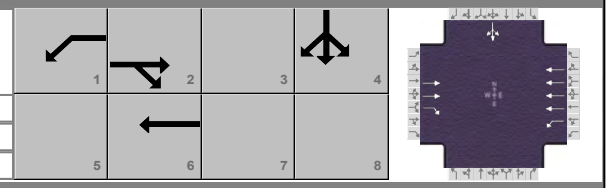
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 SB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1B_BENSON _AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		305	345	65	2235					10	0	170
Intersection Two Demand (*v*), veh/h	75	240			615	20		0	125			

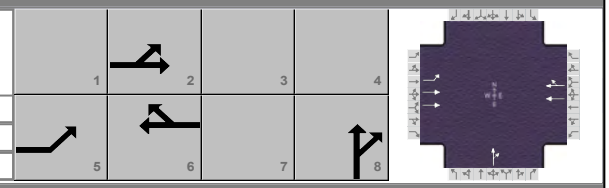
Signal One Information	
Cycle, s	75.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	2.0	46.0	12.0	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



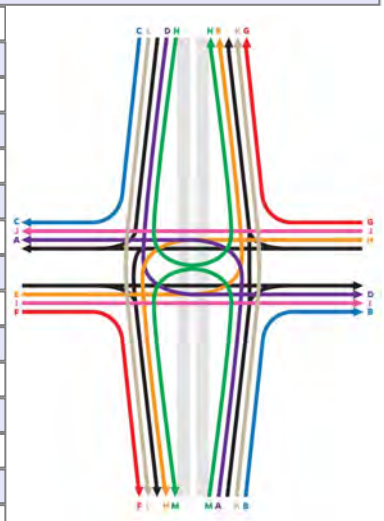
Signal Two Information	
Cycle, s	75.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	2.9	50.3	8.3	0.0	0.0	0.0
Yellow	4.0	3.5	4.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0



Interchange Results

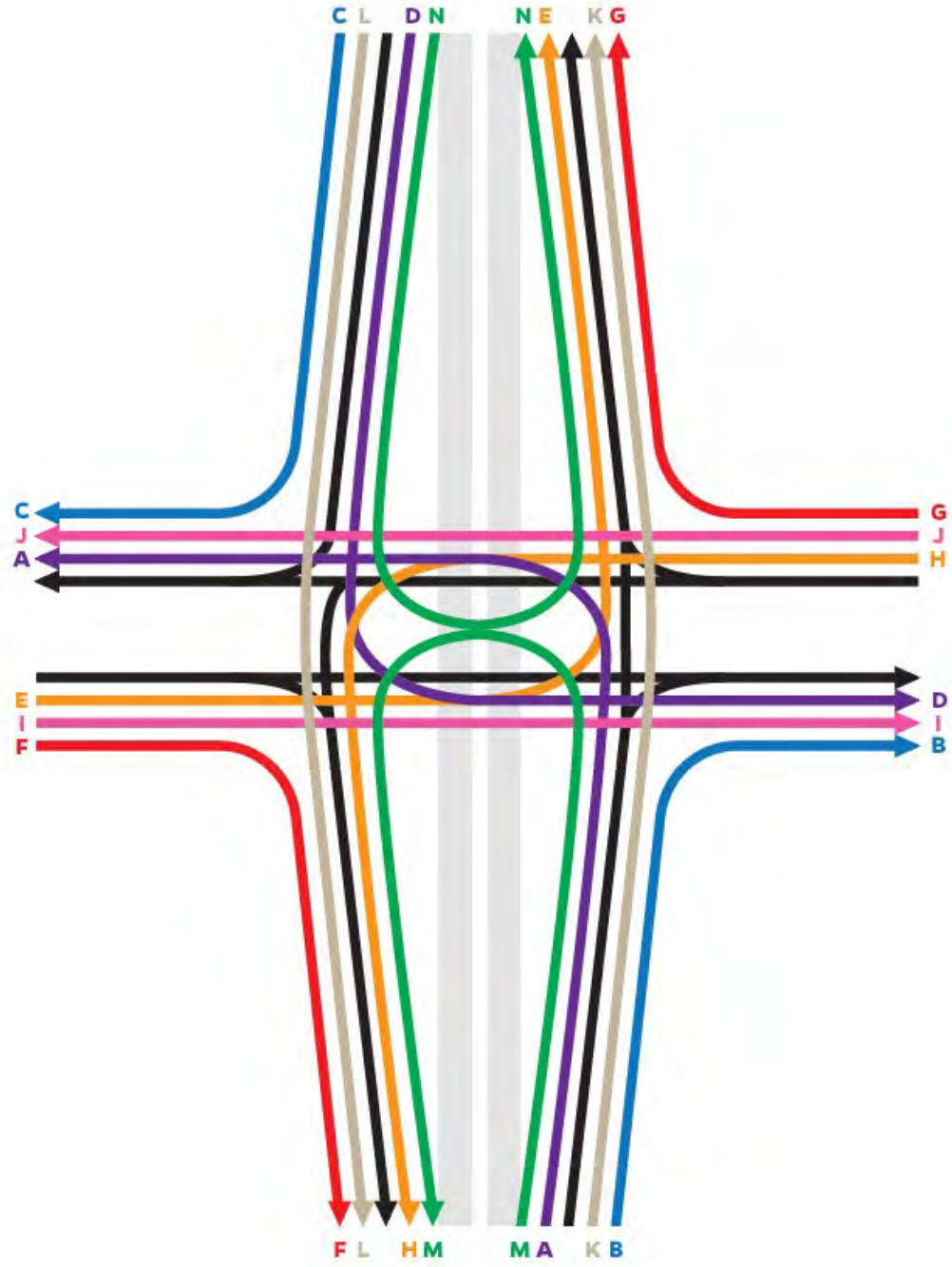
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	5.0	0.0	5.0	No	No	A
B	133	36.6	0.0	36.6	No	No	C
C	189	0.0	0.0	0.0	No	No	A
D	11	37.4	0.0	37.4	No	No	C
E	31	8.9	0.0	8.9	No	No	A
F	131	5.0	0.0	5.0	No	No	A
G	22	4.1	0.0	4.1	No	No	A
H	19	43.2	0.0	43.2	No	No	C
I	89	8.5	0.0	8.5	No	No	A
J	664	9.1	0.0	9.1	No	No	A
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		5.0	2.9	39.0	5.0						33.9	
Level of Service (LOS)		A	A	D	A						C	
Approach Delay, s/veh / LOS	3.9	A		5.9	A		0.0			33.9	C	
Intersection Delay, s/veh / LOS	10.5						B					

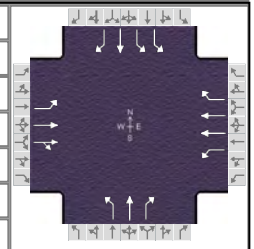
Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	3.9	3.5			4.1	4.1		36.6				
Level of Service (LOS)	A	A			A	A		D				
Approach Delay, s/veh / LOS	3.6	A		4.1	A		36.6	D		0.0		
Intersection Delay, s/veh / LOS	8.5						A					

Interchange Graphic



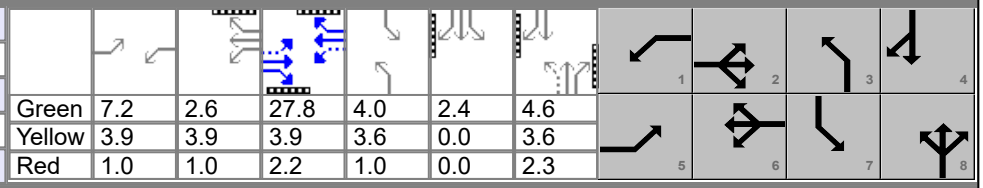
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1B_BENSON _AM.xus		
Project Description	I-229/BENSON 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	160	415	40	80	1190	545	30	25	40	165	40	125

Signal Information			
Cycle, s	75.0	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	7.2	2.6	27.8	4.0	2.4	4.6
Yellow	3.9	3.9	3.9	3.6	0.0	3.6
Red	1.0	1.0	2.2	1.0	0.0	2.3

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	12.1	33.9	19.6	41.4	8.6	10.5	11.0	12.9
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	6.8		2.5		3.4	3.6	6.2	7.0
Green Extension Time (g_e), s	0.4	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.36		0.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	176	247	242	27	405	133	33	28	33	183	44	100
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1688	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	4.8	8.3	8.4	0.5	6.5		1.4	1.1	1.6	4.2	1.8	5.0
Cycle Queue Clearance Time (g_c), s	4.8	8.3	8.4	0.5	6.5		1.4	1.1	1.6	4.2	1.8	5.0
Green Ratio (*g/C*)	0.47	0.37	0.37	0.59	0.47		0.11	0.06	0.06	0.09	0.09	0.09
Capacity (*c*), veh/h	596	641	626	649	1549		241	106	94	273	161	137
Volume-to-Capacity Ratio (*X*)	0.295	0.385	0.387	0.042	0.262		0.138	0.262	0.356	0.672	0.275	0.731
Back of Queue (*Q*), ft/ln (95 th percentile)	71.8	158.8	149.4	7.7	107.1		25.5	22.4	26.2	79.7	34.5	84.1
Back of Queue (*Q*), veh/ln (95 th percentile)	2.8	6.1	6.0	0.3	4.1		1.0	0.9	1.0	3.1	1.3	3.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.36	0.00	0.00	0.11	0.00		0.64	0.00	0.00	0.30	0.00	0.00
Uniform Delay (d_1), s/veh	11.6	19.0	18.9	7.1	14.7		30.0	33.6	33.8	33.3	31.6	33.1
Incremental Delay (d_2), s/veh	0.4	1.6	1.7	0.1	0.4		0.4	0.5	0.8	4.0	0.3	2.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	12.0	20.6	20.6	7.2	15.1	0.0	30.4	34.1	34.6	37.3	32.0	35.9
Level of Service (LOS)	B	C	C	A	B	A	C	C	C	D	C	D
Approach Delay, s/veh / LOS	18.3	B		11.2	B		33.0	C		36.2	D	
Intersection Delay, s/veh / LOS	20.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.20	B	2.63	C	3.27	C	2.88	C
Bicycle LOS Score / LOS	2.82	C	3.78	D	2.08	B	2.62	C

File Name: BUILD_1B_BENSON _AM.xus
Analyst: RL
Agency/Co.: HDR
Analysis Date: Mar 7, 2018
Time Period: AM PEAK
Jurisdiction: CITY OF SIOUX FALLS
Analysis Year: 2045
Project Description: I-229/BENSON IMJR
Urban Street: BENSON ROAD
Analysis Period: 1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	5
Number of Segments	4
Analysis period duration, h	0.25
System cycle length, s	75
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	4	1000	1000	50	50	0	0	70	70	0	0
4	40	40	1	2	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0

1: Location, ft	1320
1: Peak Hour Factor	1

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

Number of access points: 0

SEGMENT 4

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.28			43.16	
1	Running Speed, mph		41.67			41.79	
1	Through Delay, s/veh		20.6			10.37	
1	Travel Speed, mph		28.23			33.69	
1	Stop Rate, stops/veh		0.66			0.36	
1	Spatial Stop Rate, stops/mi		1.31			0.73	
1	Through vol/cap ratio		0.39			0.24	
1	Percent of Base FFS		64.05			76.44	
1	Level of Service		C			B	
1	Automobile Perception Score		2.34			2.25	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		63.24			63.58	
2	Running Speed, mph		42.64			42.41	
2	Through Delay, s/veh		5.01			15.1	
2	Travel Speed, mph		39.51			34.27	
2	Stop Rate, stops/veh		0.21			0.54	
2	Spatial Stop Rate, stops/mi		0.28			0.72	
2	Through vol/cap ratio		0.06			0.26	
2	Percent of Base FFS		89.65			77.77	
2	Level of Service		A			B	
2	Automobile Perception Score		2.28			2.3	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.7			18.8	
3	Running Speed, mph		36.46			36.27	
3	Through Delay, s/veh		3.49			4.98	
3	Travel Speed, mph		30.73			28.68	
3	Stop Rate, stops/veh		0.21			0.21	
3	Spatial Stop Rate, stops/mi		1.11			1.12	
3	Through vol/cap ratio		0.05			0.16	
3	Percent of Base FFS		69.72			65.08	
3	Level of Service		B			C	
3	Automobile Perception Score		2.31			2.52	

4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999					
4	Base Free-Flow Speed, mph		44.07			44.07	
4	Running Time, s		17.26			18.97	
4	Running Speed, mph		39.5			35.94	
4	Through Delay, s/veh		0.54			4.13	
4	Travel Speed, mph		38.3			29.52	
4	Stop Rate, stops/veh		0.03			0.17	
4	Spatial Stop Rate, stops/mi		0.16			0.89	
4	Through vol/cap ratio		0.23			0.32	
4	Percent of Base FFS		86.9			66.97	
4	Level of Service		A			C	
4	Automobile Perception Score		2.37			2.49	
	Facility Travel Time, s		172.13			179.09	
	Facility Travel Speed, mph		34.07			32.74	
	Facility Spatial Stop Rate, stops/mi		0.68			0.79	
	Facility Base Free Flow Speed, mph		44.07			44.07	
	Facility Percent Base Free Flow Speed		77.3			74.29	
	Facility Level of Service		B			B	
	Facility Automobile Perception Score		2.31			2.33	
	Facility Pedestrian Space		∞			∞	
	Facility Pedestrian Travel Speed		4.28			4.29	
	Facility Pedestrian LOS Score		2.99			3.19	
	Facility Pedestrian LOS		C			C	
	Facility Bicycle Travel Speed		13.83			14.24	
	Facility Bicycle LOS Score		2.61			2.75	
	Facility Bicycle LOS		C			C	
	Facility Transit Travel Speed		28.22			33.27	
	Facility Transit LOS Score		0.63			0.76	
	Facility Transit LOS		A			A	
	SPILLBACK TIME, h		999				

Multimodal Results

1	Average Pedestrian Space, ft2/p		∞			∞	
1	Pedestrian Travel Speed, ft/s		4.17			4.17	
1	Ped LOS Score for Intersection		2.2			2.87	
1	Cross-section Adjustment Factor		-4.74			-4.74	
1	Volume Adjustment Factor		0.8			0.66	
1	Speed Adjustment Factor		0.69			0.7	
1	Ped LOS Score for Link		2.8			2.66	
1	Ped Link LOS		C			C	
1	Roadway Crossing Difficulty Factor		1.04			1.01	
1	Ped LOS Score for Segment		3.03			2.89	
1	Ped Segment LOS		C			C	
1	Bicycle Travel Speed		13.8			13.79	
1	Bicycle LOS Score for Intersection		2.82			3.23	
1	Cross-section Adjustment Factor		-1.28			-1.28	
1	Volume Adjustment Factor		2.27			2.17	
1	Speed Adjustment Factor		0.85			0.85	
1	Pavement Adjustment Factor		0.58			0.58	
1	Bicycle LOS Score for Link		3.17			3.07	
1	Bicycle Link LOS		C			C	
1	Number of access point approaches		0			0	
1	Segment Length, ft		2645			2645	
1	Unsignalized Conflicts Factor		-0.7			-0.7	
1	Bicycle LOS Score for Segment		2.75			2.72	
1	Bicycle Segment LOS		C			B	
1	Transit Running Speed, mi/h		41.67			41.79	
1	g/C Ratio		0.37			0.43	
1	Transit Running Time, s		43.28			43.16	
1	Delay at Intersection, s/veh		20.63			11.05	
1	Transit Travel Speed, mi/h		28.22			33.27	
1	Transit Wait-Ride Score		3.57			3.79	
1	Ped LOS Score for Link		2.8			2.66	
1	Transit LOS Score for Segment		1.06			0.71	
1	Transit Segment LOS		A			A	
2	Average Pedestrian Space, ft2/p		∞			∞	
2	Pedestrian Travel Speed, ft/s		4.33			4.35	
2	Ped LOS Score for Intersection		2.02			2.63	

2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.78	0.97
2	Speed Adjustment Factor	0.73	0.72
2	Ped LOS Score for Link	2.81	3
2	Ped Link LOS	C	C
2	Roadway Crossing Difficulty Factor	1.04	1.2
2	Ped LOS Score for Segment	3.06	3.56
2	Ped Segment LOS	C	D
2	Bicycle Travel Speed	13.86	14.71
2	Bicycle LOS Score for Intersection	3.07	3.78
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.26	2.37
2	Speed Adjustment Factor	0.86	0.85
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.17	3.28
2	Bicycle Link LOS	C	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.76	2.83
2	Bicycle Segment LOS	C	C
2	Transit Running Speed, mi/h	42.64	42.41
2	g/C Ratio	0.61	0.47
2	Transit Running Time, s	63.24	63.58
2	Delay at Intersection, s/veh	5.01	15.1
2	Transit Travel Speed, mi/h	39.51	34.27
2	Transit Wait-Ride Score	4.02	3.83
2	Ped LOS Score for Link	2.81	3
2	Transit LOS Score for Segment	0.39	0.7
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.29	4.33
3	Ped LOS Score for Intersection	1.52	1.35
3	Cross-section Adjustment Factor	-4.9	-4.74
3	Volume Adjustment Factor	0.15	0.39
3	Speed Adjustment Factor	0.53	0.53
3	Ped LOS Score for Link	1.83	2.22
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.2	1.2
3	Ped LOS Score for Segment	2.51	2.86
3	Ped Segment LOS	B	C
3	Bicycle Travel Speed	13.36	13.77
3	Bicycle LOS Score for Intersection	2.77	3.53
3	Cross-section Adjustment Factor	-2.54	-1.28
3	Volume Adjustment Factor	1.42	1.9
3	Speed Adjustment Factor	0.79	0.78
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	1	2.74
3	Bicycle Link LOS	A	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.61	2.54
3	Bicycle Segment LOS	A	B
3	Transit Running Speed, mi/h	36.46	36.27
3	g/C Ratio	0.76	0.69
3	Transit Running Time, s	18.7	18.8
3	Delay at Intersection, s/veh	3.49	4.98
3	Transit Travel Speed, mi/h	30.73	28.68
3	Transit Wait-Ride Score	3.69	3.6
3	Ped LOS Score for Link	1.83	2.22
3	Transit LOS Score for Segment	0.74	0.94
3	Transit Segment LOS	A	A
4	Average Pedestrian Space, ft2/p	∞	∞
4	Pedestrian Travel Speed, ft/s	4.36	4.32
4	Ped LOS Score for Intersection	1.91	1.35
4	Cross-section Adjustment Factor	-4.74	-4.74
4	Volume Adjustment Factor	0.54	0.8
4	Speed Adjustment Factor	0.62	0.52
4	Ped LOS Score for Link	2.48	2.63
4	Ped Link LOS	B	C
4	Roadway Crossing Difficulty Factor	1.2	1.01
4	Ped LOS Score for Segment	3.09	2.84
4	Ped Segment LOS	C	C
4	Bicycle Travel Speed	14.34	14.11
4	Bicycle LOS Score for Intersection	3.15	3.06
4	Cross-section Adjustment Factor	-1.28	-1.28

4	Volume Adjustment Factor	2.07	2.27
4	Speed Adjustment Factor	0.82	0.78
4	Pavement Adjustment Factor	0.58	0.58
4	Bicycle LOS Score for Link	2.95	3.11
4	Bicycle Link LOS	C	C
4	Number of access point approaches	0	0
4	Segment Length, ft	1000	1000
4	Unsignalized Conflicts Factor	-0.7	-0.7
4	Bicycle LOS Score for Segment	2.6	2.71
4	Bicycle Segment LOS	B	B
4	Transit Running Speed, mi/h	39.5	35.94
4	g/C Ratio	0.72	0.67
4	Transit Running Time, s	17.26	18.97
4	Delay at Intersection, s/veh	0	4.12
4	Transit Travel Speed, mi/h	39.5	29.53
4	Transit Wait-Ride Score	4.02	3.63
4	Ped LOS Score for Link	2.48	2.63
4	Transit LOS Score for Segment	0.34	0.94
4	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	676	29.1	0	502	75.9	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.05	0	0	0.07	0	0	0.12	0.12	0.07	0.12	0.12	0.05
1: Thru veh delay		0.02			0.04							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	684	0	0	738	27.9	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.13	0	0	0.13	0.13	0.13	0.13	0.13	0
1: Thru veh delay		0			0.02							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	23.5	618	62.6	67.6	746	145	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0.01	0	0	0.09	0	0	0.11	0.11	0.09	0.11	0.11	0.01
2: Thru veh delay		0.04			0.07							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											
3: Volume, veh/h	0	241	467	4.7	848	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0.03	0	0	0.07	0	0	0.09	0.09	0.07	0.09	0.09	0.03
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

HCS7 Two-Way Stop-Control Report

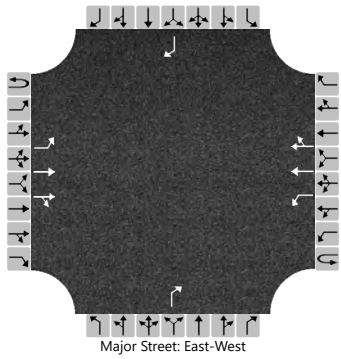
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2045
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes


Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	0	1		0	0	1
Configuration		L	T	TR		L	T	TR				R				R
Volume (veh/h)	0	25	540	55	0	165	1875	365				110				10
Percent Heavy Vehicles (%)	5	5			5	5						5				5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized									No				No			
Median Type | Storage	Undivided															

Critical and Follow-up Headways

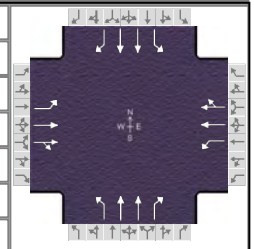
Base Critical Headway (sec)		4.1				4.1						6.9				6.9
Critical Headway (sec)		4.20				4.20						7.00				7.00
Base Follow-Up Headway (sec)		2.2				2.2						3.3				3.3
Follow-Up Headway (sec)		2.25				2.25						3.35				3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		28				183						122				11
Capacity, c (veh/h)		173				903						656				161
v/c Ratio		0.16				0.20						0.19				0.07
95% Queue Length, Q_{95} (veh)		0.6				0.8						0.7				0.2
Control Delay (s/veh)		29.8				10.0						11.7				29.0
Level of Service (LOS)		D				A						B				D
Approach Delay (s/veh)	1.2				0.7				11.7				29.0			
Approach LOS									B				D			

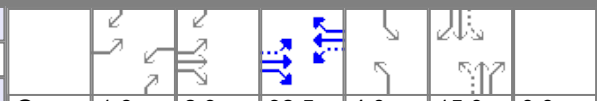
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1B_BENSON _AM.xus		
Project Description	I-229/BENSON IMJR				

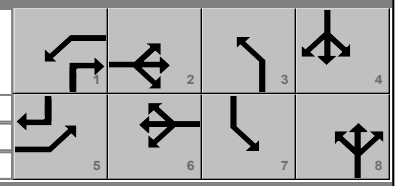


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	105	445	90	70	730	370	95	245	70	120	275	155

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	1.6	2.9	32.5	4.0	15.0	0.0						
Yellow	3.0	0.0	3.5	3.0	3.5	0.0						
Red	1.0	0.0	2.0	1.0	2.0	0.0						



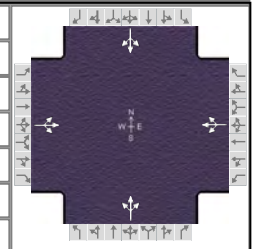
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	8.5	40.9	5.6	38.0	8.0	20.5	8.0	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	4.8		2.6		5.8	7.4	6.0	8.1
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.91		0.40		0.89	1.00	0.94	1.00
Max Out Probability	1.00		0.38		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	117	285	276	25	179	170	106	272	50	133	306	100
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1658	1647	1730	1579	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	2.8	7.8	7.9	0.6	4.0	3.4	3.8	5.4	2.1	4.0	6.1	4.1
Cycle Queue Clearance Time (g_c), s	2.8	7.8	7.9	0.6	4.0	3.4	3.8	5.4	2.1	4.0	6.1	4.1
Green Ratio (*g/C*)	0.51	0.47	0.47	0.45	0.43	0.43	0.25	0.20	0.22	0.25	0.20	0.26
Capacity (*c*), veh/h	578	816	782	413	749	683	280	659	325	293	659	382
Volume-to-Capacity Ratio (*X*)	0.202	0.350	0.352	0.060	0.239	0.248	0.377	0.413	0.154	0.455	0.464	0.262
Back of Queue (*Q*), ft/ln (95 th percentile)	42.6	135.4	126.6	10	67.6	49.7	68.4	93	31.5	88.5	105.7	61.1
Back of Queue (*Q*), veh/ln (95 th percentile)	1.6	5.2	5.1	0.4	2.6	2.0	2.6	3.6	1.2	3.4	4.1	2.4
Queue Storage Ratio (*RQ*) (95 th percentile)	0.22	0.00	0.00	0.07	0.00	0.00	0.23	0.00	0.13	0.24	0.00	0.19
Uniform Delay (d_1), s/veh	10.0	12.5	12.5	11.9	10.3	8.0	22.8	26.2	23.5	24.4	26.5	22.0
Incremental Delay (d_2), s/veh	0.2	1.2	1.2	0.1	0.7	0.8	1.2	0.2	0.1	1.6	0.2	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	0.0	0.0
Control Delay (*d*), s/veh	10.3	13.7	13.8	11.9	11.0	8.8	24.0	26.3	23.6	26.0	26.6	22.1
Level of Service (LOS)	B	B	B	B	B	A	C	C	C	C	C	C
Approach Delay, s/veh / LOS	13.2	B		10.1	B		25.4	C		25.6	C	
Intersection Delay, s/veh / LOS	18.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.70	C	2.87	C	3.00	C	2.83	C
Bicycle LOS Score / LOS	2.82	C	3.23	C	2.74	C	2.83	C

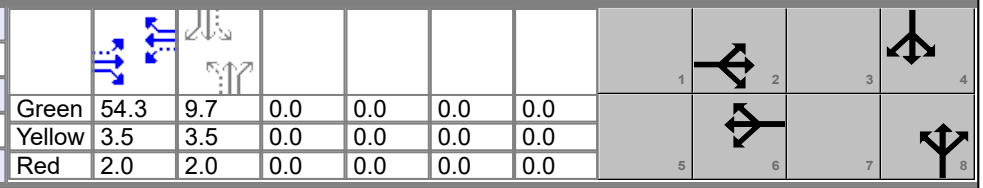
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	Hall	File Name	BUILD_1B_BENSON _AM.xus		
Project Description	I-229/BENSON 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	95	140	130	85	495	20	90	5	40	10	10	50

Signal Information			
Cycle, s	75.0	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	54.3	9.7	0.0	0.0	0.0	0.0						
Yellow	3.5	3.5	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						

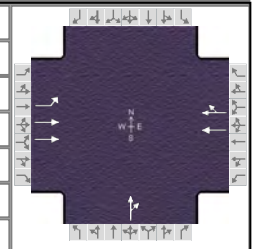
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		59.8		59.8		15.2		15.2
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		3.2		3.2
Queue Clearance Time (g_s), s						9.5		5.3
Green Extension Time (g_e), s		0.0		0.0		0.2		0.3
Phase Call Probability						0.99		0.99
Max Out Probability						0.03		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		239			667			144			78	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1324			1637			1387			1618	
Queue Service Time (g_s), s		0.0			1.3			4.2			0.0	
Cycle Queue Clearance Time (g_c), s		0.0			13.2			7.5			3.3	
Green Ratio (*g/C*)		0.72			0.72			0.13			0.13	
Capacity (*c*), veh/h		1019			1240			260			264	
Volume-to-Capacity Ratio (*X*)		0.235			0.538			0.555			0.295	
Back of Queue (*Q*), ft/ln (95 th percentile)		7.2			150.1			112.2			55.3	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.3			5.8			4.3			2.2	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		0.0			4.7			31.7			29.9	
Incremental Delay (d_2), s/veh		0.5			1.7			0.7			0.2	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		0.5			6.3			32.3			30.1	
Level of Service (LOS)		A			A			C			C	
Approach Delay, s/veh / LOS	0.5	A		6.3	A		32.3	C		30.1	C	
Intersection Delay, s/veh / LOS	10.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.91	B	1.63	B	2.28	B	2.46	B
Bicycle LOS Score / LOS	3.15	C	3.58	D	2.41	B	0.62	A

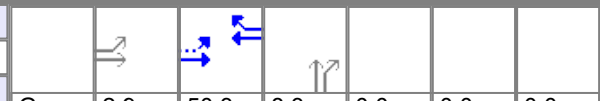
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1B_BENSON _AM.xus		
Project Description	I-229/BENSON 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	75	240			615	20		0	125			

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4		
Green	2.9	50.3	8.3	0.0	0.0	0.0	5	6	7	8		
Yellow	4.0	3.5	4.0	0.0	0.0	0.0						
Red	0.0	2.0	0.0	0.0	0.0	0.0						

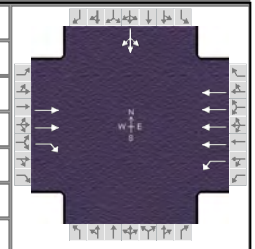
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		8.3		12.0		
Phase Duration, s	6.9	62.7		55.8		12.3		
Change Period, ($Y+R_c$), s	4.0	5.5		5.5		4.0		
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		3.3		
Queue Clearance Time (g_s), s	2.4					8.7		
Green Extension Time (g_e), s	0.0	0.0		0.0		0.2		
Phase Call Probability	0.48					0.94		
Max Out Probability	0.00					0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16		8	18			
Adjusted Flow Rate (*v*), veh/h	31	101			355	351		133				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1546			1673	1653		1466				
Queue Service Time (g_s), s	0.4	0.9			11.0	5.0		6.7				
Cycle Queue Clearance Time (g_c), s	0.4	0.9			11.0	5.0		6.7				
Green Ratio (*g/C*)	0.74	0.67			0.67	0.67		0.11				
Capacity (*c*), veh/h	540	2064			1123	1110		162				
Volume-to-Capacity Ratio (*X*)	0.058	0.049			0.316	0.316		0.824				
Back of Queue (*Q*), ft/ln (95 th percentile)	3.4	10.3			58	55.5		111.3				
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	0.4			2.2	2.2		4.3				
Queue Storage Ratio (*RQ*) (95 th percentile)	0.03	0.00			0.00	0.00		0.00				
Uniform Delay (d_1), s/veh	3.9	3.4			3.5	3.5		32.6				
Incremental Delay (d_2), s/veh	0.0	0.0			0.6	0.6		4.0				
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0		0.0				
Control Delay (*d*), s/veh	3.9	3.5			4.1	4.1		36.6				
Level of Service (LOS)	A	A			A	A		D				
Approach Delay, s/veh / LOS	3.6	A		4.1	A		36.6	D		0.0		
Intersection Delay, s/veh / LOS	8.5						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.52	B	1.35	A	2.50	B	2.60	C
Bicycle LOS Score / LOS	2.77	C	3.06	C	2.39	B		

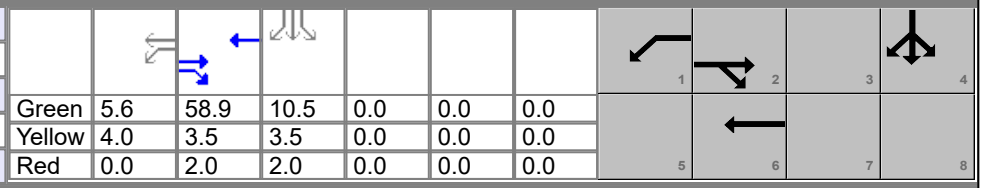
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1B_BENSON_PM.xus		
Project Description	I-229/BENSON 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		260	1485	155	580					80	0	60

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	5.6	58.9	10.5	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		64.4	9.6	74.0				16.0
Change Period, ($Y+R_c$), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.2
Queue Clearance Time (g_s), s			6.4					10.6
Green Extension Time (g_e), s		0.0	0.1	0.0				0.1
Phase Call Probability			0.88					0.98
Max Out Probability			0.00					0.02

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		86	492	83	311						156	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1547	1510	1714	1481						1596	
Queue Service Time (g_s), s		0.8	9.5	4.4	1.4						8.6	
Cycle Queue Clearance Time (g_c), s		0.8	9.5	4.4	1.4						8.6	
Green Ratio (*g/C*)		0.65	0.65	0.06	0.76						0.12	
Capacity (*c*), veh/h		2023	988	107	4508						186	
Volume-to-Capacity Ratio (*X*)		0.043	0.498	0.778	0.069						0.835	
Back of Queue (*Q*), ft/ln (95 th percentile)		10	92.4	90	12.6						154.2	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.4	3.7	3.6	0.5						6.2	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.90	0.00						0.00	
Uniform Delay (d_1), s/veh		4.9	4.0	44.1	3.2						38.9	
Incremental Delay (d_2), s/veh		0.0	0.9	4.4	0.0						3.8	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		5.0	4.9	48.5	3.3						42.7	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	4.9	A		12.8	B		0.0			42.7	D	
Intersection Delay, s/veh / LOS	12.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	4.02	D	1.33	A	2.83	C	3.13	C
Bicycle LOS Score / LOS	4.08	D	2.81	C		A	0.74	A

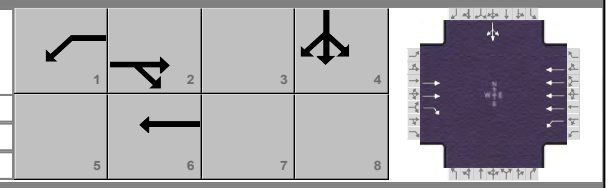
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 NB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1B_BENSON_PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		260	1485	155	580					80	0	60
Intersection Two Demand (*v*), veh/h	90	250			355	195		0	95			

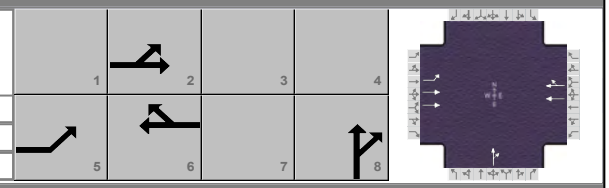
Signal One Information	
Cycle, s	90.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	5.6	58.9	10.5	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



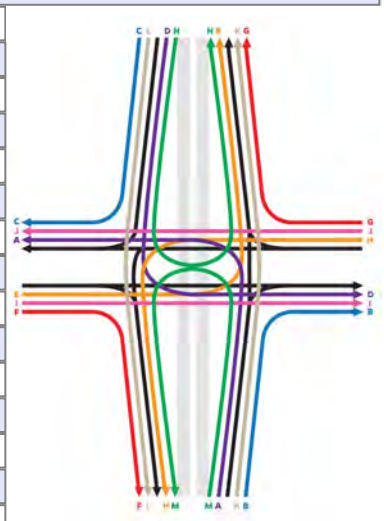
Signal Two Information	
Cycle, s	90.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	4.2	64.8	7.5	0.0	0.0	0.0
Yellow	4.0	3.5	4.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0



Interchange Results

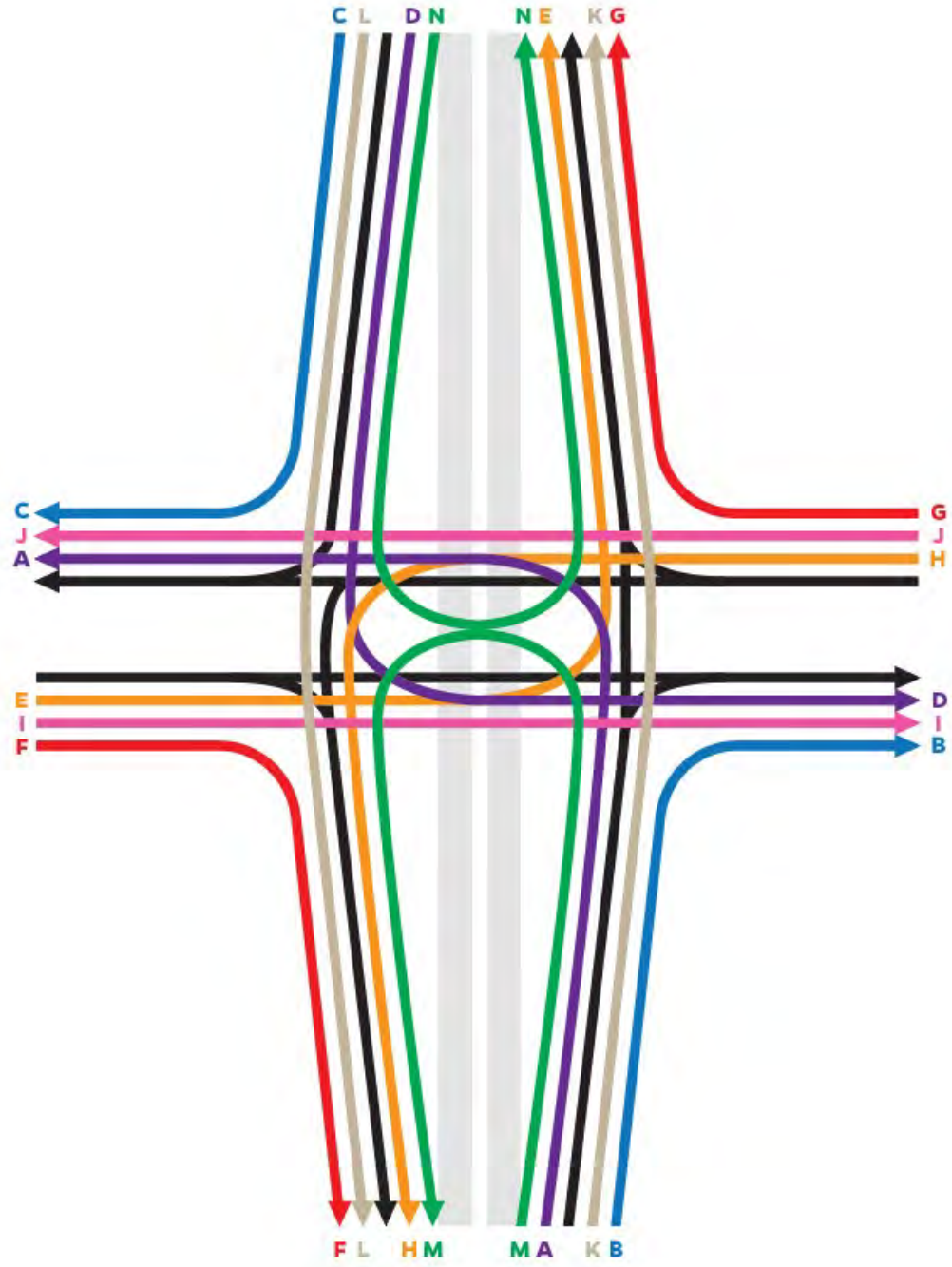
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	3.3	0.0	3.3	No	No	A
B	100	45.7	0.0	45.7	No	No	C
C	67	0.0	0.0	0.0	No	No	A
D	89	45.8	0.0	45.8	No	No	C
E	48	8.1	0.0	8.1	No	No	A
F	492	5.0	0.0	5.0	No	No	A
G	217	3.0	0.0	3.0	No	No	A
H	83	51.0	0.0	51.0	No	No	C
I	44	8.0	0.0	8.0	No	No	A
J	311	5.8	0.0	5.8	No	No	A
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		5.0	4.9	48.5	3.3						42.7	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	4.9	A		12.8	B		0.0			42.7	D	
Intersection Delay, s/veh / LOS	12.9						B					

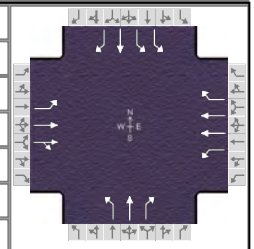
Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	3.2	3.1			2.5	3.0		45.7				
Level of Service (LOS)	A	A			A	A		D				
Approach Delay, s/veh / LOS	3.1	A		2.7	A		45.7	D		0.0		
Intersection Delay, s/veh / LOS	7.6						A					

Interchange Graphic



HCS7 Signalized Intersection Results Summary

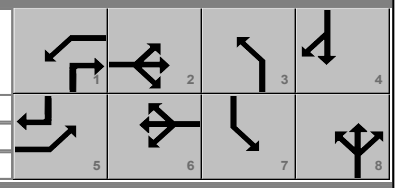
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1B_BENSON_PM.xus		
Project Description	I-229/BENSON 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	70	840	25	60	400	75	50	35	105	765	40	215

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	4.4	31.2	4.8	17.1	6.4	0.0
Yellow	3.9	3.9	3.6	3.6	3.6	0.0
Red	1.0	2.2	1.0	1.0	2.3	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	3.0	2.0	3.0
Phase Duration, s	9.3	37.3	9.3	37.3	9.4	12.3	31.1	34.0
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	4.4		3.5		4.7	7.9	25.0	11.1
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.0	0.0	1.5	0.1
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	0.00

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	69	425	422	43	287	54	56	39	106	850	44	200
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1719	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	2.4	19.6	19.6	1.5	5.6		2.7	1.9	5.9	23.0	1.6	9.1
Cycle Queue Clearance Time (g_c), s	2.4	19.6	19.6	1.5	5.6		2.7	1.9	5.9	23.0	1.6	9.1
Green Ratio (*g/C*)	0.40	0.35	0.35	0.40	0.35		0.12	0.07	0.12	0.29	0.31	0.36
Capacity (*c*), veh/h	462	600	596	229	1141		262	124	184	941	540	530
Volume-to-Capacity Ratio (*X*)	0.150	0.708	0.708	0.188	0.251		0.212	0.315	0.575	0.903	0.082	0.377
Back of Queue (*Q*), ft/ln (95 th percentile)	39	337	323.1	29.5	100.5		52.3	38.3	102.7	391.9	30.2	140.4
Back of Queue (*Q*), veh/ln (95 th percentile)	1.5	13.0	12.9	1.1	3.9		2.0	1.5	4.1	15.1	1.2	5.4
Queue Storage Ratio (*RQ*) (95 th percentile)	0.20	0.00	0.00	0.42	0.00		0.52	0.00	0.00	0.98	0.00	0.00
Uniform Delay (d_1), s/veh	16.7	27.3	27.4	19.5	21.2		35.7	39.7	37.4	30.5	21.8	21.2
Incremental Delay (d_2), s/veh	0.2	5.3	5.4	1.8	0.5		0.6	0.5	2.8	11.4	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	0.0
Control Delay (*d*), s/veh	16.8	32.6	32.7	21.3	21.8	0.0	36.3	40.2	40.3	41.9	21.9	21.4
Level of Service (LOS)	B	C	C	C	C	A	D	D	D	D	C	C
Approach Delay, s/veh / LOS	31.5	C		18.7	B		39.1	D		37.4	D	
Intersection Delay, s/veh / LOS	32.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.23	B	2.67	C	3.01	C	2.76	C
Bicycle LOS Score / LOS	3.11	C	2.75	C	2.26	B	3.89	D

HCS7 Streets Text Report

File Name:	BUILD_1B_BENSON_PM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Mar 7, 2018
Time Period:	PM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2045
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	5
Number of Segments	4
Analysis period duration, h	0.25
System cycle length, s	90
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	4	1000	1000	50	50	0	0	70	70	0	0
4	40	40	1	2	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0

1: Location, ft	1320
1: Peak Hour Factor	1

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

Number of access points: 0

SEGMENT 4

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.6			43.16	
1	Running Speed, mph		41.36			41.78	
1	Through Delay, s/veh		32.68			16.32	
1	Travel Speed, mph		23.64			30.32	
1	Stop Rate, stops/veh		0.82			0.51	
1	Spatial Stop Rate, stops/mi		1.64			1.02	
1	Through vol/cap ratio		0.71			0.17	
1	Percent of Base FFS		53.64			68.79	
1	Level of Service		C			B	
1	Automobile Perception Score		2.39			2.29	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		65.53			62.77	
2	Running Speed, mph		41.15			42.96	
2	Through Delay, s/veh		4.95			21.78	
2	Travel Speed, mph		38.26			31.9	
2	Stop Rate, stops/veh		0.2			0.6	
2	Spatial Stop Rate, stops/mi		0.27			0.8	
2	Through vol/cap ratio		0.04			0.25	
2	Percent of Base FFS		86.82			72.37	
2	Level of Service		A			B	
2	Automobile Perception Score		2.28			2.31	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.72			18.73	
3	Running Speed, mph		36.42			36.4	
3	Through Delay, s/veh		3.08			3.27	
3	Travel Speed, mph		31.28			30.98	
3	Stop Rate, stops/veh		0.2			0.14	
3	Spatial Stop Rate, stops/mi		1.07			0.73	
3	Through vol/cap ratio		0.06			0.07	
3	Percent of Base FFS		70.97			70.3	
3	Level of Service		B			B	
3	Automobile Perception Score		2.3			2.46	

4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999					
4	Base Free-Flow Speed, mph		44.07			44.07	
4	Running Time, s		17.26			18.93	
4	Running Speed, mph		39.5			36.03	
4	Through Delay, s/veh		23.8			2.58	
4	Travel Speed, mph		16.61			31.71	
4	Stop Rate, stops/veh		1			0.11	
4	Spatial Stop Rate, stops/mi		5.27			0.56	
4	Through vol/cap ratio		0.24			0.27	
4	Percent of Base FFS		37.68			71.94	
4	Level of Service		E			B	
4	Automobile Perception Score		3.27			2.43	
	Facility Travel Time, s		209.62			187.54	
	Facility Travel Speed, mph		27.97			31.27	
	Facility Spatial Stop Rate, stops/mi		1.37			0.83	
	Facility Base Free Flow Speed, mph		44.07			44.07	
	Facility Percent Base Free Flow Speed		63.47			70.95	
	Facility Level of Service		C			B	
	Facility Automobile Perception Score		2.4			2.34	
	Facility Pedestrian Space		∞			∞	
	Facility Pedestrian Travel Speed		4.25			4.26	
	Facility Pedestrian LOS Score		3.61			2.87	
	Facility Pedestrian LOS		D			C	
	Facility Bicycle Travel Speed		13.63			13.86	
	Facility Bicycle LOS Score		2.92			2.56	
	Facility Bicycle LOS		C			C	
	Facility Transit Travel Speed		23.66			30.04	
	Facility Transit LOS Score		0.86			0.81	
	Facility Transit LOS		A			A	
	SPILLBACK TIME, h		999				

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.12	4.12
1	Ped LOS Score for Intersection	2.23	2.9
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	1.1	0.66
1	Speed Adjustment Factor	0.68	0.7
1	Ped LOS Score for Link	3.09	2.67
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.12	0.88
1	Ped LOS Score for Segment	3.42	2.66
1	Ped Segment LOS	C	B
1	Bicycle Travel Speed	13.53	12.93
1	Bicycle LOS Score for Intersection	3.11	2.83
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.43	2.17
1	Speed Adjustment Factor	0.84	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.33	3.08
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.88	2.71
1	Bicycle Segment LOS	C	B
1	Transit Running Speed, mi/h	41.36	41.78
1	g/C Ratio	0.35	0.44
1	Transit Running Time, s	43.6	43.16
1	Delay at Intersection, s/veh	32.62	16.87
1	Transit Travel Speed, mi/h	23.66	30.04
1	Transit Wait-Ride Score	3.35	3.66
1	Ped LOS Score for Link	3.09	2.67
1	Transit LOS Score for Segment	1.45	0.91
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.31	4.31
2	Ped LOS Score for Intersection	4.02	2.67

2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	2.05	0.43
2	Speed Adjustment Factor	0.68	0.74
2	Ped LOS Score for Link	4.03	2.48
2	Ped Link LOS	D	B
2	Roadway Crossing Difficulty Factor	1.07	1.2
2	Ped LOS Score for Segment	4.09	3.09
2	Ped Segment LOS	D	C
2	Bicycle Travel Speed	13.55	14.79
2	Bicycle LOS Score for Intersection	4.08	2.75
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.75	1.95
2	Speed Adjustment Factor	0.84	0.86
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.64	2.87
2	Bicycle Link LOS	D	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	3.18	2.51
2	Bicycle Segment LOS	C	B
2	Transit Running Speed, mi/h	41.15	42.96
2	g/C Ratio	0.65	0.35
2	Transit Running Time, s	65.53	62.77
2	Delay at Intersection, s/veh	4.95	21.78
2	Transit Travel Speed, mi/h	38.26	31.9
2	Transit Wait-Ride Score	3.98	3.74
2	Ped LOS Score for Link	4.03	2.48
2	Transit LOS Score for Segment	0.64	0.77
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.3	4.35
3	Ped LOS Score for Intersection	1.46	1.33
3	Cross-section Adjustment Factor	-4.74	-4.74
3	Volume Adjustment Factor	0.2	0.22
3	Speed Adjustment Factor	0.53	0.53
3	Ped LOS Score for Link	2.04	2.06
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.2	1.2
3	Ped LOS Score for Segment	2.7	2.72
3	Ped Segment LOS	B	B
3	Bicycle Travel Speed	13.41	13.92
3	Bicycle LOS Score for Intersection	2.79	2.81
3	Cross-section Adjustment Factor	-1.28	-1.28
3	Volume Adjustment Factor	1.58	1.62
3	Speed Adjustment Factor	0.78	0.78
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	2.42	2.47
3	Bicycle Link LOS	B	B
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	2.28	2.28
3	Bicycle Segment LOS	B	B
3	Transit Running Speed, mi/h	36.42	36.4
3	g/C Ratio	0.81	0.76
3	Transit Running Time, s	18.72	18.73
3	Delay at Intersection, s/veh	3.08	3.27
3	Transit Travel Speed, mi/h	31.28	30.98
3	Transit Wait-Ride Score	3.71	3.7
3	Ped LOS Score for Link	2.04	2.06
3	Transit LOS Score for Segment	0.74	0.76
3	Transit Segment LOS	A	A
4	Average Pedestrian Space, ft2/p	∞	∞
4	Pedestrian Travel Speed, ft/s	4.37	4.33
4	Ped LOS Score for Intersection	2.06	1.35
4	Cross-section Adjustment Factor	-4.74	-4.74
4	Volume Adjustment Factor	0.54	0.7
4	Speed Adjustment Factor	0.62	0.52
4	Ped LOS Score for Link	2.47	2.52
4	Ped Link LOS	B	C
4	Roadway Crossing Difficulty Factor	1.2	0.96
4	Ped LOS Score for Segment	3.09	2.68
4	Ped Segment LOS	C	B
4	Bicycle Travel Speed	14.49	13.05
4	Bicycle LOS Score for Intersection	3.11	2.98
4	Cross-section Adjustment Factor	-1.28	-1.28

4	Volume Adjustment Factor	2.07	2.2
4	Speed Adjustment Factor	0.82	0.78
4	Pavement Adjustment Factor	0.58	0.58
4	Bicycle LOS Score for Link	2.95	3.03
4	Bicycle Link LOS	C	C
4	Number of access point approaches	0	0
4	Segment Length, ft	1000	1000
4	Unsignalized Conflicts Factor	-0.7	-0.7
4	Bicycle LOS Score for Segment	2.59	2.7
4	Bicycle Segment LOS	B	B
4	Transit Running Speed, mi/h	39.5	36.03
4	g/C Ratio	0.61	0.72
4	Transit Running Time, s	17.26	18.93
4	Delay at Intersection, s/veh	0	2.49
4	Transit Travel Speed, mi/h	39.5	31.84
4	Transit Wait-Ride Score	4.02	3.73
4	Ped LOS Score for Link	2.47	2.52
4	Transit LOS Score for Segment	0.34	0.78
4	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	927	39.9	0	505	76.4	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.02	0	0	0.14	0	0	0.17	0.17	0.14	0.17	0.17	0.02
1: Thru veh delay		0.03			0.04							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1798	0	0	384	14.5	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.46	0	0	0.46	0.46	0.46	0.46	0.46	0
1: Thru veh delay		0			0.01							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	60.6	1596	162	34.3	378	73.6	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0	0	0	0.44	0	0	0.44	0.44	0.44	0.44	0.44	0
2: Thru veh delay		0.16			0.04							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											
3: Volume, veh/h	0	574	1112	2.08	376	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0	0	0	0.42	0	0	0.42	0.42	0.42	0.42	0.42	0
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

HCS7 Two-Way Stop-Control Report

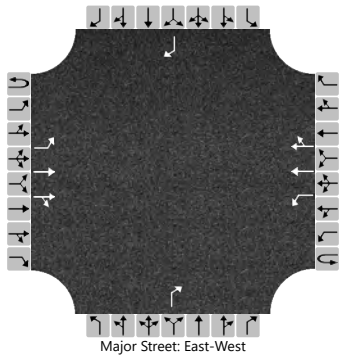
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2045
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes


Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	0	1		0	0	1
Configuration		L	T	TR		L	T	TR				R				R
Volume (veh/h)	0	10	1660	40	0	60	535	45				85				40
Percent Heavy Vehicles (%)	5	5			5	5						5				5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized									No				No			
Median Type | Storage	Undivided															

Critical and Follow-up Headways

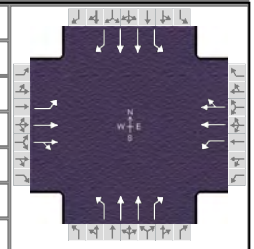
Base Critical Headway (sec)		4.1				4.1						6.9				6.9
Critical Headway (sec)		4.20				4.20						7.00				7.00
Base Follow-Up Headway (sec)		2.2				2.2						3.3				3.3
Follow-Up Headway (sec)		2.25				2.25						3.35				3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		11				67						94				44
Capacity, c (veh/h)		916				301						257				665
v/c Ratio		0.01				0.22						0.37				0.07
95% Queue Length, Q_{95} (veh)		0.0				0.8						1.6				0.2
Control Delay (s/veh)		9.0				20.3						26.9				10.8
Level of Service (LOS)		A				C						D				B
Approach Delay (s/veh)	0.1				1.9				26.9				10.8			
Approach LOS									D				B			

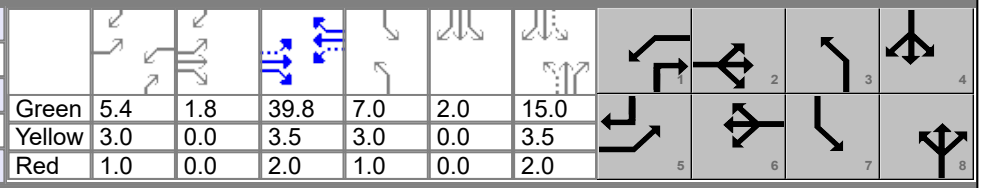
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1B_BENSON_PM.xus		
Project Description	I-229/BENSON 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	150	625	190	190	380	160	130	355	40	205	380	100

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



	EB		WB			NB			SB		
Green	5.4	1.8	39.8	7.0	2.0	15.0					
Yellow	3.0	0.0	3.5	3.0	0.0	3.5					
Red	1.0	0.0	2.0	1.0	0.0	2.0					

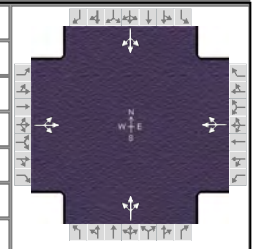
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	11.2	47.1	9.4	45.3	11.0	20.5	13.0	22.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	6.8		5.4		8.5	12.2	11.0	12.7
Green Extension Time (g_e), s	0.5	0.0	0.4	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.98		0.95		0.97	1.00	1.00	1.00
Max Out Probability	0.13		0.01		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	167	452	420	116	131	129	144	394	17	228	422	39
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1607	1647	1730	1666	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	4.8	17.1	17.1	3.4	4.4	4.2	6.5	10.2	0.8	9.0	10.7	1.8
Cycle Queue Clearance Time (g_c), s	4.8	17.1	17.1	3.4	4.4	4.2	6.5	10.2	0.8	9.0	10.7	1.8
Green Ratio (*g/C*)	0.52	0.46	0.46	0.50	0.44	0.44	0.24	0.17	0.23	0.27	0.19	0.27
Capacity (*c*), veh/h	641	799	742	334	765	737	253	549	333	296	622	394
Volume-to-Capacity Ratio (*X*)	0.260	0.566	0.566	0.349	0.172	0.175	0.571	0.719	0.050	0.769	0.679	0.099
Back of Queue (*Q*), ft/ln (95 th percentile)	76.8	289.5	264	58.4	81.4	71.2	127.2	186.8	12.7	223.9	194.1	28.1
Back of Queue (*Q*), veh/ln (95 th percentile)	3.0	11.1	10.6	2.2	3.1	2.8	4.9	7.2	0.5	8.6	7.5	1.1
Queue Storage Ratio (*RQ*) (95 th percentile)	0.39	0.00	0.00	0.42	0.00	0.00	0.42	0.00	0.05	0.61	0.00	0.09
Uniform Delay (d_1), s/veh	11.6	17.6	17.7	14.4	16.4	15.1	28.9	35.5	27.2	30.4	34.0	24.7
Incremental Delay (d_2), s/veh	0.3	2.9	3.1	0.9	0.5	0.5	3.8	1.1	0.0	12.3	0.6	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	11.9	20.5	20.8	15.3	16.9	15.6	32.7	36.6	27.2	42.6	34.6	24.7
Level of Service (LOS)	B	C	C	B	B	B	C	D	C	D	C	C
Approach Delay, s/veh / LOS	19.2	B		15.9	B		35.3	D		36.7	D	
Intersection Delay, s/veh / LOS	26.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.82	C	2.90	C	2.95	C	2.83	C
Bicycle LOS Score / LOS	3.12	C	2.83	C	2.84	C	2.95	C

HCS7 Signalized Intersection Results Summary

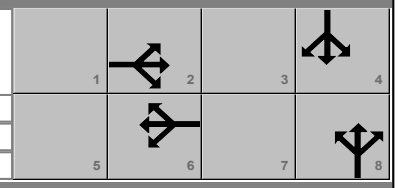
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	HALL	File Name	BUILD_1B_BENSON_PM.xus		
Project Description	I-229/BENSON 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	35	175	135	50	335	20	180	20	95	20	20	35

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	55.1	22.9	0.0	0.0	0.0	0.0	
Yellow	3.5	3.5	0.0	0.0	0.0	0.0	
Red	2.0	3.0	0.0	0.0	0.0	0.0	



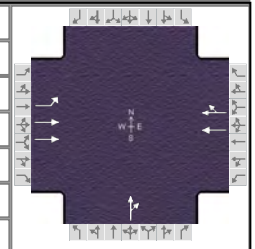
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		60.6		60.6		29.4		29.4
Change Period, ($Y+R_c$), s		5.5		5.5		6.5		6.5
Max Allow Headway (*MAH*), s		0.0		0.0		3.1		3.1
Queue Clearance Time (g_s), s						22.2		5.5
Green Extension Time (g_e), s		0.0		0.0		0.7		0.8
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		238			450			322			83	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1538			1638			1389			1577	
Queue Service Time (g_s), s		0.0			0.0			16.7			0.0	
Cycle Queue Clearance Time (g_c), s		13.0			12.4			20.2			3.5	
Green Ratio (*g/C*)		0.61			0.61			0.25			0.25	
Capacity (*c*), veh/h		985			1047			419			452	
Volume-to-Capacity Ratio (*X*)		0.242			0.430			0.769			0.184	
Back of Queue (*Q*), ft/ln (95 th percentile)		258.7			198.9			274.7			60.8	
Back of Queue (*Q*), veh/ln (95 th percentile)		10.0			7.6			10.6			2.4	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		23.2			9.2			32.4			26.3	
Incremental Delay (d_2), s/veh		0.6			1.3			1.2			0.1	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		23.8			10.5			33.6			26.4	
Level of Service (LOS)		C			B			C			C	
Approach Delay, s/veh / LOS	23.8		C	10.5		B	33.6		C	26.4		C
Intersection Delay, s/veh / LOS	21.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.06	B	1.66	B	2.20	B	2.38	B
Bicycle LOS Score / LOS	3.11	C	3.22	C	2.70	C	0.63	A

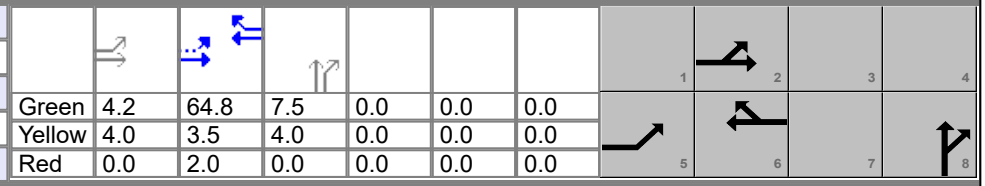
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1B_BENSON_PM.xus		
Project Description	I-229/BENSON 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	90	250			355	195		0	95			

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	4.2	64.8	7.5	0.0	0.0	0.0
Yellow	4.0	3.5	4.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		8.3		12.0		
Phase Duration, s	8.2	78.5		70.3		11.5		
Change Period, ($Y+R_c$), s	4.0	5.5		5.5		4.0		
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		3.3		
Queue Clearance Time (g_s), s	2.6					8.0		
Green Extension Time (g_e), s	0.1	0.0		0.0		0.1		
Phase Call Probability	0.70					0.92		
Max Out Probability	0.00					0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16		8	18			
Adjusted Flow Rate (*v*), veh/h	48	133			322	289		100				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1551			1678	1473		1466				
Queue Service Time (g_s), s	0.6	1.3			11.0	3.8		6.0				
Cycle Queue Clearance Time (g_c), s	0.6	1.3			11.0	3.8		6.0				
Green Ratio (*g/C*)	0.79	0.70			0.72	0.72		0.08				
Capacity (*c*), veh/h	630	2167			1209	1061		122				
Volume-to-Capacity Ratio (*X*)	0.076	0.061			0.267	0.272		0.821				
Back of Queue (*Q*), ft/ln (95 th percentile)	4.7	15.7			38.3	39.2		105.5				
Back of Queue (*Q*), veh/ln (95 th percentile)	0.2	0.6			1.5	1.6		4.1				
Queue Storage Ratio (*RQ*) (95 th percentile)	0.05	0.00			0.00	0.00		0.00				
Uniform Delay (d_1), s/veh	3.1	3.0			2.0	2.4		40.6				
Incremental Delay (d_2), s/veh	0.0	0.0			0.5	0.5		5.1				
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0		0.0				
Control Delay (*d*), s/veh	3.2	3.1			2.5	3.0		45.7				
Level of Service (LOS)	A	A			A	A		D				
Approach Delay, s/veh / LOS	3.1	A		2.7	A		45.7	D		0.0		
Intersection Delay, s/veh / LOS	7.6						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.46	A	1.35	A	2.47	B	2.54	C
Bicycle LOS Score / LOS	2.79	C	2.98	C	2.34	B		

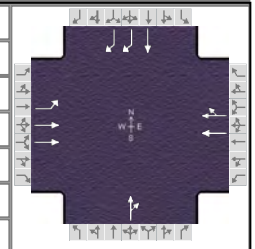
Option 1C

See Option 1A - Model is Identical

Option 1D

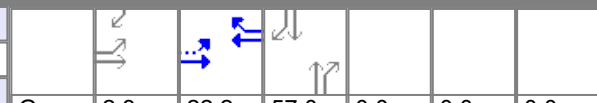
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1D_BENSON _AM.xus		
Project Description	I-229/BENSON IMJR				

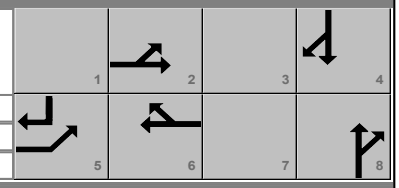


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	75	240			615	20		0	125		0	1685

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.3	22.2	57.0	0.0	0.0	0.0
Yellow	4.0	3.5	4.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0



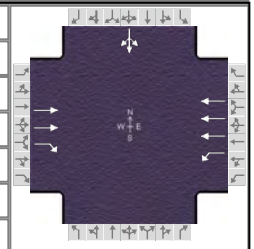
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		8.3		8.0		7.0
Phase Duration, s	6.3	34.0		27.7		61.0		61.0
Change Period, ($Y+R_c$), s	4.0	5.5		5.5		4.0		4.0
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		3.3		3.3
Queue Clearance Time (g_s), s	3.3					5.8		59.0
Green Extension Time (g_e), s	0.0	0.0		0.0		9.5		0.0
Phase Call Probability	0.56					1.00		1.00
Max Out Probability	1.00					0.01		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16		8	18		4	14
Adjusted Flow Rate (*v*), veh/h	31	101			355	351		133			0	1872
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1548			1688	1669		1466			1682	1421
Queue Service Time (g_s), s	1.3	2.0			19.2	19.4		3.8			0.0	57.0
Cycle Queue Clearance Time (g_c), s	1.3	2.0			19.2	19.4		3.8			0.0	57.0
Green Ratio (*g/C*)	0.28	0.30			0.23	0.23		0.60			0.60	0.62
Capacity (*c*), veh/h	136	929			395	391		880			1009	1773
Volume-to-Capacity Ratio (*X*)	0.230	0.108			0.897	0.898		0.152			0.000	1.056
Back of Queue (*Q*), ft/ln (95 th percentile)	23.8	33.2			389.9	372.5		48.3			0	863.7
Back of Queue (*Q*), veh/ln (95 th percentile)	0.9	1.3			15.0	14.9		1.9			0.0	34.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.24	0.00			0.00	0.00		0.00			0.00	0.00
Uniform Delay (d_1), s/veh	27.5	20.9			35.9	35.9		8.4			0.0	17.9
Incremental Delay (d_2), s/veh	0.3	0.2			22.6	22.9		0.0			0.0	37.9
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	27.8	21.1			58.5	58.8		8.4			0.0	55.8
Level of Service (LOS)	C	C			E	E		A				F
Approach Delay, s/veh / LOS	22.7	C		58.6	E		8.4	A		55.8	E	
Intersection Delay, s/veh / LOS	52.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.81	B	2.14	B	2.43	B	3.02	C
Bicycle LOS Score / LOS	2.77	C	3.06	C	2.39	B	3.58	D

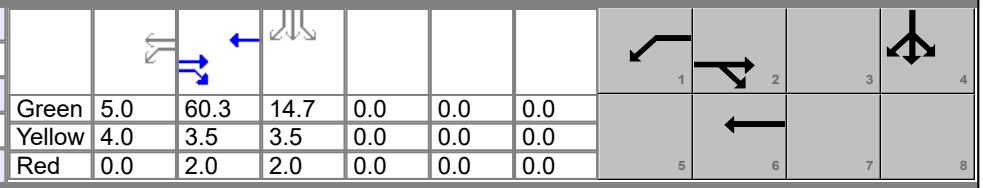
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1D_BENSON _AM.xus		
Project Description	I-229/BENSON 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		305	345	65	2235					10	0	170

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.0	60.3	14.7	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

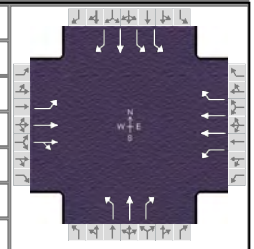
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		65.8	9.0	74.8				20.2
Change Period, ($Y+R_c$), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (g_s), s			5.8					14.5
Green Extension Time (g_e), s		0.0	0.1	0.0				0.3
Phase Call Probability			0.84					0.99
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					7	4	14
Adjusted Flow Rate (*v*), veh/h		115	131	69	2387						200	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1550	1448	1714	1623						1486	
Queue Service Time (g_s), s		1.4	4.9	3.8	26.2						12.5	
Cycle Queue Clearance Time (g_c), s		1.4	4.9	3.8	26.2						12.5	
Green Ratio (*g/C*)		0.63	0.63	0.05	0.28						0.15	
Capacity (*c*), veh/h		1967	919	91	1345						229	
Volume-to-Capacity Ratio (*X*)		0.059	0.142	0.763	1.775						0.872	
Back of Queue (*Q*), ft/ln (95 th percentile)		19.7	66.4	54.5	2150.9						216.3	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.8	2.7	2.2	82.7						8.7	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.55	0.00						0.00	
Uniform Delay (d_1), s/veh		7.1	10.7	44.1	25.4						39.2	
Incremental Delay (d_2), s/veh		0.1	0.3	0.5	348.9						9.4	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		7.1	11.0	44.6	374.3						48.7	
Level of Service (LOS)		A	B	D	F						D	
Approach Delay, s/veh / LOS	9.2	A		365.0	F		0.0			48.7	D	
Intersection Delay, s/veh / LOS	313.1						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.03	B	1.34	A	3.10	C	3.23	C
Bicycle LOS Score / LOS	3.07	C	3.88	D		A	0.82	A

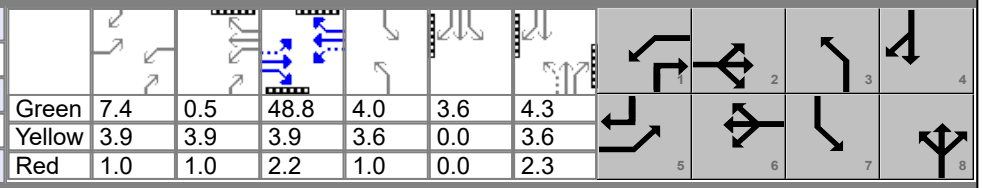
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1D_BENSON _AM.xus		
Project Description	I-229/BENSON 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	160	415	40	80	1190	545	30	25	40	165	40	125

Signal Information			
Cycle, s	95.0	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	7.4	0.5	48.8	4.0	3.6	4.3
Yellow	3.9	3.9	3.9	3.6	0.0	3.6
Red	1.0	1.0	2.2	1.0	0.0	2.3

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	12.3	54.9	17.7	60.3	8.6	10.2	12.2	13.8
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	6.8		3.0		3.8	3.7	7.3	7.8
Green Extension Time (g_e), s	0.6	0.0	0.1	0.0	0.0	0.0	0.2	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.03		0.01		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	176	247	242	52	769	252	33	28	33	183	44	100
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1688	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	4.8	8.9	8.9	1.0	7.3		1.8	1.5	1.7	5.3	2.3	5.8
Cycle Queue Clearance Time (g_c), s	4.8	8.9	8.9	1.0	7.3		1.8	1.5	1.7	5.3	2.3	5.8
Green Ratio (*g/C*)	0.59	0.51	0.51	0.67	0.57		0.09	0.05	0.18	0.08	0.08	0.16
Capacity (*c*), veh/h	528	889	867	670	1879		195	78	275	255	143	236
Volume-to-Capacity Ratio (*X*)	0.334	0.278	0.280	0.077	0.409		0.171	0.355	0.121	0.720	0.311	0.424
Back of Queue (*Q*), ft/ln (95 th percentile)	64.5	166.6	156	12.8	65.5		34.8	30.2	28.6	106.6	45.9	96.8
Back of Queue (*Q*), veh/ln (95 th percentile)	2.5	6.4	6.2	0.5	2.5		1.3	1.2	1.1	4.1	1.8	3.7
Queue Storage Ratio (*RQ*) (95 th percentile)	0.32	0.00	0.00	0.18	0.00		0.87	0.00	0.00	0.39	0.00	0.00
Uniform Delay (d_1), s/veh	8.2	16.0	15.8	5.7	5.4		40.4	44.0	32.6	42.7	41.0	35.9
Incremental Delay (d_2), s/veh	0.5	0.7	0.8	0.0	0.1		0.6	1.0	0.1	6.1	0.5	0.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	8.7	16.8	16.6	5.7	5.5	0.0	41.0	45.0	32.7	48.8	41.5	36.3
Level of Service (LOS)	A	B	B	A	A	A	D	D	C	D	D	D
Approach Delay, s/veh / LOS	14.6	B		4.2	A		39.2	D		44.0	D	
Intersection Delay, s/veh / LOS	15.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.19	B	2.62	C	3.28	C	2.89	C
Bicycle LOS Score / LOS	2.82	C	3.78	D	2.08	B	2.62	C

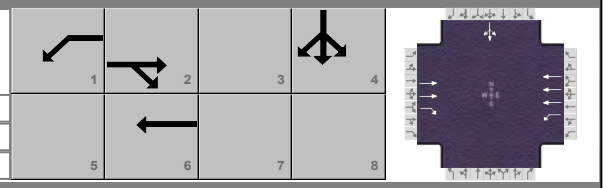
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 SB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1D_BENSON _AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		305	345	65	2235					10	0	170
Intersection Two Demand (*v*), veh/h	75	240			615	20		0	125		0	1685

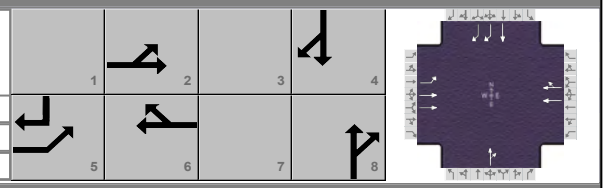
Signal One Information	
Cycle, s	95.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	5.0	60.3	14.7	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



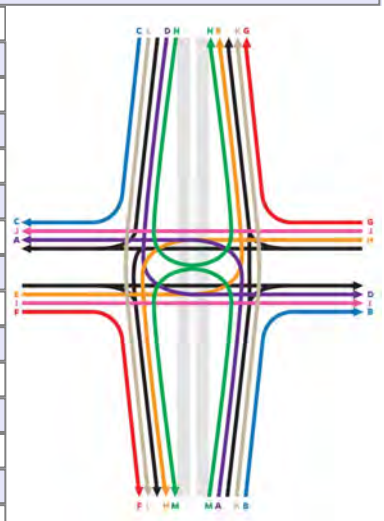
Signal Two Information	
Cycle, s	95.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	2.3	22.2	57.0	0.0	0.0	0.0
Yellow	4.0	3.5	4.0	0.0	0.0	0.0
Red	0.0	2.0	0.0	0.0	0.0	0.0



Interchange Results

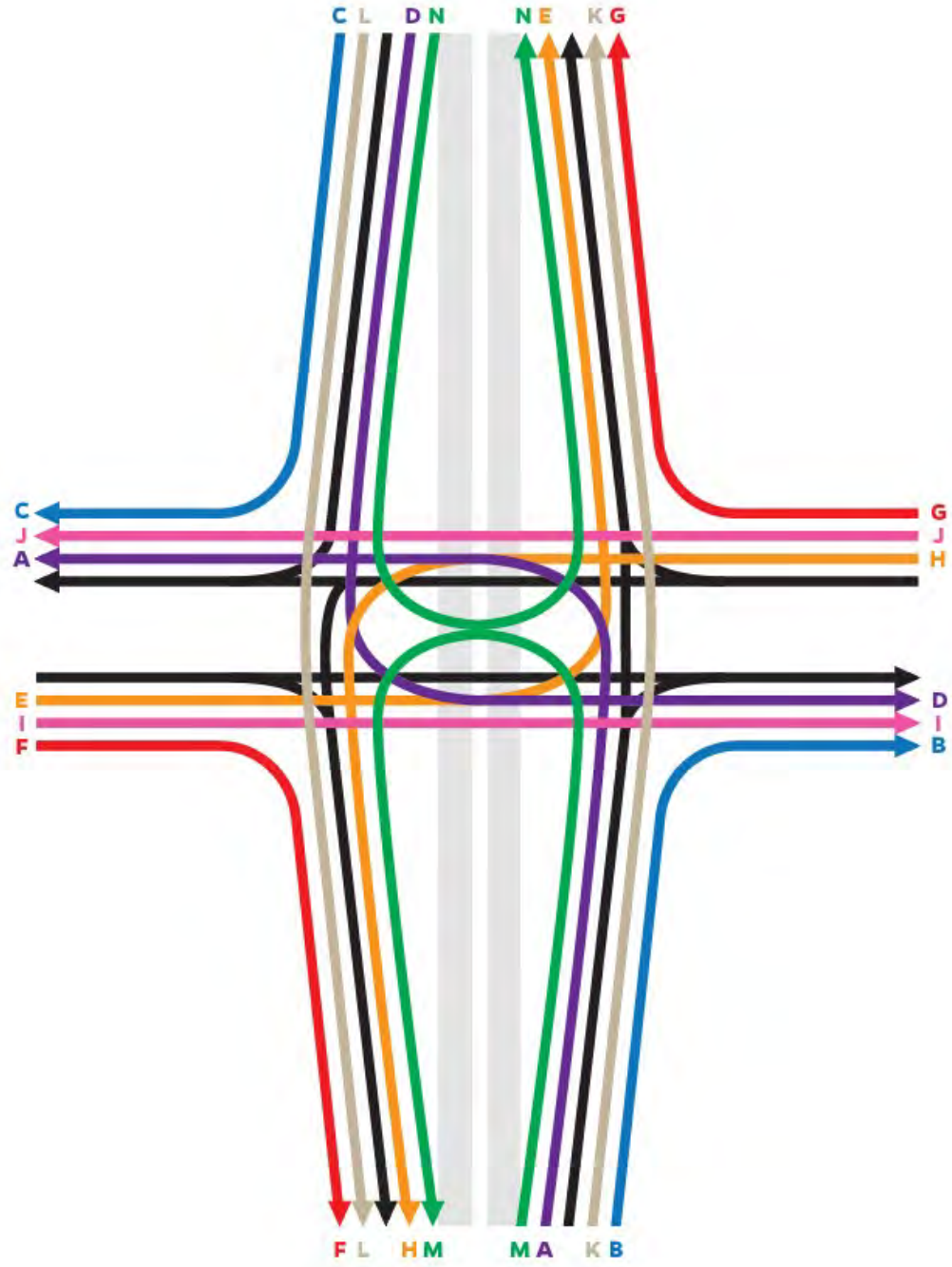
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	374.3	0.0	374.3	Yes	No	F
B	133	8.4	0.0	8.4	No	No	A
C	189	0.0	0.0	0.0	No	No	A
D	11	69.8	0.0	69.8	No	No	D
E	31	34.9	0.0	34.9	No	No	C
F	131	7.1	0.0	7.1	No	No	A
G	22	58.8	0.0	58.8	No	No	D
H	69	103.0	0.0	103.0	Yes	No	F
I	89	28.2	0.0	28.2	No	No	B
J	2387	432.8	0.0	432.8	Yes	No	F
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		7.1	11.0	44.6	374.3						48.7	
Level of Service (LOS)		A	B	D	F						D	
Approach Delay, s/veh / LOS	9.2		A	365.0		F	0.0			48.7		D
Intersection Delay, s/veh / LOS	313.1						F					

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	27.8	21.1			58.5	58.8		8.4			0.0	55.8
Level of Service (LOS)	C	C			E	E		A				F
Approach Delay, s/veh / LOS	22.7		C	58.6		E	8.4		A	55.8		E
Intersection Delay, s/veh / LOS	52.8						D					

Interchange Graphic



File Name: BUILD_1D_BENSON _AM.xus
Analyst: RL
Agency/Co.: HDR
Analysis Date: Mar 7, 2018
Time Period: AM PEAK
Jurisdiction: CITY OF SIOUX FALLS
Analysis Year: 2045
Project Description: I-229/BENSON IMJR
Urban Street: BENSON ROAD
Analysis Period: 1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	5
Number of Segments	4
Analysis period duration, h	0.25
System cycle length, s	95
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	3	1000	1000	50	50	0	0	70	70	0	0
4	40	40	1	2	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0

1: Location, ft	1320
1: Peak Hour Factor	1

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

Number of access points: 0

SEGMENT 4

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.28			43.61	
1	Running Speed, mph		41.67			41.35	
1	Through Delay, s/veh		16.69			9.61	
1	Travel Speed, mph		30.07			33.89	
1	Stop Rate, stops/veh		0.54			0.31	
1	Spatial Stop Rate, stops/mi		1.09			0.62	
1	Through vol/cap ratio		0.28			0.35	
1	Percent of Base FFS		68.23			76.9	
1	Level of Service		B			B	
1	Automobile Perception Score		2.3			2.23	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		63.24			64.99	
2	Running Speed, mph		42.64			41.49	
2	Through Delay, s/veh		7.11			5.46	
2	Travel Speed, mph		38.33			38.28	
2	Stop Rate, stops/veh		0.28			0.18	
2	Spatial Stop Rate, stops/mi		0.37			0.24	
2	Through vol/cap ratio		0.06			0.41	
2	Percent of Base FFS		86.97			86.85	
2	Level of Service		A			A	
2	Automobile Perception Score		2.3			2.23	
3	Bay/Lane Spillback Time, h	999	999	999	999	0.11	999
3	ShrdLane Spillback Time, h	999			999.08		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.7			19.52	
3	Running Speed, mph		36.46			34.92	
3	Through Delay, s/veh		21.1			374.32	
3	Travel Speed, mph		17.13			1.73	
3	Stop Rate, stops/veh		0.54			2.92	
3	Spatial Stop Rate, stops/mi		2.83			15.4	
3	Through vol/cap ratio		0.11			1.77	
3	Percent of Base FFS		38.87			3.93	
3	Level of Service		E			F	
3	Automobile Perception Score		2.58			5.14	

4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999					
4	Base Free-Flow Speed, mph		44.07			44.07	
4	Running Time, s		18.86			18.97	
4	Running Speed, mph		36.15			35.94	
4	Through Delay, s/veh		3.82			58.62	
4	Travel Speed, mph		30.06			8.79	
4	Stop Rate, stops/veh		0.16			1.09	
4	Spatial Stop Rate, stops/mi		0.85			5.75	
4	Through vol/cap ratio		0.23			0.9	
4	Percent of Base FFS		68.2			19.94	
4	Level of Service		B			F	
4	Automobile Perception Score		2.48			3.37	
	Facility Travel Time, s		192.81			595.11	
	Facility Travel Speed, mph		30.41			9.85	
	Facility Spatial Stop Rate, stops/mi		0.93			2.76	
	Facility Base Free Flow Speed, mph		44.07			44.07	
	Facility Percent Base Free Flow Speed		69			22.36	
	Facility Level of Service		B			F	
	Facility Automobile Perception Score		2.35			2.49	
	Facility Pedestrian Space		∞			∞	
	Facility Pedestrian Travel Speed		4.22			4.22	
	Facility Pedestrian LOS Score		3.11			3.69	
	Facility Pedestrian LOS		C			D	
	Facility Bicycle Travel Speed		13.31			13.52	
	Facility Bicycle LOS Score		2.63			2.98	
	Facility Bicycle LOS		C			C	
	Facility Transit Travel Speed		17.13			1.73	
	Facility Transit LOS Score		0.77			1.36	
	Facility Transit LOS		A			A	
	SPILLBACK TIME, h		0.11				

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.1	4.1
1	Ped LOS Score for Intersection	2.19	2.88
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.8	1.07
1	Speed Adjustment Factor	0.69	0.68
1	Ped LOS Score for Link	2.8	3.06
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.17	1.11
1	Ped LOS Score for Segment	3.29	3.4
1	Ped Segment LOS	C	C
1	Bicycle Travel Speed	13.98	13.98
1	Bicycle LOS Score for Intersection	2.82	3.23
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.27	2.42
1	Speed Adjustment Factor	0.85	0.84
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.17	3.32
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.75	2.87
1	Bicycle Segment LOS	B	C
1	Transit Running Speed, mi/h	41.67	41.35
1	g/C Ratio	0.51	0.55
1	Transit Running Time, s	43.28	43.61
1	Delay at Intersection, s/veh	16.76	9.95
1	Transit Travel Speed, mi/h	30.04	33.67
1	Transit Wait-Ride Score	3.66	3.81
1	Ped LOS Score for Link	2.8	3.06
1	Transit LOS Score for Segment	0.94	0.75
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.35	4.36
2	Ped LOS Score for Intersection	2.03	2.62

2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.78	1.74
2	Speed Adjustment Factor	0.73	0.69
2	Ped LOS Score for Link	2.81	3.74
2	Ped Link LOS	C	D
2	Roadway Crossing Difficulty Factor	1.18	1.2
2	Ped LOS Score for Segment	3.35	4.23
2	Ped Segment LOS	C	D
2	Bicycle Travel Speed	14.12	14.72
2	Bicycle LOS Score for Intersection	3.07	3.78
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.26	2.66
2	Speed Adjustment Factor	0.86	0.84
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.17	3.57
2	Bicycle Link LOS	C	D
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.75	3.04
2	Bicycle Segment LOS	C	C
2	Transit Running Speed, mi/h	42.64	41.49
2	g/C Ratio	0.63	0.57
2	Transit Running Time, s	63.24	64.99
2	Delay at Intersection, s/veh	7.11	5.46
2	Transit Travel Speed, mi/h	38.33	38.28
2	Transit Wait-Ride Score	3.98	3.98
2	Ped LOS Score for Link	2.81	3.74
2	Transit LOS Score for Segment	0.45	0.59
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.28	4.33
3	Ped LOS Score for Intersection	1.81	1.34
3	Cross-section Adjustment Factor	-4.9	-4.74
3	Volume Adjustment Factor	0.15	1.86
3	Speed Adjustment Factor	0.53	0.49
3	Ped LOS Score for Link	1.83	3.66
3	Ped Link LOS	B	D
3	Roadway Crossing Difficulty Factor	1.2	0.8
3	Ped LOS Score for Segment	2.51	3.05
3	Ped Segment LOS	B	C
3	Bicycle Travel Speed	13.16	9.3
3	Bicycle LOS Score for Intersection	2.77	3.88
3	Cross-section Adjustment Factor	-2.54	-1.28
3	Volume Adjustment Factor	1.42	2.7
3	Speed Adjustment Factor	0.79	0.76
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	1	3.52
3	Bicycle Link LOS	A	D
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.65	3.34
3	Bicycle Segment LOS	A	C
3	Transit Running Speed, mi/h	36.46	34.92
3	g/C Ratio	0.3	0.73
3	Transit Running Time, s	18.7	19.52
3	Delay at Intersection, s/veh	21.1	374.32
3	Transit Travel Speed, mi/h	17.13	1.73
3	Transit Wait-Ride Score	2.95	1.45
3	Ped LOS Score for Link	1.83	3.66
3	Transit LOS Score for Segment	1.85	4.38
3	Transit Segment LOS	A	E
4	Average Pedestrian Space, ft2/p	∞	∞
4	Pedestrian Travel Speed, ft/s	3.99	3.92
4	Ped LOS Score for Intersection	1.91	2.14
4	Cross-section Adjustment Factor	-4.74	-4.74
4	Volume Adjustment Factor	0.54	0.8
4	Speed Adjustment Factor	0.52	0.52
4	Ped LOS Score for Link	2.37	2.63
4	Ped Link LOS	B	C
4	Roadway Crossing Difficulty Factor	0.8	1.11
4	Ped LOS Score for Segment	2.3	3.01
4	Ped Segment LOS	B	C
4	Bicycle Travel Speed	9.92	14.14
4	Bicycle LOS Score for Intersection	3.15	3.06
4	Cross-section Adjustment Factor	-1.28	-1.28

4	Volume Adjustment Factor	2.07	2.27
4	Speed Adjustment Factor	0.78	0.78
4	Pavement Adjustment Factor	0.58	0.58
4	Bicycle LOS Score for Link	2.91	3.11
4	Bicycle Link LOS	C	C
4	Number of access point approaches	0	0
4	Segment Length, ft	1000	1000
4	Unsignalized Conflicts Factor	-0.7	-0.7
4	Bicycle LOS Score for Segment	2.81	2.71
4	Bicycle Segment LOS	C	B
4	Transit Running Speed, mi/h	36.15	35.94
4	g/C Ratio	0.76	0.23
4	Transit Running Time, s	18.86	18.97
4	Delay at Intersection, s/veh	0	58.47
4	Transit Travel Speed, mi/h	36.15	8.8
4	Transit Wait-Ride Score	3.9	2.27
4	Ped LOS Score for Link	2.37	2.63
4	Transit LOS Score for Segment	0.5	2.99
4	Transit Segment LOS	A	C

ACCESS POINT DATA

SEGMENT 1

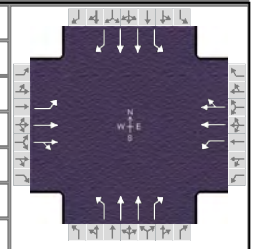
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	676	29.1	0	818	124	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.06	0	0	0.05	0	0	0.12	0.12	0.05	0.12	0.12	0.06
1: Thru veh delay		0.02			0.07							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	684	0	0	1245	47.1	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0.27	0	0	0.12	0	0	0.39	0.39	0.12	0.39	0.39	0.27
1: Thru veh delay		0			0.05							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	23.5	618	62.6	115	1272	248	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0.29	0	0	0.08	0	0	0.36	0.36	0.08	0.36	0.36	0.29
2: Thru veh delay		0.04			0.16							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											
3: Volume, veh/h	0	241	467	8.45	1525	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0.31	0	0	0.05	0	0	0.36	0.36	0.05	0.36	0.36	0.31
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

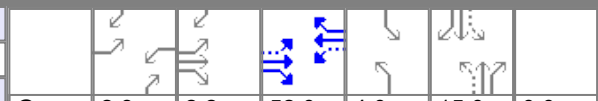
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1D_BENSON _AM.xus		
Project Description	I-229/BENSON IMJR				

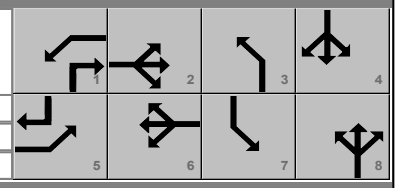


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	105	445	90	70	730	370	95	245	70	120	275	155

Signal Information			
Cycle, s	95.0	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	2.8	2.2	52.0	4.0	15.0	0.0						
Yellow	3.0	0.0	3.5	3.0	3.5	0.0						
Red	1.0	0.0	2.0	1.0	2.0	0.0						



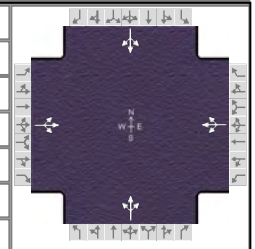
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	9.0	59.7	6.8	57.5	8.0	20.5	8.0	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	4.9		3.1		6.0	9.2	6.0	10.2
Green Extension Time (g_e), s	0.3	0.0	0.1	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.95		0.70		0.94	1.00	0.97	1.00
Max Out Probability	0.04		0.10		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	117	285	276	46	335	309	106	272	50	133	306	100
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1658	1647	1730	1577	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	2.9	8.1	8.1	1.1	8.4	7.6	4.0	7.2	2.7	4.0	8.2	5.5
Cycle Queue Clearance Time (g_c), s	2.9	8.1	8.1	1.1	8.4	7.6	4.0	7.2	2.7	4.0	8.2	5.5
Green Ratio (*g/C*)	0.60	0.57	0.57	0.58	0.55	0.55	0.20	0.16	0.19	0.20	0.16	0.21
Capacity (*c*), veh/h	514	987	946	509	948	864	198	520	275	211	520	308
Volume-to-Capacity Ratio (*X*)	0.227	0.289	0.291	0.090	0.354	0.358	0.532	0.523	0.182	0.632	0.588	0.325
Back of Queue (*Q*), ft/ln (95 th percentile)	44.1	137.9	128.4	17.7	134.4	104.4	33.2	132	44.2	74	149.9	88.8
Back of Queue (*Q*), veh/ln (95 th percentile)	1.7	5.3	5.1	0.7	5.2	4.2	1.3	5.1	1.7	2.8	5.8	3.4
Queue Storage Ratio (*RQ*) (95 th percentile)	0.23	0.00	0.00	0.13	0.00	0.00	0.11	0.00	0.18	0.20	0.00	0.28
Uniform Delay (d_1), s/veh	8.6	10.5	10.5	9.1	9.0	7.7	35.3	36.7	32.5	37.2	37.1	31.8
Incremental Delay (d_2), s/veh	0.3	0.7	0.8	0.1	1.0	1.1	3.6	0.3	0.1	6.9	0.4	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	8.9	11.2	11.3	9.2	10.0	8.8	38.8	37.0	32.6	44.1	37.5	32.0
Level of Service (LOS)	A	B	B	A	A	A	D	D	C	D	D	C
Approach Delay, s/veh / LOS	10.9	B		9.4	A		36.9	D		38.1	D	
Intersection Delay, s/veh / LOS	21.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.71	C	2.88	C	3.01	C	2.84	C
Bicycle LOS Score / LOS	2.82	C	3.23	C	2.74	C	2.83	C

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	HALL	File Name	BUILD_1D_BENSON _AM.xus		
Project Description	I-229/BENSON 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	95	140	130	85	495	20	90	5	40	10	10	50

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

								1	2	3	4	
Green	72.1	11.9	0.0	0.0	0.0	0.0						
Yellow	3.5	3.5	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0	5	6	7	8		

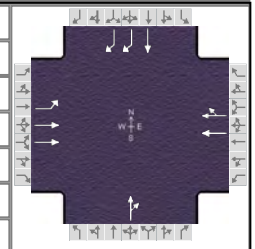
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		77.6		77.6		17.4		17.4
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		3.2		3.2
Queue Clearance Time (g_s), s						11.6		6.3
Green Extension Time (g_e), s		0.0		0.0		0.3		0.3
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		239			667			144			78	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1309			1631			1384			1624	
Queue Service Time (g_s), s		0.0			2.7			5.4			0.0	
Cycle Queue Clearance Time (g_c), s		4.0			14.8			9.6			4.3	
Green Ratio (*g/C*)		0.76			0.76			0.13			0.13	
Capacity (*c*), veh/h		1041			1281			237			246	
Volume-to-Capacity Ratio (*X*)		0.230			0.520			0.609			0.316	
Back of Queue (*Q*), ft/ln (95 th percentile)		47.6			179.5			150.1			73.6	
Back of Queue (*Q*), veh/ln (95 th percentile)		1.8			6.9			5.8			2.9	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		3.3			4.5			40.5			38.2	
Incremental Delay (d_2), s/veh		0.5			1.5			0.9			0.3	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		3.8			6.0			41.4			38.5	
Level of Service (LOS)		A			A			D			D	
Approach Delay, s/veh / LOS	3.8	A		6.0	A		41.4	D		38.5	D	
Intersection Delay, s/veh / LOS	12.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.91	B	1.63	B	2.29	B	2.47	B
Bicycle LOS Score / LOS	3.15	C	3.58	D	2.41	B	0.62	A

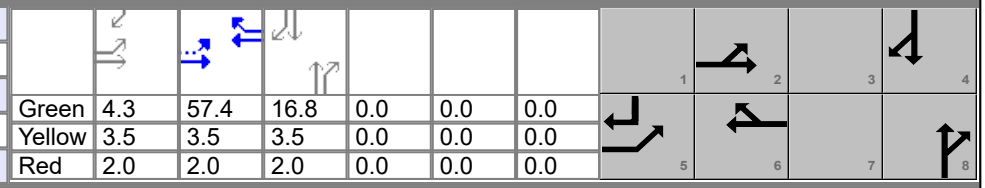
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1D_BENSON_PM.xus		
Project Description	I-229/BENSON 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	90	250			355	195		0	95		0	380

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.3	57.4	16.8	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0

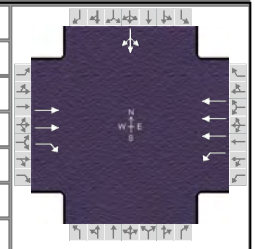
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		8.3		8.0		7.0
Phase Duration, s	9.8	72.7		62.9		22.3		22.3
Change Period, ($Y+R_c$), s	5.5	5.5		5.5		5.5		5.5
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		3.3		3.3
Queue Clearance Time (g_s), s	2.9					7.7		16.4
Green Extension Time (g_e), s	0.0	0.0		0.0		1.1		0.4
Phase Call Probability	0.72					1.00		1.00
Max Out Probability	0.00					0.01		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16		8	18		4	14
Adjusted Flow Rate (*v*), veh/h	48	133			322	289		100			0	422
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1551			1682	1475		1466			1682	1294
Queue Service Time (g_s), s	0.9	2.8			11.6	7.2		5.7			0.0	14.4
Cycle Queue Clearance Time (g_c), s	0.9	2.8			11.6	7.2		5.7			0.0	14.4
Green Ratio (*g/C*)	0.67	0.65			0.60	0.60		0.18			0.18	0.22
Capacity (*c*), veh/h	532	2022			1016	892		259			297	574
Volume-to-Capacity Ratio (*X*)	0.090	0.066			0.317	0.324		0.386			0.000	0.735
Back of Queue (*Q*), ft/ln (95 th percentile)	11.5	39.4			124.4	91.1		92.4			0	203.3
Back of Queue (*Q*), veh/ln (95 th percentile)	0.4	1.5			4.8	3.6		3.6			0.0	8.1
Queue Storage Ratio (*RQ*) (95 th percentile)	0.12	0.00			0.00	0.00		0.00			0.00	0.00
Uniform Delay (d_1), s/veh	5.9	10.4			8.1	6.7		34.6			0.0	34.4
Incremental Delay (d_2), s/veh	0.0	0.1			0.7	0.8		0.4			0.0	3.5
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	5.9	10.4			8.8	7.6		34.9			0.0	37.8
Level of Service (LOS)	A	B			A	A		C				D
Approach Delay, s/veh / LOS	9.2	A		8.2	A		34.9	C		37.8	D	
Intersection Delay, s/veh / LOS	19.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.71	B	2.08	B	2.45	B	2.64	C
Bicycle LOS Score / LOS	2.79	C	2.98	C	2.34	B	1.18	A

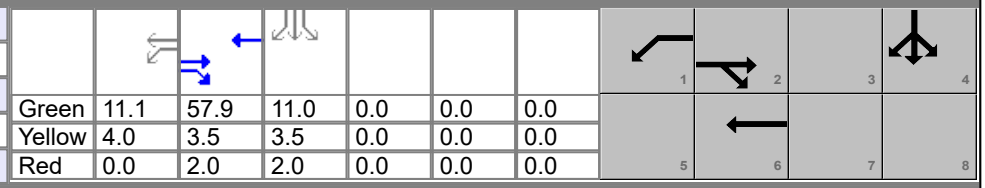
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1D_BENSON_PM.xus		
Project Description	I-229/BENSON 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		260	1485	155	580					80	0	60

Signal Information			
Cycle, s	95.0	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	11.1	57.9	11.0	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

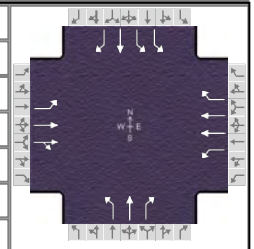
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		63.4	15.1	78.5				16.5
Change Period, ($Y+R_c$), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.2
Queue Clearance Time (g_s), s			11.1					11.1
Green Extension Time (g_e), s		0.0	0.1	0.0				0.1
Phase Call Probability			0.99					0.98
Max Out Probability			1.00					0.03

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		86	492	172	644						156	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1547	1515	1714	1507						1597	
Queue Service Time (g_s), s		1.0	14.8	9.1	6.7						9.1	
Cycle Queue Clearance Time (g_c), s		1.0	14.8	9.1	6.7						9.1	
Green Ratio (*g/C*)		0.61	0.61	0.12	0.66						0.12	
Capacity (*c*), veh/h		1886	924	200	2994						185	
Volume-to-Capacity Ratio (*X*)		0.046	0.533	0.862	0.215						0.840	
Back of Queue (*Q*), ft/ln (95 th percentile)		13.2	153.7	179.3	89.1						169.4	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.5	6.1	7.2	3.4						6.8	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.90	0.00						0.00	
Uniform Delay (d_1), s/veh		6.7	7.8	34.9	6.2						41.1	
Incremental Delay (d_2), s/veh		0.0	1.2	17.0	0.1						6.3	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		6.7	9.0	51.9	6.3						47.4	
Level of Service (LOS)		A	A	D	A						D	
Approach Delay, s/veh / LOS	8.6	A		15.9	B		0.0			47.4	D	
Intersection Delay, s/veh / LOS	16.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	4.03	D	1.33	A	2.73	C	3.07	C
Bicycle LOS Score / LOS	4.08	D	2.93	C		A	0.74	A

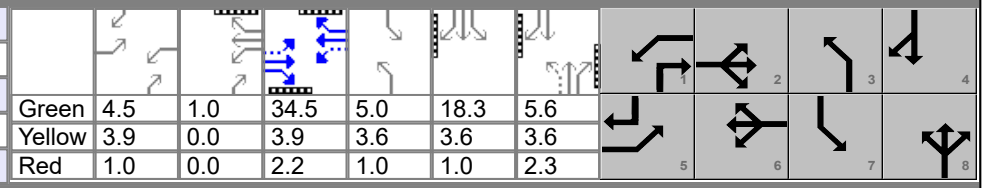
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1D_BENSON_PM.xus		
Project Description	I-229/BENSON 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	70	840	25	60	400	75	50	35	105	765	40	215

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.5	1.0	34.5	5.0	18.3	5.6						
Yellow	3.9	0.0	3.9	3.6	3.6	3.6						
Red	1.0	0.0	2.2	1.0	1.0	2.3						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	9.4	40.6	10.4	41.6	9.6	11.5	32.5	34.4
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	4.4		4.5		4.9	7.6	26.3	11.8
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.0	0.0	1.6	0.1
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	0.00

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	69	425	422	71	472	89	56	39	106	850	44	200
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1719	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	2.4	20.1	20.1	2.5	10.9		2.9	2.1	5.6	24.3	1.8	9.8
Cycle Queue Clearance Time (g_c), s	2.4	20.1	20.1	2.5	10.9		2.9	2.1	5.6	24.3	1.8	9.8
Green Ratio (*g/C*)	0.41	0.36	0.36	0.42	0.37		0.11	0.06	0.12	0.29	0.30	0.35
Capacity (*c*), veh/h	368	628	624	267	1230		240	102	178	940	519	510
Volume-to-Capacity Ratio (*X*)	0.188	0.676	0.676	0.265	0.384		0.231	0.382	0.592	0.904	0.086	0.392
Back of Queue (*Q*), ft/ln (95 th percentile)	40.6	337.2	323.9	49.8	202		56.8	41.6	111.1	410.7	32.9	154
Back of Queue (*Q*), veh/ln (95 th percentile)	1.6	13.0	13.0	1.9	7.8		2.2	1.6	4.4	15.8	1.3	5.9
Queue Storage Ratio (*RQ*) (95 th percentile)	0.20	0.00	0.00	0.71	0.00		0.57	0.00	0.00	0.97	0.00	0.00
Uniform Delay (d_1), s/veh	17.2	26.9	27.0	19.2	24.9		38.8	43.0	39.8	32.3	23.9	23.4
Incremental Delay (d_2), s/veh	0.3	4.4	4.4	2.4	0.9		0.7	0.9	3.6	11.5	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	0.0
Control Delay (*d*), s/veh	17.5	31.3	31.4	21.5	25.8	0.0	39.5	43.9	43.4	43.8	23.9	23.6
Level of Service (LOS)	B	C	C	C	C	A	D	D	D	D	C	C
Approach Delay, s/veh / LOS	30.3	C		21.7	C		42.4	D		39.3	D	
Intersection Delay, s/veh / LOS	32.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.23	B	2.67	C	3.01	C	2.77	C
Bicycle LOS Score / LOS	3.11	C	2.75	C	2.26	B	3.89	D

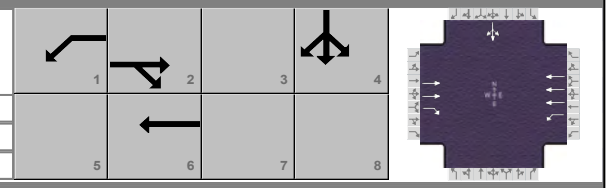
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 SB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1D_BENSON_PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		260	1485	155	580					80	0	60
Intersection Two Demand (*v*), veh/h	90	250			355	195		0	95		0	380

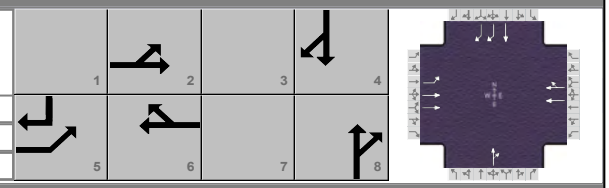
Signal One Information	
Cycle, s	95.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	11.1	57.9	11.0	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



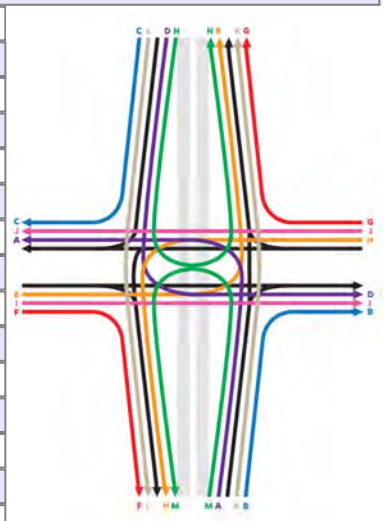
Signal Two Information	
Cycle, s	95.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	4.3	57.4	16.8	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Interchange Results

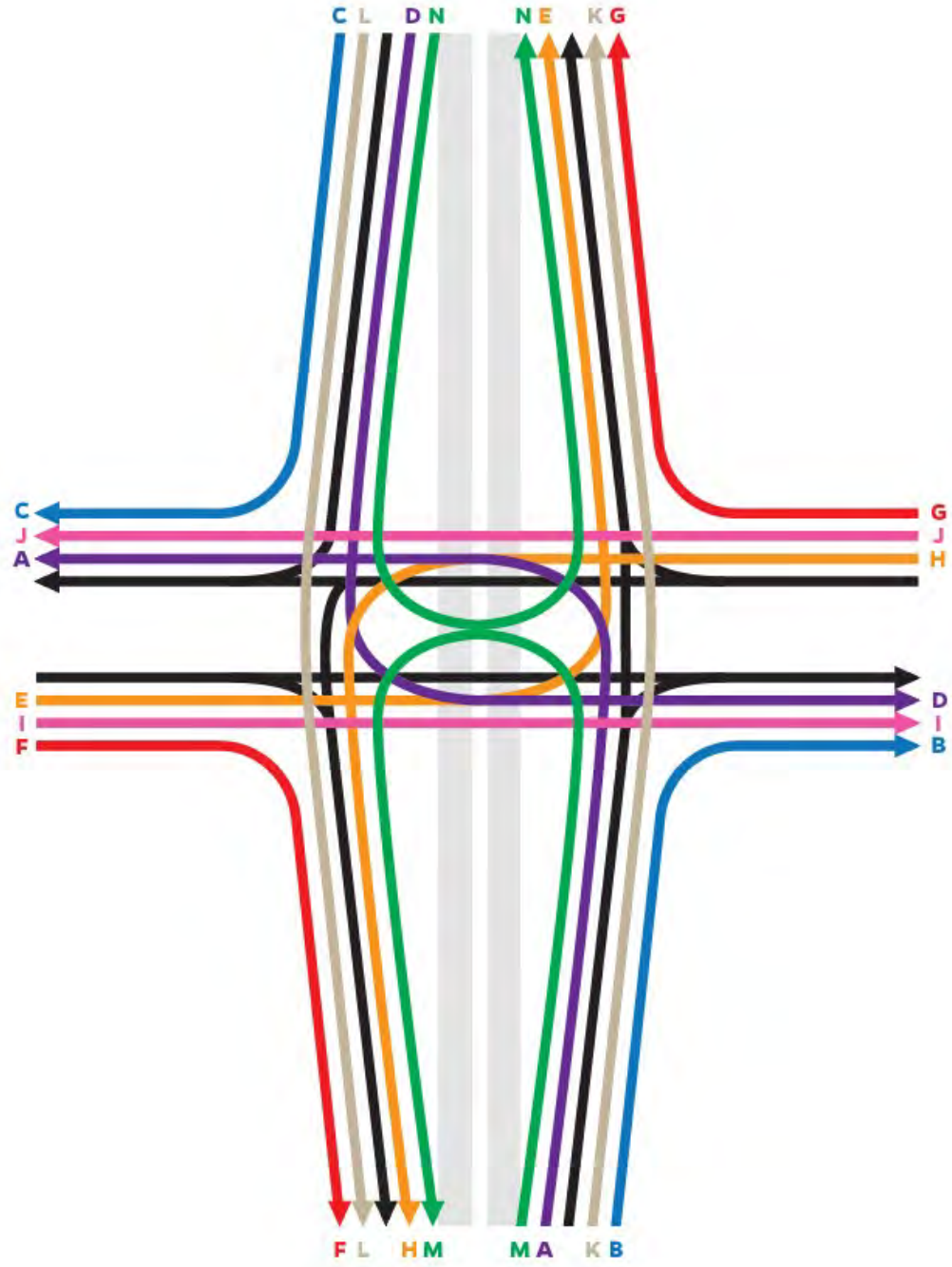
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	6.3	0.0	6.3	No	No	A
B	100	34.9	0.0	34.9	No	No	C
C	67	0.0	0.0	0.0	No	No	A
D	89	57.8	0.0	57.8	No	No	D
E	48	12.8	0.0	12.8	No	No	A
F	492	6.9	0.0	6.9	No	No	A
G	217	7.6	0.0	7.6	No	No	A
H	172	60.7	0.0	60.7	No	No	D
I	44	17.4	0.0	17.4	No	No	B
J	644	15.1	0.0	15.1	No	No	B
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		6.9	10.2	51.9	6.3						47.4	
Level of Service (LOS)		A	B	D	A						D	
Approach Delay, s/veh / LOS	9.7	A		15.9	B		0.0			47.4	D	
Intersection Delay, s/veh / LOS	16.8						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	5.9	10.5			8.8	7.6		34.9			0.0	37.8
Level of Service (LOS)	A	B			A	A		C				D
Approach Delay, s/veh / LOS	9.3	A		8.2	A		34.9	C		37.8	D	
Intersection Delay, s/veh / LOS	19.9						B					

Interchange Graphic



HCS7 Streets Text Report

File Name:	BUILD_1D_BENSON_PM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Mar 7, 2018
Time Period:	PM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2023
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	5
Number of Segments	4
Analysis period duration, h	0.25
System cycle length, s	95
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	3	1000	1000	50	50	0	0	70	70	0	0
4	40	40	1	2	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0

1: Location, ft	1320
1: Peak Hour Factor	1

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

Number of access points: 0

SEGMENT 4

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.6			43.39	
1	Running Speed, mph		41.36			41.57	
1	Through Delay, s/veh		29.11			13.67	
1	Travel Speed, mph		24.8			31.61	
1	Stop Rate, stops/veh		0.75			0.41	
1	Spatial Stop Rate, stops/mi		1.5			0.82	
1	Through vol/cap ratio		0.64			0.24	
1	Percent of Base FFS		56.28			71.72	
1	Level of Service		C			B	
1	Automobile Perception Score		2.37			2.26	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		65.53			63.33	
2	Running Speed, mph		41.15			42.58	
2	Through Delay, s/veh		6.9			25.57	
2	Travel Speed, mph		37.23			30.33	
2	Stop Rate, stops/veh		0.26			0.69	
2	Spatial Stop Rate, stops/mi		0.34			0.92	
2	Through vol/cap ratio		0.05			0.38	
2	Percent of Base FFS		84.48			68.83	
2	Level of Service		A			B	
2	Automobile Perception Score		2.29			2.33	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.72			18.89	
3	Running Speed, mph		36.42			36.09	
3	Through Delay, s/veh		10.47			6.29	
3	Travel Speed, mph		23.36			27.07	
3	Stop Rate, stops/veh		0.48			0.34	
3	Spatial Stop Rate, stops/mi		2.54			1.77	
3	Through vol/cap ratio		0.07			0.22	
3	Percent of Base FFS		53			61.43	
3	Level of Service		C			C	
3	Automobile Perception Score		2.54			2.63	

4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999					
4	Base Free-Flow Speed, mph		44.07			44.07	
4	Running Time, s		17.26			18.93	
4	Running Speed, mph		39.5			36.03	
4	Through Delay, s/veh		8.2			8.56	
4	Travel Speed, mph		26.78			24.81	
4	Stop Rate, stops/veh		0.31			0.3	
4	Spatial Stop Rate, stops/mi		1.65			1.6	
4	Through vol/cap ratio		0.24			0.32	
4	Percent of Base FFS		60.77			56.29	
4	Level of Service		C			C	
4	Automobile Perception Score		2.61			2.61	
Facility Travel Time, s			199.79			198.62	
Facility Travel Speed, mph			29.35			29.52	
Facility Spatial Stop Rate, stops/mi			1.1			1.07	
Facility Base Free Flow Speed, mph			44.07			44.07	
Facility Percent Base Free Flow Speed			66.6			66.99	
Facility Level of Service			C			C	
Facility Automobile Perception Score			2.38			2.37	
Facility Pedestrian Space			∞			∞	
Facility Pedestrian Travel Speed			4.24			4.24	
Facility Pedestrian LOS Score			3.66			3.08	
Facility Pedestrian LOS			D			C	
Facility Bicycle Travel Speed			13.48			13.76	
Facility Bicycle LOS Score			2.92			2.74	
Facility Bicycle LOS			C			C	
Facility Transit Travel Speed			23.36			27.07	
Facility Transit LOS Score			0.93			0.97	
Facility Transit LOS			A			A	
SPILLBACK TIME, h			999				

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.1	4.1
1	Ped LOS Score for Intersection	2.23	2.9
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	1.1	0.87
1	Speed Adjustment Factor	0.68	0.69
1	Ped LOS Score for Link	3.09	2.87
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.15	0.9
1	Ped LOS Score for Segment	3.49	2.82
1	Ped Segment LOS	C	C
1	Bicycle Travel Speed	13.39	12.99
1	Bicycle LOS Score for Intersection	3.11	2.83
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.43	2.31
1	Speed Adjustment Factor	0.84	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.33	3.22
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.89	2.79
1	Bicycle Segment LOS	C	C
1	Transit Running Speed, mi/h	41.36	41.57
1	g/C Ratio	0.38	0.45
1	Transit Running Time, s	43.6	43.39
1	Delay at Intersection, s/veh	29.04	14.28
1	Transit Travel Speed, mi/h	24.83	31.27
1	Transit Wait-Ride Score	3.41	3.71
1	Ped LOS Score for Link	3.09	2.87
1	Transit LOS Score for Segment	1.35	0.87
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.31	4.31
2	Ped LOS Score for Intersection	4.03	2.67

2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	2.05	0.81
2	Speed Adjustment Factor	0.68	0.73
2	Ped LOS Score for Link	4.03	2.84
2	Ped Link LOS	D	C
2	Roadway Crossing Difficulty Factor	1.11	1.2
2	Ped LOS Score for Segment	4.22	3.42
2	Ped Segment LOS	D	C
2	Bicycle Travel Speed	13.62	14.79
2	Bicycle LOS Score for Intersection	4.08	2.75
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.75	2.28
2	Speed Adjustment Factor	0.84	0.86
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.64	3.19
2	Bicycle Link LOS	D	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	3.18	2.74
2	Bicycle Segment LOS	C	B
2	Transit Running Speed, mi/h	41.15	42.58
2	g/C Ratio	0.61	0.37
2	Transit Running Time, s	65.53	63.33
2	Delay at Intersection, s/veh	6.9	25.57
2	Transit Travel Speed, mi/h	37.23	30.33
2	Transit Wait-Ride Score	3.94	3.67
2	Ped LOS Score for Link	4.03	2.84
2	Transit LOS Score for Segment	0.69	0.92
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.26	4.35
3	Ped LOS Score for Intersection	1.71	1.33
3	Cross-section Adjustment Factor	-4.74	-4.74
3	Volume Adjustment Factor	0.2	0.62
3	Speed Adjustment Factor	0.53	0.52
3	Ped LOS Score for Link	2.04	2.45
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.2	1.05
3	Ped LOS Score for Segment	2.7	2.79
3	Ped Segment LOS	B	C
3	Bicycle Travel Speed	12.94	12.89
3	Bicycle LOS Score for Intersection	2.79	2.93
3	Cross-section Adjustment Factor	-1.28	-1.28
3	Volume Adjustment Factor	1.58	2.14
3	Speed Adjustment Factor	0.78	0.78
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	2.42	2.98
3	Bicycle Link LOS	B	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	2.31	2.66
3	Bicycle Segment LOS	B	B
3	Transit Running Speed, mi/h	36.42	36.09
3	g/C Ratio	0.71	0.77
3	Transit Running Time, s	18.72	18.89
3	Delay at Intersection, s/veh	10.47	6.29
3	Transit Travel Speed, mi/h	23.36	27.07
3	Transit Wait-Ride Score	3.33	3.52
3	Ped LOS Score for Link	2.04	2.45
3	Transit LOS Score for Segment	1.31	1.09
3	Transit Segment LOS	A	A
4	Average Pedestrian Space, ft2/p	∞	∞
4	Pedestrian Travel Speed, ft/s	4.32	4.26
4	Ped LOS Score for Intersection	2.06	2.08
4	Cross-section Adjustment Factor	-4.74	-4.74
4	Volume Adjustment Factor	0.54	0.7
4	Speed Adjustment Factor	0.62	0.52
4	Ped LOS Score for Link	2.47	2.52
4	Ped Link LOS	B	C
4	Roadway Crossing Difficulty Factor	1.06	0.98
4	Ped LOS Score for Segment	2.83	2.72
4	Ped Segment LOS	C	B
4	Bicycle Travel Speed	13.77	13.13
4	Bicycle LOS Score for Intersection	3.11	2.98
4	Cross-section Adjustment Factor	-1.28	-1.28

4	Volume Adjustment Factor	2.07	2.2
4	Speed Adjustment Factor	0.82	0.78
4	Pavement Adjustment Factor	0.58	0.58
4	Bicycle LOS Score for Link	2.95	3.03
4	Bicycle Link LOS	C	C
4	Number of access point approaches	0	0
4	Segment Length, ft	1000	1000
4	Unsignalized Conflicts Factor	-0.7	-0.7
4	Bicycle LOS Score for Segment	2.63	2.69
4	Bicycle Segment LOS	B	B
4	Transit Running Speed, mi/h	39.5	36.03
4	g/C Ratio	0.63	0.6
4	Transit Running Time, s	17.26	18.93
4	Delay at Intersection, s/veh	0	8.79
4	Transit Travel Speed, mi/h	39.5	24.6
4	Transit Wait-Ride Score	4.02	3.4
4	Ped LOS Score for Link	2.47	2.52
4	Transit LOS Score for Segment	0.34	1.28
4	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

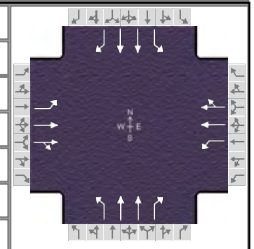
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	927	39.9	0	666	101	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.11	0	0	0.15	0	0	0.25	0.25	0.15	0.25	0.25	0.11
1: Thru veh delay		0.03			0.06							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1798	0	0	632	23.9	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0.01	0	0	0.44	0	0	0.44	0.44	0.44	0.44	0.44	0.01
1: Thru veh delay		0			0.02							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	60.6	1596	162	57.6	636	124	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0.07	0	0	0.43	0	0	0.51	0.51	0.43	0.51	0.51	0.07
2: Thru veh delay		0.16			0.06							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											
3: Volume, veh/h	0	574	1112	3.92	707	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0.07	0	0	0.41	0	0	0.48	0.48	0.41	0.48	0.48	0.07
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

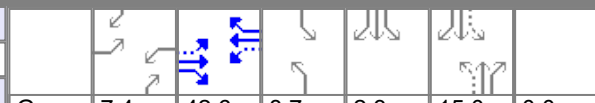
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1D_BENSON_PM.xus		
Project Description	I-229/BENSON IMJR				

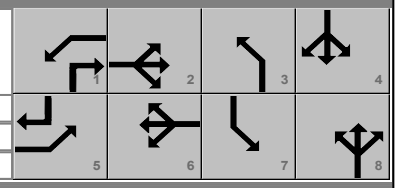


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	150	625	190	190	380	160	130	355	40	205	380	100

Signal Information			
Cycle, s	95.0	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	7.4	42.6	8.7	2.3	15.0	0.0						
Yellow	3.0	3.5	3.0	0.0	3.5	0.0						
Red	1.0	2.0	1.0	0.0	2.0	0.0						



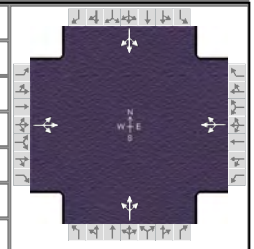
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	11.4	48.1	11.4	48.1	12.7	20.5	15.0	22.8
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	7.1		7.0		8.9	12.9	13.0	13.4
Green Extension Time (g_e), s	0.5	0.0	0.6	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.99		0.99		0.98	1.00	1.00	1.00
Max Out Probability	0.14		0.02		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	167	452	420	166	188	184	144	394	17	228	422	39
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1607	1647	1730	1666	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	5.1	18.5	18.6	5.0	5.7	5.3	6.9	10.9	0.8	11.0	11.4	1.9
Cycle Queue Clearance Time (g_c), s	5.1	18.5	18.6	5.0	5.7	5.3	6.9	10.9	0.8	11.0	11.4	1.9
Green Ratio (*g/C*)	0.53	0.45	0.45	0.53	0.45	0.45	0.25	0.16	0.24	0.28	0.18	0.26
Capacity (*c*), veh/h	566	775	720	361	775	746	265	520	346	308	601	382
Volume-to-Capacity Ratio (*X*)	0.294	0.583	0.584	0.460	0.243	0.246	0.545	0.758	0.048	0.738	0.703	0.102
Back of Queue (*Q*), ft/ln (95 th percentile)	82.3	314.1	286.3	89.7	102.9	87.4	131.5	202.5	13.3	224.5	207.2	30.4
Back of Queue (*Q*), veh/ln (95 th percentile)	3.2	12.1	11.5	3.4	4.0	3.5	5.1	7.8	0.5	8.6	8.0	1.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.42	0.00	0.00	0.64	0.00	0.00	0.44	0.00	0.06	0.61	0.00	0.09
Uniform Delay (d_1), s/veh	12.2	19.6	19.6	15.2	14.1	12.6	30.1	38.3	28.0	29.7	36.4	26.7
Incremental Delay (d_2), s/veh	0.4	3.2	3.4	1.2	0.7	0.7	2.8	1.9	0.0	9.7	1.0	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	12.6	22.8	23.0	16.4	14.8	13.4	33.0	40.2	28.0	39.4	37.4	26.7
Level of Service (LOS)	B	C	C	B	B	B	C	D	C	D	D	C
Approach Delay, s/veh / LOS	21.3	C		14.8	B		38.0	D		37.5	D	
Intersection Delay, s/veh / LOS	27.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.82	C	2.90	C	2.95	C	2.83	C
Bicycle LOS Score / LOS	3.12	C	2.83	C	2.84	C	2.95	C

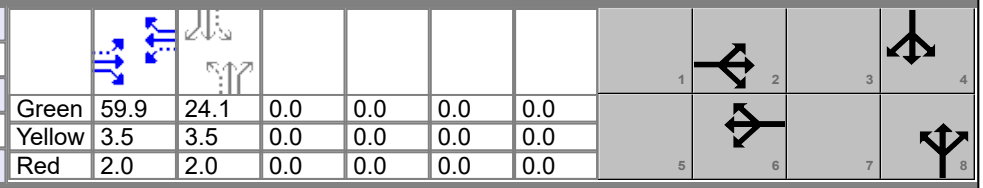
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	HALL	File Name	BUILD_1D_BENSON_PM.xus		
Project Description	I-229/BENSON 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	35	175	135	50	335	20	180	20	95	20	20	35

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	59.9	24.1	0.0	0.0	0.0	0.0						
Yellow	3.5	3.5	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		65.4		65.4		29.6		29.6
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		3.1		3.1
Queue Clearance Time (g_s), s						23.4		5.7
Green Extension Time (g_e), s		0.0		0.0		0.7		0.8
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

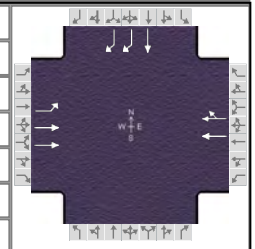
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		238			450			322			83	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1535			1636			1389			1574	
Queue Service Time (g_s), s		0.0			0.0			17.6			0.0	
Cycle Queue Clearance Time (g_c), s		6.1			12.5			21.4			3.7	
Green Ratio (*g/C*)		0.63			0.63			0.25			0.25	
Capacity (*c*), veh/h		1010			1074			414			448	
Volume-to-Capacity Ratio (*X*)		0.236			0.419			0.778			0.186	
Back of Queue (*Q*), ft/ln (95 th percentile)		91.8			199.6			290.1			65	
Back of Queue (*Q*), veh/ln (95 th percentile)		3.5			7.7			11.2			2.6	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		7.7			8.8			34.3			27.8	
Incremental Delay (d_2), s/veh		0.5			1.2			1.2			0.1	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		8.2			10.0			35.6			27.9	
Level of Service (LOS)		A			B			D			C	
Approach Delay, s/veh / LOS	8.2	A		10.0	B		35.6	D		27.9	C	
Intersection Delay, s/veh / LOS	18.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.06	B	1.66	B	2.21	B	2.38	B
Bicycle LOS Score / LOS	3.11	C	3.22	C	2.70	C	0.63	A

Option 1E

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1E_BENSON _AM.xus		
Project Description	I-229/BENSON 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	75	365			615	20					0	1685

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

							1	2	3	4
Green	5.0	26.0	57.5	0.0	0.0	0.0	5	6	7	8
Yellow	3.5	3.5	3.5	0.0	0.0	0.0				
Red	2.0	2.0	2.0	0.0	0.0	0.0				

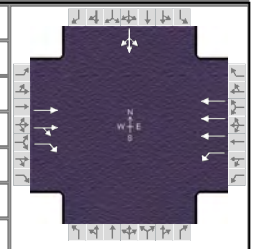
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				11.0
Phase Duration, s	10.5	42.0		31.5				63.0
Change Period, (*Y+R c*), s	5.5	5.5		5.5				5.5
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				3.3
Queue Clearance Time (*g s*), s	3.0							59.5
Green Extension Time (*g e*), s	0.0	0.0		0.0				0.0
Phase Call Probability	1.00							1.00
Max Out Probability	0.00							1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16					4	14
Adjusted Flow Rate (*v*), veh/h	23	110			355	351					0	1872
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1550			1696	1676					1682	1440
Queue Service Time (*g s*), s	1.0	2.2			21.5	21.0					0.0	57.5
Cycle Queue Clearance Time (*g c*), s	1.0	2.2			21.5	21.0					0.0	57.5
Green Ratio (*g/C*)	0.31	0.35			0.25	0.25					0.55	0.60
Capacity (*c*), veh/h	178	1078			420	415					921	1715
Volume-to-Capacity Ratio (*X*)	0.127	0.102			0.844	0.845					0.000	1.092
Back of Queue (*Q*), ft/ln (95 th percentile)	17.6	36.5			378.9	361.4					0	1049.6
Back of Queue (*Q*), veh/ln (95 th percentile)	0.7	1.4			14.6	14.5					0.0	42.0
Queue Storage Ratio (*RQ*) (95 th percentile)	0.18	0.00			0.00	0.00					0.00	0.00
Uniform Delay (*d 1*), s/veh	27.1	19.6			38.2	38.1					0.0	21.2
Incremental Delay (*d 2*), s/veh	0.1	0.2			14.1	14.4					0.0	51.4
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0					0.0	0.0
Control Delay (*d*), s/veh	27.2	19.8			52.3	52.5					0.0	72.6
Level of Service (LOS)	C	B			D	D						F
Approach Delay, s/veh / LOS	21.0	C		52.4	D		0.0			72.6	E	
Intersection Delay, s/veh / LOS	64.9						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.41	A	2.14	B	2.51	C	3.14	C
Bicycle LOS Score / LOS	2.88	C	3.06	C		A	3.58	D

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1E_BENSON _AM.xus		
Project Description	I-229/BENSON 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		305	345	65	2235					10	0	170

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

							1	2	3	4
Green	5.3	68.7	16.0	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	3.5	3.5	0.0	0.0	0.0				
Red	0.0	2.0	2.0	0.0	0.0	0.0				

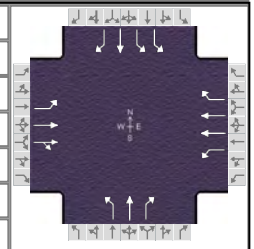
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		74.2	9.3	83.5				21.5
Change Period, ($Y+R_c$), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.3
Queue Clearance Time (g_s), s			6.1					15.8
Green Extension Time (g_e), s		0.0	0.1	0.0				0.3
Phase Call Probability			0.86					1.00
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		115	131	68	2330						200	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1629	1451	1714	1636						1491	
Queue Service Time (g_s), s		1.4	5.1	4.1	31.5						13.8	
Cycle Queue Clearance Time (g_c), s		1.4	5.1	4.1	31.5						13.8	
Green Ratio (*g/C*)		0.65	0.65	0.05	0.30						0.15	
Capacity (*c*), veh/h		2131	949	87	1473						227	
Volume-to-Capacity Ratio (*X*)		0.054	0.138	0.782	1.582						0.879	
Back of Queue (*Q*), ft/ln (95 th percentile)		20.5	69.5	58.9	1889.3						233.4	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.8	2.8	2.4	72.7						9.3	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.59	0.00						0.00	
Uniform Delay (d_1), s/veh		6.8	10.4	48.8	29.0						43.5	
Incremental Delay (d_2), s/veh		0.0	0.3	0.5	262.4						8.8	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		6.9	10.6	49.4	291.3						52.3	
Level of Service (LOS)		A	B	D	F						D	
Approach Delay, s/veh / LOS	8.9	A		284.5	F		0.0			52.3	D	
Intersection Delay, s/veh / LOS	244.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.03	B	1.34	A	3.10	C	3.24	C
Bicycle LOS Score / LOS	3.07	C	3.88	D		A	0.82	A

HCS7 Signalized Intersection Results Summary

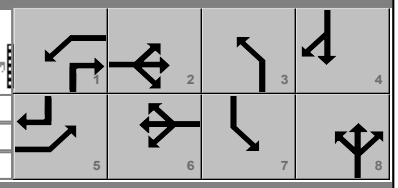
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1E_BENSON _AM.xus		
Project Description	I-229/BENSON 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	160	415	40	80	1190	545	30	25	40	165	40	125

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

Green	7.3	4.8	58.8	4.0	4.1	4.4
Yellow	3.9	0.0	3.9	3.6	0.0	3.6
Red	1.0	0.0	2.2	1.0	0.0	2.3



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	12.2	64.9	17.1	69.7	8.6	10.3	12.7	14.4
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	6.7		3.0		4.0	4.0	7.9	8.5
Green Extension Time (g_e), s	0.6	0.0	0.1	0.0	0.0	0.0	0.2	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.02		0.02		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	176	247	242	56	838	274	33	28	33	183	44	100
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1688	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	4.7	8.5	8.5	1.0	10.9		2.0	1.6	2.0	5.9	2.5	6.5
Cycle Queue Clearance Time (g_c), s	4.7	8.5	8.5	1.0	10.9		2.0	1.6	2.0	5.9	2.5	6.5
Green Ratio (*g/C*)	0.63	0.56	0.56	0.69	0.61		0.08	0.04	0.16	0.08	0.08	0.15
Capacity (*c*), veh/h	493	969	946	683	1996		182	73	241	248	141	222
Volume-to-Capacity Ratio (*X*)	0.357	0.255	0.256	0.082	0.420		0.183	0.383	0.139	0.739	0.316	0.451
Back of Queue (*Q*), ft/ln (95 th percentile)	70.8	155.3	145.4	13.2	101.9		39.3	33.9	33.2	120.4	51.4	110.2
Back of Queue (*Q*), veh/ln (95 th percentile)	2.7	6.0	5.8	0.5	3.9		1.5	1.3	1.3	4.6	2.0	4.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.35	0.00	0.00	0.19	0.00		0.98	0.00	0.00	0.45	0.00	0.00
Uniform Delay (d_1), s/veh	8.3	13.6	13.5	4.8	7.5		45.3	49.0	38.1	47.4	45.5	40.6
Incremental Delay (d_2), s/veh	0.6	0.6	0.6	0.0	0.1		0.7	1.2	0.1	7.5	0.5	0.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	8.9	14.2	14.1	4.9	7.6	0.0	46.0	50.2	38.2	54.9	45.9	41.1
Level of Service (LOS)	A	B	B	A	A	A	D	D	D	D	D	D
Approach Delay, s/veh / LOS	12.8	B		5.7	A		44.5	D		49.5	D	
Intersection Delay, s/veh / LOS	15.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.19	B	2.62	C	3.28	C	2.90	C
Bicycle LOS Score / LOS	2.82	C	3.78	D	2.08	B	2.62	C

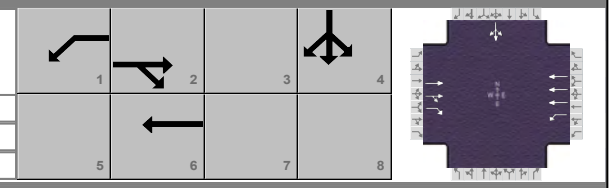
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 SB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1E_BENSON _AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		305	345	65	2235					10	0	170
Intersection Two Demand (*v*), veh/h	75	365			615	20					0	1685

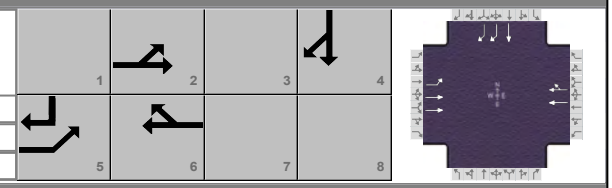
Signal One Information	
Cycle, s	105.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	5.3	68.7	16.0	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



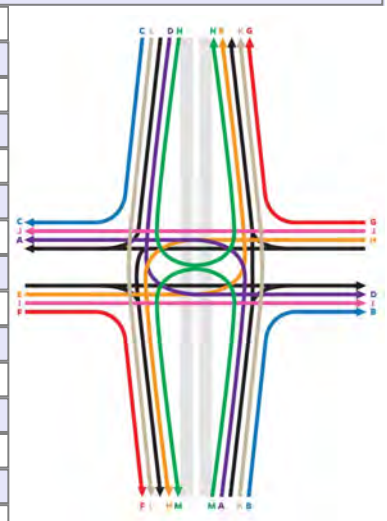
Signal Two Information	
Cycle, s	105.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	5.0	26.0	57.5	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Interchange Results

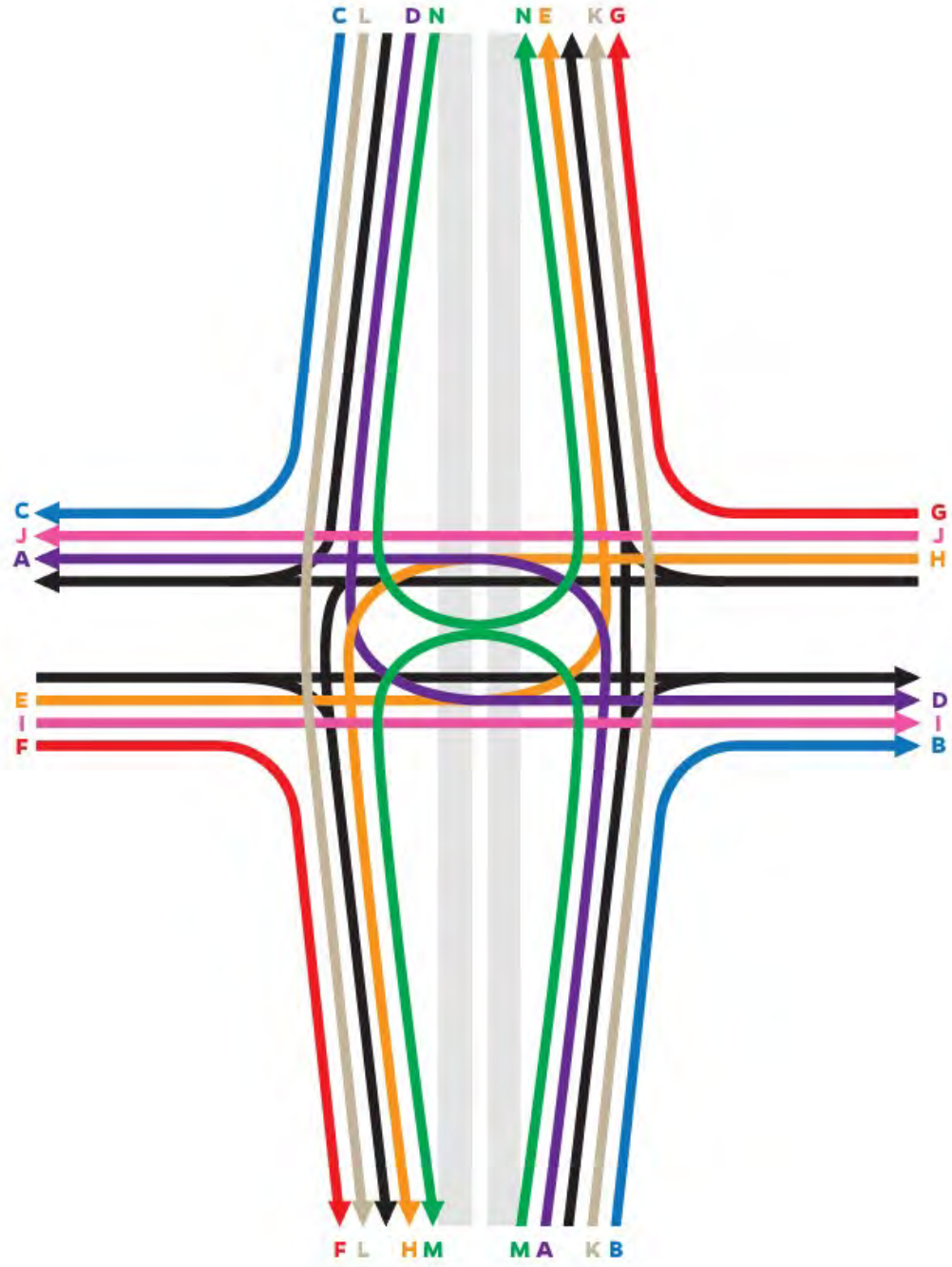
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	291.3	0.0	291.3	Yes	No	F
B	0	0.0	0.0	0.0	No	No	A
C	189	0.0	0.0	0.0	No	No	A
D	11	72.1	0.0	72.1	No	No	D
E	23	34.1	0.0	34.1	No	No	C
F	131	6.9	0.0	6.9	No	No	A
G	22	52.5	0.0	52.5	No	No	C
H	68	101.7	0.0	101.7	Yes	No	F
I	98	26.7	0.0	26.7	No	No	B
J	2330	343.6	0.0	343.6	Yes	No	F
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		6.9	10.6	49.4	291.3						52.3	
Level of Service (LOS)		A	B	D	F						D	
Approach Delay, s/veh / LOS	8.9	A		284.5	F		0.0			52.3	D	
Intersection Delay, s/veh / LOS	244.3						F					

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	27.2	19.8			52.3	52.5					0.0	72.6
Level of Service (LOS)	C	B			D	D						F
Approach Delay, s/veh / LOS	21.0	C		52.4	D		0.0			72.6	E	
Intersection Delay, s/veh / LOS	64.9						E					

Interchange Graphic



HCS7 Streets Text Report

File Name:	BUILD_1E_BENSON _AM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Mar 7, 2018
Time Period:	AM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2045
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	5
Number of Segments	4
Analysis period duration, h	0.25
System cycle length, s	105
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	3	1000	1000	50	50	0	0	70	70	0	0
4	40	40	1	2	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0

1: Location, ft	1320
1: Peak Hour Factor	1

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

Number of access points: 0

SEGMENT 4

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.28			43.7	
1	Running Speed, mph		41.67			41.27	
1	Through Delay, s/veh		14.16			14.84	
1	Travel Speed, mph		31.39			30.81	
1	Stop Rate, stops/veh		0.46			0.47	
1	Spatial Stop Rate, stops/mi		0.92			0.94	
1	Through vol/cap ratio		0.26			0.38	
1	Percent of Base FFS		71.23			69.9	
1	Level of Service		B			B	
1	Automobile Perception Score		2.28			2.28	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		63.24			65.3	
2	Running Speed, mph		42.64			41.3	
2	Through Delay, s/veh		6.89			7.57	
2	Travel Speed, mph		38.45			37.01	
2	Stop Rate, stops/veh		0.26			0.25	
2	Spatial Stop Rate, stops/mi		0.35			0.33	
2	Through vol/cap ratio		0.05			0.42	
2	Percent of Base FFS		87.24			83.97	
2	Level of Service		A			A	
2	Automobile Perception Score		2.29			2.24	
3	Bay/Lane Spillback Time, h	999	999	999	999	0.13	999
3	ShrdLane Spillback Time, h	999			999.1		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.7			19.5	
3	Running Speed, mph		36.46			34.97	
3	Through Delay, s/veh		19.76			291.32	
3	Travel Speed, mph		17.73			2.19	
3	Stop Rate, stops/veh		0.49			2.48	
3	Spatial Stop Rate, stops/mi		2.58			13.11	
3	Through vol/cap ratio		0.1			1.58	
3	Percent of Base FFS		40.22			4.98	
3	Level of Service		D			F	
3	Automobile Perception Score		2.54			4.78	

4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999					
4	Base Free-Flow Speed, mph		44.07			44.07	
4	Running Time, s		18.74			18.97	
4	Running Speed, mph		36.37			35.94	
4	Through Delay, s/veh		4.66			52.38	
4	Travel Speed, mph		29.14			9.56	
4	Stop Rate, stops/veh		0.19			0.98	
4	Spatial Stop Rate, stops/mi		0.99			5.17	
4	Through vol/cap ratio		0.13			0.84	
4	Percent of Base FFS		66.11			21.68	
4	Level of Service		C			F	
4	Automobile Perception Score		2.5			3.25	
Facility Travel Time, s			189.45			513.58	
Facility Travel Speed, mph			30.95			11.42	
Facility Spatial Stop Rate, stops/mi			0.86			2.57	
Facility Base Free Flow Speed, mph			44.07			44.07	
Facility Percent Base Free Flow Speed			70.23			25.91	
Facility Level of Service			B			F	
Facility Automobile Perception Score			2.34			2.5	
Facility Pedestrian Space			∞			∞	
Facility Pedestrian Travel Speed			4.21			4.21	
Facility Pedestrian LOS Score			3.18			3.94	
Facility Pedestrian LOS			C			D	
Facility Bicycle Travel Speed			13.36			13.39	
Facility Bicycle LOS Score			2.57			3.01	
Facility Bicycle LOS			C			C	
Facility Transit Travel Speed			17.73			2.19	
Facility Transit LOS Score			0.72			1.43	
Facility Transit LOS			A			A	
SPILLBACK TIME, h			0.13				

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.07	4.07
1	Ped LOS Score for Intersection	2.19	2.89
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.8	1.15
1	Speed Adjustment Factor	0.69	0.68
1	Ped LOS Score for Link	2.8	3.14
1	Ped Link LOS	C	C
1	Roadway Crossing Difficulty Factor	1.2	1.17
1	Ped LOS Score for Segment	3.34	3.58
1	Ped Segment LOS	C	D
1	Bicycle Travel Speed	13.93	14.05
1	Bicycle LOS Score for Intersection	2.82	3.23
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.27	2.45
1	Speed Adjustment Factor	0.85	0.84
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.17	3.35
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2645	2645
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.75	2.89
1	Bicycle Segment LOS	B	C
1	Transit Running Speed, mi/h	41.67	41.27
1	g/C Ratio	0.56	0.56
1	Transit Running Time, s	43.28	43.7
1	Delay at Intersection, s/veh	14.22	14.93
1	Transit Travel Speed, mi/h	31.36	30.76
1	Transit Wait-Ride Score	3.71	3.69
1	Ped LOS Score for Link	2.8	3.14
1	Transit LOS Score for Segment	0.85	0.94
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.35	4.36
2	Ped LOS Score for Intersection	2.03	2.62

2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	0.78	1.89
2	Speed Adjustment Factor	0.73	0.68
2	Ped LOS Score for Link	2.81	3.88
2	Ped Link LOS	C	D
2	Roadway Crossing Difficulty Factor	1.2	1.2
2	Ped LOS Score for Segment	3.39	4.35
2	Ped Segment LOS	C	E
2	Bicycle Travel Speed	14.2	14.72
2	Bicycle LOS Score for Intersection	3.07	3.78
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.26	2.71
2	Speed Adjustment Factor	0.86	0.84
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.17	3.61
2	Bicycle Link LOS	C	D
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.75	3.07
2	Bicycle Segment LOS	C	C
2	Transit Running Speed, mi/h	42.64	41.3
2	g/C Ratio	0.65	0.61
2	Transit Running Time, s	63.24	65.3
2	Delay at Intersection, s/veh	6.89	7.57
2	Transit Travel Speed, mi/h	38.45	37.01
2	Transit Wait-Ride Score	3.98	3.93
2	Ped LOS Score for Link	2.81	3.88
2	Transit LOS Score for Segment	0.44	0.68
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.28	4.33
3	Ped LOS Score for Intersection	1.41	1.34
3	Cross-section Adjustment Factor	-4.9	-4.74
3	Volume Adjustment Factor	0.15	1.82
3	Speed Adjustment Factor	0.53	0.49
3	Ped LOS Score for Link	1.83	3.62
3	Ped Link LOS	B	D
3	Roadway Crossing Difficulty Factor	1.2	1.2
3	Ped LOS Score for Segment	2.51	4.1
3	Ped Segment LOS	B	D
3	Bicycle Travel Speed	13.18	9.07
3	Bicycle LOS Score for Intersection	2.88	3.88
3	Cross-section Adjustment Factor	-2.54	-1.28
3	Volume Adjustment Factor	1.42	2.69
3	Speed Adjustment Factor	0.79	0.76
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	1	3.51
3	Bicycle Link LOS	A	D
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	1.68	3.34
3	Bicycle Segment LOS	A	C
3	Transit Running Speed, mi/h	36.46	34.97
3	g/C Ratio	0.35	0.74
3	Transit Running Time, s	18.7	19.5
3	Delay at Intersection, s/veh	19.76	291.32
3	Transit Travel Speed, mi/h	17.73	2.19
3	Transit Wait-Ride Score	2.99	1.51
3	Ped LOS Score for Link	1.83	3.62
3	Transit LOS Score for Segment	1.79	4.27
3	Transit Segment LOS	A	E
4	Average Pedestrian Space, ft2/p	∞	∞
4	Pedestrian Travel Speed, ft/s	4.01	3.89
4	Ped LOS Score for Intersection	1.94	2.14
4	Cross-section Adjustment Factor	-4.93	-4.74
4	Volume Adjustment Factor	0.26	0.8
4	Speed Adjustment Factor	0.53	0.52
4	Ped LOS Score for Link	1.9	2.63
4	Ped Link LOS	B	C
4	Roadway Crossing Difficulty Factor	1.2	1.18
4	Ped LOS Score for Segment	2.56	3.13
4	Ped Segment LOS	B	C
4	Bicycle Travel Speed	10.06	13.35
4	Bicycle LOS Score for Intersection	3.15	3.06
4	Cross-section Adjustment Factor	-2.92	-1.28

4	Volume Adjustment Factor	1.7	2.27
4	Speed Adjustment Factor	0.78	0.78
4	Pavement Adjustment Factor	0.58	0.58
4	Bicycle LOS Score for Link	0.9	3.11
4	Bicycle Link LOS	A	C
4	Number of access point approaches	0	0
4	Segment Length, ft	1000	1000
4	Unsignalized Conflicts Factor	-0.7	-0.7
4	Bicycle LOS Score for Segment	2.31	2.74
4	Bicycle Segment LOS	B	B
4	Transit Running Speed, mi/h	36.37	35.94
4	g/C Ratio	0.67	0.25
4	Transit Running Time, s	18.74	18.97
4	Delay at Intersection, s/veh	0	52.3
4	Transit Travel Speed, mi/h	36.37	9.57
4	Transit Wait-Ride Score	3.91	2.34
4	Ped LOS Score for Link	1.9	2.63
4	Transit LOS Score for Segment	0.42	2.88
4	Transit Segment LOS	A	C

ACCESS POINT DATA

SEGMENT 1

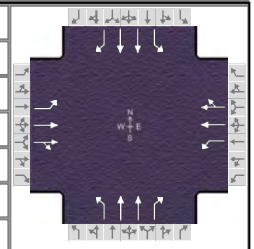
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	676	29.1	0	877	133	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.1	0	0	0.06	0	0	0.16	0.16	0.06	0.16	0.16	0.1
1: Thru veh delay		0.02			0.08							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	684	0	0	1341	50.7	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0.3	0	0	0.12	0	0	0.37	0.37	0.12	0.37	0.37	0.3
1: Thru veh delay		0			0.05							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	23.5	618	62.6	124	1371	267	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0.31	0	0	0.09	0	0	0.37	0.37	0.09	0.37	0.37	0.31
2: Thru veh delay		0.04			0.19							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											
3: Volume, veh/h	0	241	467	9.15	1652	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0.32	0	0	0.05	0	0	0.37	0.37	0.05	0.37	0.37	0.32
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

HCS7 Signalized Intersection Results Summary

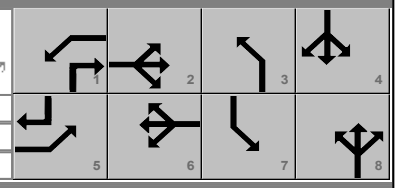
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1E_BENSON _AM.xus		
Project Description	I-229/BENSON 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	105	445	90	70	730	370	95	245	70	120	275	155

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

Green	3.1	2.2		58.7	6.0	1.0	15.0					
Yellow	3.0	0.0		3.5	3.0	0.0	3.5					
Red	1.0	0.0		2.0	1.0	0.0	2.0					



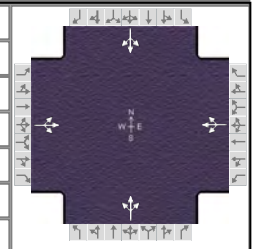
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	9.3	66.4	7.1	64.2	10.0	20.5	11.0	21.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	5.1		3.3		7.8	10.1	9.0	11.1
Green Extension Time (g_e), s	0.3	0.0	0.1	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.97		0.77		0.95	1.00	0.98	1.00
Max Out Probability	0.03		0.47		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	117	285	276	50	365	335	106	272	50	133	306	100
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1658	1647	1730	1576	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	3.1	8.7	8.8	1.3	13.0	12.8	5.8	8.1	3.1	7.0	9.1	6.1
Cycle Queue Clearance Time (g_c), s	3.1	8.7	8.8	1.3	13.0	12.8	5.8	8.1	3.1	7.0	9.1	6.1
Green Ratio (*g/C*)	0.61	0.58	0.58	0.59	0.56	0.56	0.20	0.14	0.17	0.21	0.15	0.20
Capacity (*c*), veh/h	468	1004	962	512	968	882	212	471	252	249	502	297
Volume-to-Capacity Ratio (*X*)	0.249	0.284	0.287	0.097	0.377	0.380	0.499	0.579	0.198	0.535	0.609	0.337
Back of Queue (*Q*), ft/ln (95 th percentile)	49.1	151.8	141.7	20.8	222.8	196.1	112.5	151.5	50.8	143.1	169.7	100.9
Back of Queue (*Q*), veh/ln (95 th percentile)	1.9	5.8	5.7	0.8	8.6	7.8	4.3	5.8	2.0	5.5	6.5	3.9
Queue Storage Ratio (*RQ*) (95 th percentile)	0.25	0.00	0.00	0.15	0.00	0.00	0.37	0.00	0.21	0.39	0.00	0.32
Uniform Delay (d_1), s/veh	9.5	11.1	11.1	9.2	13.9	13.5	36.4	42.0	37.3	36.4	41.6	35.8
Incremental Delay (d_2), s/veh	0.4	0.7	0.7	0.1	1.0	1.1	2.6	0.4	0.1	2.9	0.4	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	9.9	11.8	11.8	9.4	14.9	14.6	39.0	42.5	37.4	39.3	42.0	36.1
Level of Service (LOS)	A	B	B	A	B	B	D	D	D	D	D	D
Approach Delay, s/veh / LOS	11.5	B		14.4	B		41.0	D		40.2	D	
Intersection Delay, s/veh / LOS	24.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.72	C	2.89	C	3.02	C	2.85	C
Bicycle LOS Score / LOS	2.82	C	3.23	C	2.74	C	2.83	C

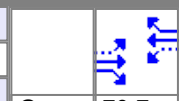
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	HALL	File Name	BUILD_1E_BENSON _AM.xus		
Project Description	I-229/BENSON IMJR				

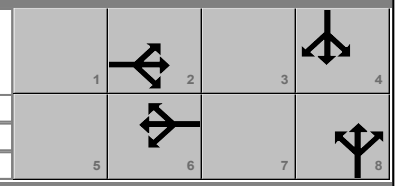


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	95	140	130	85	495	20	90	5	40	10	10	50

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



Green	70.7	6.4	11.4	0.0	0.0	0.0						
Yellow	3.5	3.5	3.5	0.0	0.0	0.0						
Red	2.0	2.0	2.0	0.0	0.0	0.0						



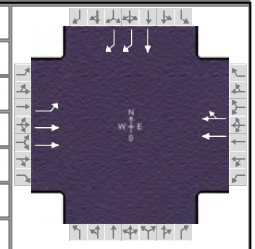
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		12.0		12.0
Phase Duration, s		76.2		76.2		16.9		11.9
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		3.1		3.2
Queue Clearance Time (g_s), s						11.3		7.1
Green Extension Time (g_e), s		0.0		0.0		0.2		0.1
Phase Call Probability						0.99		0.90
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		115			667			144			78	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1247			1652			1597			1585	
Queue Service Time (g_s), s		0.0			10.7			9.3			5.1	
Cycle Queue Clearance Time (g_c), s		1.9			22.6			9.3			5.1	
Green Ratio (*g/C*)		0.67			0.67			0.11			0.06	
Capacity (*c*), veh/h		883			1151			173			97	
Volume-to-Capacity Ratio (*X*)		0.130			0.579			0.835			0.800	
Back of Queue (*Q*), ft/ln (95 th percentile)		29.3			311			175.9			95.3	
Back of Queue (*Q*), veh/ln (95 th percentile)		1.1			12.0			6.8			3.8	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		4.4			9.2			45.9			48.6	
Incremental Delay (d_2), s/veh		0.3			2.1			4.0			5.6	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		4.7			11.3			49.9			54.2	
Level of Service (LOS)		A			B			D			D	
Approach Delay, s/veh / LOS	4.7	A		11.3	B		49.9	D		54.2	D	
Intersection Delay, s/veh / LOS	19.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.94	B	1.66	B	2.31	B	2.47	B
Bicycle LOS Score / LOS	3.15	C	3.58	D	2.41	B	0.62	A

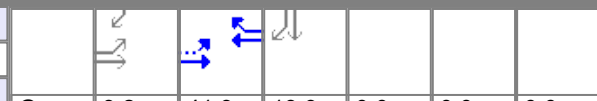
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BUILD_1E_BENSON_PM.xus		
Project Description	I-229/BENSON IMJR				

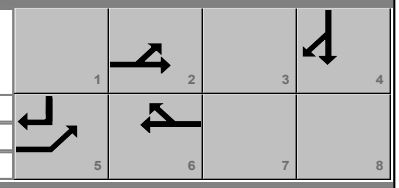


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	90	345			355	195					0	380

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.2	41.3	13.9	0.0	0.0	0.0						
Yellow	3.5	3.5	3.5	0.0	0.0	0.0						
Red	2.0	2.0	2.0	0.0	0.0	0.0						



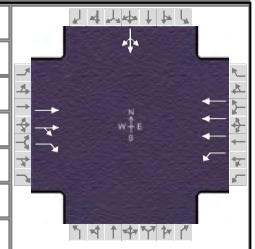
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				11.0
Phase Duration, s	8.7	55.6		46.8				19.4
Change Period, (*Y+R c*), s	5.5	5.5		5.5				5.5
Max Allow Headway (*MAH*), s	3.1	0.0		0.0				3.3
Queue Clearance Time (*g s*), s	2.6							13.3
Green Extension Time (*g e*), s	0.0	0.0		0.0				0.6
Phase Call Probability	0.54							1.00
Max Out Probability	0.00							0.29

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16					4	14
Adjusted Flow Rate (*v*), veh/h	37	143			322	289					0	422
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1550			1668	1464					1682	1287
Queue Service Time (*g s*), s	0.6	2.1			9.4	6.4					0.0	11.3
Cycle Queue Clearance Time (*g c*), s	0.6	2.1			9.4	6.4					0.0	11.3
Green Ratio (*g/C*)	0.62	0.61			0.55	0.55					0.19	0.23
Capacity (*c*), veh/h	504	1895			918	807					313	590
Volume-to-Capacity Ratio (*X*)	0.074	0.076			0.351	0.358					0.000	0.716
Back of Queue (*Q*), ft/ln (95 th percentile)	7.7	26.3			99.7	77.7					0	150
Back of Queue (*Q*), veh/ln (95 th percentile)	0.3	1.0			3.8	3.1					0.0	6.0
Queue Storage Ratio (*RQ*) (95 th percentile)	0.08	0.00			0.00	0.00					0.00	0.00
Uniform Delay (*d 1*), s/veh	6.1	7.8			7.5	6.6					0.0	26.7
Incremental Delay (*d 2*), s/veh	0.0	0.1			0.9	1.1					0.0	1.5
Initial Queue Delay (*d 3*), s/veh	0.0	0.0			0.0	0.0					0.0	0.0
Control Delay (*d*), s/veh	6.1	7.9			8.4	7.7					0.0	28.2
Level of Service (LOS)	A	A			A	A						C
Approach Delay, s/veh / LOS	7.5	A		8.1	A		0.0			28.2	C	
Intersection Delay, s/veh / LOS	15.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.34	A	2.08	B	2.46	B	2.68	C
Bicycle LOS Score / LOS	2.88	C	2.98	C		A	1.18	A

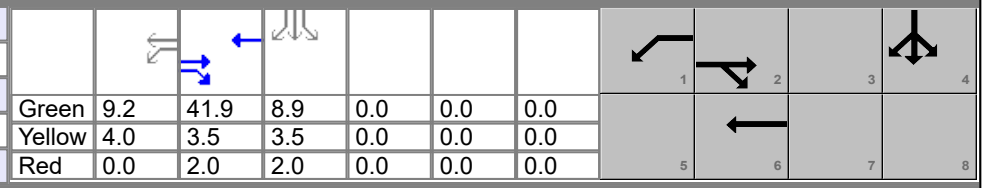
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BUILD_1E_BENSON_PM.xus		
Project Description	I-229/BENSON 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		260	1485	155	580					80	0	60

Signal Information			
Cycle, s	75.0	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	9.2	41.9	8.9	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	2.0	4.0				12.0
Phase Duration, s		47.4	13.2	60.6				14.4
Change Period, ($Y+R_c$), s		5.5	4.0	5.5				5.5
Max Allow Headway (*MAH*), s		0.0	3.1	0.0				3.2
Queue Clearance Time (g_s), s			9.2					9.1
Green Extension Time (g_e), s		0.0	0.2	0.0				0.2
Phase Call Probability			0.97					0.96
Max Out Probability			0.00					0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		86	492	172	644						156	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1623	1495	1714	1498						1593	
Queue Service Time (g_s), s		0.9	12.8	7.2	4.5						7.1	
Cycle Queue Clearance Time (g_c), s		0.9	12.8	7.2	4.5						7.1	
Green Ratio (*g/C*)		0.56	0.56	0.12	0.62						0.12	
Capacity (*c*), veh/h		1812	835	210	2806						190	
Volume-to-Capacity Ratio (*X*)		0.048	0.590	0.821	0.230						0.819	
Back of Queue (*Q*), ft/ln (95 th percentile)		12.3	117.9	125.6	51						124.3	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.5	4.7	5.0	2.0						5.0	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.84	0.00						0.00	
Uniform Delay (d_1), s/veh		7.5	7.0	29.9	4.3						32.2	
Incremental Delay (d_2), s/veh		0.0	1.3	2.5	0.2						3.3	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0						0.0	
Control Delay (*d*), s/veh		7.5	8.3	32.4	4.5						35.5	
Level of Service (LOS)		A	A	C	A						D	
Approach Delay, s/veh / LOS	8.2	A		10.4	B		0.0			35.5	D	
Intersection Delay, s/veh / LOS	12.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	4.03	D	1.33	A	2.72	C	3.06	C
Bicycle LOS Score / LOS	4.08	D	2.93	C		A	0.74	A

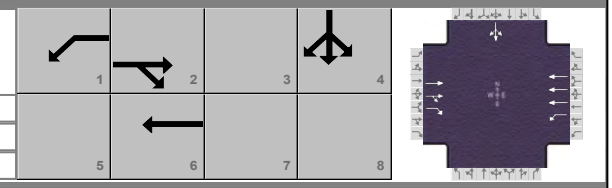
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 7, 2018	Segment Distance, ft	1000
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	North-South
Intersection	I-229 SB	PHF	0.90	Arterial Direction	East-West
File Name	BUILD_1E_BENSON_PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		260	1485	155	580					80	0	60
Intersection Two Demand (*v*), veh/h	90	345			355	195					0	380

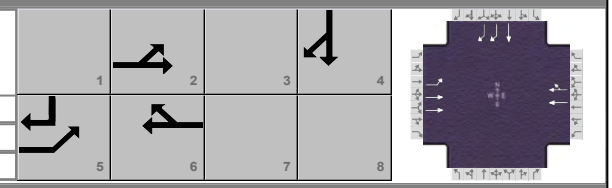
Signal One Information	
Cycle, s	75.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	9.2	41.9	8.9	0.0	0.0	0.0
Yellow	4.0	3.5	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



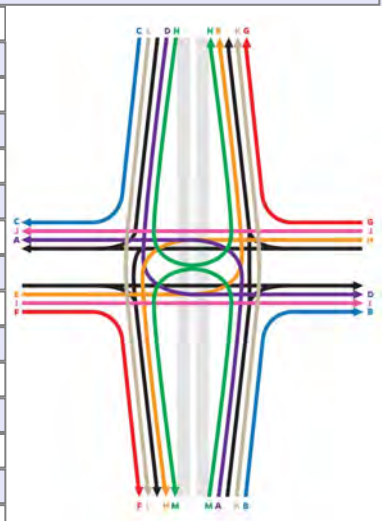
Signal Two Information	
Cycle, s	75.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	3.2	41.3	13.9	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Interchange Results

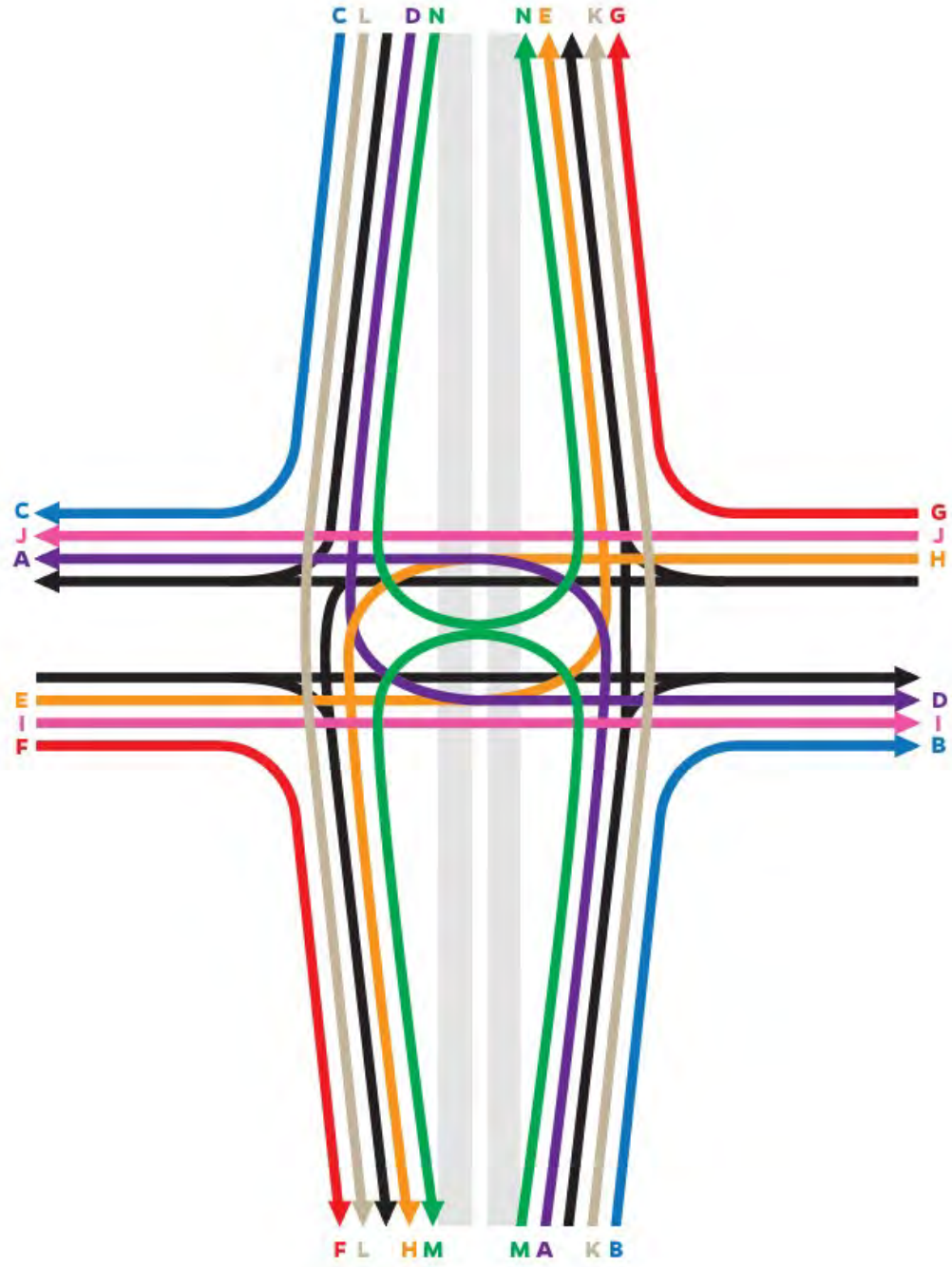
O-D	Demand (veh/h)	Delay (s)	EDTT	ETT	v/c > 1 ?	R_Q > 1 ?	LOS
A	0	4.5	0.0	4.5	No	No	A
B	0	0.0	0.0	0.0	No	No	A
C	67	0.0	0.0	0.0	No	No	A
D	89	43.4	0.0	43.4	No	No	C
E	37	13.6	0.0	13.6	No	No	A
F	492	7.5	0.0	7.5	No	No	A
G	217	7.7	0.0	7.7	No	No	A
H	172	40.8	0.0	40.8	No	No	C
I	54	15.4	0.0	15.4	No	No	B
J	644	12.9	0.0	12.9	No	No	A
K	0	-	0.0	-	-	-	-
L	0	-	0.0	-	-	-	-
M	0	-	0.0	-	-	-	-
N	0	-	0.0	-	-	-	-



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		7.5	8.3	32.4	4.5						35.5	
Level of Service (LOS)		A	A	C	A						D	
Approach Delay, s/veh / LOS	8.2	A		10.4	B		0.0			35.5	D	
Intersection Delay, s/veh / LOS	12.1						B					

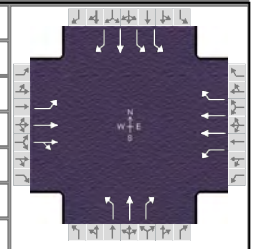
Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	6.1	7.9			8.4	7.7					0.0	28.2
Level of Service (LOS)	A	A			A	A						C
Approach Delay, s/veh / LOS	7.5	A		8.1	A		0.0			28.2	C	
Intersection Delay, s/veh / LOS	15.0						B					

Interchange Graphic



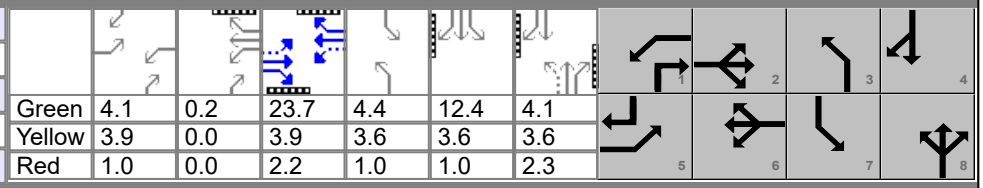
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BUILD_1E_BENSON_PM.xus		
Project Description	I-229/BENSON 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	70	840	25	60	400	75	50	35	105	765	40	215

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.1	0.2	23.7	4.4	12.4	4.1
Yellow	3.9	0.0	3.9	3.6	3.6	3.6
Red	1.0	0.0	2.2	1.0	1.0	2.3

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	9.0	29.8	9.2	30.0	9.0	10.0	26.0	27.0
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	4.0		4.1		4.3	6.1	21.4	9.9
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	0.00

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	69	425	422	71	472	89	56	39	106	850	44	200
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1719	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	2.0	16.7	16.7	2.1	9.4		2.3	1.6	4.1	19.4	1.4	7.9
Cycle Queue Clearance Time (g_c), s	2.0	16.7	16.7	2.1	9.4		2.3	1.6	4.1	19.4	1.4	7.9
Green Ratio (*g/C*)	0.37	0.32	0.32	0.37	0.32		0.11	0.05	0.11	0.29	0.28	0.34
Capacity (*c*), veh/h	336	547	543	250	1051		264	95	171	913	488	493
Volume-to-Capacity Ratio (*X*)	0.206	0.777	0.777	0.283	0.450		0.210	0.411	0.618	0.931	0.091	0.406
Back of Queue (*Q*), ft/ln (95 th percentile)	30.4	281.1	269.1	42.6	176.6		43.2	32.1	88.9	356.8	25.5	117.2
Back of Queue (*Q*), veh/ln (95 th percentile)	1.2	10.8	10.8	1.6	6.8		1.7	1.2	3.6	13.7	1.0	4.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.15	0.00	0.00	0.61	0.00		0.43	0.00	0.00	0.95	0.00	0.00
Uniform Delay (d_1), s/veh	14.5	23.1	23.1	17.5	23.9		30.5	34.3	31.8	26.1	19.8	19.1
Incremental Delay (d_2), s/veh	0.3	7.2	7.3	2.8	1.4		0.6	1.1	4.9	15.9	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	0.0
Control Delay (*d*), s/veh	14.8	30.3	30.4	20.3	25.3	0.0	31.1	35.3	36.7	42.0	19.9	19.3
Level of Service (LOS)	B	C	C	C	C	A	C	D	D	D	B	B
Approach Delay, s/veh / LOS	29.2	C		21.2	C		34.9	C		37.0	D	
Intersection Delay, s/veh / LOS	30.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.23	B	2.67	C	3.01	C	2.76	C
Bicycle LOS Score / LOS	3.11	C	2.75	C	2.26	B	3.89	D

HCS7 Streets Text Report

File Name:	BUILD_1E_BENSON_PM.xus
Analyst:	RL
Agency/Co.:	HDR
Analysis Date:	Mar 7, 2018
Time Period:	PM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2045
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	5
Number of Segments	4
Analysis period duration, h	0.25
System cycle length, s	75
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	95
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	0.51
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

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	40	40	2	2	2645	2645	50	50	0	0	70	70	0	0
2	40	40	2	2	3955	3955	50	50	0	0	70	70	0	0
3	40	40	2	3	1000	1000	50	50	0	0	70	70	0	0
4	40	40	1	2	1000	1000	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	465	20	0	925	140	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0

1: Location, ft	1320
1: Peak Hour Factor	1

Number of access points: 1

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	430	0	0	1455	55	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700											
1: Peak Hour Factor	1											
2: Volume, veh/h	15	395	40	135	1490	290	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1420											
2: Peak Hour Factor	1											
3: Volume, veh/h	0	165	320	10	1805	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Location, ft	1910											
3: Peak Hour Factor	1											

Number of access points: 3

SEGMENT 3

Number of access points: 0

SEGMENT 4

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	999			999		
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.6			43.39	
1	Running Speed, mph		41.36			41.57	
1	Through Delay, s/veh		30.36			17.27	
1	Travel Speed, mph		24.38			29.73	
1	Stop Rate, stops/veh		0.81			0.57	
1	Spatial Stop Rate, stops/mi		1.63			1.15	
1	Through vol/cap ratio		0.78			0.28	
1	Percent of Base FFS		55.32			67.46	
1	Level of Service		C			B	
1	Automobile Perception Score		2.39			2.31	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		999
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		65.53			63.33	
2	Running Speed, mph		41.15			42.58	
2	Through Delay, s/veh		7.5			25.28	
2	Travel Speed, mph		36.93			30.43	
2	Stop Rate, stops/veh		0.29			0.77	
2	Spatial Stop Rate, stops/mi		0.39			1.02	
2	Through vol/cap ratio		0.05			0.45	
2	Percent of Base FFS		83.79			69.05	
2	Level of Service		A			B	
2	Automobile Perception Score		2.3			2.35	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		18.72			18.89	
3	Running Speed, mph		36.42			36.09	
3	Through Delay, s/veh		7.86			4.48	
3	Travel Speed, mph		25.65			29.17	
3	Stop Rate, stops/veh		0.38			0.24	
3	Spatial Stop Rate, stops/mi		1.99			1.29	
3	Through vol/cap ratio		0.08			0.23	
3	Percent of Base FFS		58.2			66.19	
3	Level of Service		C			C	
3	Automobile Perception Score		2.44			2.55	

4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999					
4	Base Free-Flow Speed, mph		44.07			44.07	
4	Running Time, s		17.18			18.93	
4	Running Speed, mph		39.7			36.03	
4	Through Delay, s/veh		2.92			8.29	
4	Travel Speed, mph		33.92			25.05	
4	Stop Rate, stops/veh		0.13			0.31	
4	Spatial Stop Rate, stops/mi		0.69			1.64	
4	Through vol/cap ratio		0.15			0.35	
4	Percent of Base FFS		76.98			56.85	
4	Level of Service		B			C	
4	Automobile Perception Score		2.45			2.61	
Facility Travel Time, s			193.67			199.86	
Facility Travel Speed, mph			30.28			29.34	
Facility Spatial Stop Rate, stops/mi			0.99			1.16	
Facility Base Free Flow Speed, mph			44.07			44.07	
Facility Percent Base Free Flow Speed			68.7			66.57	
Facility Level of Service			B			C	
Facility Automobile Perception Score			2.36			2.39	
Facility Pedestrian Space			∞			∞	
Facility Pedestrian Travel Speed			4.26			4.27	
Facility Pedestrian LOS Score			3.4			3.06	
Facility Pedestrian LOS			C			C	
Facility Bicycle Travel Speed			13.52			13.81	
Facility Bicycle LOS Score			2.84			2.74	
Facility Bicycle LOS			C			C	
Facility Transit Travel Speed			25.65			29.17	
Facility Transit LOS Score			0.92			0.98	
Facility Transit LOS			A			A	
SPILLBACK TIME, h			999				

Multimodal Results

1	Average Pedestrian Space, ft2/p		∞			∞	
1	Pedestrian Travel Speed, ft/s		4.17			4.17	
1	Ped LOS Score for Intersection		2.23			2.89	
1	Cross-section Adjustment Factor		-4.74			-4.74	
1	Volume Adjustment Factor		1.1			0.87	
1	Speed Adjustment Factor		0.68			0.69	
1	Ped LOS Score for Link		3.09			2.87	
1	Ped Link LOS		C			C	
1	Roadway Crossing Difficulty Factor		1.02			0.84	
1	Ped LOS Score for Segment		3.21			2.71	
1	Ped Segment LOS		C			B	
1	Bicycle Travel Speed		13.45			13.1	
1	Bicycle LOS Score for Intersection		3.11			2.83	
1	Cross-section Adjustment Factor		-1.28			-1.28	
1	Volume Adjustment Factor		2.43			2.31	
1	Speed Adjustment Factor		0.84			0.85	
1	Pavement Adjustment Factor		0.58			0.58	
1	Bicycle LOS Score for Link		3.33			3.22	
1	Bicycle Link LOS		C			C	
1	Number of access point approaches		0			0	
1	Segment Length, ft		2645			2645	
1	Unsignalized Conflicts Factor		-0.7			-0.7	
1	Bicycle LOS Score for Segment		2.89			2.79	
1	Bicycle Segment LOS		C			C	
1	Transit Running Speed, mi/h		41.36			41.57	
1	g/C Ratio		0.32			0.39	
1	Transit Running Time, s		43.6			43.39	
1	Delay at Intersection, s/veh		30.34			17.43	
1	Transit Travel Speed, mi/h		24.39			29.65	
1	Transit Wait-Ride Score		3.38			3.64	
1	Ped LOS Score for Link		3.09			2.87	
1	Transit LOS Score for Segment		1.39			0.97	
1	Transit Segment LOS		A			A	
2	Average Pedestrian Space, ft2/p		∞			∞	
2	Pedestrian Travel Speed, ft/s		4.32			4.32	
2	Ped LOS Score for Intersection		4.03			2.67	

2	Cross-section Adjustment Factor	-4.74	-4.74
2	Volume Adjustment Factor	2.05	0.81
2	Speed Adjustment Factor	0.68	0.73
2	Ped LOS Score for Link	4.03	2.84
2	Ped Link LOS	D	C
2	Roadway Crossing Difficulty Factor	1	1.2
2	Ped LOS Score for Segment	3.88	3.42
2	Ped Segment LOS	D	C
2	Bicycle Travel Speed	13.67	14.78
2	Bicycle LOS Score for Intersection	4.08	2.75
2	Cross-section Adjustment Factor	-1.28	-1.28
2	Volume Adjustment Factor	2.75	2.28
2	Speed Adjustment Factor	0.84	0.86
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	3.64	3.19
2	Bicycle Link LOS	D	C
2	Number of access point approaches	0	0
2	Segment Length, ft	3955	3955
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	3.17	2.74
2	Bicycle Segment LOS	C	B
2	Transit Running Speed, mi/h	41.15	42.58
2	g/C Ratio	0.56	0.32
2	Transit Running Time, s	65.53	63.33
2	Delay at Intersection, s/veh	7.5	25.28
2	Transit Travel Speed, mi/h	36.93	30.43
2	Transit Wait-Ride Score	3.93	3.67
2	Ped LOS Score for Link	4.03	2.84
2	Transit LOS Score for Segment	0.71	0.92
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.26	4.35
3	Ped LOS Score for Intersection	1.34	1.33
3	Cross-section Adjustment Factor	-4.74	-4.74
3	Volume Adjustment Factor	0.2	0.62
3	Speed Adjustment Factor	0.53	0.52
3	Ped LOS Score for Link	2.04	2.45
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.15	1.2
3	Ped LOS Score for Segment	2.62	3.06
3	Ped Segment LOS	B	C
3	Bicycle Travel Speed	12.92	12.86
3	Bicycle LOS Score for Intersection	2.88	2.93
3	Cross-section Adjustment Factor	-1.28	-1.28
3	Volume Adjustment Factor	1.58	2.14
3	Speed Adjustment Factor	0.78	0.78
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	2.42	2.98
3	Bicycle Link LOS	B	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1000	1000
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	2.33	2.66
3	Bicycle Segment LOS	B	B
3	Transit Running Speed, mi/h	36.42	36.09
3	g/C Ratio	0.67	0.73
3	Transit Running Time, s	18.72	18.89
3	Delay at Intersection, s/veh	7.86	4.48
3	Transit Travel Speed, mi/h	25.65	29.17
3	Transit Wait-Ride Score	3.45	3.62
3	Ped LOS Score for Link	2.04	2.45
3	Transit LOS Score for Segment	1.13	0.94
3	Transit Segment LOS	A	A
4	Average Pedestrian Space, ft2/p	∞	∞
4	Pedestrian Travel Speed, ft/s	4.32	4.26
4	Ped LOS Score for Intersection	2.06	2.08
4	Cross-section Adjustment Factor	-4.86	-4.74
4	Volume Adjustment Factor	0.34	0.7
4	Speed Adjustment Factor	0.63	0.52
4	Ped LOS Score for Link	2.15	2.52
4	Ped Link LOS	B	C
4	Roadway Crossing Difficulty Factor	1.2	0.91
4	Ped LOS Score for Segment	2.8	2.58
4	Ped Segment LOS	C	B
4	Bicycle Travel Speed	13.75	13.21
4	Bicycle LOS Score for Intersection	3.11	2.98
4	Cross-section Adjustment Factor	-2.2	-1.28

4	Volume Adjustment Factor	1.83	2.2
4	Speed Adjustment Factor	0.83	0.78
4	Pavement Adjustment Factor	0.58	0.58
4	Bicycle LOS Score for Link	1.8	3.03
4	Bicycle Link LOS	B	C
4	Number of access point approaches	0	0
4	Segment Length, ft	1000	1000
4	Unsignalized Conflicts Factor	-0.7	-0.7
4	Bicycle LOS Score for Segment	1.94	2.69
4	Bicycle Segment LOS	A	B
4	Transit Running Speed, mi/h	39.7	36.03
4	g/C Ratio	0.59	0.55
4	Transit Running Time, s	17.18	18.93
4	Delay at Intersection, s/veh	0	8.42
4	Transit Travel Speed, mi/h	39.7	24.93
4	Transit Wait-Ride Score	4.03	3.41
4	Ped LOS Score for Link	2.15	2.52
4	Transit LOS Score for Segment	0.28	1.26
4	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

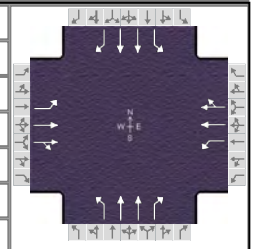
	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	927	39.9	0	666	101	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.11	0	0	0.16	0	0	0.27	0.27	0.16	0.27	0.27	0.11
1: Thru veh delay		0.03			0.06							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	1	2	3	4	5	6	7	8	9	10	11	12
1: Volume, veh/h	0	1798	0	0	632	23.9	0	0	0	20	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0	0	0	0.47	0	0	0.47	0.47	0.47	0.47	0.47	0
1: Thru veh delay		0			0.02							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	60.6	1596	162	57.6	636	124	10	5	80	10	0	10
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0.04	0	0	0.47	0	0	0.51	0.51	0.47	0.51	0.51	0.04
2: Thru veh delay		0.16			0.06							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1420											
3: Volume, veh/h	0	574	1112	3.92	707	0	0	0	0	5	0	110
3: Lanes	0	2	0	1	2	0	0	0	0	0	1	0
3: Prop blocked	0.05	0	0	0.43	0	0	0.48	0.48	0.43	0.48	0.48	0.05
3: Thru veh delay		0			0							
3: Prob inside blk		0			0							
3: Dist to upstream signal	1910											

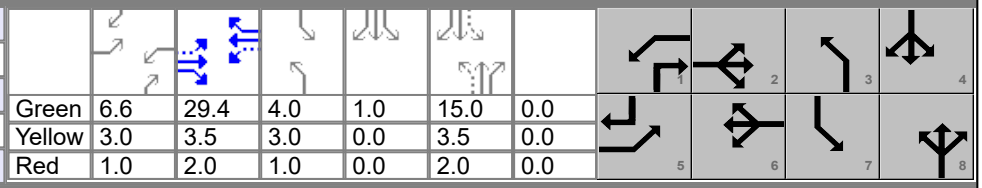
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BUILD_1E_BENSON_PM.xus		
Project Description	I-229/BENSON 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	150	625	190	190	380	160	130	355	40	205	380	100

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	6.6	29.4	4.0	1.0	15.0	0.0
Yellow	3.0	3.5	3.0	0.0	3.5	0.0
Red	1.0	2.0	1.0	0.0	2.0	0.0

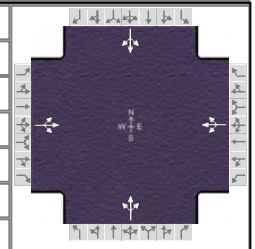
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	10.6	34.9	10.6	34.9	8.0	20.5	9.0	21.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	6.4		6.4		6.0	10.2	7.0	10.7
Green Extension Time (g_e), s	0.5	0.0	0.4	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.97		0.97		0.95	1.00	0.99	1.00
Max Out Probability	0.17		0.31		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	167	452	420	166	188	184	144	394	17	228	422	39
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1607	1647	1730	1666	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	4.4	16.1	16.1	4.4	5.8	5.8	4.0	8.2	0.6	5.0	8.7	1.4
Cycle Queue Clearance Time (g_c), s	4.4	16.1	16.1	4.4	5.8	5.8	4.0	8.2	0.6	5.0	8.7	1.4
Green Ratio (*g/C*)	0.48	0.39	0.39	0.48	0.39	0.39	0.25	0.20	0.29	0.27	0.21	0.30
Capacity (*c*), veh/h	551	679	631	334	677	652	251	659	422	294	703	442
Volume-to-Capacity Ratio (*X*)	0.302	0.666	0.666	0.498	0.278	0.282	0.576	0.599	0.040	0.775	0.601	0.088
Back of Queue (*Q*), ft/ln (95 th percentile)	67.9	283.3	259.2	72.3	106.2	97.8	39.5	140.9	9.1	126.6	149.1	21.1
Back of Queue (*Q*), veh/ln (95 th percentile)	2.6	10.9	10.4	2.8	4.1	3.9	1.5	5.4	0.4	4.9	5.7	0.8
Queue Storage Ratio (*RQ*) (95 th percentile)	0.35	0.00	0.00	0.52	0.00	0.00	0.13	0.00	0.04	0.34	0.00	0.07
Uniform Delay (d_1), s/veh	11.6	18.7	18.7	14.5	16.5	16.1	26.0	27.3	19.2	27.7	26.6	18.8
Incremental Delay (d_2), s/veh	0.4	5.1	5.5	1.5	0.9	1.0	3.9	0.3	0.0	12.9	0.3	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	12.0	23.9	24.2	16.0	17.4	17.1	29.9	27.6	19.3	40.6	26.9	18.8
Level of Service (LOS)	B	C	C	B	B	B	C	C	B	D	C	B
Approach Delay, s/veh / LOS	22.1	C		16.9	B		27.9	C		31.0	C	
Intersection Delay, s/veh / LOS	24.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.81	C	2.89	C	2.94	C	2.82	C
Bicycle LOS Score / LOS	3.12	C	2.83	C	2.84	C	2.95	C

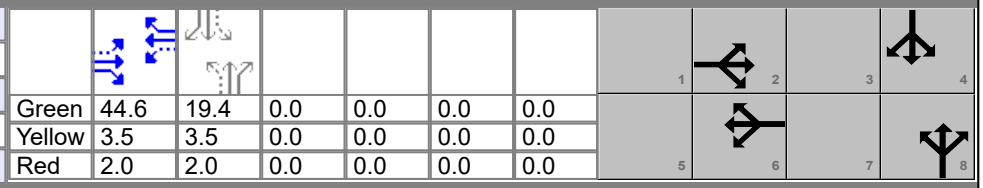
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 7, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	HALL	File Name	BUILD_1E_BENSON_PM.xus		
Project Description	I-229/BENSON 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	35	175	135	50	335	20	180	20	95	20	20	35

Signal Information			
Cycle, s	75.0	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	44.6	19.4	0.0	0.0	0.0	0.0						
Yellow	3.5	3.5	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		50.1		50.1		24.9		24.9
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		3.1		3.1
Queue Clearance Time (g_s), s						18.7		4.9
Green Extension Time (g_e), s		0.0		0.0		0.7		0.8
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

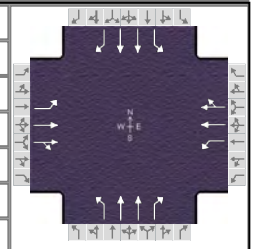
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		149			450			322			83	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1544			1657			1391			1589	
Queue Service Time (g_s), s		0.0			0.0			13.8			0.0	
Cycle Queue Clearance Time (g_c), s		1.3			10.8			16.7			2.9	
Green Ratio (*g/C*)		0.59			0.59			0.26			0.26	
Capacity (*c*), veh/h		971			1040			437			471	
Volume-to-Capacity Ratio (*X*)		0.153			0.433			0.737			0.177	
Back of Queue (*Q*), ft/ln (95 th percentile)		19.1			163.4			227.8			48.3	
Back of Queue (*Q*), veh/ln (95 th percentile)		0.7			6.3			8.8			1.9	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		2.6			8.3			26.7			21.7	
Incremental Delay (d_2), s/veh		0.3			1.3			0.9			0.1	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		2.9			9.7			27.7			21.8	
Level of Service (LOS)		A			A			C			C	
Approach Delay, s/veh / LOS	2.9	A		9.7	A		27.7	C		21.8	C	
Intersection Delay, s/veh / LOS	15.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.06	B	1.66	B	2.20	B	2.37	B
Bicycle LOS Score / LOS	3.11	C	3.22	C	2.70	C	0.63	A

Option 4A

HCS7 Signalized Intersection Results Summary

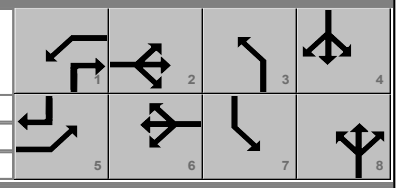
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 25, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	105	445	90	70	730	370	95	245	70	120	275	155

Signal Information			
Cycle, s	80.0	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	2.9	0.4	38.7	4.0	15.0	0.0
Yellow	3.0	0.0	3.5	3.0	3.5	0.0
Red	1.0	0.0	2.0	1.0	2.0	0.0



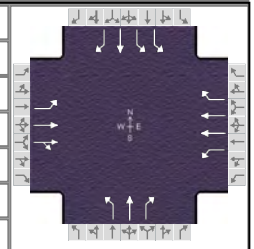
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	6.9	44.2	7.3	44.6	8.0	20.5	8.0	20.5
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	3.4		3.9		6.0	7.9	6.0	8.6
Green Extension Time (g_e), s	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	0.73		0.82		0.90	1.00	0.95	1.00
Max Out Probability	0.48		1.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	59	142	139	78	550	506	106	272	44	133	306	106
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1663	1647	1730	1591	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	1.4	5.1	5.1	1.9	19.1	19.1	4.0	5.9	1.9	4.0	6.6	4.8
Cycle Queue Clearance Time (g_c), s	1.4	5.1	5.1	1.9	19.1	19.1	4.0	5.9	1.9	4.0	6.6	4.8
Green Ratio (*g/C*)	0.52	0.48	0.48	0.52	0.49	0.49	0.24	0.19	0.23	0.24	0.19	0.22
Capacity (*c*), veh/h	268	837	805	608	845	777	256	618	335	269	618	328
Volume-to-Capacity Ratio (*X*)	0.221	0.170	0.173	0.128	0.651	0.651	0.413	0.441	0.133	0.496	0.495	0.321
Back of Queue (*Q*), ft/ln (95 th percentile)	22	92.7	84.9	28.5	307.8	279.6	76.5	102.7	29.9	29.7	116.7	74.7
Back of Queue (*Q*), veh/ln (95 th percentile)	0.8	3.6	3.4	1.1	11.8	11.2	2.9	3.9	1.1	1.1	4.5	2.9
Queue Storage Ratio (*RQ*) (95 th percentile)	0.11	0.00	0.00	0.20	0.00	0.00	0.26	0.00	0.12	0.08	0.00	0.23
Uniform Delay (d_1), s/veh	12.2	17.3	16.8	9.6	15.3	15.3	25.7	28.8	24.5	27.6	29.1	26.0
Incremental Delay (d_2), s/veh	0.5	0.4	0.4	0.1	3.9	4.2	1.5	0.2	0.1	2.0	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	0.0	0.0
Control Delay (*d*), s/veh	12.7	17.7	17.2	9.8	19.2	19.6	27.2	29.0	24.6	29.6	29.3	26.2
Level of Service (LOS)	B	B	B	A	B	B	C	C	C	C	C	C
Approach Delay, s/veh / LOS	16.6	B		18.7	B		28.1	C		28.8	C	
Intersection Delay, s/veh / LOS	22.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.71	C	2.87	C	3.05	C	2.84	C
Bicycle LOS Score / LOS	2.82	C	3.20	C	2.73	C	2.83	C

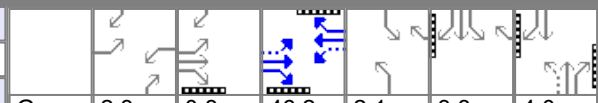
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 25, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BENSON AM.xus		
Project Description	I-229/BENSON IMJR				

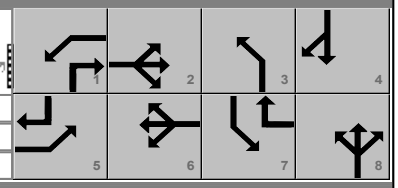


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160	415	40	80	1190	545	30	25	40	165	40	125

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.3	0.8		46.2	2.1	3.3	4.0					
Yellow	3.9	0.0		3.9	3.6	0.0	3.6					
Red	1.0	0.0		2.2	1.0	0.0	2.2					



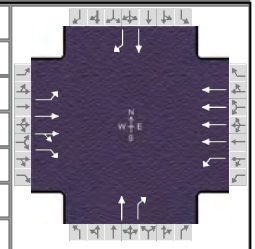
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	3.0	2.0	3.0
Phase Duration, s	7.9	53.1	7.2	52.3	6.7	9.8	10.0	13.1
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.8	4.6	5.8
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.2	5.1	1.2
Queue Clearance Time (g_s), s	3.2		2.7		3.5	3.4	6.5	6.2
Green Extension Time (g_e), s	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Phase Call Probability	0.76		0.56		0.52	0.99	0.98	1.00
Max Out Probability	0.00		0.00		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	63	87	87	37	556	182	33	28	28	183	44	83
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1695	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	1.2	2.5	2.7	0.7	4.4		1.5	1.2	1.4	4.5	1.9	4.2
Cycle Queue Clearance Time (g_c), s	1.2	2.5	2.7	0.7	4.4		1.5	1.2	1.4	4.5	1.9	4.2
Green Ratio (*g/C*)	0.62	0.59	0.59	0.61	0.58		0.08	0.05	0.08	0.07	0.09	0.13
Capacity (*c*), veh/h	587	1016	995	761	1902		189	86	119	216	157	189
Volume-to-Capacity Ratio (*X*)	0.108	0.086	0.087	0.049	0.292		0.176	0.324	0.234	0.849	0.283	0.442
Back of Queue (*Q*), ft/ln (95 th percentile)	16.9	40.1	40.8	10.2	56.7		29.2	24.7	22.6	117.6	37.3	68.6
Back of Queue (*Q*), veh/ln (95 th percentile)	0.7	1.5	1.6	0.4	2.2		1.1	0.9	0.9	4.5	1.4	2.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.08	0.00	0.00	0.15	0.00		0.73	0.00	0.00	0.44	0.00	0.00
Uniform Delay (d_1), s/veh	6.4	10.8	11.5	6.6	4.9		34.9	36.7	34.6	36.9	33.9	32.2
Incremental Delay (d_2), s/veh	0.1	0.2	0.2	0.0	0.3		0.6	0.8	0.4	26.6	0.4	0.6
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	6.5	11.0	11.6	6.7	5.2	0.0	35.5	37.5	35.0	63.5	34.3	32.8
Level of Service (LOS)	A	B	B	A	A	A	D	D	D	E	C	C
Approach Delay, s/veh / LOS	10.0	B		4.1	A		36.0	D		51.1	D	
Intersection Delay, s/veh / LOS	17.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.18	B	2.64	C	3.27	C	2.89	C
Bicycle LOS Score / LOS	2.81	C	3.78	D	2.07	B	2.59	C

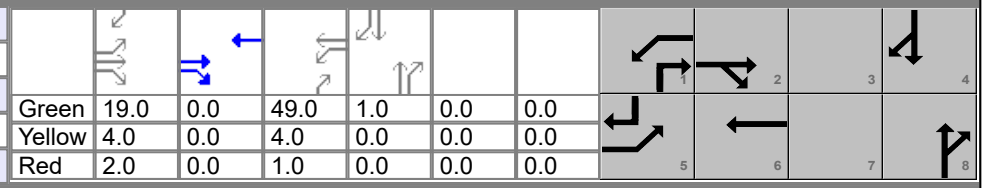
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 25, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	1	305	345	65	2235			1	10		0	170

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off



Green	19.0	0.0	49.0	1.0	0.0	0.0
Yellow	4.0	0.0	4.0	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	0.0	0.0

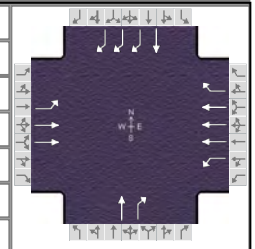
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		7.0		7.0
Phase Duration, s	25.0	25.0	54.0	54.0		1.0		1.0
Change Period, ($Y+R_c$), s	6.0	0.0	5.0	5.0		0.0		0.0
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		3.4		3.4
Queue Clearance Time (g_s), s	2.0		2.3			2.2		3.0
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			0.99		0.99
Max Out Probability	0.00		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			8	18		4	14
Adjusted Flow Rate (*v*), veh/h	0	140	159	16	541			1	11		0	189
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1714	1547			1008			1682	1427		1617	1397
Queue Service Time (g_s), s	0.0	3.0			4.8			0.1	0.2		0.0	1.0
Cycle Queue Clearance Time (g_c), s	0.0	3.0			4.8			0.1	0.2		0.0	1.0
Green Ratio (*g/C*)	0.24	0.31			0.61			0.01	0.63		0.01	0.25
Capacity (*c*), veh/h	407	967			2469			21	892		20	349
Volume-to-Capacity Ratio (*X*)	0.001	0.145			0.219			0.053	0.012		0.000	0.541
Back of Queue (*Q*), ft/ln (95 th percentile)	0.3	49.2			39.9			1	2.6		0	142.8
Back of Queue (*Q*), veh/ln (95 th percentile)	0.0	2.0			1.6			0.0	0.1		0.0	5.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.01	0.00			0.00			0.00	0.00		0.00	0.00
Uniform Delay (d_1), s/veh	24.5	23.3			6.9			39.0	5.7		0.0	26.0
Incremental Delay (d_2), s/veh	0.0	0.3			0.2			0.4	0.0		0.0	0.9
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	24.5	23.6	0.0	0.0	7.1			39.4	5.7		0.0	27.0
Level of Service (LOS)	C	C	A	A	A			D	A			C
Approach Delay, s/veh / LOS	11.1	B		6.9	A		8.7	A		27.0	C	
Intersection Delay, s/veh / LOS	11.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.86	B	1.86	B	2.60	C	2.73	C
Bicycle LOS Score / LOS	1.08	A	1.54	B	0.51	A	0.80	A

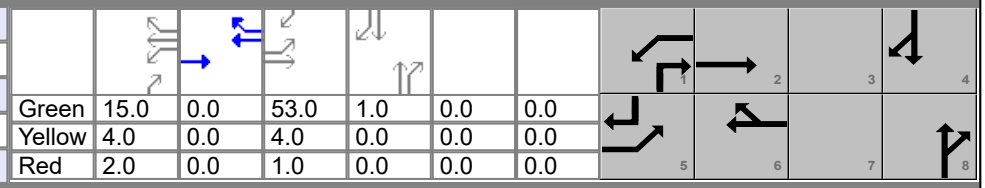
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 25, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BENSON AM.xus		
Project Description	I-229/BENSON 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	75	240		1	615	20		0	125		1	1685

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off



Green	15.0	0.0		53.0	1.0	0.0	0.0					
Yellow	4.0	0.0		4.0	0.0	0.0	0.0					
Red	2.0	0.0		1.0	0.0	0.0	0.0					

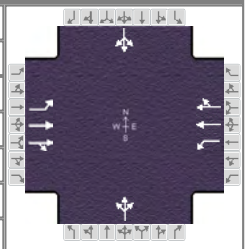
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	4.0	2.0	3.0		7.0		7.0
Phase Duration, s	58.0	58.0	21.0	21.0		1.0		1.0
Change Period, ($Y+R_c$), s	5.0	5.0	6.0	0.0		0.0		0.0
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		5.3		3.3
Queue Clearance Time (g_s), s	2.8		2.0			3.0		3.0
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		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		1	6	16		8	18		4	14
Adjusted Flow Rate (*v*), veh/h	50	161		1	706	17		0	139		1	1872
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1415		1714	1512			1617	1446		1682	1521
Queue Service Time (g_s), s		1.5		0.0	9.4			0.0	1.0		0.1	1.0
Cycle Queue Clearance Time (g_c), s		1.5		0.0	9.4			0.0	1.0		0.1	1.0
Green Ratio (*g/C*)		0.66		0.19	0.26			0.01	0.20		0.01	0.68
Capacity (*c*), veh/h		1875		321	1191			20	289		21	3081
Volume-to-Capacity Ratio (*X*)		0.086		0.004	0.593			0.000	0.480		0.053	0.608
Back of Queue (*Q*), ft/ln (95 th percentile)		16.2		0.8	132			0	104.6		1	188.1
Back of Queue (*Q*), veh/ln (95 th percentile)		0.6		0.0	5.1			0.0	4.2		0.0	7.5
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00		0.00	0.00			0.00	0.00		0.00	0.00
Uniform Delay (d_1), s/veh		4.4		26.3	18.8			0.0	28.3		39.0	7.2
Incremental Delay (d_2), s/veh		0.1		0.0	2.1			0.0	1.8		0.4	0.3
Initial Queue Delay (d_3), s/veh		0.0		0.0	0.0			0.0	0.0		0.0	0.0
Control Delay (*d*), s/veh	0.0	4.5		26.3	20.9	0.0		0.0	30.1		39.4	7.4
Level of Service (LOS)	A	A		C	C	A			C		D	A
Approach Delay, s/veh / LOS	3.4	A		20.4	C		30.1	C		7.4	A	
Intersection Delay, s/veh / LOS	11.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.91	B	2.22	B	2.81	C	3.12	C
Bicycle LOS Score / LOS	2.77	C	2.86	C	2.40	B	3.58	D

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 25, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	BAHNSON	File Name	BENSON AM 101018.xus		
Project Description	I-229/BENSON 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	95	140	130	85	495	20	90	5	40	10	10	50

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4
Green	5.4	50.7	11.9	0.0	0.0	0.0	5	6	7	8
Yellow	3.5	3.5	3.5	0.0	0.0	0.0				
Red	0.5	0.5	0.5	0.0	0.0	0.0				

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		6.3		8.0		8.0
Phase Duration, s	9.4	64.1		54.7		15.9		15.9
Change Period, ($Y+R_c$), s	4.0	4.0		4.0		4.0		4.0
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		3.3		3.3
Queue Clearance Time (g_s), s	3.4					9.7		5.5
Green Extension Time (g_e), s	0.2	0.0		0.0		0.4		0.4
Phase Call Probability	0.90					0.99		0.99
Max Out Probability	0.00					0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	106	156	144	365	1107	1107		150			78	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1714	1800	1525	1096	1800	1775		1451			1589	
Queue Service Time (g_s), s	1.4	1.9	2.1	11.3	46.8	48.5		4.3			0.0	
Cycle Queue Clearance Time (g_c), s	1.4	1.9	2.1	11.4	46.8	48.5		7.7			3.5	
Green Ratio (*g/C*)	0.73	0.75	0.75	0.63	0.63	0.63		0.15			0.15	
Capacity (*c*), veh/h	211	1352	1146	784	1140	1124		291			288	
Volume-to-Capacity Ratio (*X*)	0.500	0.115	0.126	0.466	0.971	0.985		0.515			0.270	
Back of Queue (*Q*), ft/ln (95 th percentile)	56.6	21.6	20.8	92	659	670		120.6			58.8	
Back of Queue (*Q*), veh/ln (95 th percentile)	2.3	0.9	0.8	3.7	26.4	26.8		4.8			2.4	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.17	0.00	0.00	0.33	0.00	0.00		0.00			0.00	
Uniform Delay (d_1), s/veh	20.5	2.7	2.7	5.3	13.9	13.5		32.2			30.4	
Incremental Delay (d_2), s/veh	0.7	0.2	0.2	1.5	17.4	20.2		0.5			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	21.2	2.9	3.0	6.8	31.3	33.7		32.7			30.6	
Level of Service (LOS)	C	A	A	A	C	C		C			C	
Approach Delay, s/veh / LOS	7.7	A		28.9	C		32.7	C		30.6	C	
Intersection Delay, s/veh / LOS	26.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.61	B	1.64	B	2.29	B	2.29	B
Bicycle LOS Score / LOS	0.82	A	1.04	A	0.74	A	0.62	A

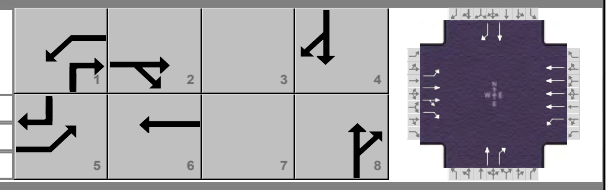
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diverging Diamond
Analyst	SS	Analysis Date	May 25, 2018	Segment Distance, ft	
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	
Intersection	I-229 SB	PHF	0.90	Arterial Direction	East-West
File Name	BENSON AM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	1	305	345	65	2235			1	10		0	170
Intersection Two Demand (*v*), veh/h	75	240		1	615	20		0	125		1	1685

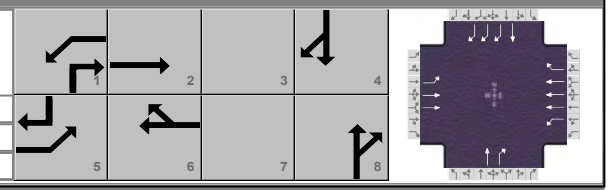
Signal One Information	
Cycle, s	80.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	19.0	0.0	49.0	1.0	0.0	0.0
Yellow	4.0	0.0	4.0	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	0.0	0.0



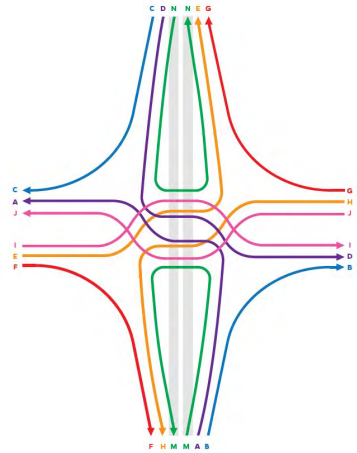
Signal Two Information	
Cycle, s	80.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	15.0	0.0	53.0	1.0	0.0	0.0
Yellow	4.0	0.0	4.0	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	0.0	0.0



Interchange Results

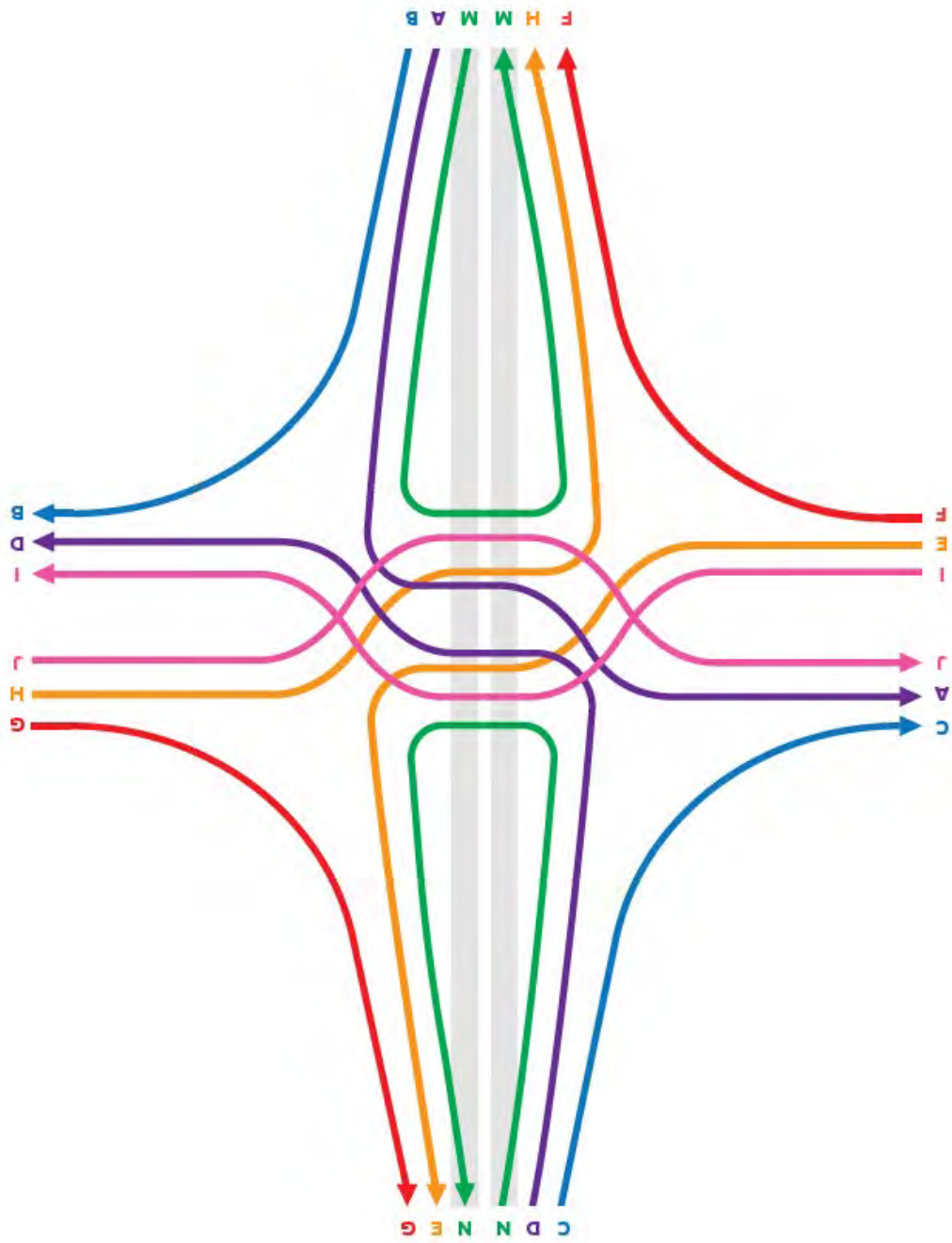
O-D	PHF-Adjusted Demand (veh/h)	Movement	Control Delay Components	Total Control Delay (s/veh)	Extra Distance (ft)	EDTT (s/veh)	ETT (s/veh)	LOS
A	189		M3 + M5	47.9	0	0.0	47.9	C
B	11		M4	5.7	0	0.0	5.7	A
C	1872		M8	7.4	0	0.0	7.4	A
D	139		M7 + M1	53.7	0	0.0	53.7	C
E	1		M6	4.5	0	0.0	4.5	A
F	0		N/A	0.0	0	0.0	0.0	A
G	0		N/A	0.0	0	0.0	0.0	A
H	1		M2	7.1	0	0.0	7.1	A
I	266		M6 + M1	28.1	30	0.6	28.7	B
J	2482		M2 + M5	28.0	30	0.6	28.6	B
M	--	--	--	--	--	--	--	--
N	--	--	--	--	--	--	--	--



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	24.5	23.6	0.0	0.0	7.1			39.4	5.7		0.0	27.0
Level of Service (LOS)	C	C	A	A	A			D	A			C
Approach Delay, s/veh / LOS	11.1	B		6.9	A		8.7	A		27.0	C	
Intersection Delay, s/veh / LOS	11.7						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	0.0	4.5		26.3	20.9	0.0		0.0	30.1		39.4	7.4
Level of Service (LOS)	A	A		C	C	A			C		D	A
Approach Delay, s/veh / LOS	3.4	A		20.4	C		30.1	C		7.4	A	
Intersection Delay, s/veh / LOS	11.4						B					

Interchange Graphic



HCS7 Streets Text Report

File Name:	BENSON AM.xus
Analyst:	SS
Agency/Co.:	HDR
Analysis Date:	May 25, 2018
Time Period:	AM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2045
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	5
Number of Segments	4
Analysis period duration, h	0.25
System cycle length, s	80
Urban street forward direction	WB
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	95
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	0.51
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

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB
1	40	40	2	2	2599	2599	50	50	0	0	70	70	0	0
2	35	40	4	2	1892	1892	50	50	0	0	70	70	0	0
3	40	35	3	2	1086	1086	50	50	0	0	70	70	0	0
4	35	40	2	2	1897	1897	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h	0	615	20	0	1170	175	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0

1: Location, ft 1320
1: Peak Hour Factor 1

Number of access points: 1

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

SEGMENT 4

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	WB LT 5	WB TH 2	WB RT 12	EB LT 1	EB TH 6	EB RT 16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h	999			999		999
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		43.1			42.16	
1	Running Speed, mph		41.11			42.04	
1	Through Delay, s/veh		4.98			19.42	
1	Travel Speed, mph		36.85			28.78	
1	Stop Rate, stops/veh		0.19			0.69	
1	Spatial Stop Rate, stops/mi		0.39			1.4	
1	Through vol/cap ratio		0.29			0.14	
1	Percent of Base FFS		83.62			65.3	
1	Level of Service		A			C	
1	Automobile Perception Score		2.2			2.35	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999					
2	Base Free-Flow Speed, mph		41.72			44.07	
2	Running Time, s		33.19			31.48	
2	Running Speed, mph		38.86			40.98	
2	Through Delay, s/veh		7.66			16.31	
2	Travel Speed, mph		31.58			26.99	
2	Stop Rate, stops/veh		0.32			0.65	
2	Spatial Stop Rate, stops/mi		0.88			1.82	
2	Through vol/cap ratio		0.27			0.05	
2	Percent of Base FFS		75.68			61.25	
2	Level of Service		B			C	
2	Automobile Perception Score		2.27			2.42	
3	Bay/Lane Spillback Time, h	999	999	999	999	9.75	999
3	ShrdLane Spillback Time, h	999					
3	Base Free-Flow Speed, mph		44.07			41.72	
3	Running Time, s		20.15			20.84	
3	Running Speed, mph		36.74			35.54	
3	Through Delay, s/veh		72.22			20.12	
3	Travel Speed, mph		8.02			18.08	
3	Stop Rate, stops/veh		1.38			0.6	
3	Spatial Stop Rate, stops/mi		6.71			2.91	
3	Through vol/cap ratio		1.01			0.14	
3	Percent of Base FFS		18.19			43.34	
3	Level of Service		F			D	
3	Automobile Perception Score		3.29			2.6	
4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999			999.36		
4	Base Free-Flow Speed, mph		41.72			44.07	
4	Running Time, s		36.42			31.59	
4	Running Speed, mph		35.51			40.94	
4	Through Delay, s/veh		17.71			2.91	
4	Travel Speed, mph		23.89			37.48	
4	Stop Rate, stops/veh		0.53			0.13	
4	Spatial Stop Rate, stops/mi		1.47			0.35	
4	Through vol/cap ratio		0.92			0.08	
4	Percent of Base FFS		57.27			85.04	
4	Level of Service		C			A	
4	Automobile Perception Score		2.36			2.19	

Facility Travel Time, s	235.45	184.83
Facility Travel Speed, mph	21.64	27.57
Facility Spatial Stop Rate, stops/mi	1.71	1.46
Facility Base Free Flow Speed, mph	42.85	43.71
Facility Percent Base Free Flow Speed	50.51	63.07
Facility Level of Service	F	C
Facility Automobile Perception Score	2.37	2.36
Facility Pedestrian Space	∞	∞
Facility Pedestrian Travel Speed	4.3	4.3
Facility Pedestrian LOS Score	3.48	2.69
Facility Pedestrian LOS	C	C
Facility Bicycle Travel Speed	13.26	13.5
Facility Bicycle LOS Score	2.79	2.17
Facility Bicycle LOS	C	B
Facility Transit Travel Speed	8.02	35.54
Facility Transit LOS Score	1.28	0.73
Facility Transit LOS	A	A
SPILLBACK TIME, h	9.75	

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.35	4.35
1	Ped LOS Score for Intersection	2.63	2.71
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	1.24	0.36
1	Speed Adjustment Factor	0.68	0.71
1	Ped LOS Score for Link	3.22	2.38
1	Ped Link LOS	C	B
1	Roadway Crossing Difficulty Factor	1.05	1.1
1	Ped LOS Score for Segment	3.39	2.84
1	Ped Segment LOS	C	C
1	Bicycle Travel Speed	13.8	14.18
1	Bicycle LOS Score for Intersection	3.78	2.82
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.49	1.87
1	Speed Adjustment Factor	0.84	0.85
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.39	2.78
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2599	2599
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.97	2.47
1	Bicycle Segment LOS	C	B
1	Transit Running Speed, mi/h	41.11	42.04
1	g/C Ratio	0.59	0.48
1	Transit Running Time, s	43.1	42.16
1	Delay at Intersection, s/veh	4.98	19.5
1	Transit Travel Speed, mi/h	36.85	28.74
1	Transit Wait-Ride Score	3.93	3.6
1	Ped LOS Score for Link	3.22	2.38
1	Transit LOS Score for Segment	0.59	0.96
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.36	4.36
2	Ped LOS Score for Intersection	1.86	2.18
2	Cross-section Adjustment Factor	-4.74	-4.86
2	Volume Adjustment Factor	0.41	0.17
2	Speed Adjustment Factor	0.6	0.67
2	Ped LOS Score for Link	2.33	2.03
2	Ped Link LOS	B	B
2	Roadway Crossing Difficulty Factor	1.05	1.17
2	Ped LOS Score for Segment	2.7	2.65
2	Ped Segment LOS	B	B
2	Bicycle Travel Speed	13.9	14.3
2	Bicycle LOS Score for Intersection	1.54	2.81
2	Cross-section Adjustment Factor	-1.28	-2.15
2	Volume Adjustment Factor	1.94	1.49
2	Speed Adjustment Factor	0.82	0.84

2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	2.81	1.51
2	Bicycle Link LOS	C	B
2	Number of access point approaches	0	0
2	Segment Length, ft	1892	1892
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.43	1.64
2	Bicycle Segment LOS	B	A
2	Transit Running Speed, mi/h	38.86	40.98
2	g/C Ratio	0.68	0.59
2	Transit Running Time, s	33.19	31.48
2	Delay at Intersection, s/veh	7.66	16.25
2	Transit Travel Speed, mi/h	31.58	27.03
2	Transit Wait-Ride Score	3.72	3.52
2	Ped LOS Score for Link	2.33	2.03
2	Transit LOS Score for Segment	0.76	1.03
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.02	4.03
3	Ped LOS Score for Intersection	2.3	1.86
3	Cross-section Adjustment Factor	-4.74	-4.74
3	Volume Adjustment Factor	0.68	0.34
3	Speed Adjustment Factor	0.54	0.51
3	Ped LOS Score for Link	2.53	2.15
3	Ped Link LOS	C	B
3	Roadway Crossing Difficulty Factor	1.14	1.16
3	Ped LOS Score for Segment	3.01	2.7
3	Ped Segment LOS	C	B
3	Bicycle Travel Speed	13.82	10.3
3	Bicycle LOS Score for Intersection	2.86	1.08
3	Cross-section Adjustment Factor	-1.28	-1.28
3	Volume Adjustment Factor	2.19	1.83
3	Speed Adjustment Factor	0.79	0.77
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	3.03	2.66
3	Bicycle Link LOS	C	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1086	1086
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	2.66	2.18
3	Bicycle Segment LOS	B	B
3	Transit Running Speed, mi/h	36.74	35.54
3	g/C Ratio	0.24	0.68
3	Transit Running Time, s	20.15	20.84
3	Delay at Intersection, s/veh	72.22	0
3	Transit Travel Speed, mi/h	8.02	35.54
3	Transit Wait-Ride Score	2.19	3.88
3	Ped LOS Score for Link	2.53	2.15
3	Transit LOS Score for Segment	3.09	0.5
3	Transit Segment LOS	C	A
4	Average Pedestrian Space, ft2/p	∞	∞
4	Pedestrian Travel Speed, ft/s	4.36	4.36
4	Ped LOS Score for Intersection	1.63	2
4	Cross-section Adjustment Factor	-4.74	-4.74
4	Volume Adjustment Factor	3.1	0.23
4	Speed Adjustment Factor	0.5	0.67
4	Ped LOS Score for Link	4.91	2.21
4	Ped Link LOS	E	B
4	Roadway Crossing Difficulty Factor	1.03	1
4	Ped LOS Score for Segment	4.65	2.53
4	Ped Segment LOS	E	B
4	Bicycle Travel Speed	11.81	14.3
4	Bicycle LOS Score for Intersection	1.03	2.77
4	Cross-section Adjustment Factor	-1.28	-1.28
4	Volume Adjustment Factor	2.96	1.65
4	Speed Adjustment Factor	0.77	0.84
4	Pavement Adjustment Factor	0.58	0.58
4	Bicycle LOS Score for Link	3.79	2.54
4	Bicycle Link LOS	D	C
4	Number of access point approaches	0	0
4	Segment Length, ft	1897	1897
4	Unsignalized Conflicts Factor	-0.7	-0.7
4	Bicycle LOS Score for Segment	2.98	2.3
4	Bicycle Segment LOS	C	B
4	Transit Running Speed, mi/h	35.51	40.94
4	g/C Ratio	0.68	0.25
4	Transit Running Time, s	36.42	31.59

4	Delay at Intersection, s/veh	17.38	0
4	Transit Travel Speed, mi/h	24.04	40.94
4	Transit Wait-Ride Score	3.37	4.07
4	Ped LOS Score for Link	4.91	2.21
4	Transit LOS Score for Segment	1.69	0.23
4	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h	0	310	10.1	0	947	142	0	0	0	0	0	0
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.19	0	0	0.02	0	0	0.19	0.19	0.02	0.19	0.19	0.19
1: Thru veh delay		0.01			0.08							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

HCS7 Two-Way Stop-Control Report

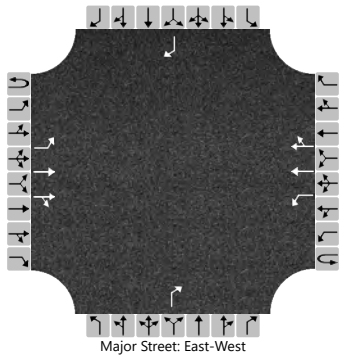
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2045
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes


Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	0	1		0	0	1
Configuration		L	T	TR		L	T	TR				R				R
Volume (veh/h)	0	25	540	55	0	165	1875	365				110				10
Percent Heavy Vehicles (%)	5	5			5	5						5				5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized									No				No			
Median Type | Storage	Undivided															

Critical and Follow-up Headways

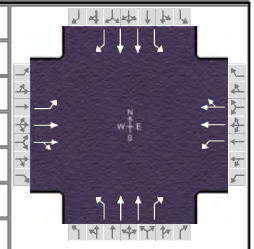
Base Critical Headway (sec)		4.1				4.1						6.9				6.9
Critical Headway (sec)		4.20				4.20						7.00				7.00
Base Follow-Up Headway (sec)		2.2				2.2						3.3				3.3
Follow-Up Headway (sec)		2.25				2.25						3.35				3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		28				183						122				11
Capacity, c (veh/h)		173				903						656				161
v/c Ratio		0.16				0.20						0.19				0.07
95% Queue Length, Q_{95} (veh)		0.6				0.8						0.7				0.2
Control Delay (s/veh)		29.8				10.0						11.7				29.0
Level of Service (LOS)		D				A						B				D
Approach Delay (s/veh)	1.2				0.7				11.7				29.0			
Approach LOS									B				D			

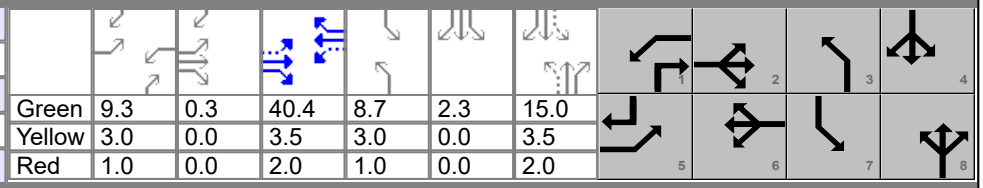
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 25, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045 Build DDI	Analysis Period	1> 7:00
Intersection	CLIFF AVENUE	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	150	625	190	190	380	160	130	355	40	205	380	100

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	9.3	0.3	40.4	8.7	2.3	15.0						
Yellow	3.0	0.0	3.5	3.0	0.0	3.5						
Red	1.0	0.0	2.0	1.0	0.0	2.0						

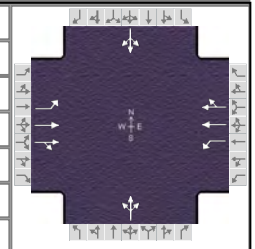
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	13.6	46.2	13.3	45.9	12.7	20.5	15.0	22.8
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.0	5.1	1.0
Queue Clearance Time (g_s), s	9.1		8.7		8.9	12.9	13.0	13.4
Green Extension Time (g_e), s	0.6	0.0	0.7	0.0	0.0	0.1	0.0	0.1
Phase Call Probability	1.00		1.00		0.98	1.00	1.00	1.00
Max Out Probability	0.51		0.09		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	225	569	539	211	271	256	144	394	28	228	422	67
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1636	1647	1730	1610	1647	1647	1466	1647	1647	1466
Queue Service Time (g_s), s	7.1	25.4	26.1	6.7	10.2	10.3	6.9	10.9	1.4	11.0	11.4	3.2
Cycle Queue Clearance Time (g_c), s	7.1	25.4	26.1	6.7	10.2	10.3	6.9	10.9	1.4	11.0	11.4	3.2
Green Ratio (*g/C*)	0.53	0.43	0.43	0.52	0.43	0.43	0.25	0.16	0.26	0.28	0.18	0.28
Capacity (*c*), veh/h	513	741	700	303	735	685	265	520	375	308	601	416
Volume-to-Capacity Ratio (*X*)	0.438	0.768	0.769	0.696	0.369	0.374	0.545	0.758	0.074	0.738	0.703	0.160
Back of Queue (*Q*), ft/ln (95 th percentile)	113.9	341.9	336	120.3	191.8	175.9	131.5	202.5	21.7	224.5	207.2	51.1
Back of Queue (*Q*), veh/ln (95 th percentile)	4.4	13.1	13.4	4.6	7.4	7.0	5.1	7.8	0.8	8.6	8.0	2.0
Queue Storage Ratio (*RQ*) (95 th percentile)	0.58	0.00	0.00	0.86	0.00	0.00	0.44	0.00	0.09	0.61	0.00	0.16
Uniform Delay (d_1), s/veh	13.3	19.9	21.5	19.0	18.6	18.7	30.1	38.3	26.8	29.7	36.4	25.5
Incremental Delay (d_2), s/veh	0.5	4.2	4.5	4.1	1.4	1.6	2.8	1.9	0.0	9.7	1.0	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	0.0	0.0
Control Delay (*d*), s/veh	13.7	24.1	26.0	23.1	20.0	20.2	33.0	40.2	26.8	39.4	37.4	25.6
Level of Service (LOS)	B	C	C	C	C	C	C	D	C	D	D	C
Approach Delay, s/veh / LOS	23.1	C		21.0	C		37.7	D		36.9	D	
Intersection Delay, s/veh / LOS	28.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.83	C	2.88	C	2.94	C	2.92	C
Bicycle LOS Score / LOS	3.08	C	2.87	C	2.85	C	2.98	C

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 25, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.92
Urban Street	BENSON ROAD	Analysis Year	2045 Build DDI	Analysis Period	1> 7:00
Intersection	BAHNSON AVE	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	35	175	135	50	335	20	180	20	95	20	20	35

Signal Information			
Cycle, s	95.0	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	61.2	22.8	0.0	0.0	0.0	0.0	1	2	3	4		
Yellow	3.5	3.5	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0	5	6	7	8		

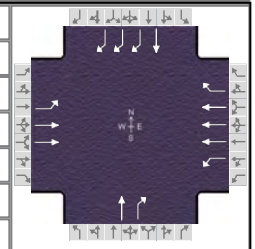
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		8.0		8.0
Phase Duration, s		66.7		66.7		28.3		28.3
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		3.2		3.2
Queue Clearance Time (g_s), s						22.0		5.5
Green Extension Time (g_e), s		0.0		0.0		0.8		0.8
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	38	176	161	97	348	341		321			82	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	766	1900	1632	1060	1900	1862		1475			1655	
Queue Service Time (g_s), s	2.1	3.5	3.7	2.9	5.6	5.7		16.5			0.0	
Cycle Queue Clearance Time (g_c), s	7.8	3.5	3.7	6.8	5.6	5.7		20.0			3.5	
Green Ratio (*g/C*)	0.64	0.64	0.64	0.64	0.64	0.64		0.24			0.24	
Capacity (*c*), veh/h	523	1223	1051	717	1223	1199		416			446	
Volume-to-Capacity Ratio (*X*)	0.073	0.144	0.153	0.135	0.284	0.285		0.771			0.183	
Back of Queue (*Q*), ft/ln (95 th percentile)	15.9	58.8	54.6	29.6	89.7	89.2		285.6			65.5	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.6	2.4	2.2	1.2	3.6	3.6		11.4			2.6	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.05	0.00	0.00	0.11	0.00	0.00		0.00			0.00	
Uniform Delay (d_1), s/veh	8.7	6.6	6.7	6.2	5.0	5.1		34.9			28.7	
Incremental Delay (d_2), s/veh	0.3	0.2	0.3	0.4	0.6	0.6		1.2			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	
Control Delay (*d*), s/veh	8.9	6.9	7.0	6.6	5.6	5.7		36.1			28.8	
Level of Service (LOS)	A	A	A	A	A	A		D			C	
Approach Delay, s/veh / LOS	7.1	A		5.7	A		36.1	D		28.8	C	
Intersection Delay, s/veh / LOS	13.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.64	B	1.64	B	2.29	B	2.29	B
Bicycle LOS Score / LOS	0.80	A	0.85	A	1.02	A	0.62	A

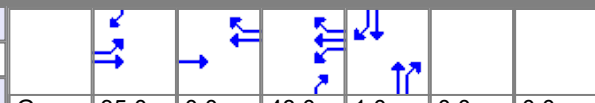
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 25, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045 Build DDI	Analysis Period	1> 7:00
Intersection	I-229 NB	File Name	BENSON PM.xus		
Project Description	I-229/BENSON IMJR				

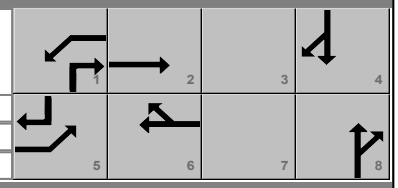


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	90	250		1	355	195		0	95		1	380

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off



Green	35.0	0.0	48.0	1.0	0.0	0.0
Yellow	4.0	0.0	4.0	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	0.0	0.0



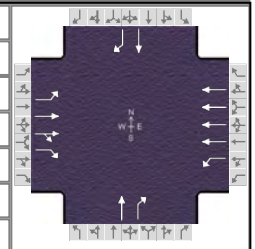
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	4.0	2.0	3.0		7.0		7.0
Phase Duration, s	41.0	41.0	53.0	53.0		1.0		1.0
Change Period, ($Y+R_c$), s	6.0	0.0	5.0	5.0		0.0		0.0
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		5.3		3.3
Queue Clearance Time (g_s), s	5.4		2.0			3.0		3.0
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		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		1	6	16		8	18		4	14
Adjusted Flow Rate (*v*), veh/h	83	232		1	363	133		0	106		1	422
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1423		1714	1498			1617	1444		1682	1450
Queue Service Time (g_s), s		5.6		0.0	4.3			0.0	1.0		0.1	1.0
Cycle Queue Clearance Time (g_c), s		5.6		0.0	4.3			0.0	1.0		0.1	1.0
Green Ratio (*g/C*)		0.43		0.51	0.51			0.01	0.52		0.01	0.38
Capacity (*c*), veh/h		1228		866	2270			17	745		18	1649
Volume-to-Capacity Ratio (*X*)		0.189		0.001	0.160			0.000	0.142		0.063	0.256
Back of Queue (*Q*), ft/ln (95 th percentile)		85.3		0.4	63.4			0	50.9		2.6	94.1
Back of Queue (*Q*), veh/ln (95 th percentile)		3.3		0.0	2.4			0.0	2.0		0.1	3.8
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00		0.00	0.00			0.00	0.00		0.00	0.00
Uniform Delay (d_1), s/veh		20.1		11.0	13.1			0.0	12.0		46.5	20.3
Incremental Delay (d_2), s/veh		0.3		0.0	0.1			0.0	0.4		6.7	0.4
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	0.0	20.4		11.0	13.2	0.0		0.0	12.4		53.2	20.7
Level of Service (LOS)	A	C		B	B	A			B		D	C
Approach Delay, s/veh / LOS	15.0	B		9.7	A		12.4	B		20.8	C	
Intersection Delay, s/veh / LOS	14.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.94	B	2.30	B	2.88	C	2.79	C
Bicycle LOS Score / LOS	2.79	C	2.77	C	2.35	B	1.19	A

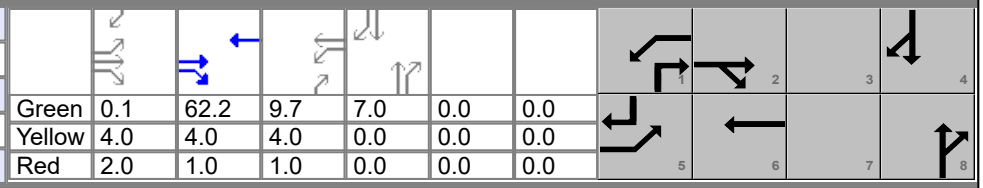
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 25, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045 Build DDI	Analysis Period	1> 7:00
Intersection	I-229 SB	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	1	260	1485	155	580			1	80		0	60

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	Off
Force Mode	Fixed	Simult. Gap N/S	Off



Green	0.1	62.2	9.7	7.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	1.0	1.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	4.0		7.0		7.0
Phase Duration, s	6.1	73.3	14.7	81.9		7.0		7.0
Change Period, ($Y+R_c$), s	6.0	5.0	5.0	5.0		0.0		0.0
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		3.3		3.3
Queue Clearance Time (g_s), s	2.0		9.3			7.1		6.3
Green Extension Time (g_e), s	0.0	0.0	0.1	0.0		0.0		0.0
Phase Call Probability	0.01		0.97			0.98		0.98
Max Out Probability	0.00		0.01			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			8	18		4	14
Adjusted Flow Rate (*v*), veh/h	0	50	287	134	503			1	89		0	67
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1480			971			1617	1441		1682	1437
Queue Service Time (g_s), s	0.0	0.4			1.5			0.1	5.1		0.0	4.3
Cycle Queue Clearance Time (g_c), s	0.0	0.4			1.5			0.1	5.1		0.0	4.3
Green Ratio (*g/C*)	0.00	0.72			0.81			0.07	0.18		0.07	0.07
Capacity (*c*), veh/h	2	2127			3143			120	254		124	107
Volume-to-Capacity Ratio (*X*)	0.111	0.024			0.160			0.009	0.350		0.000	0.622
Back of Queue (*Q*), ft/ln (95 th percentile)	0.4	4.6			6.8			1.1	78.3		0	75.7
Back of Queue (*Q*), veh/ln (95 th percentile)	0.0	0.2			0.3			0.0	3.1		0.0	3.0
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00			0.00			0.00	0.00		0.00	0.00
Uniform Delay (d_1), s/veh	47.5	3.4			1.0			40.8	34.4		0.0	42.7
Incremental Delay (d_2), s/veh	10.1	0.0			0.1			0.0	0.3		0.0	7.0
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0			0.0	0.0		0.0	0.0
Control Delay (*d*), s/veh	57.6	3.4	0.0	0.0	1.1			40.8	34.7		0.0	49.7
Level of Service (LOS)	E	A	A	A	A			D	C			D
Approach Delay, s/veh / LOS	0.5	A		0.9	A		34.7	C		49.7	D	
Intersection Delay, s/veh / LOS	6.4						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.88	C	1.87	B	2.91	C	3.23	C
Bicycle LOS Score / LOS	4.08	D	2.78	C	2.32	B	0.60	A

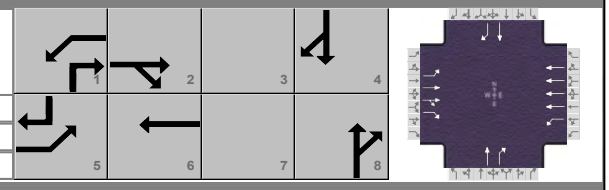
HCS7 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diverging Diamond
Analyst	SS	Analysis Date	May 25, 2018	Segment Distance, ft	
Jurisdiction	CITY OF SIOUX FALLS	Duration, h	0.25	Freeway Direction	
Intersection	I-229 SB	PHF	0.90	Arterial Direction	East-West
File Name	BENSON PM.xus				
Project Description	I-229/BENSON IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	1	260	1485	155	580			1	80		0	60
Intersection Two Demand (*v*), veh/h	90	250		1	355	195		0	95		1	380

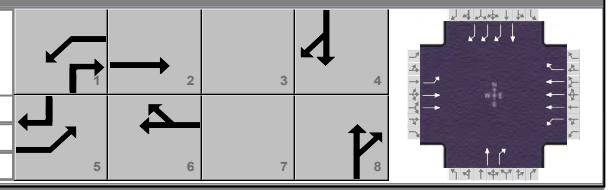
Signal One Information	
Cycle, s	95.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	0.1	62.2	9.7	7.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	1.0	1.0	0.0	0.0	0.0



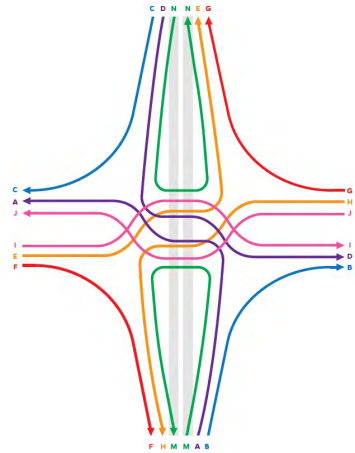
Signal Two Information	
Cycle, s	95.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	35.0	0.0	48.0	1.0	0.0	0.0
Yellow	4.0	0.0	4.0	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	0.0	0.0



Interchange Results

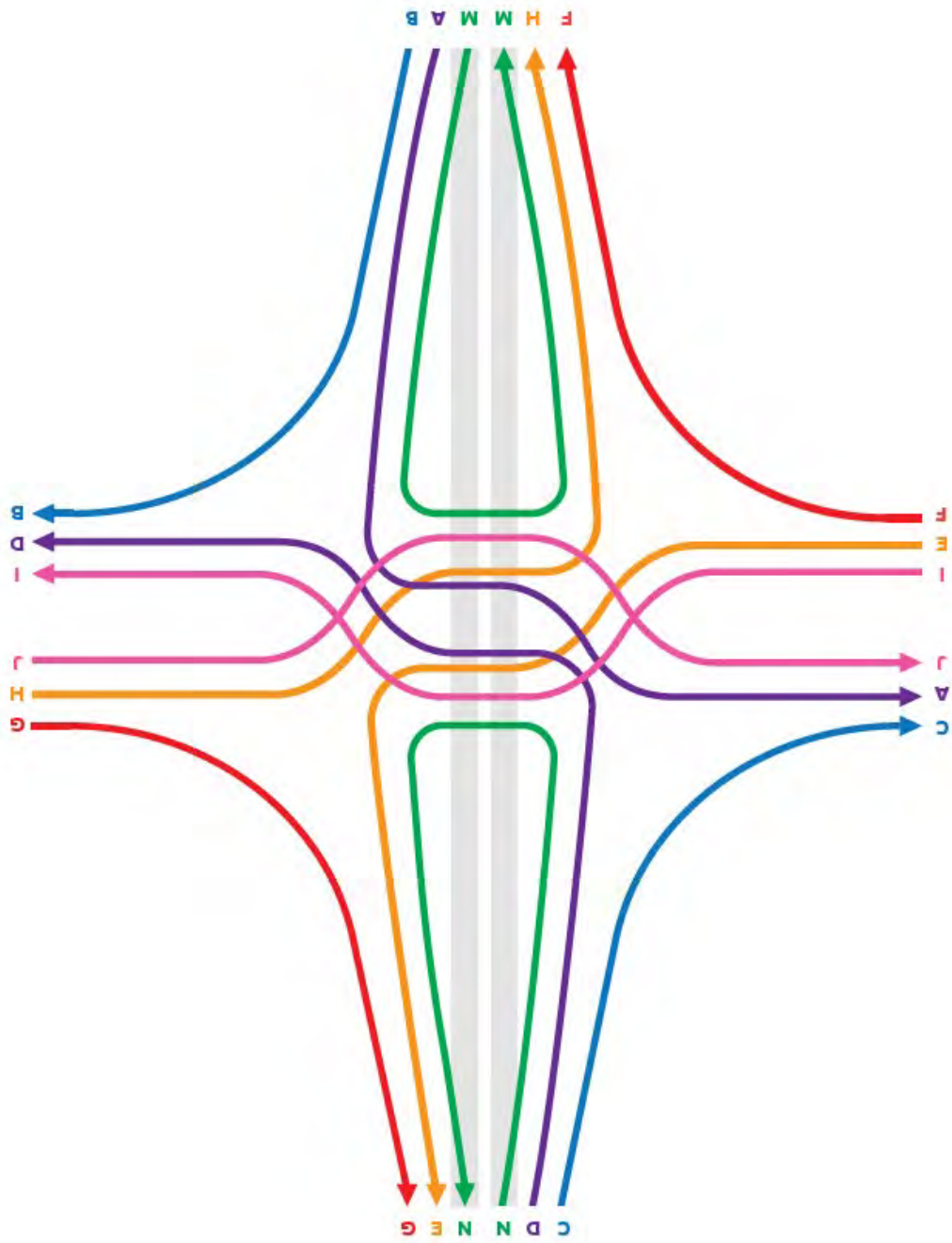
O-D	PHF-Adjusted Demand (veh/h)	Movement	Control Delay Components	Total Control Delay (s/veh)	Extra Distance (ft)	EDTT (s/veh)	ETT (s/veh)	LOS
A	67		M3 + M5	62.9	0	0.0	62.9	D
B	89		M4	34.7	0	0.0	34.7	C
C	422		M8	20.7	0	0.0	20.7	B
D	106		M7 + M1	15.8	0	0.0	15.8	B
E	1		M6	20.4	0	0.0	20.4	B
F	0		N/A	0.0	0	0.0	0.0	A
G	0		N/A	0.0	0	0.0	0.0	A
H	1		M2	1.1	0	0.0	1.1	A
I	277		M6 + M1	23.8	30	0.6	24.4	B
J	643		M2 + M5	14.4	30	0.6	14.9	A
M	--	--	--	--	--	--	--	--
N	--	--	--	--	--	--	--	--



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	57.6	3.4	0.0	0.0	1.1			40.8	34.7		0.0	49.7
Level of Service (LOS)	E	A	A	A	A			D	C			D
Approach Delay, s/veh / LOS	0.5	A		0.9	A		34.7	C		49.7	D	
Intersection Delay, s/veh / LOS	6.4						A					

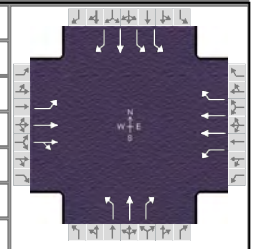
Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	0.0	20.4		11.0	13.2	0.0		0.0	12.4		53.2	20.7
Level of Service (LOS)	A	C		B	B	A			B		D	C
Approach Delay, s/veh / LOS	15.0	B		9.7	A		12.4	B		20.8	C	
Intersection Delay, s/veh / LOS	14.6						B					

Interchange Graphic



HCS7 Signalized Intersection Results Summary

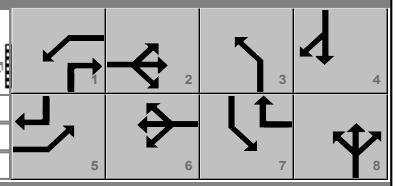
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	SS	Analysis Date	May 25, 2018	Area Type	Other
Jurisdiction	CITY OF SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Urban Street	BENSON ROAD	Analysis Year	2045 Build DDI	Analysis Period	1> 7:00
Intersection	LEWIS AVENUE	File Name	BENSON PM.xus		
Project Description	I-229/BENSON 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	70	840	25	60	400	75	50	35	105	765	40	215

Signal Information			
Cycle, s	95.0	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	4.0	5.5	28.0	5.0	15.8	5.8
Yellow	3.9	3.9	3.9	3.6	3.6	3.6
Red	1.0	1.0	2.2	1.0	1.0	2.2



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	3.0	2.0	3.0
Phase Duration, s	8.9	34.1	19.3	44.5	9.6	11.6	30.0	32.0
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.8	4.6	5.8
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0	5.1	1.3	5.1	1.3
Queue Clearance Time (g_s), s	3.3		4.9		4.9	5.7	27.2	9.1
Green Extension Time (g_e), s	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.00		0.03		1.00	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	33	202	201	84	560	77	56	39	72	850	44	144
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1647	1730	1719	1647	1647		1647	1730	1525	1600	1730	1466
Queue Service Time (g_s), s	1.3	8.3	8.3	2.9	13.5		2.9	2.1	3.7	25.2	1.8	7.1
Cycle Queue Clearance Time (g_c), s	1.3	8.3	8.3	2.9	13.5		2.9	2.1	3.7	25.2	1.8	7.1
Green Ratio (*g/C*)	0.34	0.29	0.29	0.47	0.40		0.11	0.06	0.21	0.27	0.28	0.32
Capacity (*c*), veh/h	345	510	507	525	1333		243	105	324	855	477	466
Volume-to-Capacity Ratio (*X*)	0.095	0.395	0.396	0.160	0.420		0.229	0.371	0.223	0.994	0.093	0.310
Back of Queue (*Q*), ft/ln (95 th percentile)	23.1	161.5	155.3	52.4	246.3		56.7	41.4	60.7	487.3	34.4	112.4
Back of Queue (*Q*), veh/ln (95 th percentile)	0.9	6.2	6.2	2.0	9.5		2.2	1.6	2.4	18.7	1.3	4.3
Queue Storage Ratio (*RQ*) (95 th percentile)	0.12	0.00	0.00	0.15	0.00		0.57	0.00	0.00	0.97	0.00	0.00
Uniform Delay (d_1), s/veh	21.6	24.2	24.3	16.2	26.2		38.7	42.9	30.9	34.7	25.6	24.5
Incremental Delay (d_2), s/veh	0.2	2.2	2.3	0.6	0.9		0.7	0.8	0.1	29.2	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	0.0
Control Delay (*d*), s/veh	21.8	26.4	26.6	16.8	27.1	0.0	39.4	43.7	31.1	63.9	25.6	24.7
Level of Service (LOS)	C	C	C	B	C	A	D	D	C	E	C	C
Approach Delay, s/veh / LOS	26.1	C		23.0	C		36.8	D		56.8	E	
Intersection Delay, s/veh / LOS	39.4						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.28	B	2.72	C	3.15	C	2.77	C
Bicycle LOS Score / LOS	3.11	C	2.74	C	2.20	B	3.79	D

HCS7 Streets Text Report

File Name:	BENSON PM.xus
Analyst:	SS
Agency/Co.:	HDR
Analysis Date:	May 25, 2018
Time Period:	PM PEAK
Jurisdiction:	CITY OF SIOUX FALLS
Analysis Year:	2045 Build DDI
Project Description:	I-229/BENSON IMJR
Urban Street:	BENSON ROAD
Analysis Period:	1> 7:00

Input

URBAN STREET PARAMETERS

Number of Intersections	5
Number of Segments	4
Analysis period duration, h	0.25
System cycle length, s	95
Urban street forward direction	WB
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	95
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	0.51
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

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB
1	40	40	2	2	2598	2598	50	50	0	0	70	70	0	0
2	40	40	4	2	1891	1891	50	50	0	0	70	70	0	0
3	40	40	3	2	1084	1084	50	50	0	0	70	70	0	0
4	35	40	2	2	1897	1897	50	50	0	0	70	70	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

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h	0	850	20	0	665	0	30	0	45	40	0	35
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0

1: Location, ft	1320												
1: Peak Hour Factor	1												

Number of access points: 1

SEGMENT 2

		EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement		4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h		0	1510	0	0	545	40	0	0	0	145	0	0
1: Lanes		1	2	0	0	2	0	0	0	0	1	0	1
1: Location, ft	700												
1: Peak Hour Factor	1												
2: Volume, veh/h		5	1435	25	40	340	30	10	5	95	70	0	40
2: Lanes		1	2	0	1	2	0	1	1	0	0	1	0
2: Location, ft	1410												
2: Peak Hour Factor	1												

Number of access points: 2

SEGMENT 3

Number of access points: 0

SEGMENT 4

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	WB LT	WB TH	WB RT	EB LT	EB TH	EB RT
		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		999
1	Base Free-Flow Speed, mph		44.07			44.07	
1	Running Time, s		42.52			43.39	
1	Running Speed, mph		41.66			40.82	
1	Through Delay, s/veh		27.13			24.84	
1	Travel Speed, mph		25.44			25.96	
1	Stop Rate, stops/veh		0.77			0.65	
1	Spatial Stop Rate, stops/mi		1.57			1.32	
1	Through vol/cap ratio		0.42			0.77	
1	Percent of Base FFS		57.71			58.91	
1	Level of Service		C			C	
1	Automobile Perception Score		2.38			2.34	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999					
2	Base Free-Flow Speed, mph		44.07			44.07	
2	Running Time, s		31.75			31.46	
2	Running Speed, mph		40.6			40.99	
2	Through Delay, s/veh		1.13			26.49	
2	Travel Speed, mph		39.2			22.25	
2	Stop Rate, stops/veh		0.04			0.65	
2	Spatial Stop Rate, stops/mi		0.12			1.82	
2	Through vol/cap ratio		0.16			0.4	
2	Percent of Base FFS		88.95			50.48	
2	Level of Service		A			C	
2	Automobile Perception Score		2.23			2.49	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h						
3	Base Free-Flow Speed, mph		44.07			44.07	
3	Running Time, s		20.02			19.99	
3	Running Speed, mph		36.93			36.96	
3	Through Delay, s/veh		13.23			3.42	
3	Travel Speed, mph		22.23			31.56	
3	Stop Rate, stops/veh		0.42			0.15	
3	Spatial Stop Rate, stops/mi		2.06			0.72	
3	Through vol/cap ratio		0.16			0.02	
3	Percent of Base FFS		50.44			71.61	
3	Level of Service		C			B	
3	Automobile Perception Score		2.46			2.25	
4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h				999		
4	Base Free-Flow Speed, mph		41.72			44.07	

4	Running Time, s	33.66	31.68
4	Running Speed, mph	38.43	40.83
4	Through Delay, s/veh	5.63	20.39
4	Travel Speed, mph	32.92	24.84
4	Stop Rate, stops/veh	0.22	0.6
4	Spatial Stop Rate, stops/mi	0.61	1.66
4	Through vol/cap ratio	0.28	0.19
4	Percent of Base FFS	78.91	56.36
4	Level of Service	B	C
4	Automobile Perception Score	2.23	2.39
Facility Travel Time, s		175.07	201.67
Facility Travel Speed, mph		29.09	25.25
Facility Spatial Stop Rate, stops/mi		1.03	1.44
Facility Base Free Flow Speed, mph		43.45	44.07
Facility Percent Base Free Flow Speed		66.96	57.3
Facility Level of Service		C	C
Facility Automobile Perception Score		2.31	2.37
Facility Pedestrian Space		∞	∞
Facility Pedestrian Travel Speed		4.31	4.21
Facility Pedestrian LOS Score		3.07	3.08
Facility Pedestrian LOS		C	C
Facility Bicycle Travel Speed		13.3	12.22
Facility Bicycle LOS Score		2.65	2.65
Facility Bicycle LOS		C	C
Facility Transit Travel Speed		22.23	36.96
Facility Transit LOS Score		0.93	0.94
Facility Transit LOS		A	A
SPILLBACK TIME, h		999	

Multimodal Results

1	Average Pedestrian Space, ft2/p	∞	∞
1	Pedestrian Travel Speed, ft/s	4.28	4.23
1	Ped LOS Score for Intersection	2.72	2.83
1	Cross-section Adjustment Factor	-4.74	-4.74
1	Volume Adjustment Factor	0.77	1.55
1	Speed Adjustment Factor	0.69	0.67
1	Ped LOS Score for Link	2.77	3.52
1	Ped Link LOS	C	D
1	Roadway Crossing Difficulty Factor	1.16	1.13
1	Ped LOS Score for Segment	3.28	3.82
1	Ped Segment LOS	C	D
1	Bicycle Travel Speed	13.24	12.5
1	Bicycle LOS Score for Intersection	2.74	3.08
1	Cross-section Adjustment Factor	-1.28	-1.28
1	Volume Adjustment Factor	2.25	2.6
1	Speed Adjustment Factor	0.85	0.84
1	Pavement Adjustment Factor	0.58	0.58
1	Bicycle LOS Score for Link	3.15	3.5
1	Bicycle Link LOS	C	C
1	Number of access point approaches	0	0
1	Segment Length, ft	2598	2598
1	Unsignalized Conflicts Factor	-0.7	-0.7
1	Bicycle LOS Score for Segment	2.74	3.01
1	Bicycle Segment LOS	B	C
1	Transit Running Speed, mi/h	41.66	40.82
1	g/C Ratio	0.4	0.43
1	Transit Running Time, s	42.52	43.39
1	Delay at Intersection, s/veh	27.13	24.11
1	Transit Travel Speed, mi/h	25.44	26.24
1	Transit Wait-Ride Score	3.44	3.48
1	Ped LOS Score for Link	2.77	3.52
1	Transit LOS Score for Segment	1.26	1.31
1	Transit Segment LOS	A	A
2	Average Pedestrian Space, ft2/p	∞	∞
2	Pedestrian Travel Speed, ft/s	4.38	4.04
2	Ped LOS Score for Intersection	1.87	2.28
2	Cross-section Adjustment Factor	-4.74	-4.88
2	Volume Adjustment Factor	0.49	0.16
2	Speed Adjustment Factor	0.66	0.67
2	Ped LOS Score for Link	2.45	2
2	Ped Link LOS	B	B

2	Roadway Crossing Difficulty Factor	0.93	1.16
2	Ped LOS Score for Segment	2.59	2.61
2	Ped Segment LOS	B	B
2	Bicycle Travel Speed	12.54	10.38
2	Bicycle LOS Score for Intersection	2.78	3.11
2	Cross-section Adjustment Factor	-1.28	-2.37
2	Volume Adjustment Factor	2.02	1.45
2	Speed Adjustment Factor	0.84	0.84
2	Pavement Adjustment Factor	0.58	0.58
2	Bicycle LOS Score for Link	2.91	1.25
2	Bicycle Link LOS	C	A
2	Number of access point approaches	0	0
2	Segment Length, ft	1891	1891
2	Unsignalized Conflicts Factor	-0.7	-0.7
2	Bicycle LOS Score for Segment	2.61	2.29
2	Bicycle Segment LOS	B	B
2	Transit Running Speed, mi/h	40.6	40.99
2	g/C Ratio	0.81	0.29
2	Transit Running Time, s	31.75	31.46
2	Delay at Intersection, s/veh	1.13	26.43
2	Transit Travel Speed, mi/h	39.2	22.27
2	Transit Wait-Ride Score	4.01	3.27
2	Ped LOS Score for Link	2.45	2
2	Transit LOS Score for Segment	0.35	1.4
2	Transit Segment LOS	A	A
3	Average Pedestrian Space, ft2/p	∞	∞
3	Pedestrian Travel Speed, ft/s	4.24	4.24
3	Ped LOS Score for Intersection	2.3	2.88
3	Cross-section Adjustment Factor	-4.74	-4.74
3	Volume Adjustment Factor	0.43	0.38
3	Speed Adjustment Factor	0.55	0.55
3	Ped LOS Score for Link	2.28	2.24
3	Ped Link LOS	B	B
3	Roadway Crossing Difficulty Factor	1.18	1.2
3	Ped LOS Score for Segment	2.88	2.89
3	Ped Segment LOS	C	C
3	Bicycle Travel Speed	14.49	12.62
3	Bicycle LOS Score for Intersection	2.77	4.08
3	Cross-section Adjustment Factor	-1.28	-1.28
3	Volume Adjustment Factor	1.96	1.9
3	Speed Adjustment Factor	0.79	0.79
3	Pavement Adjustment Factor	0.58	0.58
3	Bicycle LOS Score for Link	2.81	2.75
3	Bicycle Link LOS	C	C
3	Number of access point approaches	0	0
3	Segment Length, ft	1084	1084
3	Unsignalized Conflicts Factor	-0.7	-0.7
3	Bicycle LOS Score for Segment	2.47	2.78
3	Bicycle Segment LOS	B	C
3	Transit Running Speed, mi/h	36.93	36.96
3	g/C Ratio	0.56	0.1
3	Transit Running Time, s	20.02	19.99
3	Delay at Intersection, s/veh	13.23	0
3	Transit Travel Speed, mi/h	22.23	36.96
3	Transit Wait-Ride Score	3.27	3.93
3	Ped LOS Score for Link	2.28	2.24
3	Transit LOS Score for Segment	1.44	0.44
3	Transit Segment LOS	A	A
4	Average Pedestrian Space, ft2/p	∞	∞
4	Pedestrian Travel Speed, ft/s	4.34	4.34
4	Ped LOS Score for Intersection	1.64	1.94
4	Cross-section Adjustment Factor	-4.74	-4.74
4	Volume Adjustment Factor	0.89	0.36
4	Speed Adjustment Factor	0.59	0.67
4	Ped LOS Score for Link	2.79	2.33
4	Ped Link LOS	C	B
4	Roadway Crossing Difficulty Factor	1.2	1
4	Ped LOS Score for Segment	3.37	2.63
4	Ped Segment LOS	C	B
4	Bicycle Travel Speed	13.54	14.02
4	Bicycle LOS Score for Intersection	0.85	2.79
4	Cross-section Adjustment Factor	-1.28	-1.28
4	Volume Adjustment Factor	2.33	1.86
4	Speed Adjustment Factor	0.81	0.84
4	Pavement Adjustment Factor	0.58	0.58
4	Bicycle LOS Score for Link	3.19	2.76
4	Bicycle Link LOS	C	C

4	Number of access point approaches	0	0
4	Segment Length, ft	1897	1897
4	Unsignalized Conflicts Factor	-0.7	-0.7
4	Bicycle LOS Score for Segment	2.67	2.46
4	Bicycle Segment LOS	B	B
4	Transit Running Speed, mi/h	38.43	40.83
4	g/C Ratio	0.64	0.56
4	Transit Running Time, s	33.66	31.68
4	Delay at Intersection, s/veh	5.59	0
4	Transit Travel Speed, mi/h	32.96	40.83
4	Transit Wait-Ride Score	3.78	4.06
4	Ped LOS Score for Link	2.79	2.33
4	Transit LOS Score for Segment	0.75	0.25
4	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h	0	1331	31.3	0	678	0	30	0	45	40	0	35
1: Lanes	1	2	0	1	2	0	0	1	0	0	1	0
1: Prop blocked	0.06	0	0	0.33	0	0	0.39	0.39	0.33	0.39	0.39	0.06
1: Thru veh delay		0.03			0							
1: Prob inside blk		0			0							
1: Dist to upstream signal	1320											

SEGMENT 2

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Movement	4	5	6	1	2	3	10	11	12	7	8	9
1: Volume, veh/h	0	301	0	0	796	58.4	0	0	0	145	0	0
1: Lanes	1	2	0	0	2	0	0	0	0	1	0	1
1: Prop blocked	0.13	0	0	0	0	0	0.13	0.13	0	0.13	0.13	0.13
1: Thru veh delay		0			0.04							
1: Prob inside blk		0			0							
1: Dist to upstream signal	700											
2: Volume, veh/h	0.47	136	2.37	77.6	660	58.2	10	5	95	70	0	40
2: Lanes	1	2	0	1	2	0	1	1	0	0	1	0
2: Prop blocked	0.09	0	0	0	0	0	0.09	0.09	0	0.09	0.09	0.09
2: Thru veh delay		0			0.04							
2: Prob inside blk		0			0							
2: Dist to upstream signal	1410											

HCS7 Two-Way Stop-Control Report

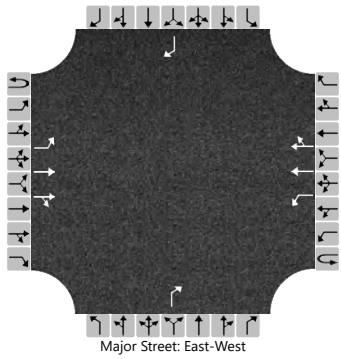
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	3/7/2018
Analysis Year	2045
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-229/BENSON IMJR

Site Information

Intersection	BENSON/POTSDAM
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	BENSON ROAD
North/South Street	POTSDAM AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes


Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	2	0	0	1	2	0		0	0	1		0	0	1
Configuration		L	T	TR		L	T	TR				R				R
Volume (veh/h)	0	10	1660	40	0	60	535	45				85				40
Percent Heavy Vehicles (%)	5	5			5	5						5				5
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized									No				No			
Median Type | Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1						6.9				6.9
Critical Headway (sec)		4.20				4.20						7.00				7.00
Base Follow-Up Headway (sec)		2.2				2.2						3.3				3.3
Follow-Up Headway (sec)		2.25				2.25						3.35				3.35

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		11				67						94				44
Capacity, c (veh/h)		916				301						257				665
v/c Ratio		0.01				0.22						0.37				0.07
95% Queue Length, Q_{95} (veh)		0.0				0.8						1.6				0.2
Control Delay (s/veh)		9.0				20.3						26.9				10.8
Level of Service (LOS)		A				C						D				B
Approach Delay (s/veh)	0.1				1.9				26.9				10.8			
Approach LOS									D				B			

Option 4B

Same as 4A

SECTION 6

PREDICTIVE CRASH MEMORANDUM

Technical Memo

Date: June 29, 2018

Project: I-229 Exit 9 (Benson Road) Interchange Modification Justification Report
Project # PL0100(82) P, PCN 06MF

To: Study Advisory Team

From: HDR

Subject: Predictive Crash Analysis for Interstate 229 Interchange at Benson Road

1. Introduction

The South Dakota Department of Transportation (SDDOT) is proposing to reconstruct the existing Interstate 229 (I-229) / Benson Road interchange in Sioux Falls. The build alternatives are a dual-lane loop ramp (DLLR) and a Diverging Diamond Interchange (DDI), which would replace the existing diamond interchange. In accordance with The Federal Highway Administration (FHWA) requirements, a change in Interstate access requires an Interchange Modification Justification Report (IMJR), including a safety analysis assessing the no-build and proposed build interchange alternatives. This memorandum presents a summary of the methodology and findings for the predicted safety performance analysis for the no-build and build alternatives for the I-229 / Benson Road project.

The analysis limits for this study are focused on the immediate interchange area as shown in **Figure 1**. On I-229, the limits extend from the interchange of I-229 / Rice Street to the interchange of I-229 / I-90, for a total distance of 2.3 miles. In addition to the freeway, the four interchange ramps and the two ramp terminals were analyzed.

Three alternatives were evaluated with this predictive safety analysis. The “No-Build” alternative maintains the existing diamond interchange layout. The second alternative adds a dual-lane loop ramp in the northeast quadrant to serve northbound I-229 traffic turning west onto Benson Road. This alternative would also reconfigure the alignments and lane layouts for other ramps, but they would still maintain the traditional diamond interchange layout. The third alternative would convert the interchange to a diverging diamond interchange. Within these general configurations, the IMJR includes review of several variations of the DLLR and DDI. However, the crash prediction analysis herein is based on the DLLR concept numbered 1a and the DDI concept denoted 4a.

The predictive crash analysis presented in this memorandum is based on the principles and methods of the Highway Safety Manual (HSM) 2010 edition with 2014 supplement published by AASHTO as discussed in detail below. It presents a comparative analysis of the predicted crashes anticipated within the interchange area for the “No-Build” future condition (maintain diamond interchange) and the planned build alternatives (DLLR and DDI). The results are intended to verify the assumption that the construction of a DLLR or DDI at this location will not result in a decrease in overall safety performance in the interchange area.

Appendix A provides the concept layouts for the no-build condition and the build alternatives.

Appendix B provides the Interactive Highway Safety Design Model (IHSDM) worksheets.

Figure 1 – IHSDM Analysis Limits

Source: Google Earth, April 2018

2. Methodology

This predictive safety analysis was completed using the American Association of State Highway and Transportation Officials (AASHTO) HSM method, including the National Cooperative Highway Research Program (NCHRP) Report 17-45 method for evaluating freeways and interchanges, which is now part of the HSM as a supplemental volume published in 2014.

FHWA supports, and in many cases now requires, the use of the method for the evaluation of proposed freeway facility improvements, including new or modified Interstate access. According to the HSM preface: *"The focus of the HSM is to provide quantitative information for decision making. The HSM assembles currently available information and methodologies on measuring, estimating, and evaluating roadways in terms of crash frequency (number of crashes per year) and crash severity (level of injures due to crashes). The HSM presents tools and methodologies for consideration of 'safety' across the range of highway activities …"*

For this study, the HSM predictive method was used. *"The predictive method provides a quantitative measure of expected crash frequency under both existing conditions and conditions which have not yet occurred. This allows proposed roadway conditions to be quantitatively assessed …"* (HSM, 2010)

The HSM method crash prediction estimates are developed using safety performance functions (SPFs) for specific facility types. The SPFs take into account the daily traffic volume information, but they assume that other geometric and traffic control features match a theoretical base condition for that facility type. Therefore, crash modification factors (CMFs) are used to make adjustments to the initial SPF results, to account for differences between the actual analysis condition and the theoretical base condition. A CMF of 1 means the analysis condition and the theoretical base condition will predict the same number of crashes. Thus, if a CMF is greater than 1, that will increase the number of predicted crashes, while if it is less than 1, it will decrease the number of predicted crashes. For example, if a depressed freeway median is narrower than the assumed 60-foot base condition, then a CMF of greater than 1 is applied to adjust the SPF results for the segment.

The HSM methodology has been in development for many years and is rapidly advancing; however, there are still many limitations where the available tools do not yet offer SPFs and/or CMFs for certain conditions. Where this is the case, recent research and crash data were also considered to refine the results as described later in this section.

2.1 Facilities, Segmentation and Data Inputs:

In keeping with the site based HSM analysis approach, each type of facility was examined separately. This involved segmenting the I-229 mainline and the I-229 ramps into functional elements. The Interactive Highway Safety Design Model (IHSDM) software automatically segments highways (including freeway segments, ramps and C-D roads) following HSM guidance. The ramp terminal intersections were also considered individually. IHSDM reports provided in the **Appendix** list all freeway, ramp, and ramp terminal intersection sites that were reviewed.

The HSM method requires several geometric and operational inputs to accurately compute the SPFs and apply the correct CMFs. This includes information such as segment length, daily traffic volume, ramp locations, merge distances, and horizontal curvature. The geometric inputs were primarily obtained from the conceptual design files and aerial photography. The traffic volume data was based on data and design year volume forecasts from the 2040 Sioux Falls Travel Demand Model.

2.2 I-229 Mainline Segments

The I-229 mainline segments were evaluated using HSM methods implemented using the Interactive Highway Safety Design Model (IHSDM) version 13.1.0 software provided by FHWA.

2.3 I-229 Entrance and Exit Ramps

The I-229 entrance and exit ramps were also evaluated using HSM methods in the IHSDM software. Consistent with this method, each ramp was evaluated as one or more specific ramp segments, taking into account the ramp geometry. Some of the ramps were subdivided into multiple segments to account for changes in number of lanes or shoulder widths.

In the DLLR alternative, the I-229 Northbound exit ramp traverses a portion of two-lane ramp alignment with a tight curve radius before intersecting Benson Road. The condition is uncommon in practice and was very likely unobserved or under-sampled in the development of the HSM crash prediction models. Past research for SDDOT on this gap in the crash prediction methodology led to the “Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI) and Two-Lane Loop Ramp” memo dated November 4th, 2015. In the memo, it is recommended to analyze the two-lane loop ramp, now called DLLR, with standard HSM procedures with greater scrutiny unless the research results of NCHRP 03-105 should develop enhanced models / guidance. The referenced research project was published in 2017 as NCHRP Web-Only Document 227: Design of Interchange Loop Ramps and Pavement/Shoulder Cross-Slope Breaks. The report includes a chapter reviewing the HSM procedure for loop ramps against directional ramps, but does not make recommendations on the specific DLLR geometry. The report’s most poignant comment on loop ramp crash prediction is that *“HSM prediction models for ramp crashes do a better job of predicting diamond ramp crashes than predicting loop ramp crashes”,* which the researchers arrived at through advanced statistical analysis of geometry and crash data.

2.4 Benson Road Ramp Terminals

For the No-Build and Build options, the ramps connect to Benson Road at signalized and non-signalized intersections. Interchange ramp terminals are evaluated using the HSM ramp terminal procedure in IHSDM. The IHSDM ramp terminal method does not, however, address DDIs. It only predicts crashes for a variety of more typical diamond and partial cloverleaf interchange ramp terminals. Therefore, it was necessary to develop an estimate for an "operationally-similar" diamond interchange design and then use CMFs from HDR's "Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI) and Two-Lane Loop Ramp" memo dated November 4th, 2015 to modify the results to estimate the predictions for a DDI design. Based on research done in Missouri on safety evaluations of DDIs, the preliminary CMF for conversion of a traditional diamond interchange to a DDI is 0.37 for Fatal + Injury (F+I) crashes at ramp terminal intersections and 0.49 for Property Damage Only (PDO) crashes at ramp terminal intersections.

2.5 Benson Road Segments

Crash prediction for an interchange study area within a typical urban footprint can be almost entirely described by evaluating the crashes from the freeway, freeway ramps, and ramp terminal intersections due to how the HSM defines the influence area for those types of sites. For that reason, this analysis does not report urban arterial crashes outside of those estimated directly through ramp terminal analysis. Given the emerging nature of both the DLLR and DDI configurations in crash prediction practice, it is likely that the base HSM models would struggle to replicate the crash patterns for the proposed Benson Road configuration between the interchange ramp terminals.

2.6 Calibration Factors:

According to the HSM, *"the predictive models were developed from the most complete and consistent data sets available."* However, the report also recommends that the equations be calibrated for each jurisdiction because *"the general level of crash frequencies may vary substantially from one jurisdiction to another."* However, SDDOT has not yet conducted the extensive analyses required to develop a complete set of HSM related calibration factors. Therefore, using the national HSM equations is proposed as the best approach for this current analysis.

2.7 Empirical Bayes Approach: Considering Historical Crash Data:

The HSM method includes an optional step called the Empirical Bayes (EB) approach, which combines "*the estimate from a predictive model with observed crash data to obtain a more reliable estimate of the expected average crash frequency."* (HSM, 2010) Essentially, the historical crash data is used to adjust the future crash prediction. Typically, the EB method is only used when it can be applied equally to all of the alternatives under consideration. Thus the improvements being considered must be moderate, so that the historical crash data is reasonable to consider for the No-Build and Build conditions. When major alignment or traffic control changes are proposed (such as the proposed DLLR or DDI), it is not used because *"there is typically a small difference in the results obtained from the predictive method when it is used with and without the EB Method."* Therefore, *"if the EB Method is not applied consistently, such differences will likely introduce a small bias in the comparison of expected crash frequency among alternatives."* (HSM Supplement, 2014) Therefore, the results are presented without the EB method adjustment.

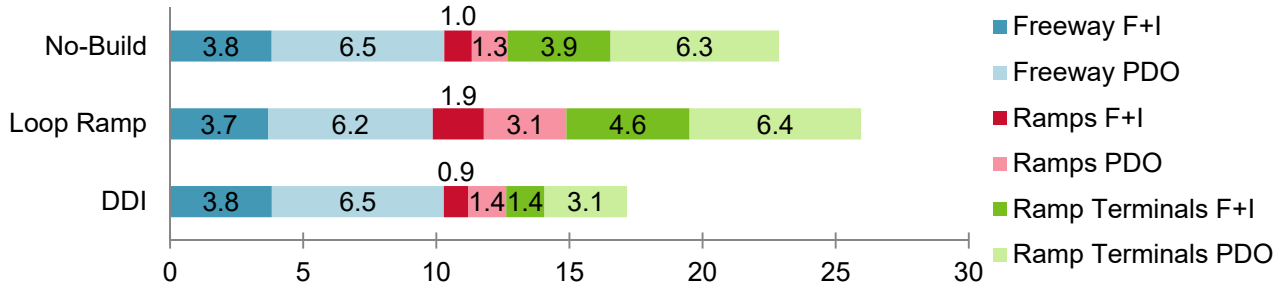
3. Analysis Results

The No-Build and Build interchange alternatives were evaluated and the predicted number of crashes was compared for the 2023 to 2045 analysis period. As mentioned previously, the required inputs were derived from design plans, aerial photography, and traffic volume data from the 2040 Sioux Falls Travel Demand Model. The following sections present the details of the analyses.

3.1 Build and No-Build Crash Frequency Comparison:

The predicted annual crash frequencies for the No-Build and Build scenarios (2023 to 2045) are presented in **Table 1** including a breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes. The resulting total number of annual predicted crashes is 26.0 for the DLLR concept, 17.2 for the DDI concept, and 22.9 predicted crashes for the No-Build condition. The No-Build and Build detailed IHSDM results sheets are provided in **Appendix B**.

Table 1: 2023 to 2045 Predicted Build and No-Build Annual Crash Frequencies



As shown, the majority of predicted crashes for all scenarios occur on the freeway and at the ramp terminal intersections. The freeway crashes for the Build scenarios introduce small changes in the predicted number of crashes versus the No-Build. The ramp crashes are expected to increase due to added lanes and additional length on some of the ramps.

Focusing on the ramp terminals, the DLLR ramp terminal crashes are expected to increase by 8% and the DDI ramp terminal crashes are expected to be reduced by 56%. The reduction for the DDI is consistent with what would be expected from eliminating left-turns with the DDI concept. The DLLR findings are more surprising given that the loop ramp re-aligns a significant amount of traffic from a left turn movement to a right turn movement at the northbound ramp terminal. A more in-depth review of this site does show that the DLLR reduces total crashes from 7 crashes per year to 2.5 crashes per year, consistent with the significant amount of traffic that has moved to the loop ramp and no longer would be in conflict with cross street traffic. This means the net increase in ramp terminal crashes is projected to happen entirely at the southbound ramp terminal. The primary consideration in this increase is the traffic control device at the intersection as the No-Build assumes a continuation of the stop-controlled condition where the DLLR alternative recommends a traffic signal to improve traffic operations. Since there is not a traffic signal planned for the southbound ramp terminal, it was not considered for the No-Build scenario, even though operations would degrade to a failing level of service condition if volumes increased to the 2045 forecasted levels.

Considering predicted crash severity, the DDI concept may decrease the number of F+I crashes at the ramp terminals by 63% while the DLLR concept may increase F+I crashes by 17%. In addition, the DDI concept may decrease the number of PDO crashes at the ramp terminals by 51% while the DLLR concept may increase by 2%. This result took into account the significant reduction in F+I crashes observed at DDIs compared to standard diamond interchanges in the Missouri research (63% reduction).

4. Conclusions

Based on the preceding HSM analysis, it is concluded that the DDI interchange is likely to exhibit significantly less overall crash frequencies than the existing diamond interchange. The DLLR would likely result in an increase in crashes, but this is due to a longer northbound ramp, and the southbound terminal being signalized instead of stop-controlled. The northbound terminal, in this scenario, would be expected to have a decrease in crashes compared to the No-Build. The freeway crashes for the Build scenarios introduce small changes in the predicted number of crashes versus the No-Build. The ramp crashes are expected to increase due to added lanes and additional length on some of the ramps. The ramp terminal crashes are expected to be reduced by 56% for the DDI and increased by 8% for the DLLR. The DDI has an even better crash benefit when looking at F+I crashes. The DDI reduces F+I crashes at the ramp terminals by 63%, compared to an increase of 19% for the DLLR. The PDO crashes at the ramp terminals are reduced by 51% for the DDI and an increase of 2% for the DLLR. The DDI alternative would be expected to provide significant safety benefits compared to the No-Build, but the DLLR alternative would likely result in an increase of crashes compared to the No-Build.

APPENDIX A

Interchange Alternatives

6300 S. Old Village Pl., Suite 100, Sioux Falls, SD 57108 **hdrinc.com**
P 605-977-7740

Figure 1A – No-Build Scenario

Source: Google Earth, April 2018

Legend

- Interchange/Ramp/Loop Construction
- Pedestrian Underpass Construction
- Raised Median Construction
- Bridge Construction
- Retaining Wall
- Existing ROW / Property Line
- ROW Acquisition
- Road Closure
- Signalized Intersection
- < 3 Number of Traffic Lanes

N

Scale in Feet
0 200 400

St Paul Avenue
Benson Road
Potsdam Avenue
52nd Street N
54th Street N
Hainje Avenue
INTERSTATE 229
300' Radius
V = 30 mph

Benson 1a Option Features:

- Dual right turn lane and free right turn movement for EB Benson Road to SB I-229 traffic.
- 30 mph 2-lane ramp loop for NB I-229 to WB Benson Road traffic.
- Pedestrian underpass for NB off-ramp / NB on-ramp loop.
- Realign I-229 NB off-ramp, EB on Benson Road yield movement.
- 3rd WB lane on Benson Road from I-229 to the west.
- 3rd EB lane on Benson Road from Lewis Avenue to I-229.
- Widen existing Benson Road bridge.
- Raised median Benson Road with left turn lanes.
- Retaining walls necessary for power poles and pedestrian underpass.

Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision:

Alternative Scenario 1a
2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
2A

Legend

- Interchange/Ramp/Loop Construction
- Pedestrian Underpass Construction
- Raised Median Construction
- Bridge Construction
- Retaining Wall
- Existing ROW / Property Line
- ROW Acquisition
- Road Closure
- Signalized Intersection
- < 3 Number of Traffic Lanes

N

Scale in Feet
0 200 400

St Paul Avenue
Benson Road
Potsdam Avenue
52nd Street N
54th Street N
Hainje Avenue
INTERSTATE 229

< 3 | 3 > | < 2 | 2 > | < 3 | 3 > | < 4 | 2 > | < 2 | 2 > | < 2 | 2 > | < 4 | 2 > | 3 > | 1 > | 2 > | 2 > | 2 > | < 2

Benson 4a Option Features:

- Diverging Diamond Interchange configuration.
- Widen existing Benson Road bridge.
- Realign west I-229 ramps to maximize separation distance to Potsdam Avenue.
- 2-lane free right turn movement for EB Benson Road to SB I-229 traffic.

Drawn By: B.Miller
Date: 5/14/2018
Chked By: P.Sanow
Date: 5/14/2018
Revision:

Alternative Scenario 4a
Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add 2 WB Lanes to Existing Overpass.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
3A

APPENDIX B

Crash Prediction Evaluation Reports

6300 S. Old Village Pl., Suite 100, Sioux Falls, SD 57108 **hdrinc.com**
P 605-977-7740

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 13, 2018

Disclaimer

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Report Overview

Report Generated: Jun 13, 2018 1:23 PM
Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Wed Jun 13 13:17:04 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Highway Title: I-229
Highway Comment: Created Wed Apr 11 10:14:11 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Wed Jun 13 13:14:11 CDT 2018

Minimum Location: 324+28.000
Maximum Location: 447+11.000
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Section 1 Evaluation

Section: Section 1
Evaluation Start Location: 324+28.000
Evaluation End Location: 447+11.000
Functional Class: Freeway
Type of Alignment: Divided, Multilane
Model Category: Freeway Segment
Calibration Factor: FI_EN=1.0; FI_EX=1.0; FI_MV=1.0; FI_SV=1.0; PDO_EN=1.0; PDO_EX=1.0; PDO_MV=1.0; PDO_SV=1.0;

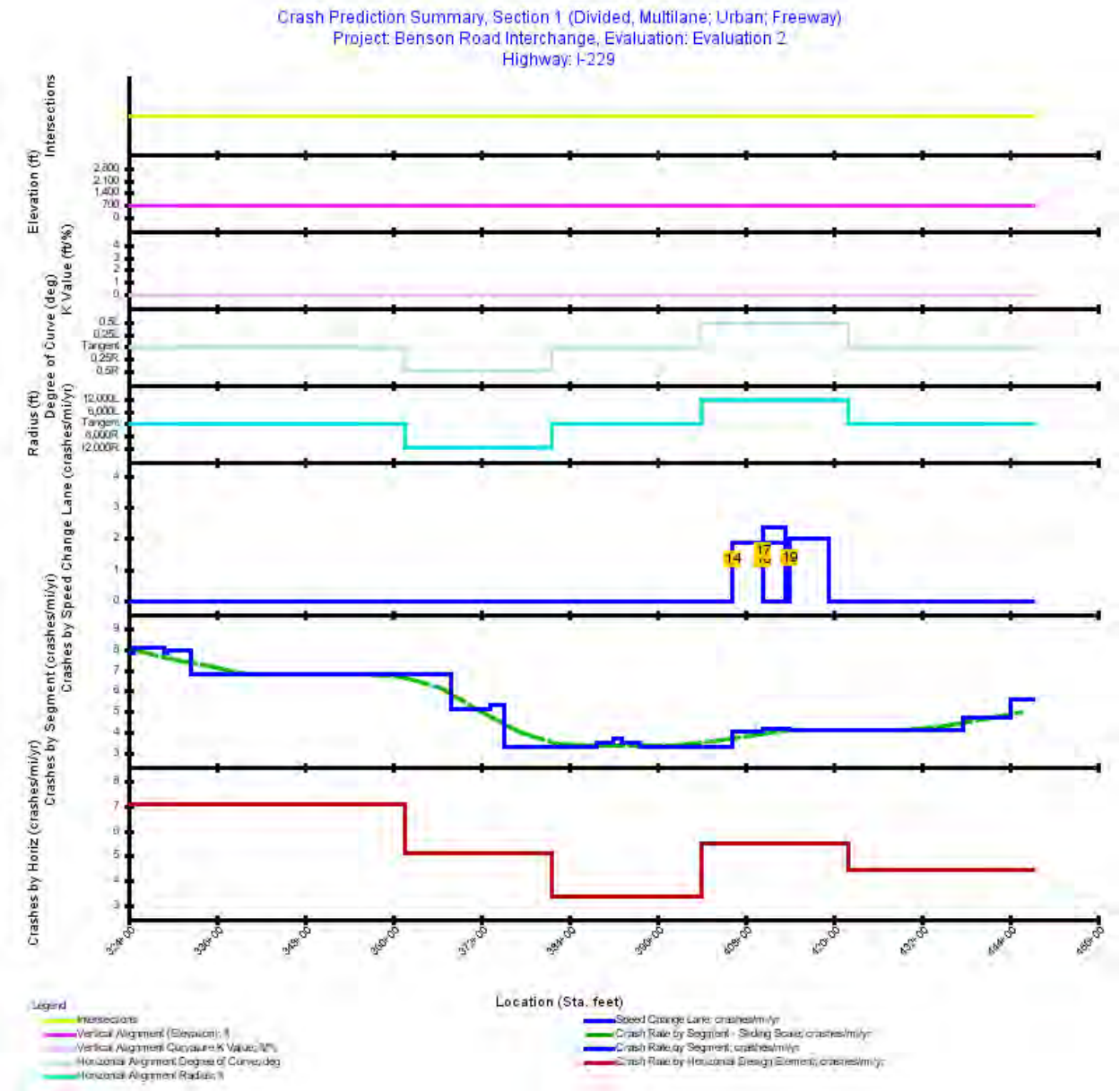

Figure 1. Crash Prediction Summary (Section 1)

Table 1. Evaluation Freeway - Homogeneous Segments (Section 1)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
1	6F	Urban	324+28.000	324+58.000	30.00	0.0057	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
2	6F	Urban	324+58.000	328+83.000	425.00	0.0805	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
3	6F	Urban	328+83.000	329+22.000	39.00	0.0074	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
4	6F	Urban	329+22.000	332+44.000	322.00	0.0610	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
5	6F	Urban	332+44.000	367+88.000	3,544.00	0.6712	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
6	6F	Urban	367+88.000	373+20.500	532.50	0.1008	2023: 26,300; 2024: 26,775; 2025: 27,250; 2026: 27,725; 2027: 28,200; 2028: 28,675; 2029: 29,150; 2030: 29,625; 2031: 30,100; 2032: 30,575; 2033: 31,050; 2034: 31,526; 2035: 32,001; 2036: 32,476; 2037: 32,951; 2038: 33,426; 2039: 33,901; 2040: 34,376; 2041: 34,851; 2042: 35,326; 2043: 35,801; 2044: 36,276; 2045: 36,752	60.00	Traversable Median	72.00
7	5F	Urban	373+20.500	375+20.000	199.50	0.0378	2023: 26,300; 2024: 26,775; 2025: 27,250; 2026: 27,725; 2027: 28,200; 2028: 28,675; 2029: 29,150; 2030: 29,625; 2031: 30,100; 2032: 30,575; 2033: 31,050; 2034: 31,526; 2035: 32,001; 2036: 32,476; 2037: 32,951; 2038: 33,426; 2039: 33,901; 2040: 34,376; 2041: 34,851; 2042: 35,326; 2043: 35,801; 2044: 36,276; 2045: 36,752	60.00	Traversable Median	72.00
8	4F	Urban	375+20.000	387+71.000	1,251.00	0.2369	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
9	4F	Urban	387+71.000	390+06.000	235.00	0.0445	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
10	4F	Urban	390+06.000	391+17.000	111.00	0.0210	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
11	4F	Urban	391+17.000	393+63.000	246.00	0.0466	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
12	4F	Urban	393+63.000	406+26.000	1,263.00	0.2392	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
13	4F	Urban	406+26.000	410+39.300	413.30	0.0783	2023: 19,200; 2024: 19,603; 2025: 20,006; 2026: 20,409; 2027: 20,812; 2028: 21,216; 2029: 21,619; 2030: 22,022; 2031: 22,425; 2032: 22,829; 2033: 23,232; 2034: 23,635; 2035: 24,038; 2036: 24,441; 2037: 24,845; 2038: 25,248; 2039: 25,651; 2040: 26,054; 2041: 26,458; 2042: 26,861; 2043: 27,264; 2044: 27,667; 2045: 28,071	60.00	Traversable Median	72.00
15	4F	Urban	410+39.300	414+02.000	362.70	0.0687	2023: 19,200; 2024: 19,603; 2025: 20,006; 2026: 20,409; 2027: 20,812; 2028: 21,216; 2029: 21,619; 2030: 22,022; 2031: 22,425; 2032: 22,829; 2033: 23,232; 2034: 23,635; 2035: 24,038; 2036: 24,441; 2037: 24,845; 2038: 25,248; 2039: 25,651; 2040: 26,054; 2041: 26,458; 2042: 26,861; 2043: 27,264; 2044: 27,667; 2045: 28,071	60.00	Traversable Median	72.00
18	4F	Urban	414+02.000	437+61.000	2,359.00	0.4468	2023: 20,500; 2024: 20,909; 2025: 21,318; 2026: 21,727; 2027: 22,136; 2028: 22,545; 2029: 22,954; 2030: 23,363; 2031: 23,772; 2032: 24,181; 2033: 24,590; 2034: 25,000; 2035: 25,409; 2036: 25,818; 2037: 26,227; 2038: 26,636; 2039: 27,045; 2040: 27,454; 2041: 27,863; 2042: 28,272; 2043: 28,681; 2044: 29,090; 2045: 29,500	60.00	Traversable Median	72.00
20	4F	Urban	437+61.000	444+19.000	658.00	0.1246	2023: 20,500; 2024: 20,909; 2025: 21,318; 2026: 21,727; 2027: 22,136; 2028: 22,545; 2029: 22,954; 2030: 23,363; 2031: 23,772; 2032: 24,181; 2033: 24,590; 2034: 25,000; 2035: 25,409; 2036: 25,818; 2037: 26,227; 2038: 26,636; 2039: 27,045; 2040: 27,454; 2041: 27,863; 2042: 28,272; 2043: 28,681; 2044: 29,090; 2045: 29,500	60.00	Traversable Median	72.00
21	4F	Urban	444+19.000	447+11.000	292.00	0.0553	2023: 20,500; 2024: 20,909; 2025: 21,318; 2026: 21,727; 2027: 22,136; 2028: 22,545; 2029: 22,954; 2030: 23,363; 2031: 23,772; 2032: 24,181; 2033: 24,590; 2034: 25,000; 2035: 25,409; 2036: 25,818; 2037: 26,227; 2038: 26,636; 2039: 27,045; 2040: 27,454; 2041: 27,863; 2042: 28,272; 2043: 28,681; 2044: 29,090; 2045: 29,500	60.00	Traversable Median	72.00

Table 2. Evaluation Freeway - Speed Change Lanes (Speed Change)

Seg. No.	Type	Ramp Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
14	4SC	Entrance	406+26.000	410+39.300	413.30	0.0783	2023: 19,200; 2024: 19,603; 2025: 20,006; 2026: 20,409; 2027: 20,812; 2028: 21,216; 2029: 21,619; 2030: 22,022; 2031: 22,425; 2032: 22,829; 2033: 23,232; 2034: 23,635; 2035: 24,038; 2036: 24,441; 2037: 24,845; 2038: 25,248; 2039: 25,651; 2040: 26,054; 2041: 26,458; 2042: 26,861; 2043: 27,264; 2044: 27,667; 2045: 28,071	60.00	Traversable Median	72.00
16	4SC	Entrance	410+39.300	414+02.000	362.70	0.0687	2023: 19,200; 2024: 19,603; 2025: 20,006; 2026: 20,409; 2027: 20,812; 2028: 21,216; 2029: 21,619; 2030: 22,022; 2031: 22,425; 2032: 22,829; 2033: 23,232; 2034: 23,635; 2035: 24,038; 2036: 24,441; 2037: 24,845; 2038: 25,248; 2039: 25,651; 2040: 26,054; 2041: 26,458; 2042: 26,861; 2043: 27,264; 2044: 27,667; 2045: 28,071	60.00	Traversable Median	72.00
17	4SC	Exit	410+39.300	413+39.300	300.00	0.0568	2023: 19,200; 2024: 19,603; 2025: 20,006; 2026: 20,409; 2027: 20,812; 2028: 21,216; 2029: 21,619; 2030: 22,022; 2031: 22,425; 2032: 22,829; 2033: 23,232; 2034: 23,635; 2035: 24,038; 2036: 24,441; 2037: 24,845; 2038: 25,248; 2039: 25,651; 2040: 26,054; 2041: 26,458; 2042: 26,861; 2043: 27,264; 2044: 27,667; 2045: 28,071	60.00	Traversable Median	72.00
19	4SC	Entrance	414+02.000	419+26.000	524.00	0.0992	2023: 20,500; 2024: 20,909; 2025: 21,318; 2026: 21,727; 2027: 22,136; 2028: 22,545; 2029: 22,954; 2030: 23,363; 2031: 23,772; 2032: 24,181; 2033: 24,590; 2034: 25,000; 2035: 25,409; 2036: 25,818; 2037: 26,227; 2038: 26,636; 2039: 27,045; 2040: 27,454; 2041: 27,863; 2042: 28,272; 2043: 28,681; 2044: 29,090; 2045: 29,500	60.00	Traversable Median	72.00

Table 3. Expected Freeway Crash Rates and Frequencies (Section 1)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	2.3263
Average Future Road AADT (vpd)	30,282
Expected Crashes	
Total Crashes	257.45
Fatal and Injury Crashes	95.44
Property-Damage-Only Crashes	162.00
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	37
Percent Property-Damage-Only Crashes (%)	63
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	4.8116
Fatal and Injury Crash Rate (crashes/mi/yr)	1.7838
Property-Damage-Only Crash Rate (crashes/mi/yr)	3.0278
Expected Travel Crash Rate	
Total Travel (million veh-mi)	591.39
Travel Crash Rate (crashes/million veh-mi)	0.43
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.16
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.27

Table 4. Expected Freeway Speed Change Lane Crash Rates and Frequencies (Speed Change)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.3030
Average Future Road AADT (vpd)	12,041
Expected Crashes	
Total Crashes	13.95
Fatal and Injury Crashes	4.12
Property-Damage-Only Crashes	9.83
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	30
Percent Property-Damage-Only Crashes (%)	70
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	2.0008
Fatal and Injury Crash Rate (crashes/mi/yr)	0.5909
Property-Damage-Only Crash Rate (crashes/mi/yr)	1.4099
Expected Travel Crash Rate	
Total Travel (million veh-mi)	30.63
Travel Crash Rate (crashes/million veh-mi)	0.46
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.13
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.32

Note: *Total Travel and Crash Rates/Million Vehicle Miles* for *Speed Change Lanes* reflect AADTs that are **half of the Freeway Segment AADTs** based on the assumption of 50/50 directional distribution.

Table 5. Expected Crash Frequencies and Rates by Freeway Segment (Section 1)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Effective Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	324+28.000	324+58.000	0.0057	1.021	7.8142	0.51
2	324+58.000	328+83.000	0.0805	14.940	8.0700	0.53
3	328+83.000	329+22.000	0.0074	1.327	7.8142	0.51
4	329+22.000	332+44.000	0.0610	11.177	7.9687	0.52
5	332+44.000	367+88.000	0.6712	105.010	6.8021	0.45
6	367+88.000	373+20.500	0.1009	11.936	5.1458	0.45
7	373+20.500	375+20.000	0.0378	4.621	5.3169	0.46
8	375+20.000	387+71.000	0.2369	18.004	3.3039	0.43
9	387+71.000	390+06.000	0.0445	3.569	3.4861	0.45
10	390+06.000	391+17.000	0.0210	1.787	3.6960	0.48
11	391+17.000	393+63.000	0.0466	3.736	3.4861	0.45
12	393+63.000	406+26.000	0.2392	18.134	3.2960	0.42
13	406+26.000	410+39.300	0.0391	3.625	4.0266	0.47
15	410+39.300	414+02.000	0.0059	0.575	4.2070	0.49
18	414+02.000	437+61.000	0.3972	37.390	4.0932	0.45
20	437+61.000	444+19.000	0.1246	13.519	4.7165	0.52
21	444+19.000	447+11.000	0.0553	7.076	5.5630	0.61

Note: *Effective Length* is the *segment length* minus the length of the *speed change lanes* if present.

Table 6. Expected Crash Frequencies and Rates by Freeway Speed Change Lane (Speed Change)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
14	406+26.000	410+39.300	0.0783	3.355	1.8635	0.43
16	410+39.300	414+02.000	0.0687	2.944	1.8635	0.43
17	410+39.300	413+39.300	0.0568	3.095	2.3687	0.55
19	414+02.000	419+26.000	0.0992	4.550	1.9935	0.44

Note: *Travel Crash Rates/Million Vehicle Miles* for *Speed Change Lanes* reflect AADTs that are **half of the Freeway Segment AADTs** based on the assumption of 50/50 directional distribution.

Table 7. Expected Crash Frequencies and Rates by Horizontal Design Element (Section 1)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	324+28.000	361+59.260	0.7067	114.846	7.0659	0.46
Simple Curve 1	361+59.260	381+62.890	0.3795	44.439	5.0916	0.44
Tangent	381+62.890	401+97.440	0.3853	29.824	3.3651	0.43
Simple Curve 2	401+97.440	422+00.920	0.3794	36.960	5.5274	0.82
Tangent	422+00.920	447+11.000	0.4754	45.322	4.4276	0.48

Table 8. Expected Crash Severity by Freeway Segment (Section 1)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0064	0.0165	0.1181	0.2311	0.6490
2	0.0845	0.2236	1.6266	3.3876	9.6179
3	0.0083	0.0215	0.1536	0.3004	0.8438
4	0.0704	0.1816	1.2818	2.4132	7.2302
5	0.8108	2.0437	13.6569	22.3709	66.1273
6	0.1131	0.2910	1.7560	2.4984	7.2777
7	0.0421	0.1084	0.6542	0.9307	2.8851
8	0.1567	0.3963	2.5253	3.8291	11.0968
9	0.0258	0.0652	0.4481	0.7736	2.2559
10	0.0116	0.0297	0.2080	0.3823	1.1555
11	0.0270	0.0682	0.4691	0.8098	2.3615
12	0.1540	0.3870	2.5147	3.9013	11.1764
13	0.0335	0.0863	0.5206	0.7406	2.2436
15	0.0053	0.0137	0.0830	0.1180	0.3544
18	0.3002	0.7565	4.9925	7.9945	23.3466
20	0.0879	0.2256	1.5822	2.9172	8.7059
21	0.0382	0.1010	0.7344	1.5257	4.6766
Total	1.9758	5.0160	33.3250	55.1246	162.0043

Table 9. Expected Crash Severity by Speed Change Lane (Speed Change)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
14	0.0235	0.0605	0.3648	0.5191	2.3872
16	0.0206	0.0531	0.3202	0.4555	2.0949
17	0.0240	0.0619	0.3733	0.5311	2.1051
19	0.0313	0.0808	0.4899	0.7086	3.2397
Total	0.0994	0.2562	1.5482	2.2143	9.8269

Table 10. Expected Speed Change Lane Crash Type Distribution (Section 1)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.24	0.1	2.45	1.0	2.69	1.0
Highway Segment	Collision with Fixed Object	44.15	17.1	79.70	31.0	123.85	48.1
Highway Segment	Collision with Other Object	3.12	1.2	15.47	6.0	18.59	7.2
Highway Segment	Other Single-vehicle Collision	12.72	4.9	11.91	4.6	24.63	9.6
Highway Segment	Collision with Parked Vehicle	0.92	0.4	1.78	0.7	2.70	1.0
Highway Segment	Total Single Vehicle Crashes	61.15	23.8	111.32	43.2	172.47	67.0
Highway Segment	Right-Angle Collision	1.06	0.4	0.91	0.4	1.98	0.8
Highway Segment	Head-on Collision	0.27	0.1	0.10	0.0	0.38	0.1
Highway Segment	Other Multi-vehicle Collision	1.06	0.4	1.22	0.5	2.28	0.9
Highway Segment	Rear-end Collision	25.72	10.0	34.97	13.6	60.69	23.6
Highway Segment	Sideswipe, Same Direction Collision	6.17	2.4	13.48	5.2	19.66	7.6
Highway Segment	Total Multiple Vehicle Crashes	34.29	13.3	50.69	19.7	84.98	33.0
Highway Segment	Total Highway Segment Crashes	95.44	37.1	162.00	62.9	257.45	100.0
	Total Crashes	95.44	37.1	162.00	62.9	257.45	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 11. Expected Exit Speed Change Lane Crash Type Distribution (Speed Change)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.0	0.01	0.5	0.01	0.5
Highway Segment	Collision with Fixed Object	0.19	6.3	0.44	14.1	0.63	20.3
Highway Segment	Collision with Other Object	0.02	0.5	0.06	2.0	0.08	2.6
Highway Segment	Other Single-vehicle Collision	0.05	1.6	0.05	1.6	0.10	3.1
Highway Segment	Collision with Parked Vehicle	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Total Single Vehicle Crashes	0.26	8.3	0.56	18.2	0.82	26.5
Highway Segment	Right-Angle Collision	0.01	0.4	0.03	0.8	0.04	1.2
Highway Segment	Head-on Collision	0.01	0.2	0.00	0.1	0.01	0.3
Highway Segment	Other Multi-vehicle Collision	0.02	0.5	0.03	1.1	0.05	1.6
Highway Segment	Rear-end Collision	0.54	17.6	1.19	38.4	1.73	56.0
Highway Segment	Sideswipe, Same Direction Collision	0.16	5.1	0.29	9.4	0.45	14.4
Highway Segment	Total Multiple Vehicle Crashes	0.73	23.6	1.54	49.8	2.27	73.5
Highway Segment	Total Highway Segment Crashes	0.99	32.0	2.10	68.0	3.10	100.0
	Total Crashes	0.99	32.0	2.10	68.0	3.10	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 12. Expected Entrance Speed Change Lane Crash Type Distribution (Speed Change)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.0	0.01	0.1	0.01	0.1
Highway Segment	Collision with Fixed Object	0.61	5.6	1.00	9.2	1.60	14.8
Highway Segment	Collision with Other Object	0.06	0.5	0.28	2.6	0.34	3.1
Highway Segment	Other Single-vehicle Collision	0.21	1.9	0.12	1.1	0.33	3.1
Highway Segment	Collision with Parked Vehicle	0.01	0.1	0.02	0.2	0.04	0.3
Highway Segment	Total Single Vehicle Crashes	0.89	8.2	1.44	13.2	2.33	21.4
Highway Segment	Right-Angle Collision	0.06	0.5	0.12	1.1	0.18	1.7
Highway Segment	Head-on Collision	0.01	0.1	0.01	0.1	0.02	0.2
Highway Segment	Other Multi-vehicle Collision	0.05	0.5	0.12	1.1	0.17	1.6
Highway Segment	Rear-end Collision	1.70	15.7	4.09	37.7	5.79	53.4
Highway Segment	Sideswipe, Same Direction Collision	0.42	3.8	1.95	17.9	2.36	21.8
Highway Segment	Total Multiple Vehicle Crashes	2.24	20.6	6.29	57.9	8.53	78.6
Highway Segment	Total Highway Segment Crashes	3.13	28.8	7.72	71.2	10.85	100.0
	Total Crashes	3.13	28.8	7.72	71.2	10.85	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 13. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
373+20.500	375+20.000	for segment #7 (373+20.500 to 375+20.000), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 13, 2018

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Report Overview

Report Generated: Jun 13, 2018 1:45 PM
Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Wed Jun 13 13:38:39 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Highway Title: NB On Ramp
Highway Comment: Created Wed Apr 11 11:56:51 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Wed Jun 13 13:38:29 CDT 2018

Minimum Location: 5300+00.000
Maximum Location: 5315+54.070
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 5300+00.000
Evaluation End Location: 5315+54.070
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: ENT_RAMP_MV_FI=1.0; ENT_RAMP_MV_PDO=1.0; ENT_RAMP_SV_FI=1.0; ENT_RAMP_SV_PDO=1.0;

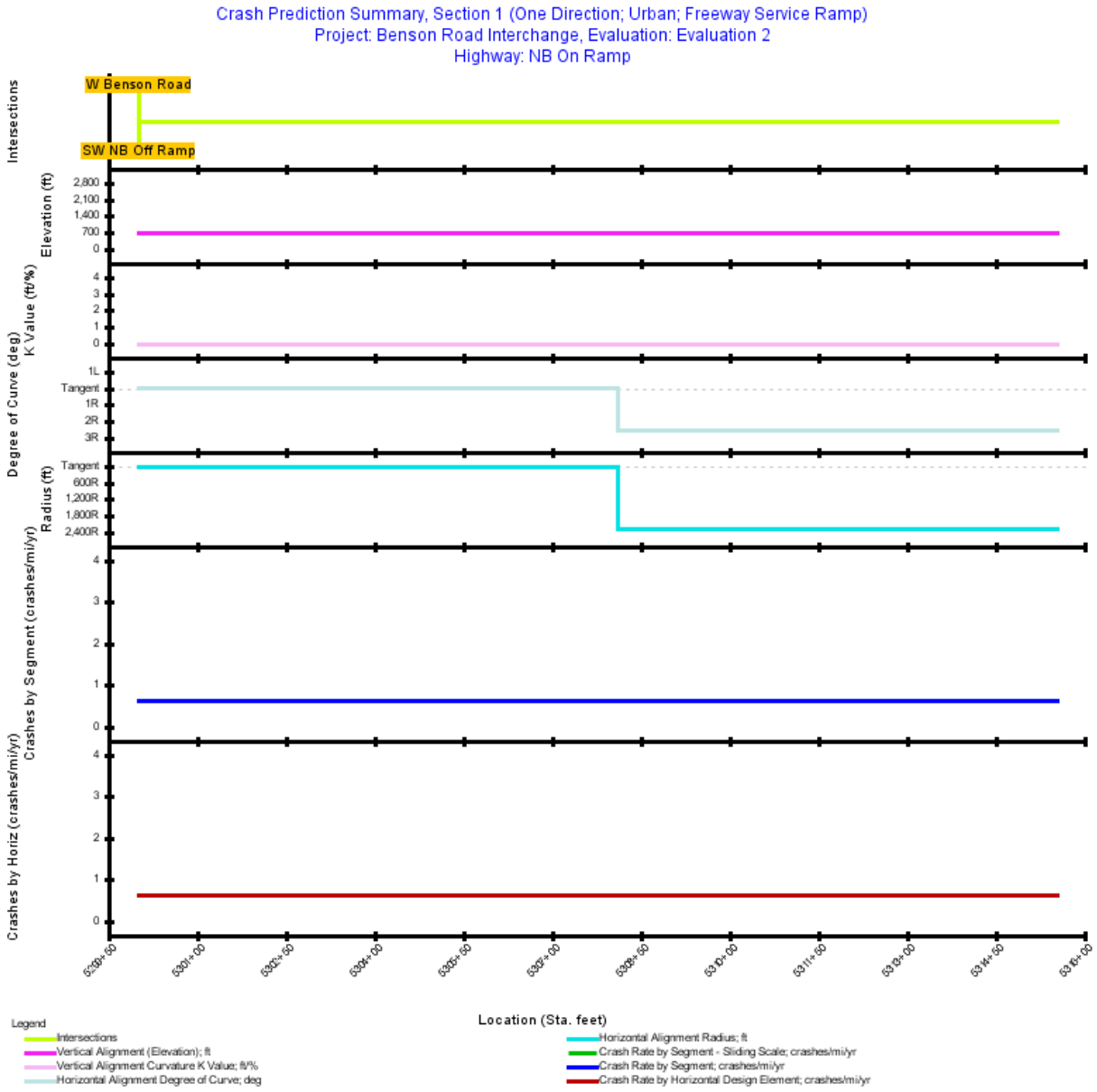

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	1EN	Urban	5300+00.000	5315+54.070	1,554.07	0.2943	2023: 1,900; 2024: 1,878; 2025: 1,857; 2026: 1,835; 2027: 1,814; 2028: 1,792; 2029: 1,771; 2030: 1,750; 2031: 1,728; 2032: 1,707; 2033: 1,685; 2034: 1,664; 2035: 1,643; 2036: 1,621; 2037: 1,600; 2038: 1,578; 2039: 1,557; 2040: 1,536; 2041: 1,514; 2042: 1,493; 2043: 1,471; 2044: 1,450; 2045: 1,429

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.2943
Average Future Road AADT (vpd)	1,664
Expected Crashes	
Total Crashes	4.29
Fatal and Injury Crashes	1.93
Property-Damage-Only Crashes	2.37
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	45
Percent Property-Damage-Only Crashes (%)	55
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	0.6340
Fatal and Injury Crash Rate (crashes/mi/yr)	0.2845
Property-Damage-Only Crash Rate (crashes/mi/yr)	0.3495
Expected Travel Crash Rate	
Total Travel (million veh-mi)	4.11
Travel Crash Rate (crashes/million veh-mi)	1.04
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.47
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.57

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	5300+00.000	5315+54.070	0.2943	4.292	0.6340	1.04

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	5300+00.000	5308+09.660	0.1533	2.236	0.6340	1.04
Simple Curve 1	5308+09.660	5315+54.070	0.1410	2.056	0.6340	1.04

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0411	0.1245	0.7928	0.9674	2.3662

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.01	0.1	0.04	1.1	0.05	1.2
Highway Segment	Collision with Fixed Object	1.15	26.8	1.47	34.2	2.62	60.9
Highway Segment	Collision with Other Object	0.08	1.9	0.28	6.6	0.37	8.5
Highway Segment	Other Single-vehicle Collision	0.33	7.7	0.22	5.1	0.55	12.8
Highway Segment	Collision with Parked Vehicle	0.02	0.6	0.03	0.8	0.06	1.3
Highway Segment	Total Single Vehicle Crashes	1.59	37.1	2.05	47.8	3.64	84.8
Highway Segment	Right-Angle Collision	0.01	0.2	0.01	0.1	0.02	0.4
Highway Segment	Head-on Collision	0.00	0.1	0.00	0.0	0.00	0.1
Highway Segment	Other Multi-vehicle Collision	0.01	0.2	0.01	0.2	0.02	0.4
Highway Segment	Rear-end Collision	0.25	5.9	0.22	5.1	0.47	11.0
Highway Segment	Sideswipe, Same Direction Collision	0.06	1.4	0.08	2.0	0.14	3.4
Highway Segment	Total Multiple Vehicle Crashes	0.34	7.8	0.32	7.4	0.65	15.2
Highway Segment	Total Highway Segment Crashes	1.93	44.9	2.37	55.1	4.29	100.0
	Total Crashes	1.93	44.9	2.37	55.1	4.29	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 13, 2018

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Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Wed Jun 13 13:46:18 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Highway Title: SB On Ramp
Highway Comment: Created Wed Apr 11 12:08:08 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Wed Jun 13 13:46:09 CDT 2018

Minimum Location: 5000+00.000
Maximum Location: 5015+45.940
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 5000+00.000
Evaluation End Location: 5015+45.940
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: ENT_RAMP_MV_FI=1.0; ENT_RAMP_MV_PDO=1.0; ENT_RAMP_SV_FI=1.0; ENT_RAMP_SV_PDO=1.0;

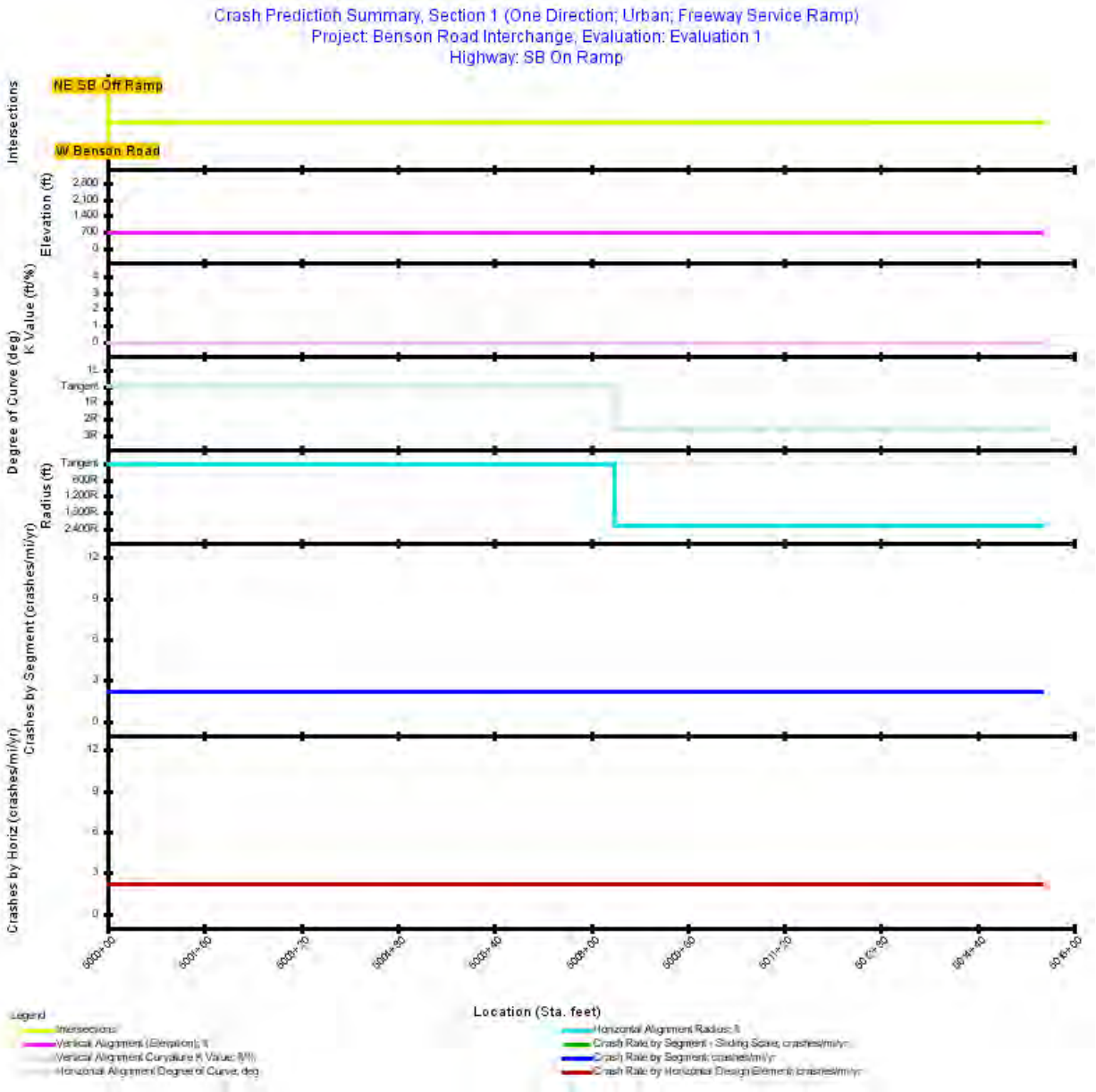

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	1EN	Urban	5000+00.000	5015+45.940	1,545.94	0.2928	2023: 9,000; 2024: 8,965; 2025: 8,930; 2026: 8,896; 2027: 8,861; 2028: 8,827; 2029: 8,792; 2030: 8,758; 2031: 8,723; 2032: 8,689; 2033: 8,654; 2034: 8,620; 2035: 8,585; 2036: 8,550; 2037: 8,516; 2038: 8,481; 2039: 8,447; 2040: 8,412; 2041: 8,378; 2042: 8,343; 2043: 8,309; 2044: 8,274; 2045: 8,240

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.2928
Average Future Road AADT (vpd)	8,620
Expected Crashes	
Total Crashes	14.53
Fatal and Injury Crashes	5.96
Property-Damage-Only Crashes	8.57
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	41
Percent Property-Damage-Only Crashes (%)	59
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	2.1575
Fatal and Injury Crash Rate (crashes/mi/yr)	0.8843
Property-Damage-Only Crash Rate (crashes/mi/yr)	1.2733
Expected Travel Crash Rate	
Total Travel (million veh-mi)	21.19
Travel Crash Rate (crashes/million veh-mi)	0.69
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.28
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.40

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	5000+00.000	5015+45.940	0.2928	14.529	2.1575	0.69

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	5000+00.000	5008+38.790	0.1589	7.883	2.1575	0.69
Simple Curve 1	5008+38.790	5015+45.940	0.1339	6.646	2.1575	0.69

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.1270	0.3851	2.4515	2.9912	8.5746

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.02	0.1	0.14	0.9	0.15	1.1
Highway Segment	Collision with Fixed Object	3.44	23.7	4.41	30.3	7.85	54.0
Highway Segment	Collision with Other Object	0.24	1.7	0.86	5.9	1.10	7.6
Highway Segment	Other Single-vehicle Collision	0.99	6.8	0.66	4.5	1.65	11.4
Highway Segment	Collision with Parked Vehicle	0.07	0.5	0.10	0.7	0.17	1.2
Highway Segment	Total Single Vehicle Crashes	4.76	32.8	6.16	42.4	10.92	75.2
Highway Segment	Right-Angle Collision	0.04	0.3	0.04	0.3	0.08	0.6
Highway Segment	Head-on Collision	0.01	0.1	0.01	0.0	0.01	0.1
Highway Segment	Other Multi-vehicle Collision	0.04	0.3	0.06	0.4	0.10	0.7
Highway Segment	Rear-end Collision	0.89	6.1	1.67	11.5	2.56	17.6
Highway Segment	Sideswipe, Same Direction Collision	0.21	1.5	0.64	4.4	0.86	5.9
Highway Segment	Total Multiple Vehicle Crashes	1.19	8.2	2.42	16.6	3.61	24.8
Highway Segment	Total Highway Segment Crashes	5.96	41.0	8.57	59.0	14.53	100.0
	Total Crashes	5.96	41.0	8.57	59.0	14.53	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 13, 2018

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Evaluation Date: Wed Jun 13 13:48:42 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Highway Title: NB Off Ramp
Highway Comment: Created Wed Apr 11 12:37:16 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Wed Jun 13 13:48:33 CDT 2018

Minimum Location: 5+28.500
Maximum Location: 24+28.450
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 5+28.500
Evaluation End Location: 24+28.450
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

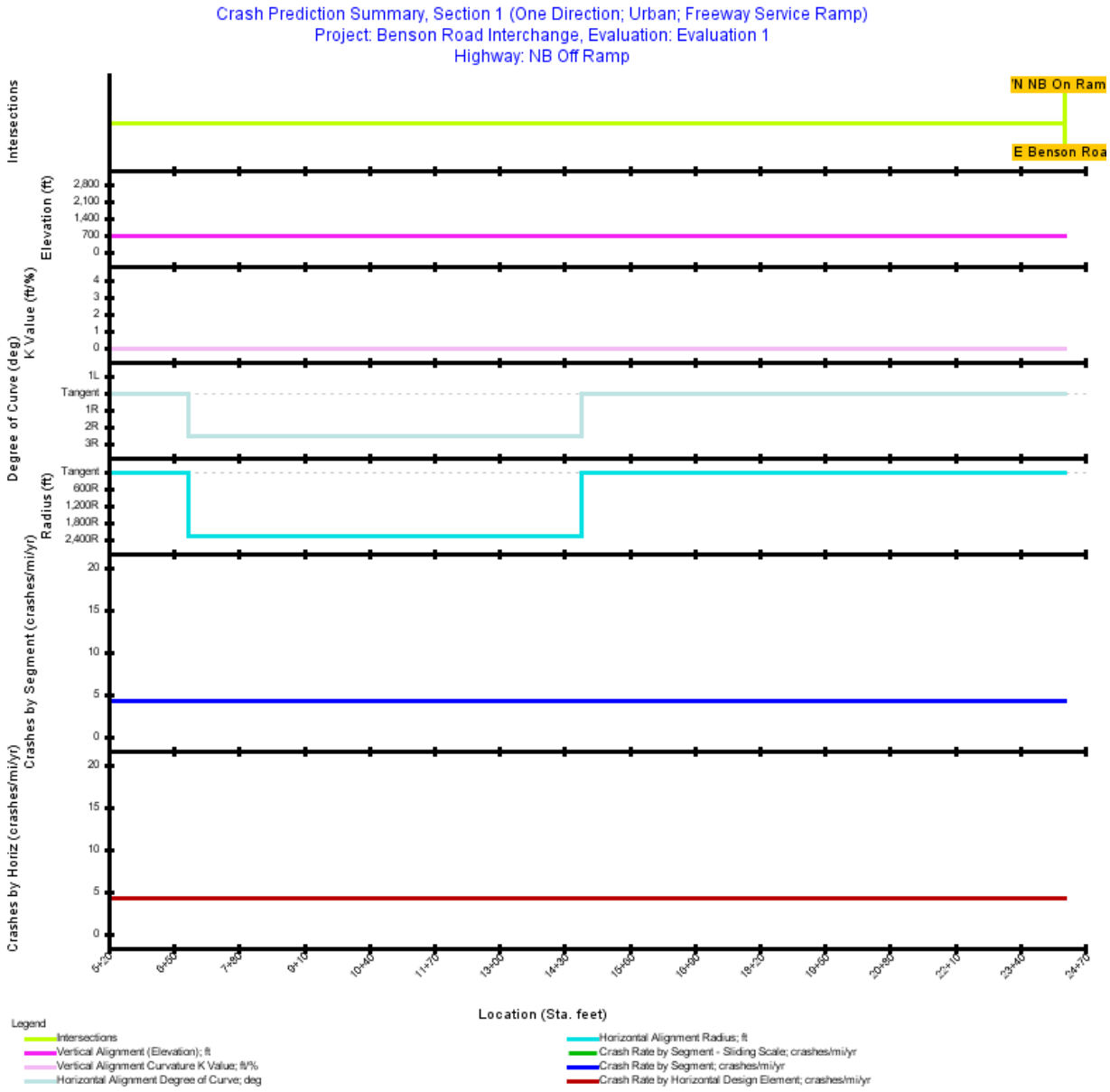

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	2EX	Urban	5+28.500	24+28.450	1,899.95	0.3598	2023: 8,600; 2024: 8,743; 2025: 8,886; 2026: 9,029; 2027: 9,172; 2028: 9,315; 2029: 9,458; 2030: 9,601; 2031: 9,744; 2032: 9,887; 2033: 10,030; 2034: 10,174; 2035: 10,317; 2036: 10,460; 2037: 10,603; 2038: 10,746; 2039: 10,889; 2040: 11,032; 2041: 11,175; 2042: 11,318; 2043: 11,461; 2044: 11,604; 2045: 11,748

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.3598
Average Future Road AADT (vpd)	10,174
Expected Crashes	
Total Crashes	35.09
Fatal and Injury Crashes	15.50
Property-Damage-Only Crashes	19.59
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	44
Percent Property-Damage-Only Crashes (%)	56
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	4.2393
Fatal and Injury Crash Rate (crashes/mi/yr)	1.8728
Property-Damage-Only Crash Rate (crashes/mi/yr)	2.3665
Expected Travel Crash Rate	
Total Travel (million veh-mi)	30.73
Travel Crash Rate (crashes/million veh-mi)	1.14
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.50
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.64

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	5+28.500	24+28.450	0.3598	35.086	4.2393	1.14

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	5+28.500	6+78.060	0.0283	2.762	4.2393	1.14
Simple Curve 1	6+78.060	14+62.820	0.1486	14.492	4.2393	1.14
Tangent	14+62.820	24+28.450	0.1829	17.832	4.2393	1.14

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.4612	1.3986	4.7278	8.9125	19.5855

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.06	0.2	0.36	1.0	0.41	1.2
Highway Segment	Collision with Fixed Object	10.40	29.6	11.57	33.0	21.97	62.6
Highway Segment	Collision with Other Object	0.73	2.1	2.25	6.4	2.98	8.5
Highway Segment	Other Single-vehicle Collision	3.00	8.5	1.73	4.9	4.72	13.5
Highway Segment	Collision with Parked Vehicle	0.22	0.6	0.26	0.7	0.47	1.4
Highway Segment	Total Single Vehicle Crashes	14.40	41.0	16.16	46.1	30.56	87.1
Highway Segment	Right-Angle Collision	0.03	0.1	0.06	0.2	0.10	0.3
Highway Segment	Head-on Collision	0.01	0.0	0.01	0.0	0.02	0.0
Highway Segment	Other Multi-vehicle Collision	0.03	0.1	0.08	0.2	0.12	0.3
Highway Segment	Rear-end Collision	0.82	2.3	2.36	6.7	3.19	9.1
Highway Segment	Sideswipe, Same Direction Collision	0.20	0.6	0.91	2.6	1.11	3.2
Highway Segment	Total Multiple Vehicle Crashes	1.10	3.1	3.42	9.8	4.52	12.9
Highway Segment	Total Highway Segment Crashes	15.50	44.2	19.59	55.8	35.09	100.0
	Total Crashes	15.50	44.2	19.59	55.8	35.09	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 13, 2018

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Report Generated: Jun 13, 2018 1:50 PM
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Evaluation Date: Wed Jun 13 13:49:48 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Highway Title: SB Off Ramp
Highway Comment: Created Wed Apr 11 12:42:33 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Wed Jun 13 13:49:40 CDT 2018

Minimum Location: 3+59.600
Maximum Location: 24+86.000
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 3+59.600
Evaluation End Location: 24+86.000
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

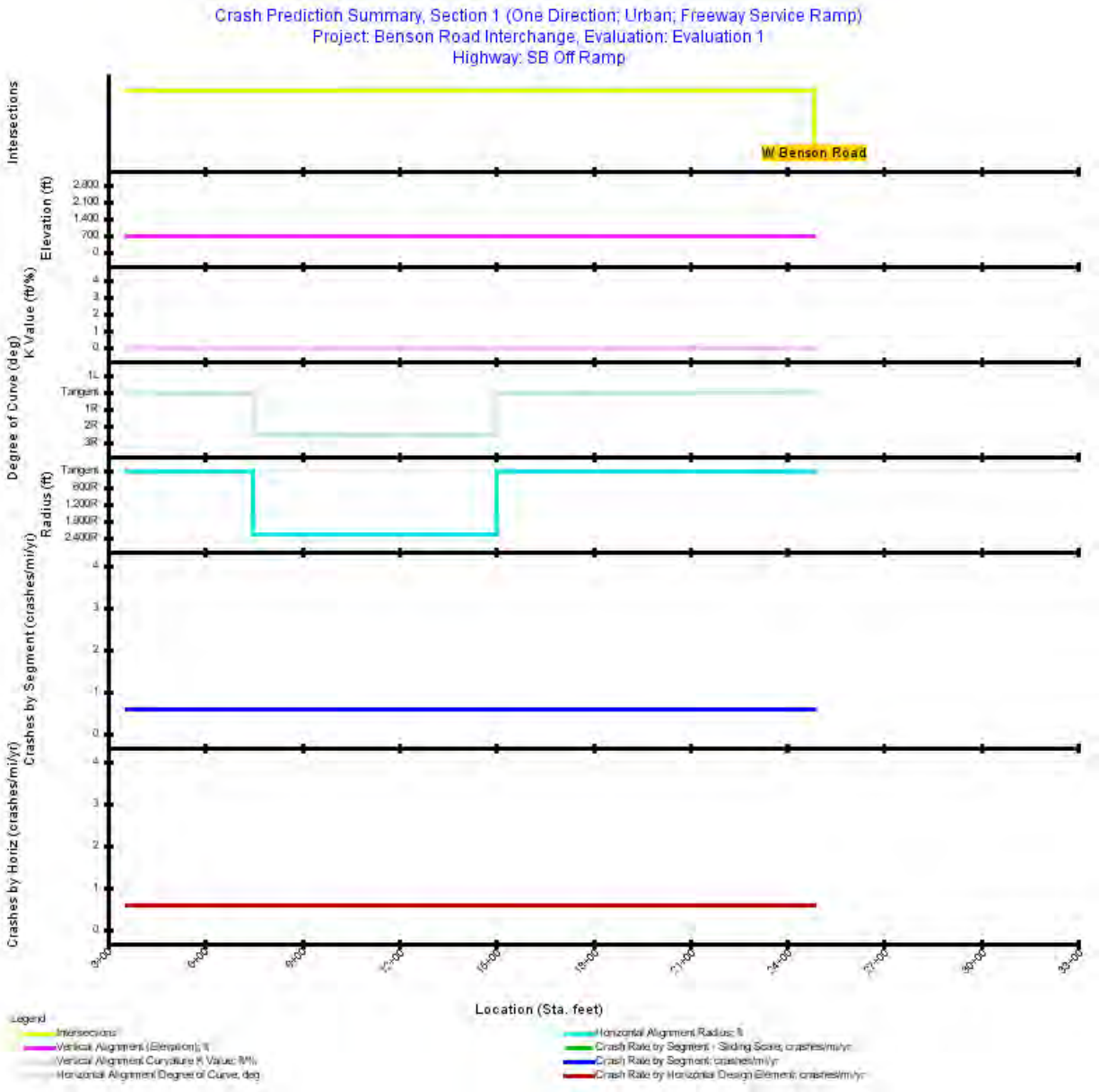

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	1EX	Urban	3+59.600	24+86.000	2,126.40	0.4027	2023: 1,300; 2024: 1,274; 2025: 1,248; 2026: 1,222; 2027: 1,197; 2028: 1,171; 2029: 1,145; 2030: 1,119; 2031: 1,094; 2032: 1,068; 2033: 1,042; 2034: 1,017; 2035: 991; 2036: 965; 2037: 939; 2038: 914; 2039: 888; 2040: 862; 2041: 836; 2042: 811; 2043: 785; 2044: 759; 2045: 734

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.4027
Average Future Road AADT (vpd)	1,017
Expected Crashes	
Total Crashes	5.26
Fatal and Injury Crashes	2.49
Property-Damage-Only Crashes	2.77
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	47
Percent Property-Damage-Only Crashes (%)	53
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	0.5675
Fatal and Injury Crash Rate (crashes/mi/yr)	0.2690
Property-Damage-Only Crash Rate (crashes/mi/yr)	0.2985
Expected Travel Crash Rate	
Total Travel (million veh-mi)	3.44
Travel Crash Rate (crashes/million veh-mi)	1.53
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.72
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.80

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	3+59.600	24+86.000	0.4027	5.257	0.5675	1.53

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	3+59.600	7+48.480	0.0737	0.961	0.5675	1.53
Simple Curve 1	7+48.480	15+01.540	0.1426	1.862	0.5675	1.53
Tangent	15+01.540	24+86.000	0.1865	2.434	0.5675	1.53

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0778	0.2359	0.9810	1.1970	2.7648

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.01	0.2	0.06	1.1	0.07	1.3
Highway Segment	Collision with Fixed Object	1.73	33.0	1.91	36.4	3.65	69.4
Highway Segment	Collision with Other Object	0.12	2.3	0.37	7.1	0.49	9.4
Highway Segment	Other Single-vehicle Collision	0.50	9.5	0.29	5.4	0.79	14.9
Highway Segment	Collision with Parked Vehicle	0.04	0.7	0.04	0.8	0.08	1.5
Highway Segment	Total Single Vehicle Crashes	2.40	45.7	2.67	50.8	5.07	96.5
Highway Segment	Right-Angle Collision	0.00	0.1	0.00	0.0	0.00	0.1
Highway Segment	Head-on Collision	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Other Multi-vehicle Collision	0.00	0.1	0.00	0.0	0.01	0.1
Highway Segment	Rear-end Collision	0.07	1.3	0.06	1.2	0.13	2.5
Highway Segment	Sideswipe, Same Direction Collision	0.02	0.3	0.03	0.5	0.04	0.8
Highway Segment	Total Multiple Vehicle Crashes	0.09	1.7	0.09	1.8	0.18	3.5
Highway Segment	Total Highway Segment Crashes	2.49	47.4	2.77	52.6	5.26	100.0
	Total Crashes	2.49	47.4	2.77	52.6	5.26	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 13, 2018

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Evaluation Date: Wed Jun 13 13:50:40 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Intersection Title: NB Terminal
Intersection Comment: Created Wed Apr 11 12:49:16 CDT 2018
Intersection Version: v1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Wed Jun 13 13:50:31 CDT 2018

Minimum Location: 10+00.000
Maximum Location: 31+00.000
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

NB Terminal Evaluation

Intersection: NB Terminal
Evaluation Start Location: 10+00.000
Evaluation End Location: 31+00.000
Calibration Factor: RT_SG_FI=1.0; RT_SG_PDO=1.0;

Table 1. Evaluation Ramp Terminal - Site (NB Terminal)

Inter. No.	Ramp Terminal Type	Area Type	Legs	Location (Sta. ft)	Traffic Control	AADT
1	D4-Four-Leg Ramp Terminal with Diagonal Ramps	Urban	4	25+34.430	Signalized	Inside: 2023: 9,000; 2024: 9,559; 2025: 10,119; 2026: 10,678; 2027: 11,238; 2028: 11,797; 2029: 12,357; 2030: 12,917; 2031: 13,476; 2032: 14,036; 2033: 14,595; 2034: 15,155; 2035: 15,715; 2036: 16,274; 2037: 16,834; 2038: 17,393; 2039: 17,953; 2040: 18,513; 2041: 19,072; 2042: 19,632; 2043: 20,191; 2044: 20,751; 2045: 21,311; Outside: 2023: 1,500; 2024: 2,089; 2025: 2,679; 2026: 3,269; 2027: 3,859; 2028: 4,449; 2029: 5,038; 2030: 5,628; 2031: 6,218; 2032: 6,808; 2033: 7,398; 2034: 7,988; 2035: 8,577; 2036: 9,167; 2037: 9,757; 2038: 10,347; 2039: 10,937; 2040: 11,526; 2041: 12,116; 2042: 12,706; 2043: 13,296; 2044: 13,886; 2045: 14,476 :: Entrance: 2023: 1,900; 2024: 1,878; 2025: 1,857; 2026: 1,835; 2027: 1,814; 2028: 1,792; 2029: 1,771; 2030: 1,750; 2031: 1,728; 2032: 1,707; 2033: 1,685; 2034: 1,664; 2035: 1,643; 2036: 1,621; 2037: 1,600; 2038: 1,578; 2039: 1,557; 2040: 1,536; 2041: 1,514; 2042: 1,493; 2043: 1,471; 2044: 1,450; 2045: 1,429; Exit: 2023: 8,600; 2024: 8,743; 2025: 8,886; 2026: 9,029; 2027: 9,172; 2028: 9,315; 2029: 9,458; 2030: 9,601; 2031: 9,744; 2032: 9,887; 2033: 10,030; 2034: 10,174; 2035: 10,317; 2036: 10,460; 2037: 10,603; 2038: 10,746; 2039: 10,889; 2040: 11,032; 2041: 11,175; 2042: 11,318; 2043: 11,461; 2044: 11,604; 2045: 11,748

Table 2. Expected Ramp Terminal Crash Rates and Frequencies (NB Terminal)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.0000
Expected Crashes	
Total Crashes	156.07
Fatal and Injury Crashes	68.01
Property-Damage-Only Crashes	88.06
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	44
Percent Property-Damage-Only Crashes (%)	56

Table 3. Expected Crash Frequencies and Rates by Ramp Terminal (NB Terminal)

Segment Number/Intersection Name/Cross Road	Location (Sta. ft)	Expected No. Crashes for Evaluation Period	Expected No. Crashes/Year (crashes/million veh)	Expected Crash Rate (crashes/yr)
NB Terminal	25+34.430	156.069	1.06	6.7856

Table 4. Expected Crash Severity by Ramp Terminal (NB Terminal)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0801	1.9996	11.9200	54.0127	88.0562

Table 5. Expected Ramp Terminal Crash Type Distribution (NB Terminal)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Ramp Terminal	Collision with Animal	0.00	0.0	0.00	0.0	0.00	0.0
Ramp Terminal	Collision with Fixed Object	2.24	1.4	4.40	2.8	6.65	4.3
Ramp Terminal	Collision with Other Object	0.07	0.0	0.18	0.1	0.24	0.2
Ramp Terminal	Other Single-vehicle Collision	1.22	0.8	0.62	0.4	1.84	1.2
Ramp Terminal	Collision with Parked Vehicle	0.07	0.0	0.18	0.1	0.24	0.2
Ramp Terminal	Total Single Vehicle Crashes	3.60	2.3	5.37	3.4	8.98	5.8
Ramp Terminal	Right-Angle Collision	17.68	11.3	19.37	12.4	37.06	23.7
Ramp Terminal	Head-on Collision	0.75	0.5	0.62	0.4	1.36	0.9
Ramp Terminal	Other Multi-vehicle Collision	0.61	0.4	1.76	1.1	2.37	1.5
Ramp Terminal	Rear-end Collision	42.51	27.2	47.81	30.6	90.32	57.9
Ramp Terminal	Sideswipe, Same Direction Collision	2.86	1.8	13.12	8.4	15.98	10.2
Ramp Terminal	Total Multiple Vehicle Crashes	64.41	41.3	82.69	53.0	147.09	94.2
Ramp Terminal	Total Ramp Terminal Crashes	68.01	43.6	88.06	56.4	156.07	100.0
	Total Crashes	68.01	43.6	88.06	56.4	156.07	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 13, 2018

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Evaluation Date: Wed Jun 13 13:55:45 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
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Phone: 402-578-9254
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Project Title: Benson Road Interchange
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Intersection Title: SB Terminal
Intersection Comment: Created Wed Apr 11 12:56:42 CDT 2018
Intersection Version: v1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Wed Jun 13 13:55:39 CDT 2018

Minimum Location: 10+00.000
Maximum Location: 31+00.000
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

SB Terminal Evaluation

Intersection: SB Terminal
Evaluation Start Location: 10+00.000
Evaluation End Location: 31+00.000
Calibration Factor: RT_ST_FI=1.0; RT_ST_PDO=1.0;

Table 1. Evaluation Ramp Terminal - Site (SB Terminal)

Inter. No.	Ramp Terminal Type	Area Type	Legs	Location (Sta. ft)	Traffic Control	AADT
1	D4-Four-Leg Ramp Terminal with Diagonal Ramps	Urban	4	14+66.230	Stop-Controlled	Inside: 2023: 9,000; 2024: 9,559; 2025: 10,119; 2026: 10,678; 2027: 11,238; 2028: 11,797; 2029: 12,357; 2030: 12,917; 2031: 13,476; 2032: 14,036; 2033: 14,595; 2034: 15,155; 2035: 15,715; 2036: 16,274; 2037: 16,834; 2038: 17,393; 2039: 17,953; 2040: 18,513; 2041: 19,072; 2042: 19,632; 2043: 20,191; 2044: 20,751; 2045: 21,311; Outside: 2023: 17,300; 2024: 17,748; 2025: 18,197; 2026: 18,645; 2027: 19,094; 2028: 19,542; 2029: 19,991; 2030: 20,439; 2031: 20,888; 2032: 21,336; 2033: 21,785; 2034: 22,234; 2035: 22,682; 2036: 23,131; 2037: 23,579; 2038: 24,028; 2039: 24,476; 2040: 24,925; 2041: 25,373; 2042: 25,822; 2043: 26,270; 2044: 26,719; 2045: 27,168 :: Entrance: 2023: 9,000; 2024: 8,965; 2025: 8,930; 2026: 8,896; 2027: 8,861; 2028: 8,827; 2029: 8,792; 2030: 8,758; 2031: 8,723; 2032: 8,689; 2033: 8,654; 2034: 8,620; 2035: 8,585; 2036: 8,550; 2037: 8,516; 2038: 8,481; 2039: 8,447; 2040: 8,412; 2041: 8,378; 2042: 8,343; 2043: 8,309; 2044: 8,274; 2045: 8,240; Exit: 2023: 1,300; 2024: 1,274; 2025: 1,248; 2026: 1,222; 2027: 1,197; 2028: 1,171; 2029: 1,145; 2030: 1,119; 2031: 1,094; 2032: 1,068; 2033: 1,042; 2034: 1,017; 2035: 991; 2036: 965; 2037: 939; 2038: 914; 2039: 888; 2040: 862; 2041: 836; 2042: 811; 2043: 785; 2044: 759; 2045: 734

Table 2. Expected Ramp Terminal Crash Rates and Frequencies (SB Terminal)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.0000
Expected Crashes	
Total Crashes	99.20
Fatal and Injury Crashes	29.03
Property-Damage-Only Crashes	70.17
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	29
Percent Property-Damage-Only Crashes (%)	71

Table 3. Expected Crash Frequencies and Rates by Ramp Terminal (SB Terminal)

Segment Number/Intersection Name/Cross Road	Location (Sta. ft)	Expected No. Crashes for Evaluation Period	Expected No. Crashes/Year (crashes/million veh)	Expected Crash Rate (crashes/yr)
SB Terminal	14+66.230	99.196	0.50	4.3129

Table 4. Expected Crash Severity by Ramp Terminal (SB Terminal)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.1538	0.8077	5.2214	22.8456	70.1676

Table 5. Expected Ramp Terminal Crash Type Distribution (SB Terminal)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Ramp Terminal	Collision with Animal	0.00	0.0	0.00	0.0	0.00	0.0
Ramp Terminal	Collision with Fixed Object	2.47	2.5	7.72	7.8	10.19	10.3
Ramp Terminal	Collision with Other Object	0.00	0.0	0.00	0.0	0.00	0.0
Ramp Terminal	Other Single-vehicle Collision	0.73	0.7	1.40	1.4	2.13	2.1
Ramp Terminal	Collision with Parked Vehicle	0.00	0.0	0.56	0.6	0.56	0.6
Ramp Terminal	Total Single Vehicle Crashes	3.19	3.2	9.68	9.8	12.88	13.0
Ramp Terminal	Right-Angle Collision	13.29	13.4	26.52	26.7	39.82	40.1
Ramp Terminal	Head-on Collision	0.49	0.5	0.84	0.8	1.33	1.3
Ramp Terminal	Other Multi-vehicle Collision	0.49	0.5	1.12	1.1	1.62	1.6
Ramp Terminal	Rear-end Collision	10.83	10.9	26.45	26.7	37.28	37.6
Ramp Terminal	Sideswipe, Same Direction Collision	0.73	0.7	5.54	5.6	6.27	6.3
Ramp Terminal	Total Multiple Vehicle Crashes	25.84	26.0	60.48	61.0	86.32	87.0
Ramp Terminal	Total Ramp Terminal Crashes	29.03	29.3	70.17	70.7	99.20	100.0
	Total Crashes	29.03	29.3	70.17	70.7	99.20	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 6. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (18,197 vpd) for 2025 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (18,645 vpd) for 2026 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (19,094 vpd) for 2027 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (19,542 vpd) for 2028 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (19,991 vpd) for 2029 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (20,439 vpd) for 2030 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (20,888 vpd) for 2031 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (21,336 vpd) for 2032 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (21,785 vpd) for 2033 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (22,234 vpd) for 2034 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (22,682 vpd) for 2035 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (23,131 vpd) for 2036 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (23,579 vpd) for 2037 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (24,028 vpd) for 2038 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), outside crossroad traffic volume (24,476 vpd) for 2039 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), inside crossroad traffic volume (18,513 vpd) for 2040 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), inside crossroad traffic volume (19,072 vpd) for 2041 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), inside crossroad traffic volume (19,632 vpd) for 2042 exceeds model limit (18,000 vpd) for reliable results for intersection type D4

Start Location (Sta. ft)	End Location (Sta. ft)	Message
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), inside crossroad traffic volume (20,191 vpd) for 2043 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), inside crossroad traffic volume (20,751 vpd) for 2044 exceeds model limit (18,000 vpd) for reliable results for intersection type D4
14+66.230	14+66.230	for intersection #1 (14+66.230 to 14+66.230), inside crossroad traffic volume (21,311 vpd) for 2045 exceeds model limit (18,000 vpd) for reliable results for intersection type D4

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 13, 2018

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Report Overview

Report Generated: Jun 13, 2018 2:12 PM
Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Wed Jun 13 14:10:27 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
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Project Title: Benson Road Interchange DDI
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Highway Title: I-229
Highway Comment: Created Wed Apr 11 10:14:11 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Wed Jun 13 14:10:15 CDT 2018

Minimum Location: 324+28.000
Maximum Location: 447+11.000
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Section 1 Evaluation

Section: Section 1
Evaluation Start Location: 324+28.000
Evaluation End Location: 447+11.000
Functional Class: Freeway
Type of Alignment: Divided, Multilane
Model Category: Freeway Segment
Calibration Factor: FI_EN=1.0; FI_EX=1.0; FI_MV=1.0; FI_SV=1.0; PDO_EN=1.0; PDO_EX=1.0; PDO_MV=1.0; PDO_SV=1.0;

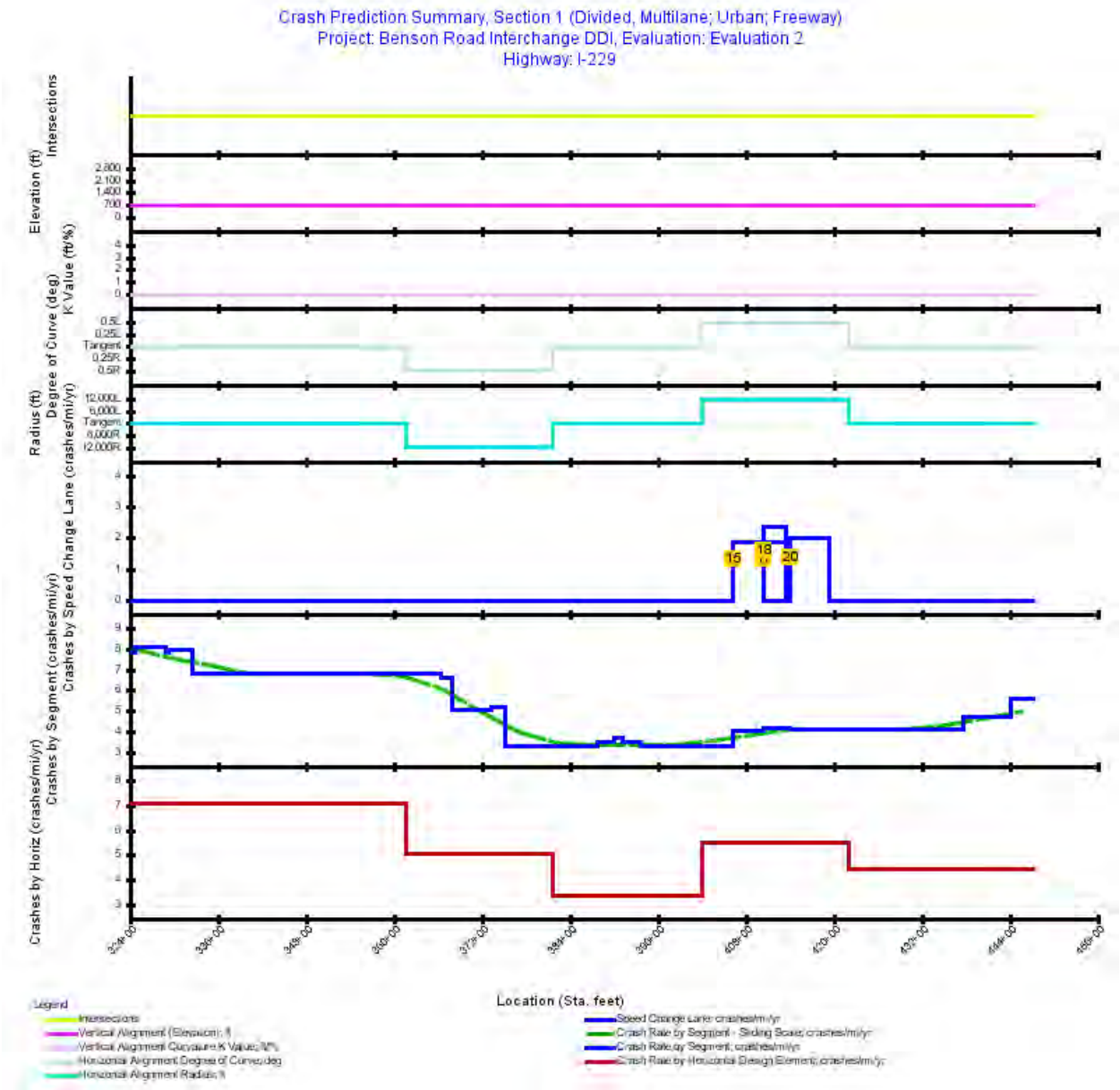

Figure 1. Crash Prediction Summary (Section 1)

Table 1. Evaluation Freeway - Homogeneous Segments (Section 1)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
1	6F	Urban	324+28.000	324+58.000	30.00	0.0057	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
2	6F	Urban	324+58.000	328+83.000	425.00	0.0805	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
3	6F	Urban	328+83.000	329+22.000	39.00	0.0074	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
4	6F	Urban	329+22.000	332+44.000	322.00	0.0610	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
5	6F	Urban	332+44.000	366+45.000	3,401.00	0.6441	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
6	7F	Urban	366+45.000	367+88.000	143.00	0.0271	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
7	7F	Urban	367+88.000	373+20.500	532.50	0.1008	2023: 26,300; 2024: 26,775; 2025: 27,250; 2026: 27,725; 2027: 28,200; 2028: 28,675; 2029: 29,150; 2030: 29,625; 2031: 30,100; 2032: 30,575; 2033: 31,050; 2034: 31,526; 2035: 32,001; 2036: 32,476; 2037: 32,951; 2038: 33,426; 2039: 33,901; 2040: 34,376; 2041: 34,851; 2042: 35,326; 2043: 35,801; 2044: 36,276; 2045: 36,752	60.00	Traversable Median	72.00
8	6F	Urban	373+20.500	375+20.000	199.50	0.0378	2023: 26,300; 2024: 26,775; 2025: 27,250; 2026: 27,725; 2027: 28,200; 2028: 28,675; 2029: 29,150; 2030: 29,625; 2031: 30,100; 2032: 30,575; 2033: 31,050; 2034: 31,526; 2035: 32,001; 2036: 32,476; 2037: 32,951; 2038: 33,426; 2039: 33,901; 2040: 34,376; 2041: 34,851; 2042: 35,326; 2043: 35,801; 2044: 36,276; 2045: 36,752	60.00	Traversable Median	72.00
9	4F	Urban	375+20.000	387+71.000	1,251.00	0.2369	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
10	4F	Urban	387+71.000	390+06.000	235.00	0.0445	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
11	4F	Urban	390+06.000	391+17.000	111.00	0.0210	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
12	4F	Urban	391+17.000	393+63.000	246.00	0.0466	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
13	4F	Urban	393+63.000	406+26.000	1,263.00	0.2392	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
14	4F	Urban	406+26.000	410+39.300	413.30	0.0783	2023: 19,200; 2024: 19,603; 2025: 20,006; 2026: 20,409; 2027: 20,812; 2028: 21,216; 2029: 21,619; 2030: 22,022; 2031: 22,425; 2032: 22,829; 2033: 23,232; 2034: 23,635; 2035: 24,038; 2036: 24,441; 2037: 24,845; 2038: 25,248; 2039: 25,651; 2040: 26,054; 2041: 26,458; 2042: 26,861; 2043: 27,264; 2044: 27,667; 2045: 28,071	60.00	Traversable Median	72.00
16	4F	Urban	410+39.300	414+02.000	362.70	0.0687	2023: 19,200; 2024: 19,603; 2025: 20,006; 2026: 20,409; 2027: 20,812; 2028: 21,216; 2029: 21,619; 2030: 22,022; 2031: 22,425; 2032: 22,829; 2033: 23,232; 2034: 23,635; 2035: 24,038; 2036: 24,441; 2037: 24,845; 2038: 25,248; 2039: 25,651; 2040: 26,054; 2041: 26,458; 2042: 26,861; 2043: 27,264; 2044: 27,667; 2045: 28,071	60.00	Traversable Median	72.00
19	4F	Urban	414+02.000	437+61.000	2,359.00	0.4468	2023: 20,500; 2024: 20,909; 2025: 21,318; 2026: 21,727; 2027: 22,136; 2028: 22,545; 2029: 22,954; 2030: 23,363; 2031: 23,772; 2032: 24,181; 2033: 24,590; 2034: 25,000; 2035: 25,409; 2036: 25,818; 2037: 26,227; 2038: 26,636; 2039: 27,045; 2040: 27,454; 2041: 27,863; 2042: 28,272; 2043: 28,681; 2044: 29,090; 2045: 29,500	60.00	Traversable Median	72.00
21	4F	Urban	437+61.000	444+19.000	658.00	0.1246	2023: 20,500; 2024: 20,909; 2025: 21,318; 2026: 21,727; 2027: 22,136; 2028: 22,545; 2029: 22,954; 2030: 23,363; 2031: 23,772; 2032: 24,181; 2033: 24,590; 2034: 25,000; 2035: 25,409; 2036: 25,818; 2037: 26,227; 2038: 26,636; 2039: 27,045; 2040: 27,454; 2041: 27,863; 2042: 28,272; 2043: 28,681; 2044: 29,090; 2045: 29,500	60.00	Traversable Median	72.00
22	4F	Urban	444+19.000	447+11.000	292.00	0.0553	2023: 20,500; 2024: 20,909; 2025: 21,318; 2026: 21,727; 2027: 22,136; 2028: 22,545; 2029: 22,954; 2030: 23,363; 2031: 23,772; 2032: 24,181; 2033: 24,590; 2034: 25,000; 2035: 25,409; 2036: 25,818; 2037: 26,227; 2038: 26,636; 2039: 27,045; 2040: 27,454; 2041: 27,863; 2042: 28,272; 2043: 28,681; 2044: 29,090; 2045: 29,500	60.00	Traversable Median	72.00

Table 2. Evaluation Freeway - Speed Change Lanes (Speed Change)

Seg. No.	Type	Ramp Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
15	4SC	Entrance	406+26.000	410+39.300	413.30	0.0783	2023: 19,200; 2024: 19,603; 2025: 20,006; 2026: 20,409; 2027: 20,812; 2028: 21,216; 2029: 21,619; 2030: 22,022; 2031: 22,425; 2032: 22,829; 2033: 23,232; 2034: 23,635; 2035: 24,038; 2036: 24,441; 2037: 24,845; 2038: 25,248; 2039: 25,651; 2040: 26,054; 2041: 26,458; 2042: 26,861; 2043: 27,264; 2044: 27,667; 2045: 28,071	60.00	Traversable Median	72.00
17	4SC	Entrance	410+39.300	414+02.000	362.70	0.0687	2023: 19,200; 2024: 19,603; 2025: 20,006; 2026: 20,409; 2027: 20,812; 2028: 21,216; 2029: 21,619; 2030: 22,022; 2031: 22,425; 2032: 22,829; 2033: 23,232; 2034: 23,635; 2035: 24,038; 2036: 24,441; 2037: 24,845; 2038: 25,248; 2039: 25,651; 2040: 26,054; 2041: 26,458; 2042: 26,861; 2043: 27,264; 2044: 27,667; 2045: 28,071	60.00	Traversable Median	72.00
18	4SC	Exit	410+39.300	413+39.300	300.00	0.0568	2023: 19,200; 2024: 19,603; 2025: 20,006; 2026: 20,409; 2027: 20,812; 2028: 21,216; 2029: 21,619; 2030: 22,022; 2031: 22,425; 2032: 22,829; 2033: 23,232; 2034: 23,635; 2035: 24,038; 2036: 24,441; 2037: 24,845; 2038: 25,248; 2039: 25,651; 2040: 26,054; 2041: 26,458; 2042: 26,861; 2043: 27,264; 2044: 27,667; 2045: 28,071	60.00	Traversable Median	72.00
20	4SC	Entrance	414+02.000	419+26.000	524.00	0.0992	2023: 20,500; 2024: 20,909; 2025: 21,318; 2026: 21,727; 2027: 22,136; 2028: 22,545; 2029: 22,954; 2030: 23,363; 2031: 23,772; 2032: 24,181; 2033: 24,590; 2034: 25,000; 2035: 25,409; 2036: 25,818; 2037: 26,227; 2038: 26,636; 2039: 27,045; 2040: 27,454; 2041: 27,863; 2042: 28,272; 2043: 28,681; 2044: 29,090; 2045: 29,500	60.00	Traversable Median	72.00

Table 3. Expected Freeway Crash Rates and Frequencies (Section 1)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	2.3263
Average Future Road AADT (vpd)	30,282
Expected Crashes	
Total Crashes	257.02
Fatal and Injury Crashes	95.54
Property-Damage-Only Crashes	161.47
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	37
Percent Property-Damage-Only Crashes (%)	63
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	4.8035
Fatal and Injury Crash Rate (crashes/mi/yr)	1.7857
Property-Damage-Only Crash Rate (crashes/mi/yr)	3.0179
Expected Travel Crash Rate	
Total Travel (million veh-mi)	591.39
Travel Crash Rate (crashes/million veh-mi)	0.43
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.16
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.27

Table 4. Expected Freeway Speed Change Lane Crash Rates and Frequencies (Speed Change)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.3030
Average Future Road AADT (vpd)	12,041
Expected Crashes	
Total Crashes	13.95
Fatal and Injury Crashes	4.12
Property-Damage-Only Crashes	9.83
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	30
Percent Property-Damage-Only Crashes (%)	70
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	2.0008
Fatal and Injury Crash Rate (crashes/mi/yr)	0.5909
Property-Damage-Only Crash Rate (crashes/mi/yr)	1.4099
Expected Travel Crash Rate	
Total Travel (million veh-mi)	30.63
Travel Crash Rate (crashes/million veh-mi)	0.46
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.13
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.32

Note: *Total Travel and Crash Rates/Million Vehicle Miles* for *Speed Change Lanes* reflect AADTs that are **half of the Freeway Segment AADTs** based on the assumption of 50/50 directional distribution.

Table 5. Expected Crash Frequencies and Rates by Freeway Segment (Section 1)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Effective Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	324+28.000	324+58.000	0.0057	1.021	7.8142	0.51
2	324+58.000	328+83.000	0.0805	14.940	8.0700	0.53
3	328+83.000	329+22.000	0.0074	1.327	7.8142	0.51
4	329+22.000	332+44.000	0.0610	11.177	7.9687	0.52
5	332+44.000	366+45.000	0.6441	100.780	6.8026	0.45
6	366+45.000	367+88.000	0.0271	4.129	6.6291	0.44
7	367+88.000	373+20.500	0.1009	11.695	5.0420	0.44
8	373+20.500	375+20.000	0.0378	4.532	5.2148	0.45
9	375+20.000	387+71.000	0.2369	18.004	3.3039	0.43
10	387+71.000	390+06.000	0.0445	3.569	3.4861	0.45
11	390+06.000	391+17.000	0.0210	1.787	3.6960	0.48
12	391+17.000	393+63.000	0.0466	3.736	3.4861	0.45
13	393+63.000	406+26.000	0.2392	18.134	3.2960	0.42
14	406+26.000	410+39.300	0.0391	3.625	4.0266	0.47
16	410+39.300	414+02.000	0.0059	0.575	4.2070	0.49
19	414+02.000	437+61.000	0.3972	37.390	4.0932	0.45
21	437+61.000	444+19.000	0.1246	13.519	4.7165	0.52
22	444+19.000	447+11.000	0.0553	7.076	5.5630	0.61

Note: *Effective Length* is the *segment length* minus the length of the *speed change lanes* if present.

Table 6. Expected Crash Frequencies and Rates by Freeway Speed Change Lane (Speed Change)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
15	406+26.000	410+39.300	0.0783	3.355	1.8635	0.43
17	410+39.300	414+02.000	0.0687	2.944	1.8635	0.43
18	410+39.300	413+39.300	0.0568	3.095	2.3687	0.55
20	414+02.000	419+26.000	0.0992	4.550	1.9935	0.44

Note: *Travel Crash Rates/Million Vehicle Miles* for *Speed Change Lanes* reflect AADTs that are **half of the Freeway Segment AADTs** based on the assumption of 50/50 directional distribution.

Table 7. Expected Crash Frequencies and Rates by Horizontal Design Element (Section 1)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	324+28.000	361+59.260	0.7067	114.853	7.0663	0.46
Simple Curve 1	361+59.260	381+62.890	0.3795	44.003	5.0416	0.44
Tangent	381+62.890	401+97.440	0.3853	29.824	3.3651	0.43
Simple Curve 2	401+97.440	422+00.920	0.3794	36.960	5.5274	0.82
Tangent	422+00.920	447+11.000	0.4754	45.322	4.4276	0.48

Table 8. Expected Crash Severity by Freeway Segment (Section 1)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0064	0.0165	0.1181	0.2311	0.6490
2	0.0845	0.2236	1.6266	3.3876	9.6179
3	0.0083	0.0215	0.1536	0.3004	0.8438
4	0.0704	0.1816	1.2818	2.4132	7.2302
5	0.7730	1.9468	13.0650	21.5285	63.4669
6	0.0385	0.0992	0.5983	0.8512	2.5422
7	0.1146	0.2948	1.7788	2.5308	6.9765
8	0.0427	0.1099	0.6628	0.9431	2.7734
9	0.1567	0.3963	2.5253	3.8291	11.0968
10	0.0258	0.0652	0.4481	0.7736	2.2559
11	0.0116	0.0297	0.2080	0.3823	1.1555
12	0.0270	0.0682	0.4691	0.8098	2.3615
13	0.1540	0.3870	2.5147	3.9013	11.1764
14	0.0335	0.0863	0.5206	0.7406	2.2436
16	0.0053	0.0137	0.0830	0.1180	0.3544
19	0.3002	0.7565	4.9925	7.9945	23.3466
21	0.0879	0.2256	1.5822	2.9172	8.7059
22	0.0382	0.1010	0.7344	1.5257	4.6766
Total	1.9786	5.0234	33.3629	55.1782	161.4732

Table 9. Expected Crash Severity by Speed Change Lane (Speed Change)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
15	0.0235	0.0605	0.3648	0.5191	2.3872
17	0.0206	0.0531	0.3202	0.4555	2.0949
18	0.0240	0.0619	0.3733	0.5311	2.1051
20	0.0313	0.0808	0.4899	0.7086	3.2397
Total	0.0994	0.2562	1.5482	2.2143	9.8269

Table 10. Expected Speed Change Lane Crash Type Distribution (Section 1)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.24	0.1	2.45	1.0	2.69	1.0
Highway Segment	Collision with Fixed Object	44.28	17.2	79.59	31.0	123.87	48.2
Highway Segment	Collision with Other Object	3.13	1.2	15.45	6.0	18.58	7.2
Highway Segment	Other Single-vehicle Collision	12.76	5.0	11.89	4.6	24.65	9.6
Highway Segment	Collision with Parked Vehicle	0.92	0.4	1.78	0.7	2.70	1.1
Highway Segment	Total Single Vehicle Crashes	61.32	23.9	111.16	43.3	172.49	67.1
Highway Segment	Right-Angle Collision	1.06	0.4	0.91	0.4	1.97	0.8
Highway Segment	Head-on Collision	0.27	0.1	0.10	0.0	0.37	0.1
Highway Segment	Other Multi-vehicle Collision	1.06	0.4	1.21	0.5	2.27	0.9
Highway Segment	Rear-end Collision	25.66	10.0	34.71	13.5	60.38	23.5
Highway Segment	Sideswipe, Same Direction Collision	6.16	2.4	13.38	5.2	19.54	7.6
Highway Segment	Total Multiple Vehicle Crashes	34.22	13.3	50.31	19.6	84.53	32.9
Highway Segment	Total Highway Segment Crashes	95.54	37.2	161.47	62.8	257.02	100.0
	Total Crashes	95.54	37.2	161.47	62.8	257.02	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 11. Expected Exit Speed Change Lane Crash Type Distribution (Speed Change)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.0	0.01	0.5	0.01	0.5
Highway Segment	Collision with Fixed Object	0.19	6.3	0.44	14.1	0.63	20.3
Highway Segment	Collision with Other Object	0.02	0.5	0.06	2.0	0.08	2.6
Highway Segment	Other Single-vehicle Collision	0.05	1.6	0.05	1.6	0.10	3.1
Highway Segment	Collision with Parked Vehicle	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Total Single Vehicle Crashes	0.26	8.3	0.56	18.2	0.82	26.5
Highway Segment	Right-Angle Collision	0.01	0.4	0.03	0.8	0.04	1.2
Highway Segment	Head-on Collision	0.01	0.2	0.00	0.1	0.01	0.3
Highway Segment	Other Multi-vehicle Collision	0.02	0.5	0.03	1.1	0.05	1.6
Highway Segment	Rear-end Collision	0.54	17.6	1.19	38.4	1.73	56.0
Highway Segment	Sideswipe, Same Direction Collision	0.16	5.1	0.29	9.4	0.45	14.4
Highway Segment	Total Multiple Vehicle Crashes	0.73	23.6	1.54	49.8	2.27	73.5
Highway Segment	Total Highway Segment Crashes	0.99	32.0	2.10	68.0	3.10	100.0
	Total Crashes	0.99	32.0	2.10	68.0	3.10	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 12. Expected Entrance Speed Change Lane Crash Type Distribution (Speed Change)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.0	0.01	0.1	0.01	0.1
Highway Segment	Collision with Fixed Object	0.61	5.6	1.00	9.2	1.60	14.8
Highway Segment	Collision with Other Object	0.06	0.5	0.28	2.6	0.34	3.1
Highway Segment	Other Single-vehicle Collision	0.21	1.9	0.12	1.1	0.33	3.1
Highway Segment	Collision with Parked Vehicle	0.01	0.1	0.02	0.2	0.04	0.3
Highway Segment	Total Single Vehicle Crashes	0.89	8.2	1.44	13.2	2.33	21.4
Highway Segment	Right-Angle Collision	0.06	0.5	0.12	1.1	0.18	1.7
Highway Segment	Head-on Collision	0.01	0.1	0.01	0.1	0.02	0.2
Highway Segment	Other Multi-vehicle Collision	0.05	0.5	0.12	1.1	0.17	1.6
Highway Segment	Rear-end Collision	1.70	15.7	4.09	37.7	5.79	53.4
Highway Segment	Sideswipe, Same Direction Collision	0.42	3.8	1.95	17.9	2.36	21.8
Highway Segment	Total Multiple Vehicle Crashes	2.24	20.6	6.29	57.9	8.53	78.6
Highway Segment	Total Highway Segment Crashes	3.13	28.8	7.72	71.2	10.85	100.0
	Total Crashes	3.13	28.8	7.72	71.2	10.85	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 13. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
366+45.000	367+88.000	for segment #6 (366+45.000 to 367+88.000), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
367+88.000	373+20.500	for segment #7 (367+88.000 to 373+20.500), Freeway Segment of type Seven-lane Freeway is using unbalanced lane processing with types Six-lane Freeway and Eight-lane Freeway
373+20.500	375+20.000	for segment #8 (373+20.500 to 375+20.000), Freeway Segment of type Six-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Eight-lane Freeway

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 13, 2018

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Report Overview

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Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Wed Jun 13 14:12:35 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange DDI
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Highway Title: NB On Ramp
Highway Comment: Created Wed Apr 11 11:56:51 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Wed Jun 13 14:12:25 CDT 2018

Minimum Location: 5300+00.000
Maximum Location: 5315+54.070
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 5300+00.000
Evaluation End Location: 5315+54.070
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: ENT_RAMP_MV_FI=1.0; ENT_RAMP_MV_PDO=1.0; ENT_RAMP_SV_FI=1.0; ENT_RAMP_SV_PDO=1.0;

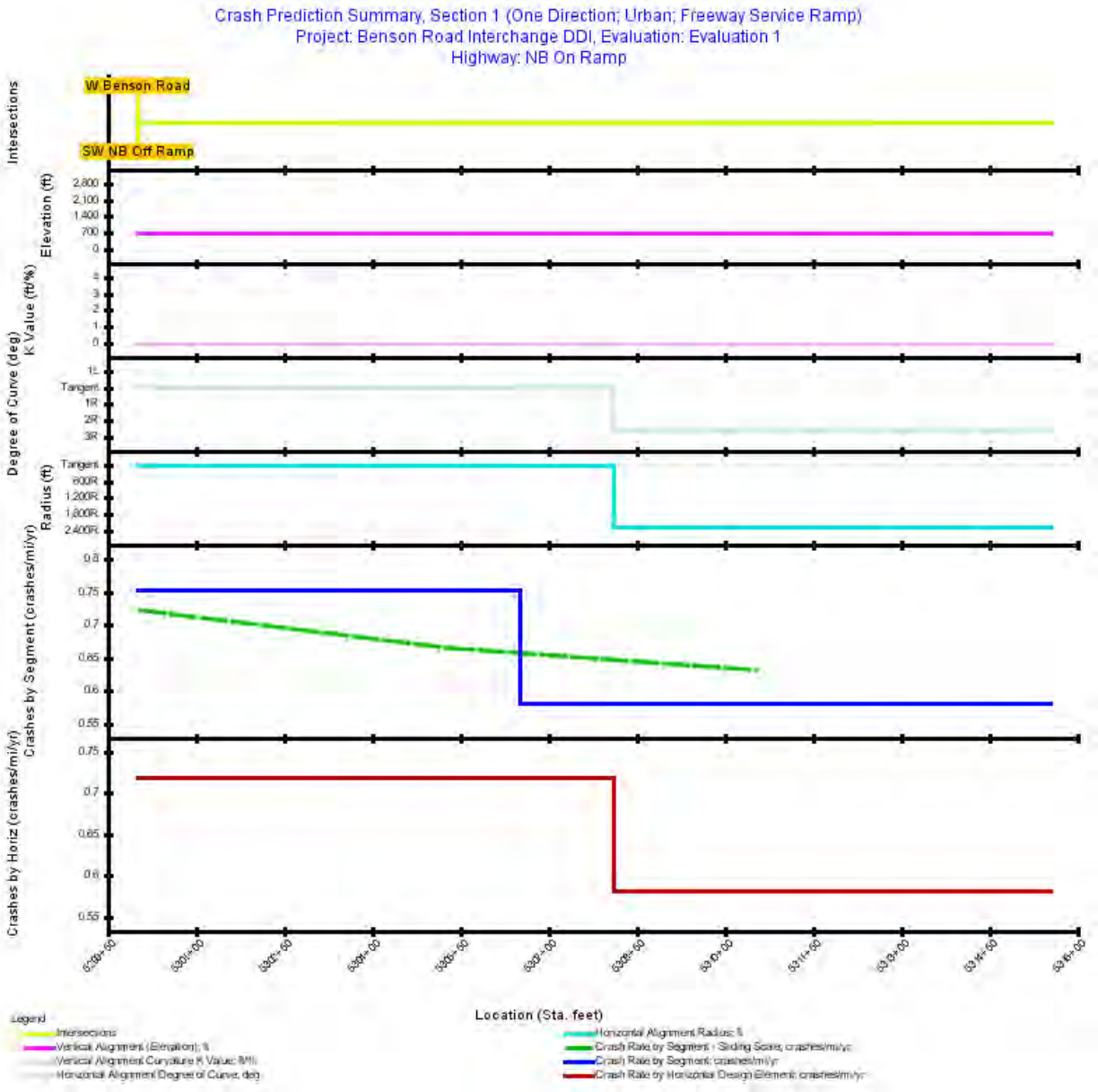

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	2EN	Urban	5300+00.000	5306+51.000	651.00	0.1233	2023: 1,900; 2024: 1,878; 2025: 1,857; 2026: 1,835; 2027: 1,814; 2028: 1,792; 2029: 1,771; 2030: 1,750; 2031: 1,728; 2032: 1,707; 2033: 1,685; 2034: 1,664; 2035: 1,643; 2036: 1,621; 2037: 1,600; 2038: 1,578; 2039: 1,557; 2040: 1,536; 2041: 1,514; 2042: 1,493; 2043: 1,471; 2044: 1,450; 2045: 1,429
2	1EN	Urban	5306+51.000	5315+54.070	903.07	0.1710	2023: 1,900; 2024: 1,878; 2025: 1,857; 2026: 1,835; 2027: 1,814; 2028: 1,792; 2029: 1,771; 2030: 1,750; 2031: 1,728; 2032: 1,707; 2033: 1,685; 2034: 1,664; 2035: 1,643; 2036: 1,621; 2037: 1,600; 2038: 1,578; 2039: 1,557; 2040: 1,536; 2041: 1,514; 2042: 1,493; 2043: 1,471; 2044: 1,450; 2045: 1,429

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.2943
Average Future Road AADT (vpd)	1,664
Expected Crashes	
Total Crashes	4.42
Fatal and Injury Crashes	1.73
Property-Damage-Only Crashes	2.69
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	39
Percent Property-Damage-Only Crashes (%)	61
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	0.6530
Fatal and Injury Crash Rate (crashes/mi/yr)	0.2554
Property-Damage-Only Crash Rate (crashes/mi/yr)	0.3976
Expected Travel Crash Rate	
Total Travel (million veh-mi)	4.11
Travel Crash Rate (crashes/million veh-mi)	1.07
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.42
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.66

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	5300+00.000	5306+51.000	0.1233	2.136	0.7533	1.24
2	5306+51.000	5315+54.070	0.1710	2.284	0.5807	0.96

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	5300+00.000	5308+09.660	0.1533	2.538	0.7195	1.19
Simple Curve 1	5308+09.660	5315+54.070	0.1410	1.883	0.5807	0.96

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0163	0.0494	0.2559	0.4824	1.3323
2	0.0197	0.0598	0.3807	0.4645	1.3595
Total	0.0360	0.1092	0.6365	0.9468	2.6918

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.01	0.1	0.05	1.1	0.05	1.2
Highway Segment	Collision with Fixed Object	0.98	22.1	1.60	36.1	2.57	58.2
Highway Segment	Collision with Other Object	0.07	1.6	0.31	7.0	0.38	8.6
Highway Segment	Other Single-vehicle Collision	0.28	6.4	0.24	5.4	0.52	11.8
Highway Segment	Collision with Parked Vehicle	0.02	0.5	0.04	0.8	0.06	1.3
Highway Segment	Total Single Vehicle Crashes	1.35	30.7	2.23	50.4	3.58	81.1
Highway Segment	Right-Angle Collision	0.01	0.3	0.01	0.2	0.02	0.5
Highway Segment	Head-on Collision	0.00	0.1	0.00	0.0	0.00	0.1
Highway Segment	Other Multi-vehicle Collision	0.01	0.3	0.01	0.3	0.02	0.5
Highway Segment	Rear-end Collision	0.28	6.3	0.32	7.2	0.60	13.6
Highway Segment	Sideswipe, Same Direction Collision	0.07	1.5	0.12	2.8	0.19	4.3
Highway Segment	Total Multiple Vehicle Crashes	0.37	8.4	0.46	10.5	0.84	18.9
Highway Segment	Total Highway Segment Crashes	1.73	39.1	2.69	60.9	4.42	100.0
	Total Crashes	1.73	39.1	2.69	60.9	4.42	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 13, 2018

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Report Overview

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Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Wed Jun 13 14:26:53 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
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Project Title: Benson Road Interchange DDI
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Highway Title: SB On Ramp
Highway Comment: Created Wed Apr 11 12:08:08 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Wed Jun 13 14:26:43 CDT 2018

Minimum Location: 5000+20.800
Maximum Location: 5015+45.940
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 5000+20.800
Evaluation End Location: 5015+45.940
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: ENT_RAMP_MV_FI=1.0; ENT_RAMP_MV_PDO=1.0; ENT_RAMP_SV_FI=1.0; ENT_RAMP_SV_PDO=1.0;

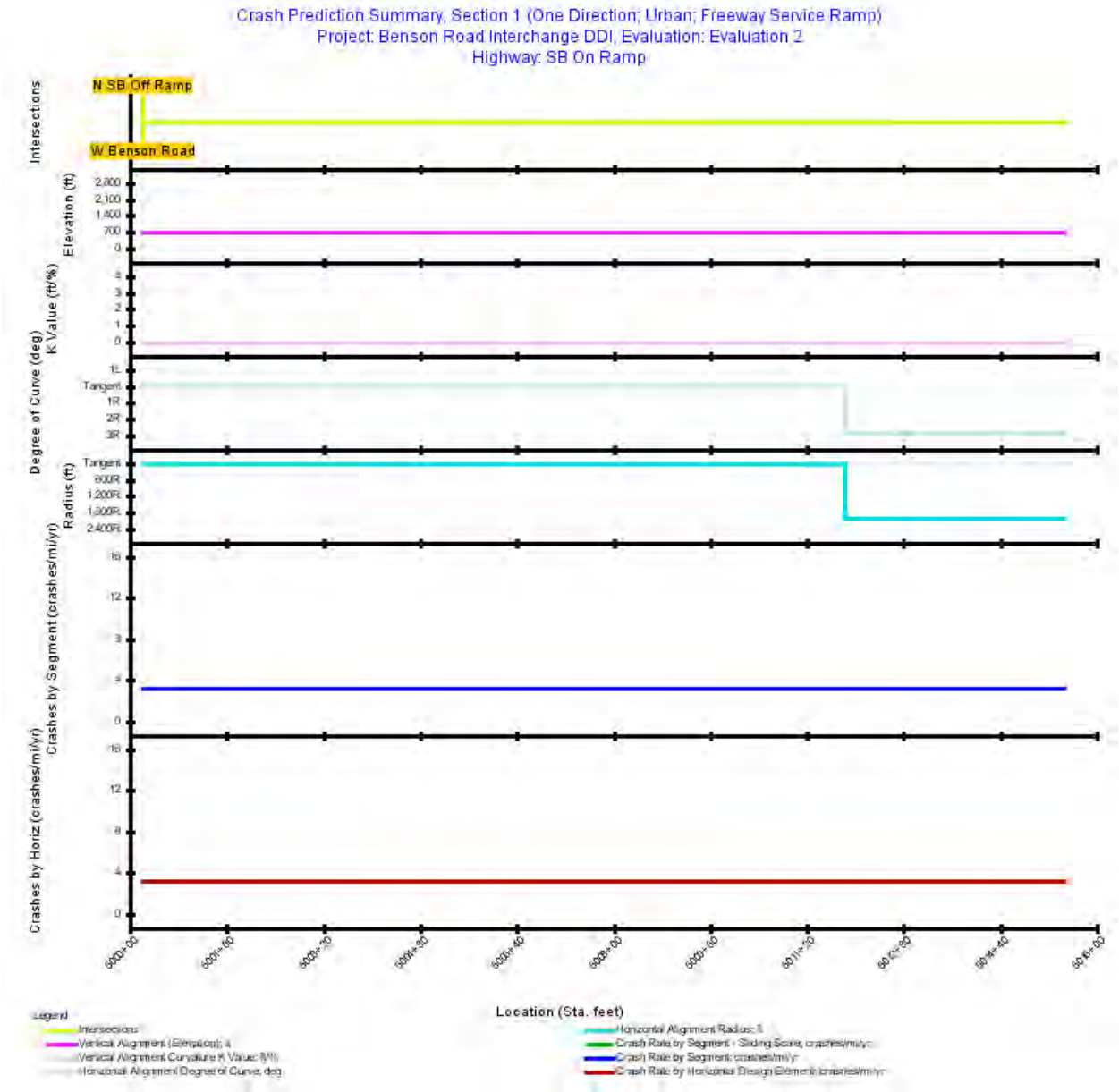

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	2EN	Urban	5000+20.800	5015+45.940	1,525.14	0.2888	2023: 9,000; 2024: 8,965; 2025: 8,930; 2026: 8,896; 2027: 8,861; 2028: 8,827; 2029: 8,792; 2030: 8,758; 2031: 8,723; 2032: 8,689; 2033: 8,654; 2034: 8,620; 2035: 8,585; 2036: 8,550; 2037: 8,516; 2038: 8,481; 2039: 8,447; 2040: 8,412; 2041: 8,378; 2042: 8,343; 2043: 8,309; 2044: 8,274; 2045: 8,240

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.2889
Average Future Road AADT (vpd)	8,620
Expected Crashes	
Total Crashes	20.88
Fatal and Injury Crashes	7.59
Property-Damage-Only Crashes	13.29
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	36
Percent Property-Damage-Only Crashes (%)	64
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	3.1430
Fatal and Injury Crash Rate (crashes/mi/yr)	1.1422
Property-Damage-Only Crash Rate (crashes/mi/yr)	2.0008
Expected Travel Crash Rate	
Total Travel (million veh-mi)	20.90
Travel Crash Rate (crashes/million veh-mi)	1.00
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.36
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.64

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	5000+20.800	5015+45.940	0.2889	20.881	3.1430	1.00

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	5000+20.800	5011+83.600	0.2202	15.920	3.1430	1.00
Simple Curve 1	5011+83.600	5015+45.940	0.0686	4.961	3.1430	1.00

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.1539	0.4666	2.4150	4.5527	13.2924

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.02	0.1	0.17	0.8	0.20	0.9
Highway Segment	Collision with Fixed Object	3.85	18.4	5.69	27.3	9.54	45.7
Highway Segment	Collision with Other Object	0.27	1.3	1.10	5.3	1.38	6.6
Highway Segment	Other Single-vehicle Collision	1.11	5.3	0.85	4.1	1.96	9.4
Highway Segment	Collision with Parked Vehicle	0.08	0.4	0.13	0.6	0.21	1.0
Highway Segment	Total Single Vehicle Crashes	5.33	25.5	7.95	38.1	13.28	63.6
Highway Segment	Right-Angle Collision	0.07	0.3	0.10	0.5	0.17	0.8
Highway Segment	Head-on Collision	0.02	0.1	0.01	0.1	0.03	0.1
Highway Segment	Other Multi-vehicle Collision	0.07	0.3	0.13	0.6	0.20	0.9
Highway Segment	Rear-end Collision	1.69	8.1	3.69	17.7	5.38	25.8
Highway Segment	Sideswipe, Same Direction Collision	0.41	1.9	1.42	6.8	1.83	8.7
Highway Segment	Total Multiple Vehicle Crashes	2.25	10.8	5.34	25.6	7.60	36.4
Highway Segment	Total Highway Segment Crashes	7.59	36.3	13.29	63.7	20.88	100.0
	Total Crashes	7.59	36.3	13.29	63.7	20.88	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 14, 2018

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Report Generated: Jun 14, 2018 11:08 AM
Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Wed Jun 13 14:29:58 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange DDI
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Highway Title: NB Off Ramp
Highway Comment: Created Wed Apr 11 12:37:16 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Wed Jun 13 14:29:49 CDT 2018

Minimum Location: 5+28.500
Maximum Location: 24+28.450
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 5+28.500
Evaluation End Location: 24+28.450
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

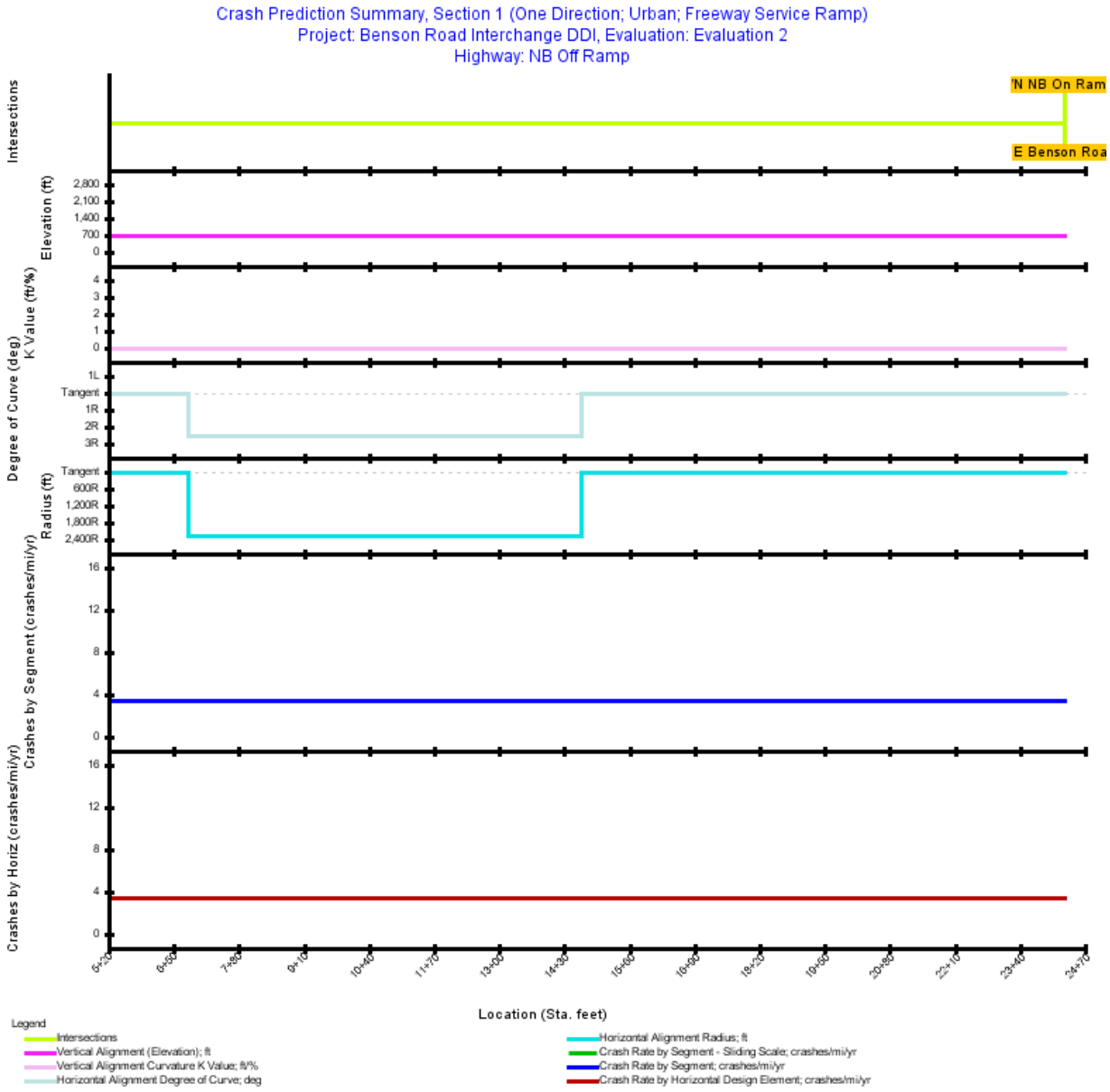

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	2EX	Urban	5+28.500	24+28.450	1,899.95	0.3598	2023: 8,600; 2024: 8,743; 2025: 8,886; 2026: 9,029; 2027: 9,172; 2028: 9,315; 2029: 9,458; 2030: 9,601; 2031: 9,744; 2032: 9,887; 2033: 10,030; 2034: 10,174; 2035: 10,317; 2036: 10,460; 2037: 10,603; 2038: 10,746; 2039: 10,889; 2040: 11,032; 2041: 11,175; 2042: 11,318; 2043: 11,461; 2044: 11,604; 2045: 11,748

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.3598
Average Future Road AADT (vpd)	10,174
Expected Crashes	
Total Crashes	27.98
Fatal and Injury Crashes	11.22
Property-Damage-Only Crashes	16.77
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	40
Percent Property-Damage-Only Crashes (%)	60
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	3.3812
Fatal and Injury Crash Rate (crashes/mi/yr)	1.3553
Property-Damage-Only Crash Rate (crashes/mi/yr)	2.0259
Expected Travel Crash Rate	
Total Travel (million veh-mi)	30.73
Travel Crash Rate (crashes/million veh-mi)	0.91
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.36
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.55

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	5+28.500	24+28.450	0.3598	27.984	3.3812	0.91

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	5+28.500	6+78.060	0.0283	2.203	3.3812	0.91
Simple Curve 1	6+78.060	14+62.820	0.1486	11.559	3.3812	0.91
Tangent	14+62.820	24+28.450	0.1829	14.223	3.3812	0.91

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.3338	1.0121	3.4214	6.4499	16.7666

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.04	0.1	0.30	1.1	0.35	1.2
Highway Segment	Collision with Fixed Object	7.53	26.9	9.91	35.4	17.43	62.3
Highway Segment	Collision with Other Object	0.53	1.9	1.92	6.9	2.46	8.8
Highway Segment	Other Single-vehicle Collision	2.17	7.7	1.48	5.3	3.65	13.0
Highway Segment	Collision with Parked Vehicle	0.16	0.6	0.22	0.8	0.38	1.4
Highway Segment	Total Single Vehicle Crashes	10.42	37.2	13.84	49.4	24.26	86.7
Highway Segment	Right-Angle Collision	0.03	0.1	0.05	0.2	0.08	0.3
Highway Segment	Head-on Collision	0.01	0.0	0.01	0.0	0.01	0.0
Highway Segment	Other Multi-vehicle Collision	0.03	0.1	0.07	0.3	0.10	0.3
Highway Segment	Rear-end Collision	0.60	2.1	2.02	7.2	2.62	9.4
Highway Segment	Sideswipe, Same Direction Collision	0.14	0.5	0.78	2.8	0.92	3.3
Highway Segment	Total Multiple Vehicle Crashes	0.79	2.8	2.93	10.5	3.73	13.3
Highway Segment	Total Highway Segment Crashes	11.22	40.1	16.77	59.9	27.98	100.0
	Total Crashes	11.22	40.1	16.77	59.9	27.98	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 13, 2018

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Report Overview

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Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Wed Jun 13 14:29:58 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange DDI
Project Comment: Benson Road & I-229 Interchange
Project Unit System: U.S. Customary

Highway Title: NB Off Ramp
Highway Comment: Created Wed Apr 11 12:37:16 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Wed Jun 13 14:29:49 CDT 2018

Minimum Location: 5+28.500
Maximum Location: 24+28.450
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 5+28.500
Evaluation End Location: 24+28.450
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

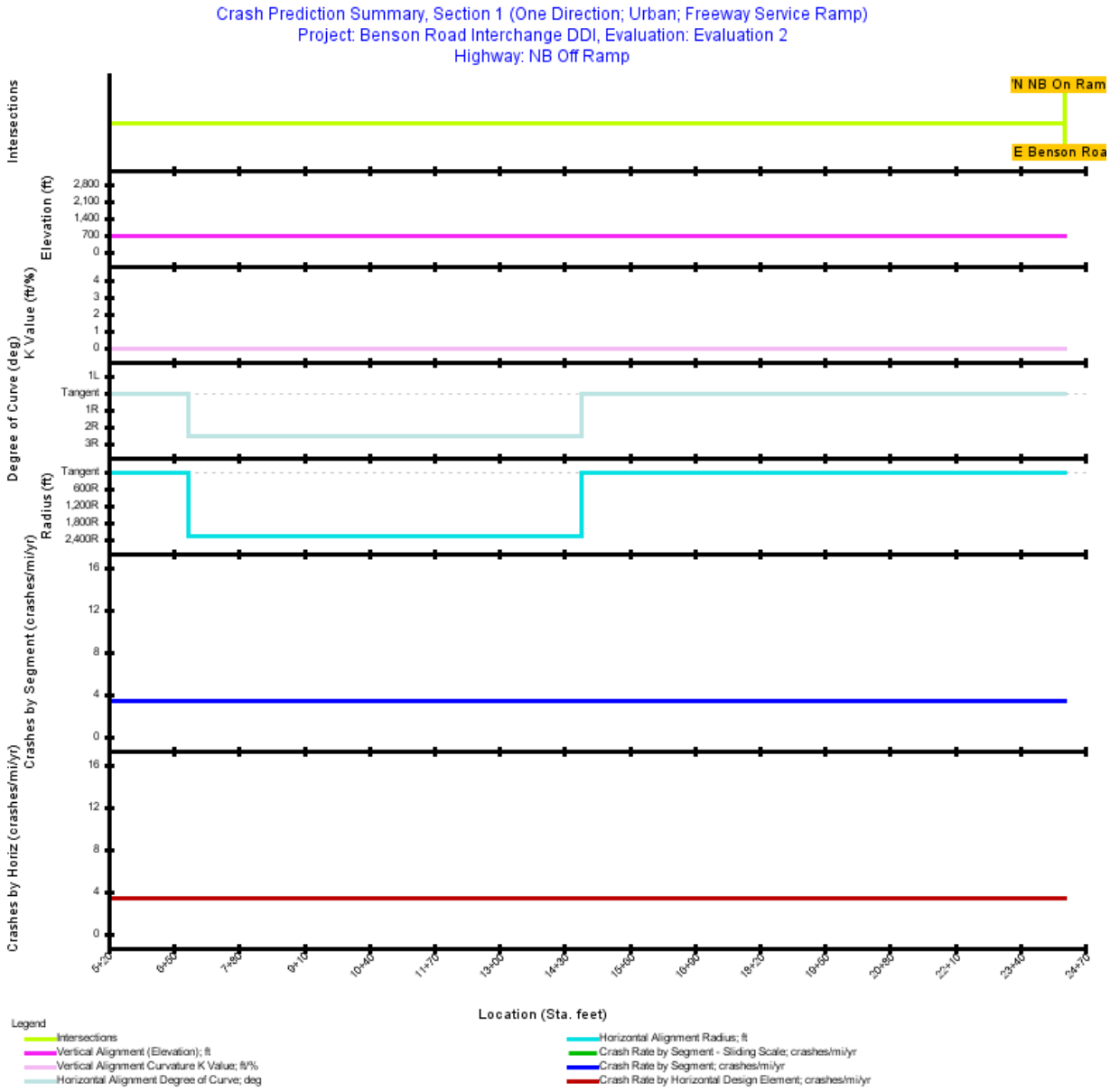

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	2EX	Urban	5+28.500	24+28.450	1,899.95	0.3598	2023: 8,600; 2024: 8,743; 2025: 8,886; 2026: 9,029; 2027: 9,172; 2028: 9,315; 2029: 9,458; 2030: 9,601; 2031: 9,744; 2032: 9,887; 2033: 10,030; 2034: 10,174; 2035: 10,317; 2036: 10,460; 2037: 10,603; 2038: 10,746; 2039: 10,889; 2040: 11,032; 2041: 11,175; 2042: 11,318; 2043: 11,461; 2044: 11,604; 2045: 11,748

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.3598
Average Future Road AADT (vpd)	10,174
Expected Crashes	
Total Crashes	27.98
Fatal and Injury Crashes	11.22
Property-Damage-Only Crashes	16.77
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	40
Percent Property-Damage-Only Crashes (%)	60
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	3.3812
Fatal and Injury Crash Rate (crashes/mi/yr)	1.3553
Property-Damage-Only Crash Rate (crashes/mi/yr)	2.0259
Expected Travel Crash Rate	
Total Travel (million veh-mi)	30.73
Travel Crash Rate (crashes/million veh-mi)	0.91
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.36
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.55

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	5+28.500	24+28.450	0.3598	27.984	3.3812	0.91

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	5+28.500	6+78.060	0.0283	2.203	3.3812	0.91
Simple Curve 1	6+78.060	14+62.820	0.1486	11.559	3.3812	0.91
Tangent	14+62.820	24+28.450	0.1829	14.223	3.3812	0.91

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.3338	1.0121	3.4214	6.4499	16.7666

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.04	0.1	0.30	1.1	0.35	1.2
Highway Segment	Collision with Fixed Object	7.53	26.9	9.91	35.4	17.43	62.3
Highway Segment	Collision with Other Object	0.53	1.9	1.92	6.9	2.46	8.8
Highway Segment	Other Single-vehicle Collision	2.17	7.7	1.48	5.3	3.65	13.0
Highway Segment	Collision with Parked Vehicle	0.16	0.6	0.22	0.8	0.38	1.4
Highway Segment	Total Single Vehicle Crashes	10.42	37.2	13.84	49.4	24.26	86.7
Highway Segment	Right-Angle Collision	0.03	0.1	0.05	0.2	0.08	0.3
Highway Segment	Head-on Collision	0.01	0.0	0.01	0.0	0.01	0.0
Highway Segment	Other Multi-vehicle Collision	0.03	0.1	0.07	0.3	0.10	0.3
Highway Segment	Rear-end Collision	0.60	2.1	2.02	7.2	2.62	9.4
Highway Segment	Sideswipe, Same Direction Collision	0.14	0.5	0.78	2.8	0.92	3.3
Highway Segment	Total Multiple Vehicle Crashes	0.79	2.8	2.93	10.5	3.73	13.3
Highway Segment	Total Highway Segment Crashes	11.22	40.1	16.77	59.9	27.98	100.0
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Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 14, 2018

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Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Thu Jun 14 10:39:31 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange Loop Ramp
Project Comment: Created Thu May 31 14:28:00 CDT 2018
Project Unit System: U.S. Customary

Intersection Title: SB Ramp Terminal
Intersection Comment: Created Wed Jun 06 14:30:34 CDT 2018
Intersection Version: v1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Thu Jun 14 10:39:22 CDT 2018

Minimum Location: 10+00.000
Maximum Location: 31+00.000
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

SB Ramp Terminal Evaluation

Intersection: SB Ramp Terminal
Evaluation Start Location: 10+00.000
Evaluation End Location: 31+00.000
Calibration Factor: RT_SG_FI=1.0; RT_SG_PDO=1.0;

Table 1. Evaluation Ramp Terminal - Site (SB Ramp Terminal)

Inter. No.	Ramp Terminal Type	Area Type	Legs	Location (Sta. ft)	Traffic Control	AADT
1	D4-Four-Leg Ramp Terminal with Diagonal Ramps	Urban	4	14+20.000	Signalized	Inside: 2023: 17,300; 2024: 17,748; 2025: 18,197; 2026: 18,645; 2027: 19,094; 2028: 19,542; 2029: 19,991; 2030: 20,439; 2031: 20,888; 2032: 21,336; 2033: 21,785; 2034: 22,234; 2035: 22,682; 2036: 23,131; 2037: 23,579; 2038: 24,028; 2039: 24,476; 2040: 24,925; 2041: 25,373; 2042: 25,822; 2043: 26,270; 2044: 26,719; 2045: 27,168; Outside: 2023: 17,300; 2024: 17,748; 2025: 18,197; 2026: 18,645; 2027: 19,094; 2028: 19,542; 2029: 19,991; 2030: 20,439; 2031: 20,888; 2032: 21,336; 2033: 21,785; 2034: 22,234; 2035: 22,682; 2036: 23,131; 2037: 23,579; 2038: 24,028; 2039: 24,476; 2040: 24,925; 2041: 25,373; 2042: 25,822; 2043: 26,270; 2044: 26,719; 2045: 27,168 :: Entrance: 2023: 9,000; 2024: 8,965; 2025: 8,930; 2026: 8,896; 2027: 8,861; 2028: 8,827; 2029: 8,792; 2030: 8,758; 2031: 8,723; 2032: 8,689; 2033: 8,654; 2034: 8,620; 2035: 8,585; 2036: 8,550; 2037: 8,516; 2038: 8,481; 2039: 8,447; 2040: 8,412; 2041: 8,378; 2042: 8,343; 2043: 8,309; 2044: 8,274; 2045: 8,240; Exit: 2023: 1,300; 2024: 1,274; 2025: 1,248; 2026: 1,222; 2027: 1,197; 2028: 1,171; 2029: 1,145; 2030: 1,119; 2031: 1,094; 2032: 1,068; 2033: 1,042; 2034: 1,017; 2035: 991; 2036: 965; 2037: 939; 2038: 914; 2039: 888; 2040: 862; 2041: 836; 2042: 811; 2043: 785; 2044: 759; 2045: 734

Table 2. Expected Ramp Terminal Crash Rates and Frequencies (SB Ramp Terminal)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.0000
Expected Crashes	
Total Crashes	221.16
Fatal and Injury Crashes	92.32
Property-Damage-Only Crashes	128.84
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	42
Percent Property-Damage-Only Crashes (%)	58

Table 3. Expected Crash Frequencies and Rates by Ramp Terminal (SB Ramp Terminal)

Segment Number/Intersection Name/Cross Road	Location (Sta. ft)	Expected No. Crashes for Evaluation Period	Expected No. Crashes/Year (crashes/million veh)	Expected Crash Rate (crashes/yr)
SB Ramp Terminal	14+20.000	221.164	0.97	9.6158

Table 4. Expected Crash Severity by Ramp Terminal (SB Ramp Terminal)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0847	2.1165	13.8738	76.2488	128.8401

Table 5. Expected Ramp Terminal Crash Type Distribution (SB Ramp Terminal)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Ramp Terminal	Collision with Animal	0.00	0.0	0.00	0.0	0.00	0.0
Ramp Terminal	Collision with Fixed Object	3.05	1.4	6.44	2.9	9.49	4.3
Ramp Terminal	Collision with Other Object	0.09	0.0	0.26	0.1	0.35	0.2
Ramp Terminal	Other Single-vehicle Collision	1.66	0.8	0.90	0.4	2.56	1.2
Ramp Terminal	Collision with Parked Vehicle	0.09	0.0	0.26	0.1	0.35	0.2
Ramp Terminal	Total Single Vehicle Crashes	4.89	2.2	7.86	3.6	12.75	5.8
Ramp Terminal	Right-Angle Collision	24.00	10.9	28.34	12.8	52.35	23.7
Ramp Terminal	Head-on Collision	1.02	0.5	0.90	0.4	1.92	0.9
Ramp Terminal	Other Multi-vehicle Collision	0.83	0.4	2.58	1.2	3.41	1.5
Ramp Terminal	Rear-end Collision	57.70	26.1	69.96	31.6	127.66	57.7
Ramp Terminal	Sideswipe, Same Direction Collision	3.88	1.8	19.20	8.7	23.07	10.4
Ramp Terminal	Total Multiple Vehicle Crashes	87.43	39.5	120.98	54.7	208.41	94.2
Ramp Terminal	Total Ramp Terminal Crashes	92.32	41.7	128.84	58.3	221.16	100.0
	Total Crashes	92.32	41.7	128.84	58.3	221.16	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 14, 2018

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Report Overview

Report Generated: Jun 14, 2018 10:29 AM
Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Thu Jun 14 10:28:09 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange Loop Ramp
Project Comment: Created Thu May 31 14:28:00 CDT 2018
Project Unit System: U.S. Customary

Highway Title: I-229
Highway Comment: Created Fri Jun 01 07:44:25 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Thu Jun 14 10:27:57 CDT 2018

Minimum Location: 324+28.000
Maximum Location: 447+11.000
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Section 1 Evaluation

Section: Section 1
Evaluation Start Location: 324+28.000
Evaluation End Location: 447+11.000
Functional Class: Freeway
Type of Alignment: Divided, Multilane
Model Category: Freeway Segment
Calibration Factor: FI_EN=1.0; FI_EX=1.0; FI_MV=1.0; FI_SV=1.0; PDO_EN=1.0; PDO_EX=1.0; PDO_MV=1.0; PDO_SV=1.0;

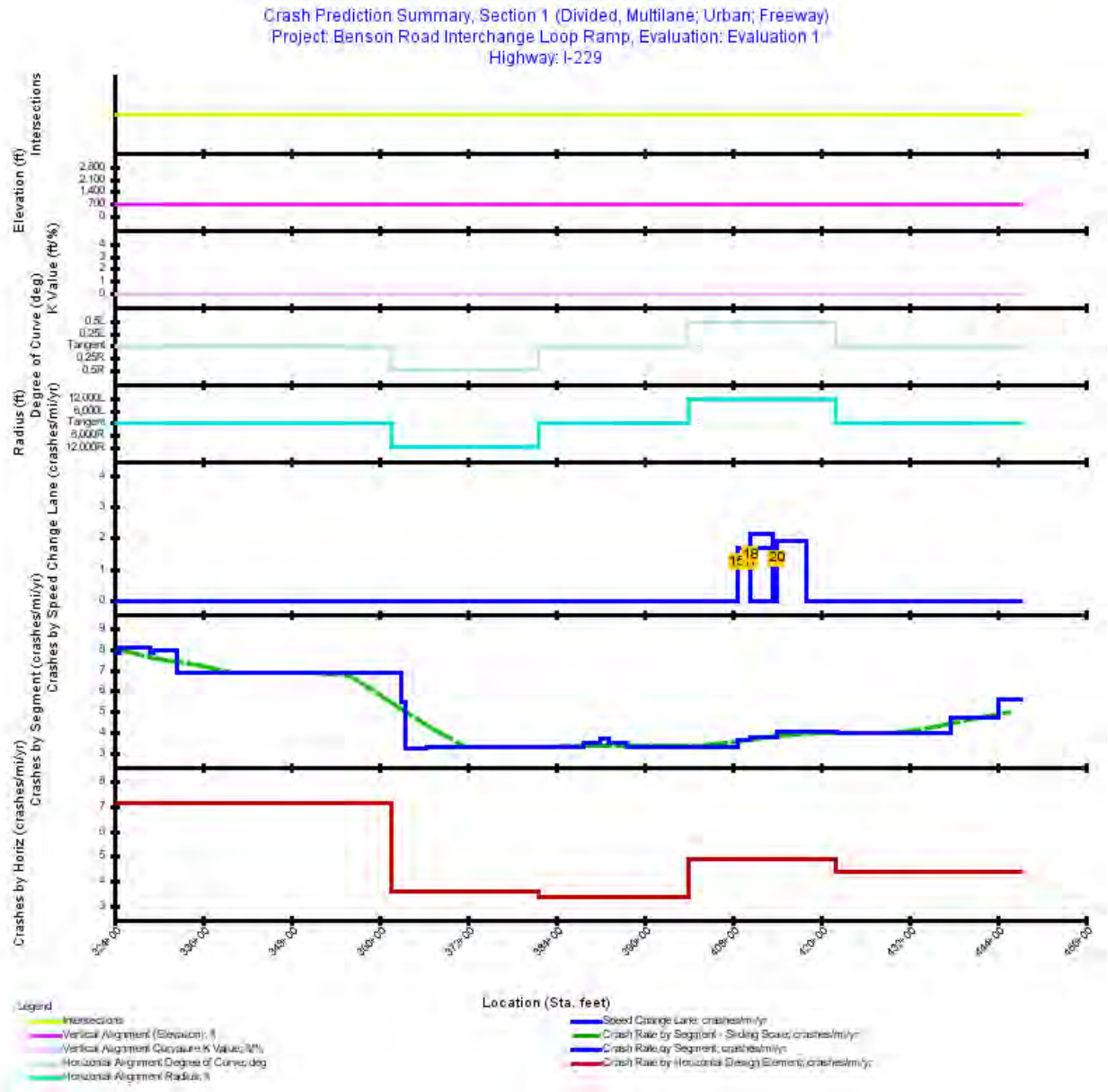

Figure 1. Crash Prediction Summary (Section 1)

Table 1. Evaluation Freeway - Homogeneous Segments (Section 1)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
1	6F	Urban	324+28.000	324+58.000	30.00	0.0057	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
2	6F	Urban	324+58.000	328+83.000	425.00	0.0805	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
3	6F	Urban	328+83.000	329+22.000	39.00	0.0074	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
4	6F	Urban	329+22.000	332+44.000	322.00	0.0610	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
5	6F	Urban	332+44.000	362+91.900	3,047.90	0.5773	2023: 34,900; 2024: 35,518; 2025: 36,136; 2026: 36,754; 2027: 37,372; 2028: 37,990; 2029: 38,609; 2030: 39,227; 2031: 39,845; 2032: 40,463; 2033: 41,081; 2034: 41,700; 2035: 42,318; 2036: 42,936; 2037: 43,554; 2038: 44,172; 2039: 44,790; 2040: 45,409; 2041: 46,027; 2042: 46,645; 2043: 47,263; 2044: 47,881; 2045: 48,500	60.00	Traversable Median	72.00
6	6F	Urban	362+91.900	363+44.800	52.90	0.0100	2023: 25,900; 2024: 26,552; 2025: 27,205; 2026: 27,858; 2027: 28,510; 2028: 29,163; 2029: 29,816; 2030: 30,469; 2031: 31,121; 2032: 31,774; 2033: 32,427; 2034: 33,080; 2035: 33,732; 2036: 34,385; 2037: 35,038; 2038: 35,690; 2039: 36,343; 2040: 36,996; 2041: 37,649; 2042: 38,301; 2043: 38,954; 2044: 39,607; 2045: 40,260	60.00	Traversable Median	72.00
7	5F	Urban	363+44.800	366+45.000	300.20	0.0569	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
8	6F	Urban	366+45.000	375+18.100	873.10	0.1654	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
9	4F	Urban	375+18.100	387+71.000	1,252.90	0.2373	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
10	4F	Urban	387+71.000	390+06.000	235.00	0.0445	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
11	4F	Urban	390+06.000	391+17.000	111.00	0.0210	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
12	4F	Urban	391+17.000	393+63.000	246.00	0.0466	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
13	4F	Urban	393+63.000	408+57.300	1,494.30	0.2830	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
14	4F	Urban	408+57.300	410+39.300	182.00	0.0345	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
16	4F	Urban	410+39.300	414+02.000	362.70	0.0687	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
19	4F	Urban	414+02.000	422+22.000	820.00	0.1553	2023: 18,600; 2024: 19,030; 2025: 19,461; 2026: 19,891; 2027: 20,322; 2028: 20,752; 2029: 21,183; 2030: 21,613; 2031: 22,044; 2032: 22,474; 2033: 22,905; 2034: 23,335; 2035: 23,766; 2036: 24,196; 2037: 24,627; 2038: 25,057; 2039: 25,488; 2040: 25,918; 2041: 26,349; 2042: 26,779; 2043: 27,210; 2044: 27,640; 2045: 28,071	60.00	Traversable Median	72.00
21	4F	Urban	422+22.000	437+61.000	1,539.00	0.2915	2023: 20,500; 2024: 20,909; 2025: 21,318; 2026: 21,727; 2027: 22,136; 2028: 22,545; 2029: 22,954; 2030: 23,363; 2031: 23,772; 2032: 24,181; 2033: 24,590; 2034: 25,000; 2035: 25,409; 2036: 25,818; 2037: 26,227; 2038: 26,636; 2039: 27,045; 2040: 27,454; 2041: 27,863; 2042: 28,272; 2043: 28,681; 2044: 29,090; 2045: 29,500	60.00	Traversable Median	72.00
22	4F	Urban	437+61.000	444+19.000	658.00	0.1246	2023: 20,500; 2024: 20,909; 2025: 21,318; 2026: 21,727; 2027: 22,136; 2028: 22,545; 2029: 22,954; 2030: 23,363; 2031: 23,772; 2032: 24,181; 2033: 24,590; 2034: 25,000; 2035: 25,409; 2036: 25,818; 2037: 26,227; 2038: 26,636; 2039: 27,045; 2040: 27,454; 2041: 27,863; 2042: 28,272; 2043: 28,681; 2044: 29,090; 2045: 29,500	60.00	Traversable Median	72.00
23	4F	Urban	444+19.000	447+11.000	292.00	0.0553	2023: 20,500; 2024: 20,909; 2025: 21,318; 2026: 21,727; 2027: 22,136; 2028: 22,545; 2029: 22,954; 2030: 23,363; 2031: 23,772; 2032: 24,181; 2033: 24,590; 2034: 25,000; 2035: 25,409; 2036: 25,818; 2037: 26,227; 2038: 26,636; 2039: 27,045; 2040: 27,454; 2041: 27,863; 2042: 28,272; 2043: 28,681; 2044: 29,090; 2045: 29,500	60.00	Traversable Median	72.00

Table 2. Evaluation Freeway - Speed Change Lanes (Speed Change)

Seg. No.	Type	Ramp Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT	Median Width (ft)	Type	Effective Median Width (ft)
15	4SC	Entrance	408+57.300	410+39.300	182.00	0.0345	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
17	4SC	Entrance	410+39.300	414+02.000	362.70	0.0687	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
18	4SC	Exit	410+39.300	413+39.300	300.00	0.0568	2023: 17,300; 2024: 17,659; 2025: 18,018; 2026: 18,377; 2027: 18,736; 2028: 19,095; 2029: 19,454; 2030: 19,813; 2031: 20,172; 2032: 20,531; 2033: 20,890; 2034: 21,250; 2035: 21,609; 2036: 21,968; 2037: 22,327; 2038: 22,686; 2039: 23,045; 2040: 23,404; 2041: 23,763; 2042: 24,122; 2043: 24,481; 2044: 24,840; 2045: 25,200	60.00	Traversable Median	72.00
20	4SC	Entrance	414+02.000	418+07.300	405.30	0.0768	2023: 18,600; 2024: 19,030; 2025: 19,461; 2026: 19,891; 2027: 20,322; 2028: 20,752; 2029: 21,183; 2030: 21,613; 2031: 22,044; 2032: 22,474; 2033: 22,905; 2034: 23,335; 2035: 23,766; 2036: 24,196; 2037: 24,627; 2038: 25,057; 2039: 25,488; 2040: 25,918; 2041: 26,349; 2042: 26,779; 2043: 27,210; 2044: 27,640; 2045: 28,071	60.00	Traversable Median	72.00

Table 3. Expected Freeway Crash Rates and Frequencies (Section 1)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	2.3263
Average Future Road AADT (vpd)	28,633
Expected Crashes	
Total Crashes	246.71
Fatal and Injury Crashes	91.96
Property-Damage-Only Crashes	154.75
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	37
Percent Property-Damage-Only Crashes (%)	63
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	4.6109
Fatal and Injury Crash Rate (crashes/mi/yr)	1.7186
Property-Damage-Only Crash Rate (crashes/mi/yr)	2.8922
Expected Travel Crash Rate	
Total Travel (million veh-mi)	559.18
Travel Crash Rate (crashes/million veh-mi)	0.44
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.16
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.28

Table 4. Expected Freeway Speed Change Lane Crash Rates and Frequencies (Speed Change)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.2367
Average Future Road AADT (vpd)	10,963
Expected Crashes	
Total Crashes	10.23
Fatal and Injury Crashes	3.06
Property-Damage-Only Crashes	7.17
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	30
Percent Property-Damage-Only Crashes (%)	70
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	1.8792
Fatal and Injury Crash Rate (crashes/mi/yr)	0.5622
Property-Damage-Only Crash Rate (crashes/mi/yr)	1.3170
Expected Travel Crash Rate	
Total Travel (million veh-mi)	21.79
Travel Crash Rate (crashes/million veh-mi)	0.47
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.14
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.33

Note: *Total Travel and Crash Rates/Million Vehicle Miles* for *Speed Change Lanes* reflect AADTs that are **half of the Freeway Segment AADTs** based on the assumption of 50/50 directional distribution.

Table 5. Expected Crash Frequencies and Rates by Freeway Segment (Section 1)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Effective Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	324+28.000	324+58.000	0.0057	1.021	7.8142	0.51
2	324+58.000	328+83.000	0.0805	14.940	8.0700	0.53
3	328+83.000	329+22.000	0.0074	1.327	7.8142	0.51
4	329+22.000	332+44.000	0.0610	11.177	7.9687	0.52
5	332+44.000	362+91.900	0.5773	91.383	6.8829	0.45
6	362+91.900	363+44.800	0.0100	1.262	5.4770	0.45
7	363+44.800	366+45.000	0.0569	4.271	3.2661	0.42
8	366+45.000	375+18.100	0.1654	12.555	3.3010	0.43
9	375+18.100	387+71.000	0.2373	18.032	3.3039	0.43
10	387+71.000	390+06.000	0.0445	3.569	3.4861	0.45
11	390+06.000	391+17.000	0.0210	1.787	3.6960	0.48
12	391+17.000	393+63.000	0.0466	3.736	3.4861	0.45
13	393+63.000	408+57.300	0.2830	21.485	3.3006	0.43
14	408+57.300	410+39.300	0.0172	1.446	3.6477	0.47
16	410+39.300	414+02.000	0.0059	0.519	3.7992	0.49
19	414+02.000	422+22.000	0.1169	10.927	4.0634	0.48
21	422+22.000	437+61.000	0.2915	26.674	3.9789	0.44
22	437+61.000	444+19.000	0.1246	13.519	4.7165	0.52
23	444+19.000	447+11.000	0.0553	7.076	5.5630	0.61

Note: *Effective Length* is the *segment length* minus the length of the *speed change lanes* if present.

Table 6. Expected Crash Frequencies and Rates by Freeway Speed Change Lane (Speed Change)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
15	408+57.300	410+39.300	0.0345	1.354	1.7075	0.44
17	410+39.300	414+02.000	0.0687	2.698	1.7075	0.44
18	410+39.300	413+39.300	0.0568	2.806	2.1472	0.55
20	414+02.000	418+07.300	0.0768	3.375	1.9115	0.45

Note: *Travel Crash Rates/Million Vehicle Miles* for *Speed Change Lanes* reflect AADTs that are **half of the Freeway Segment AADTs** based on the assumption of 50/50 directional distribution.

Table 7. Expected Crash Frequencies and Rates by Horizontal Design Element (Section 1)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	324+28.000	361+59.260	0.7067	115.873	7.1290	0.47
Simple Curve 1	361+59.260	381+62.890	0.3795	31.345	3.5913	0.43
Tangent	381+62.890	401+97.440	0.3853	29.840	3.3670	0.43
Simple Curve 2	401+97.440	422+00.920	0.3794	32.331	4.8990	0.76
Tangent	422+00.920	447+11.000	0.4754	47.550	4.3572	0.48

Table 8. Expected Crash Severity by Freeway Segment (Section 1)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0064	0.0165	0.1181	0.2311	0.6490
2	0.0845	0.2236	1.6266	3.3876	9.6179
3	0.0083	0.0215	0.1536	0.3004	0.8438
4	0.0704	0.1816	1.2818	2.4132	7.2302
5	0.6885	1.7299	11.7534	19.6994	57.5120
6	0.0118	0.0305	0.1839	0.2617	0.7741
7	0.0412	0.1059	0.6389	0.9090	2.5762
8	0.1252	0.3221	1.9434	2.7650	7.3989
9	0.1569	0.3970	2.5293	3.8348	11.1137
10	0.0258	0.0652	0.4481	0.7736	2.2559
11	0.0116	0.0297	0.2080	0.3823	1.1555
12	0.0270	0.0682	0.4691	0.8098	2.3615
13	0.1851	0.4669	2.9994	4.5913	13.2418
14	0.0136	0.0350	0.2114	0.3008	0.8850
16	0.0049	0.0126	0.0763	0.1086	0.3163
19	0.0961	0.2498	1.5332	2.2896	6.7587
21	0.2083	0.5188	3.5125	5.7579	16.6769
22	0.0879	0.2256	1.5822	2.9172	8.7059
23	0.0382	0.1010	0.7344	1.5257	4.6766
Total	1.8918	4.8015	32.0036	53.2591	154.7501

Table 9. Expected Crash Severity by Speed Change Lane (Speed Change)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
15	0.0096	0.0246	0.1487	0.2116	0.9592
17	0.0191	0.0491	0.2964	0.4217	1.9115
18	0.0218	0.0562	0.3391	0.4825	1.9064
20	0.0237	0.0611	0.3691	0.5267	2.3942
Total	0.0742	0.1911	1.1533	1.6424	7.1713

Table 10. Expected Speed Change Lane Crash Type Distribution (Section 1)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.24	0.1	2.37	1.0	2.61	1.1
Highway Segment	Collision with Fixed Object	43.13	17.5	77.16	31.3	120.29	48.8
Highway Segment	Collision with Other Object	3.05	1.2	14.98	6.1	18.03	7.3
Highway Segment	Other Single-vehicle Collision	12.42	5.0	11.53	4.7	23.95	9.7
Highway Segment	Collision with Parked Vehicle	0.90	0.4	1.72	0.7	2.62	1.1
Highway Segment	Total Single Vehicle Crashes	59.73	24.2	107.77	43.7	167.50	67.9
Highway Segment	Right-Angle Collision	1.00	0.4	0.85	0.3	1.84	0.7
Highway Segment	Head-on Collision	0.26	0.1	0.09	0.0	0.35	0.1
Highway Segment	Other Multi-vehicle Collision	1.00	0.4	1.13	0.5	2.13	0.9
Highway Segment	Rear-end Collision	24.17	9.8	32.42	13.1	56.59	22.9
Highway Segment	Sideswipe, Same Direction Collision	5.80	2.4	12.50	5.1	18.30	7.4
Highway Segment	Total Multiple Vehicle Crashes	32.22	13.1	46.98	19.0	79.21	32.1
Highway Segment	Total Highway Segment Crashes	91.96	37.3	154.75	62.7	246.71	100.0
	Total Crashes	91.96	37.3	154.75	62.7	246.71	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 11. Expected Exit Speed Change Lane Crash Type Distribution (Speed Change)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.0	0.01	0.5	0.01	0.5
Highway Segment	Collision with Fixed Object	0.18	6.3	0.40	14.1	0.57	20.3
Highway Segment	Collision with Other Object	0.01	0.5	0.06	2.0	0.07	2.6
Highway Segment	Other Single-vehicle Collision	0.04	1.6	0.04	1.6	0.09	3.1
Highway Segment	Collision with Parked Vehicle	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Total Single Vehicle Crashes	0.23	8.4	0.51	18.1	0.74	26.5
Highway Segment	Right-Angle Collision	0.01	0.4	0.02	0.8	0.03	1.2
Highway Segment	Head-on Collision	0.00	0.2	0.00	0.1	0.01	0.3
Highway Segment	Other Multi-vehicle Collision	0.01	0.5	0.03	1.1	0.04	1.6
Highway Segment	Rear-end Collision	0.49	17.6	1.08	38.4	1.57	56.0
Highway Segment	Sideswipe, Same Direction Collision	0.14	5.1	0.26	9.4	0.41	14.4
Highway Segment	Total Multiple Vehicle Crashes	0.67	23.7	1.40	49.8	2.06	73.5
Highway Segment	Total Highway Segment Crashes	0.90	32.1	1.91	67.9	2.81	100.0
	Total Crashes	0.90	32.1	1.91	67.9	2.81	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 12. Expected Entrance Speed Change Lane Crash Type Distribution (Speed Change)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.00	0.0	0.01	0.1	0.01	0.1
Highway Segment	Collision with Fixed Object	0.42	5.6	0.68	9.1	1.10	14.8
Highway Segment	Collision with Other Object	0.04	0.6	0.19	2.6	0.23	3.1
Highway Segment	Other Single-vehicle Collision	0.14	1.9	0.08	1.1	0.23	3.1
Highway Segment	Collision with Parked Vehicle	0.01	0.1	0.02	0.2	0.02	0.3
Highway Segment	Total Single Vehicle Crashes	0.61	8.3	0.98	13.2	1.59	21.5
Highway Segment	Right-Angle Collision	0.04	0.6	0.08	1.1	0.12	1.7
Highway Segment	Head-on Collision	0.01	0.1	0.01	0.1	0.01	0.2
Highway Segment	Other Multi-vehicle Collision	0.04	0.5	0.08	1.1	0.12	1.6
Highway Segment	Rear-end Collision	1.17	15.8	2.79	37.6	3.96	53.4
Highway Segment	Sideswipe, Same Direction Collision	0.29	3.9	1.33	17.9	1.61	21.7
Highway Segment	Total Multiple Vehicle Crashes	1.55	20.8	4.29	57.7	5.83	78.5
Highway Segment	Total Highway Segment Crashes	2.16	29.1	5.26	70.9	7.43	100.0
	Total Crashes	2.16	29.1	5.26	70.9	7.43	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Table 13. Evaluation Message

Start Location (Sta. ft)	End Location (Sta. ft)	Message
363+44.800	366+45.000	for segment #7 (363+44.800 to 366+45.000), Freeway Segment of type Five-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Six-lane Freeway
366+45.000	375+18.100	for segment #8 (366+45.000 to 375+18.100), Freeway Segment of type Six-lane Freeway is using unbalanced lane processing with types Four-lane Freeway and Eight-lane Freeway

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 14, 2018

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Report Overview

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Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Thu Jun 14 10:31:57 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
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Project Title: Benson Road Interchange Loop Ramp
Project Comment: Created Thu May 31 14:28:00 CDT 2018
Project Unit System: U.S. Customary

Highway Title: NB On Ramp
Highway Comment: Created Mon Jun 04 10:02:27 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Thu Jun 14 10:31:48 CDT 2018

Minimum Location: 0.000
Maximum Location: 18+47.400
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 18+47.400
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: ENT_RAMP_MV_FI=1.0; ENT_RAMP_MV_PDO=1.0; ENT_RAMP_SV_FI=1.0; ENT_RAMP_SV_PDO=1.0;

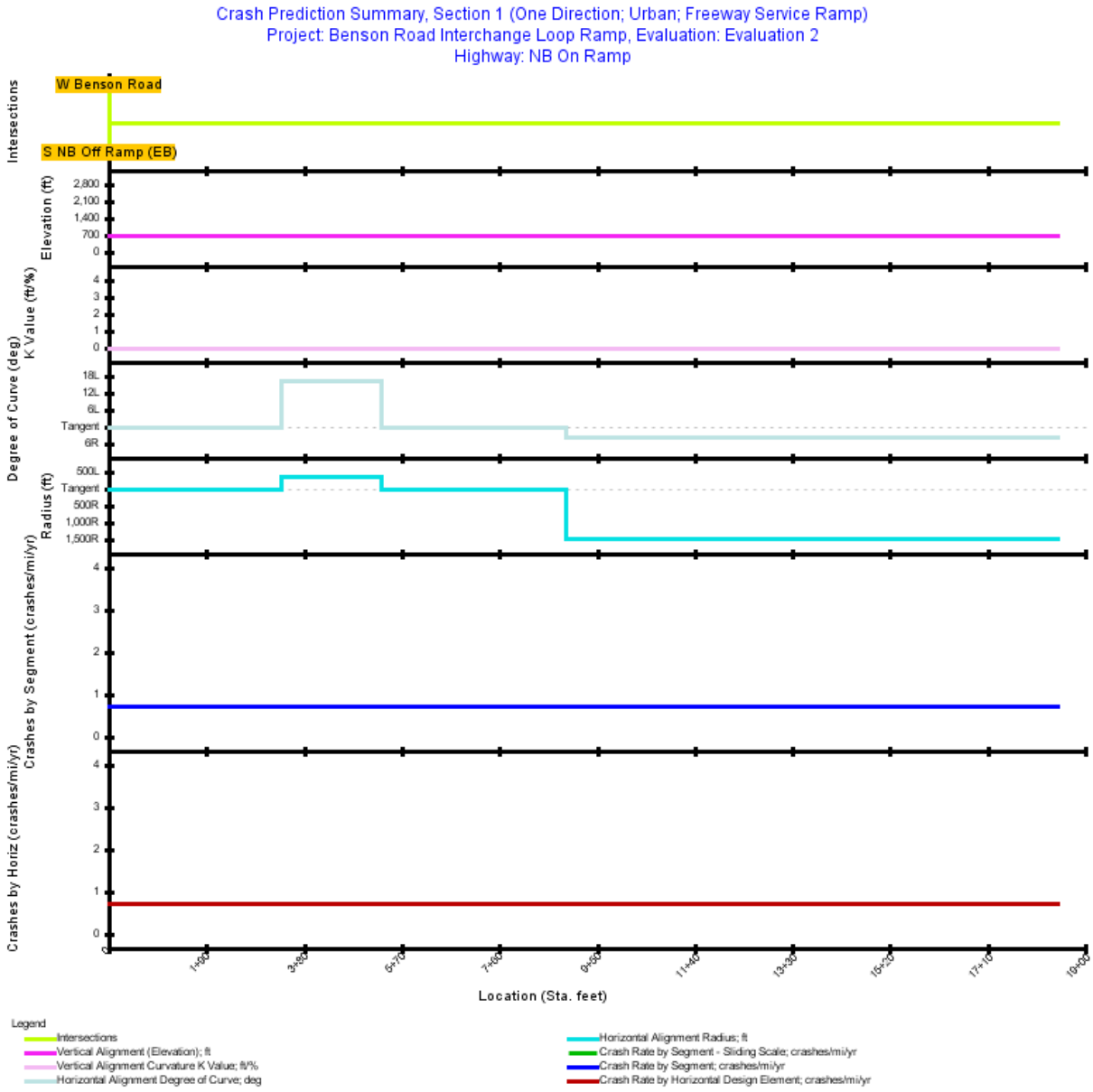

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	1EN	Urban	0.000	18+47.400	1,847.40	0.3499	2023: 1,900; 2024: 1,878; 2025: 1,857; 2026: 1,835; 2027: 1,814; 2028: 1,792; 2029: 1,771; 2030: 1,750; 2031: 1,728; 2032: 1,707; 2033: 1,685; 2034: 1,664; 2035: 1,643; 2036: 1,621; 2037: 1,600; 2038: 1,578; 2039: 1,557; 2040: 1,536; 2041: 1,514; 2042: 1,493; 2043: 1,471; 2044: 1,450; 2045: 1,429

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.3499
Average Future Road AADT (vpd)	1,664
Expected Crashes	
Total Crashes	5.87
Fatal and Injury Crashes	2.59
Property-Damage-Only Crashes	3.28
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	44
Percent Property-Damage-Only Crashes (%)	56
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	0.7289
Fatal and Injury Crash Rate (crashes/mi/yr)	0.3216
Property-Damage-Only Crash Rate (crashes/mi/yr)	0.4073
Expected Travel Crash Rate	
Total Travel (million veh-mi)	4.89
Travel Crash Rate (crashes/million veh-mi)	1.20
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.53
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.67

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	0.000	18+47.400	0.3499	5.866	0.7289	1.20

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	0.000	3+34.900	0.0634	1.063	0.7289	1.20
Simple Curve 1	3+34.900	5+30.600	0.0371	0.621	0.7289	1.20
Tangent	5+30.600	8+89.300	0.0679	1.139	0.7289	1.20
Simple Curve 2	8+89.300	18+47.400	0.1815	3.042	0.7289	1.20

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0552	0.1674	1.0655	1.3001	3.2775

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.01	0.1	0.06	1.1	0.07	1.2
Highway Segment	Collision with Fixed Object	1.57	26.8	2.08	35.4	3.65	62.3
Highway Segment	Collision with Other Object	0.11	1.9	0.40	6.9	0.52	8.8
Highway Segment	Other Single-vehicle Collision	0.45	7.7	0.31	5.3	0.76	13.0
Highway Segment	Collision with Parked Vehicle	0.03	0.6	0.05	0.8	0.08	1.3
Highway Segment	Total Single Vehicle Crashes	2.18	37.1	2.90	49.5	5.08	86.6
Highway Segment	Right-Angle Collision	0.01	0.2	0.01	0.1	0.02	0.3
Highway Segment	Head-on Collision	0.00	0.1	0.00	0.0	0.00	0.1
Highway Segment	Other Multi-vehicle Collision	0.01	0.2	0.01	0.2	0.02	0.4
Highway Segment	Rear-end Collision	0.31	5.2	0.26	4.4	0.56	9.6
Highway Segment	Sideswipe, Same Direction Collision	0.07	1.3	0.10	1.7	0.17	3.0
Highway Segment	Total Multiple Vehicle Crashes	0.41	7.0	0.37	6.4	0.78	13.4
Highway Segment	Total Highway Segment Crashes	2.59	44.1	3.28	55.9	5.87	100.0
	Total Crashes	2.59	44.1	3.28	55.9	5.87	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 14, 2018

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Report Overview

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Evaluation Date: Thu Jun 14 10:31:08 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
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Phone: 402-578-9254
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Project Title: Benson Road Interchange Loop Ramp
Project Comment: Created Thu May 31 14:28:00 CDT 2018
Project Unit System: U.S. Customary

Highway Title: SB On Ramp
Highway Comment: Created Mon Jun 04 08:18:56 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Thu Jun 14 10:31:01 CDT 2018

Minimum Location: 0.000
Maximum Location: 15+45.940
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 0.000
Evaluation End Location: 15+45.940
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: ENT_RAMP_MV_FI=1.0; ENT_RAMP_MV_PDO=1.0; ENT_RAMP_SV_FI=1.0; ENT_RAMP_SV_PDO=1.0;

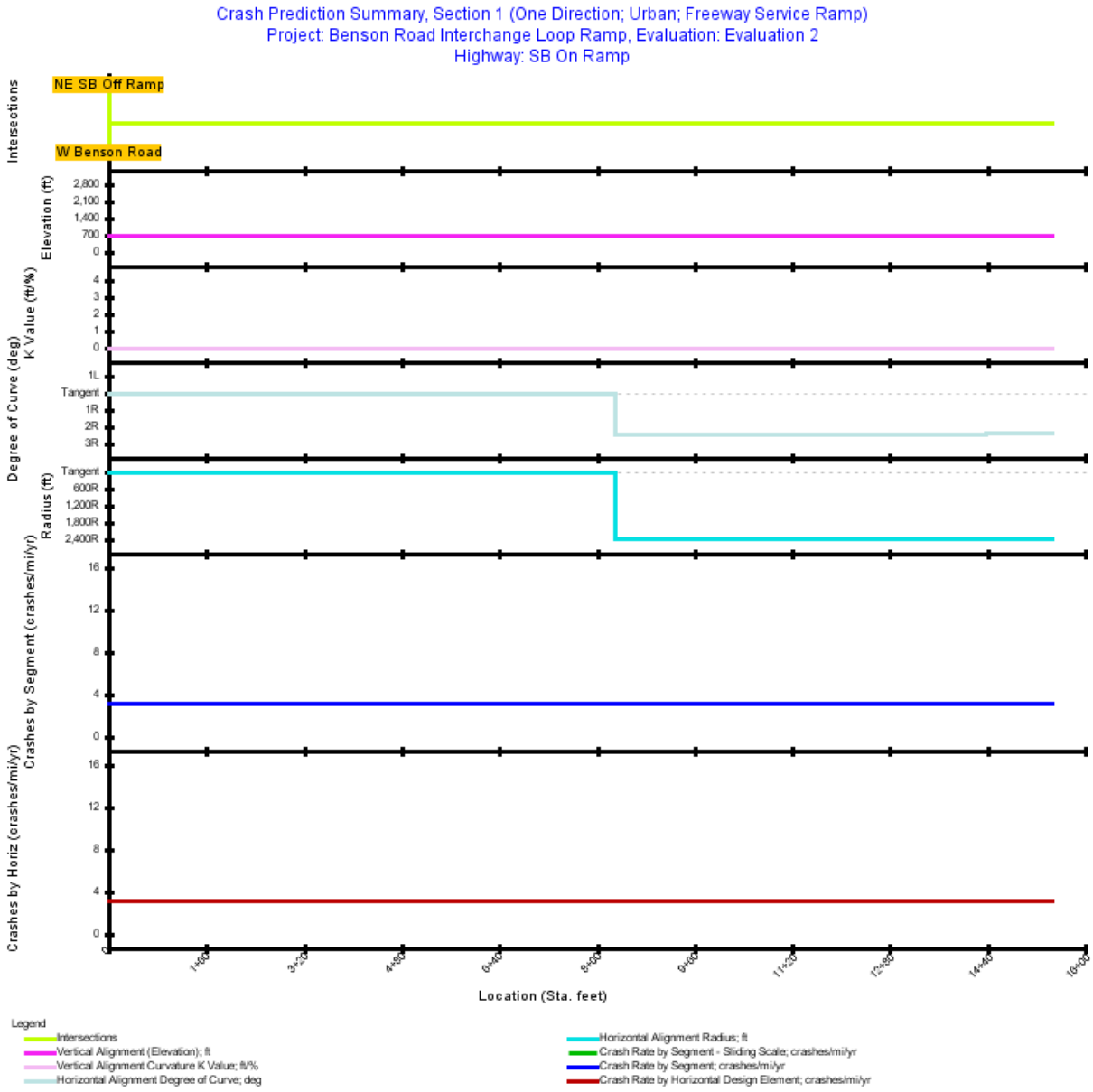

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	2EN	Urban	0.000	15+45.940	1,545.94	0.2928	2023: 9,000; 2024: 8,965; 2025: 8,930; 2026: 8,896; 2027: 8,861; 2028: 8,827; 2029: 8,792; 2030: 8,758; 2031: 8,723; 2032: 8,689; 2033: 8,654; 2034: 8,620; 2035: 8,585; 2036: 8,550; 2037: 8,516; 2038: 8,481; 2039: 8,447; 2040: 8,412; 2041: 8,378; 2042: 8,343; 2043: 8,309; 2044: 8,274; 2045: 8,240

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.2928
Average Future Road AADT (vpd)	8,620
Expected Crashes	
Total Crashes	21.40
Fatal and Injury Crashes	7.77
Property-Damage-Only Crashes	13.63
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	36
Percent Property-Damage-Only Crashes (%)	64
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	3.1775
Fatal and Injury Crash Rate (crashes/mi/yr)	1.1541
Property-Damage-Only Crash Rate (crashes/mi/yr)	2.0234
Expected Travel Crash Rate	
Total Travel (million veh-mi)	21.19
Travel Crash Rate (crashes/million veh-mi)	1.01
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.37
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.64

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	0.000	15+45.940	0.2928	21.398	3.1775	1.01

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	0.000	8+29.200	0.1570	11.477	3.1775	1.01
Simple Curve 1	8+29.200	14+37.400	0.1152	8.418	3.1775	1.01
Simple Curve 2	14+37.400	15+45.940	0.0206	1.502	3.1775	1.01

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.1576	0.4779	2.4736	4.6631	13.6259

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.02	0.1	0.18	0.8	0.20	0.9
Highway Segment	Collision with Fixed Object	3.96	18.5	5.87	27.4	9.82	45.9
Highway Segment	Collision with Other Object	0.28	1.3	1.14	5.3	1.42	6.6
Highway Segment	Other Single-vehicle Collision	1.14	5.3	0.88	4.1	2.02	9.4
Highway Segment	Collision with Parked Vehicle	0.08	0.4	0.13	0.6	0.21	1.0
Highway Segment	Total Single Vehicle Crashes	5.48	25.6	8.19	38.3	13.67	63.9
Highway Segment	Right-Angle Collision	0.07	0.3	0.10	0.5	0.17	0.8
Highway Segment	Head-on Collision	0.02	0.1	0.01	0.1	0.03	0.1
Highway Segment	Other Multi-vehicle Collision	0.07	0.3	0.13	0.6	0.20	0.9
Highway Segment	Rear-end Collision	1.72	8.0	3.75	17.5	5.47	25.6
Highway Segment	Sideswipe, Same Direction Collision	0.41	1.9	1.45	6.8	1.86	8.7
Highway Segment	Total Multiple Vehicle Crashes	2.29	10.7	5.43	25.4	7.73	36.1
Highway Segment	Total Highway Segment Crashes	7.77	36.3	13.63	63.7	21.40	100.0
	Total Crashes	7.77	36.3	13.63	63.7	21.40	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 14, 2018

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Report Overview

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Evaluation Date: Thu Jun 14 10:36:38 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange Loop Ramp
Project Comment: Created Thu May 31 14:28:00 CDT 2018
Project Unit System: U.S. Customary

Highway Title: NB Off Ramp (WB)
Highway Comment: Created Mon Jun 04 11:02:45 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Thu Jun 14 10:36:27 CDT 2018

Minimum Location: 3+20.200
Maximum Location: 48+03.900
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 3+20.200
Evaluation End Location: 48+03.900
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

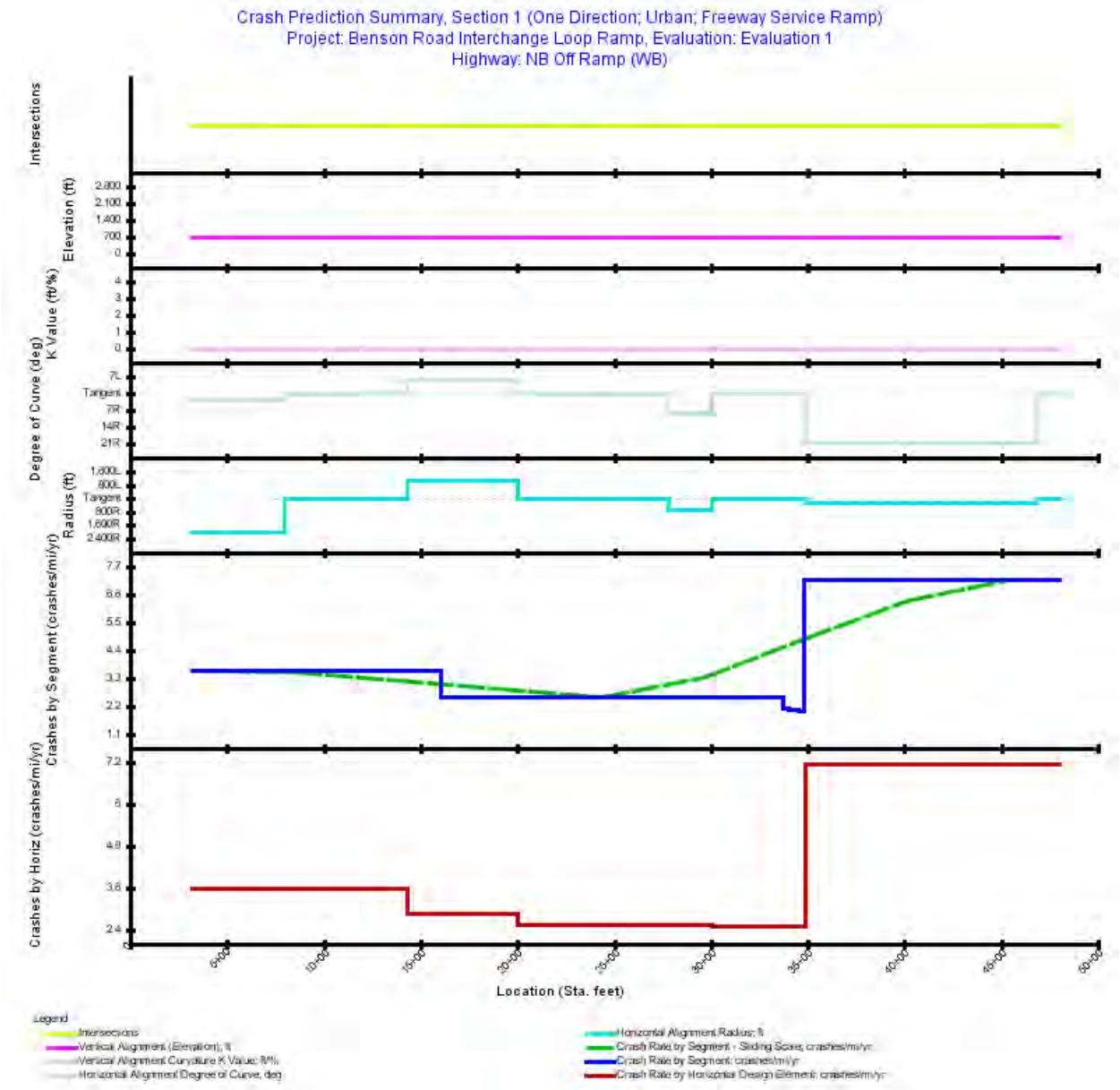

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	2EX	Urban	3+20.200	16+03.600	1,283.40	0.2431	2023: 8,600; 2024: 8,743; 2025: 8,886; 2026: 9,029; 2027: 9,172; 2028: 9,315; 2029: 9,458; 2030: 9,601; 2031: 9,744; 2032: 9,887; 2033: 10,030; 2034: 10,174; 2035: 10,317; 2036: 10,460; 2037: 10,603; 2038: 10,746; 2039: 10,889; 2040: 11,032; 2041: 11,175; 2042: 11,318; 2043: 11,461; 2044: 11,604; 2045: 11,748
2	2EX	Urban	16+03.600	33+74.200	1,770.60	0.3353	2023: 7,930; 2024: 7,753; 2025: 7,577; 2026: 7,401; 2027: 7,224; 2028: 7,048; 2029: 6,872; 2030: 6,695; 2031: 6,519; 2032: 6,343; 2033: 6,166; 2034: 5,990; 2035: 5,814; 2036: 5,637; 2037: 5,461; 2038: 5,285; 2039: 5,108; 2040: 4,932; 2041: 4,756; 2042: 4,579; 2043: 4,403; 2044: 4,227; 2045: 4,051
3	2EX	Urban	33+74.200	33+89.200	15.00	0.0028	2023: 7,930; 2024: 7,753; 2025: 7,577; 2026: 7,401; 2027: 7,224; 2028: 7,048; 2029: 6,872; 2030: 6,695; 2031: 6,519; 2032: 6,343; 2033: 6,166; 2034: 5,990; 2035: 5,814; 2036: 5,637; 2037: 5,461; 2038: 5,285; 2039: 5,108; 2040: 4,932; 2041: 4,756; 2042: 4,579; 2043: 4,403; 2044: 4,227; 2045: 4,051
4	2EX	Urban	33+89.200	34+04.200	15.00	0.0028	2023: 7,930; 2024: 7,753; 2025: 7,577; 2026: 7,401; 2027: 7,224; 2028: 7,048; 2029: 6,872; 2030: 6,695; 2031: 6,519; 2032: 6,343; 2033: 6,166; 2034: 5,990; 2035: 5,814; 2036: 5,637; 2037: 5,461; 2038: 5,285; 2039: 5,108; 2040: 4,932; 2041: 4,756; 2042: 4,579; 2043: 4,403; 2044: 4,227; 2045: 4,051
5	2EX	Urban	34+04.200	34+19.200	15.00	0.0028	2023: 7,930; 2024: 7,753; 2025: 7,577; 2026: 7,401; 2027: 7,224; 2028: 7,048; 2029: 6,872; 2030: 6,695; 2031: 6,519; 2032: 6,343; 2033: 6,166; 2034: 5,990; 2035: 5,814; 2036: 5,637; 2037: 5,461; 2038: 5,285; 2039: 5,108; 2040: 4,932; 2041: 4,756; 2042: 4,579; 2043: 4,403; 2044: 4,227; 2045: 4,051
6	2EX	Urban	34+19.200	34+34.200	15.00	0.0028	2023: 7,930; 2024: 7,753; 2025: 7,577; 2026: 7,401; 2027: 7,224; 2028: 7,048; 2029: 6,872; 2030: 6,695; 2031: 6,519; 2032: 6,343; 2033: 6,166; 2034: 5,990; 2035: 5,814; 2036: 5,637; 2037: 5,461; 2038: 5,285; 2039: 5,108; 2040: 4,932; 2041: 4,756; 2042: 4,579; 2043: 4,403; 2044: 4,227; 2045: 4,051
7	2EX	Urban	34+34.200	34+49.200	15.00	0.0028	2023: 7,930; 2024: 7,753; 2025: 7,577; 2026: 7,401; 2027: 7,224; 2028: 7,048; 2029: 6,872; 2030: 6,695; 2031: 6,519; 2032: 6,343; 2033: 6,166; 2034: 5,990; 2035: 5,814; 2036: 5,637; 2037: 5,461; 2038: 5,285; 2039: 5,108; 2040: 4,932; 2041: 4,756; 2042: 4,579; 2043: 4,403; 2044: 4,227; 2045: 4,051
8	2EX	Urban	34+49.200	34+64.200	15.00	0.0028	2023: 7,930; 2024: 7,753; 2025: 7,577; 2026: 7,401; 2027: 7,224; 2028: 7,048; 2029: 6,872; 2030: 6,695; 2031: 6,519; 2032: 6,343; 2033: 6,166; 2034: 5,990; 2035: 5,814; 2036: 5,637; 2037: 5,461; 2038: 5,285; 2039: 5,108; 2040: 4,932; 2041: 4,756; 2042: 4,579; 2043: 4,403; 2044: 4,227; 2045: 4,051
9	2EX	Urban	34+64.200	34+79.200	15.00	0.0028	2023: 7,930; 2024: 7,753; 2025: 7,577; 2026: 7,401; 2027: 7,224; 2028: 7,048; 2029: 6,872; 2030: 6,695; 2031: 6,519; 2032: 6,343; 2033: 6,166; 2034: 5,990; 2035: 5,814; 2036: 5,637; 2037: 5,461; 2038: 5,285; 2039: 5,108; 2040: 4,932; 2041: 4,756; 2042: 4,579; 2043: 4,403; 2044: 4,227; 2045: 4,051
10	2EX	Urban	34+79.200	48+03.900	1,324.70	0.2509	2023: 7,930; 2024: 7,753; 2025: 7,577; 2026: 7,401; 2027: 7,224; 2028: 7,048; 2029: 6,872; 2030: 6,695; 2031: 6,519; 2032: 6,343; 2033: 6,166; 2034: 5,990; 2035: 5,814; 2036: 5,637; 2037: 5,461; 2038: 5,285; 2039: 5,108; 2040: 4,932; 2041: 4,756; 2042: 4,579; 2043: 4,403; 2044: 4,227; 2045: 4,051

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.8492
Average Future Road AADT (vpd)	7,188
Expected Crashes	
Total Crashes	82.01
Fatal and Injury Crashes	30.09
Property-Damage-Only Crashes	51.92
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	37
Percent Property-Damage-Only Crashes (%)	63
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	4.1990
Fatal and Injury Crash Rate (crashes/mi/yr)	1.5406
Property-Damage-Only Crash Rate (crashes/mi/yr)	2.6584
Expected Travel Crash Rate	
Total Travel (million veh-mi)	51.24
Travel Crash Rate (crashes/million veh-mi)	1.60
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.59
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	1.01

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	3+20.200	16+03.600	0.2431	20.076	3.5910	0.97
2	16+03.600	33+74.200	0.3353	19.714	2.5560	1.17
3	33+74.200	33+89.200	0.0028	0.139	2.1275	0.97
4	33+89.200	34+04.200	0.0028	0.138	2.1081	0.96
5	34+04.200	34+19.200	0.0028	0.137	2.0892	0.96
6	34+19.200	34+34.200	0.0028	0.135	2.0707	0.95
7	34+34.200	34+49.200	0.0028	0.134	2.0527	0.94
8	34+49.200	34+64.200	0.0028	0.133	2.0350	0.93
9	34+64.200	34+79.200	0.0028	0.132	2.0177	0.92
10	34+79.200	48+03.900	0.2509	41.275	7.1527	3.27

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Simple Curve 1	3+20.200	8+00.700	0.0910	7.516	3.5910	0.97
Tangent	8+00.700	14+29.000	0.1190	9.828	3.5910	0.97
Simple Curve 2	14+29.000	20+01.300	0.1084	7.159	2.8717	1.11
Tangent	20+01.300	27+82.900	0.1480	8.702	2.5560	1.17
Simple Curve 3	27+82.900	30+07.500	0.0425	2.501	2.5560	1.17
Tangent	30+07.500	34+86.300	0.0907	5.252	2.5179	1.15
Simple Curve 4	34+86.300	46+89.600	0.2279	37.492	7.1527	3.27
Tangent	46+89.600	48+03.900	0.0216	3.561	7.1527	3.27

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.2388	0.7240	2.4475	4.6138	12.0518
2	0.2351	0.7130	2.4102	4.5436	11.8118
3	0.0017	0.0050	0.0170	0.0321	0.0832
4	0.0016	0.0049	0.0166	0.0314	0.0832
5	0.0016	0.0048	0.0163	0.0307	0.0832
6	0.0016	0.0047	0.0159	0.0300	0.0832
7	0.0015	0.0046	0.0155	0.0293	0.0832
8	0.0015	0.0045	0.0152	0.0286	0.0832
9	0.0014	0.0044	0.0148	0.0280	0.0832
10	0.4106	1.2450	4.2086	7.9338	27.4767
Total	0.8953	2.7149	9.1777	17.3011	51.9226

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.11	0.1	1.03	1.3	1.14	1.4
Highway Segment	Collision with Fixed Object	20.64	25.2	33.49	40.8	54.12	66.0
Highway Segment	Collision with Other Object	1.46	1.8	6.50	7.9	7.96	9.7
Highway Segment	Other Single-vehicle Collision	5.95	7.2	5.00	6.1	10.95	13.4
Highway Segment	Collision with Parked Vehicle	0.43	0.5	0.75	0.9	1.18	1.4
Highway Segment	Total Single Vehicle Crashes	28.58	34.9	46.77	57.0	75.36	91.9
Highway Segment	Right-Angle Collision	0.05	0.1	0.09	0.1	0.14	0.2
Highway Segment	Head-on Collision	0.01	0.0	0.01	0.0	0.02	0.0
Highway Segment	Other Multi-vehicle Collision	0.05	0.1	0.12	0.2	0.17	0.2
Highway Segment	Rear-end Collision	1.13	1.4	3.56	4.3	4.68	5.7
Highway Segment	Sideswipe, Same Direction Collision	0.27	0.3	1.37	1.7	1.64	2.0
Highway Segment	Total Multiple Vehicle Crashes	1.50	1.8	5.15	6.3	6.66	8.1
Highway Segment	Total Highway Segment Crashes	30.09	36.7	51.92	63.3	82.01	100.0
	Total Crashes	30.09	36.7	51.92	63.3	82.01	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 14, 2018

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Evaluation Date: Thu Jun 14 10:37:47 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange Loop Ramp
Project Comment: Created Thu May 31 14:28:00 CDT 2018
Project Unit System: U.S. Customary

Highway Title: NB Off Ramp (EB)
Highway Comment: Created Mon Jun 04 11:09:58 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Thu Jun 14 10:37:38 CDT 2018

Minimum Location: 1+74.600
Maximum Location: 16+68.300
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 1+74.600
Evaluation End Location: 16+68.300
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

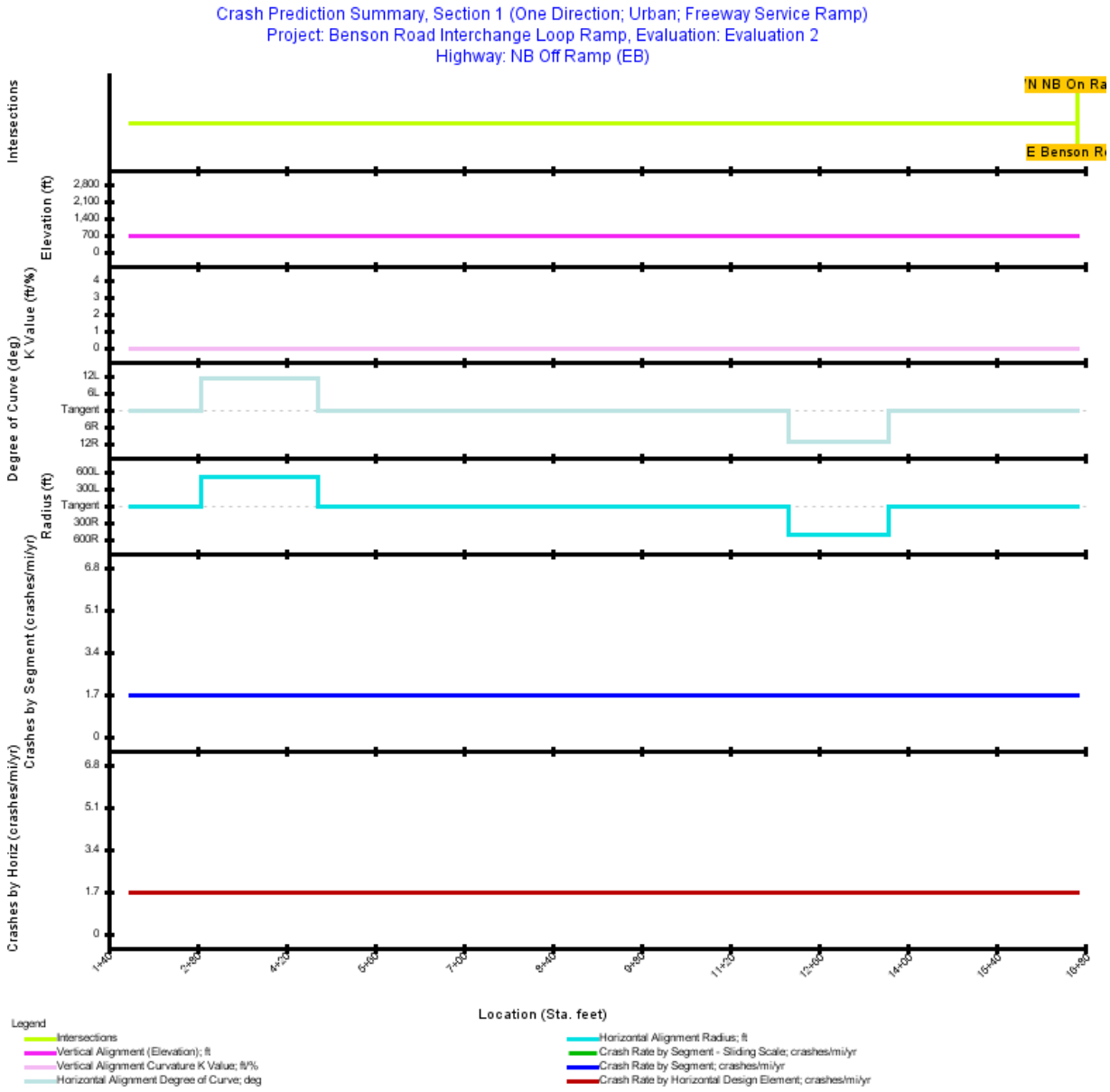

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	1EX	Urban	1+74.600	16+68.300	1,493.70	0.2829	2023: 670; 2024: 989; 2025: 1,308; 2026: 1,628; 2027: 1,947; 2028: 2,267; 2029: 2,586; 2030: 2,905; 2031: 3,225; 2032: 3,544; 2033: 3,864; 2034: 4,183; 2035: 4,502; 2036: 4,822; 2037: 5,141; 2038: 5,461; 2039: 5,780; 2040: 6,099; 2041: 6,419; 2042: 6,738; 2043: 7,058; 2044: 7,377; 2045: 7,697

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.2829
Average Future Road AADT (vpd)	4,183
Expected Crashes	
Total Crashes	10.92
Fatal and Injury Crashes	4.95
Property-Damage-Only Crashes	5.97
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	45
Percent Property-Damage-Only Crashes (%)	55
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	1.6783
Fatal and Injury Crash Rate (crashes/mi/yr)	0.7611
Property-Damage-Only Crash Rate (crashes/mi/yr)	0.9172
Expected Travel Crash Rate	
Total Travel (million veh-mi)	9.93
Travel Crash Rate (crashes/million veh-mi)	1.10
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.50
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.60

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	1+74.600	16+68.300	0.2829	10.920	1.6783	1.10

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	1+74.600	2+85.000	0.0209	0.807	1.6783	1.10
Simple Curve 1	2+85.000	4+69.900	0.0350	1.352	1.6783	1.10
Tangent	4+69.900	12+11.600	0.1405	5.422	1.6783	1.10
Simple Curve 2	12+11.600	13+69.900	0.0300	1.157	1.6783	1.10
Tangent	13+69.900	16+68.300	0.0565	2.182	1.6783	1.10

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.1546	0.4689	1.9497	2.3790	5.9677

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.02	0.2	0.12	1.1	0.14	1.3
Highway Segment	Collision with Fixed Object	3.46	31.7	4.01	36.8	7.48	68.5
Highway Segment	Collision with Other Object	0.24	2.2	0.78	7.1	1.02	9.4
Highway Segment	Other Single-vehicle Collision	1.00	9.1	0.60	5.5	1.60	14.6
Highway Segment	Collision with Parked Vehicle	0.07	0.7	0.09	0.8	0.16	1.5
Highway Segment	Total Single Vehicle Crashes	4.80	44.0	5.61	51.3	10.40	95.3
Highway Segment	Right-Angle Collision	0.01	0.0	0.01	0.1	0.01	0.1
Highway Segment	Head-on Collision	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Other Multi-vehicle Collision	0.01	0.0	0.01	0.1	0.01	0.1
Highway Segment	Rear-end Collision	0.11	1.0	0.25	2.3	0.36	3.3
Highway Segment	Sideswipe, Same Direction Collision	0.03	0.3	0.10	0.9	0.12	1.1
Highway Segment	Total Multiple Vehicle Crashes	0.15	1.4	0.36	3.3	0.52	4.7
Highway Segment	Total Highway Segment Crashes	4.95	45.4	5.97	54.6	10.92	100.0
	Total Crashes	4.95	45.4	5.97	54.6	10.92	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 14, 2018

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Report Generated: Jun 14, 2018 10:30 AM
Report Template: System: Single Page [System] (mlcpm3, Jun 8, 2018 1:30 PM)

Evaluation Date: Thu Jun 14 10:29:50 CDT 2018
IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange Loop Ramp
Project Comment: Created Thu May 31 14:28:00 CDT 2018
Project Unit System: U.S. Customary

Highway Title: SB Off Ramp
Highway Comment: Created Fri Jun 01 10:04:18 CDT 2018
Highway Version: 1

Evaluation Title: Evaluation 2
Evaluation Comment: Created Thu Jun 14 10:29:41 CDT 2018

Minimum Location: 3+59.600
Maximum Location: 24+86.000
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

Freeway Ramp Evaluation

Section: Section 1
Evaluation Start Location: 3+59.600
Evaluation End Location: 24+86.000
Functional Class: Freeway Service Ramp
Type of Alignment: One Direction
Model Category: Freeway Service Ramp
Calibration Factor: EX_RAMP_MV_FI=1.0; EX_RAMP_MV_PDO=1.0; EX_RAMP_SV_FI=1.0; EX_RAMP_SV_PDO=1.0;

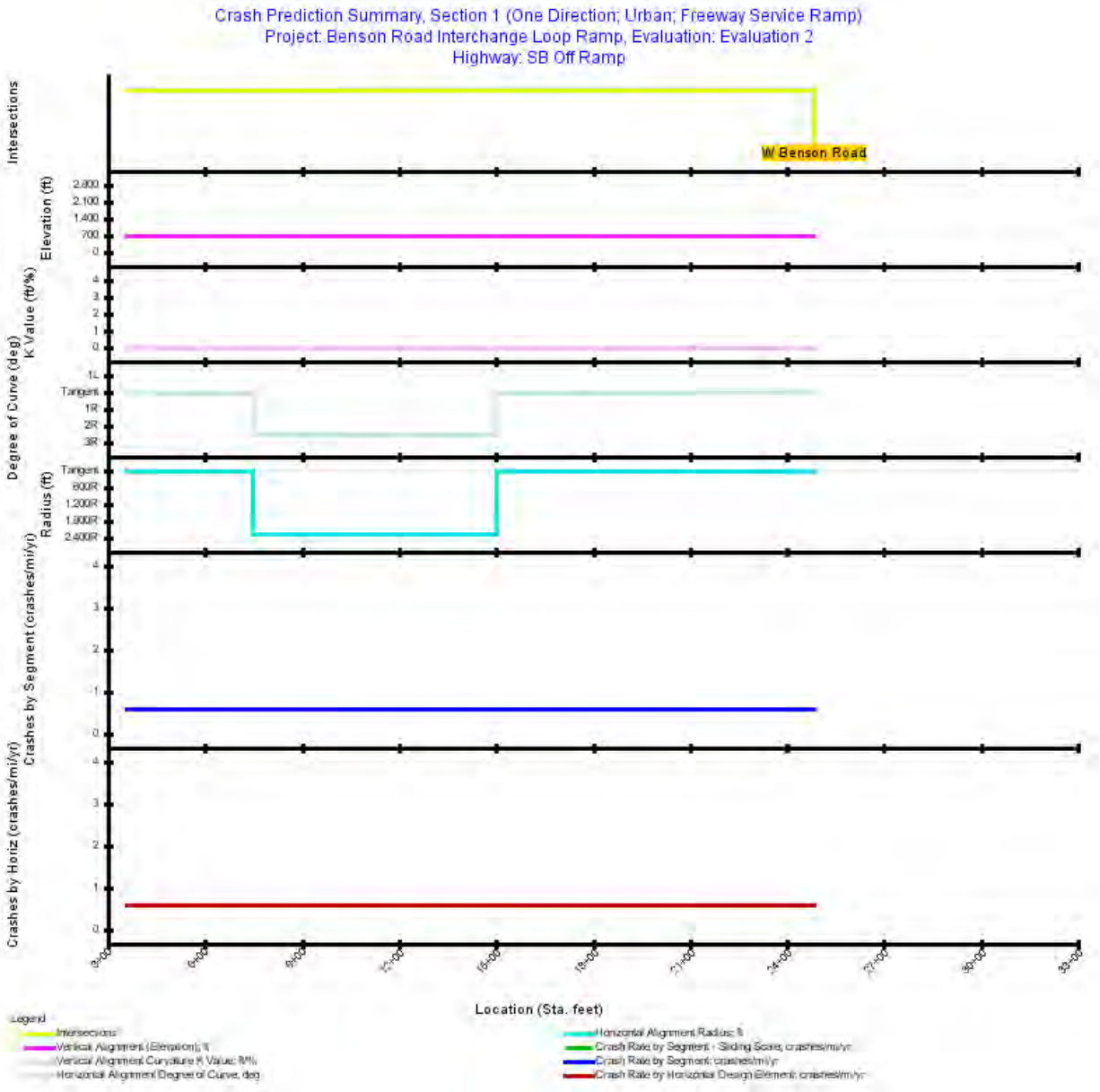

Figure 1. Crash Prediction Summary (Freeway Ramp Sections)

Table 1. Evaluation Freeway - Homogeneous Segments (Freeway Ramp Sections)

Seg. No.	Type	Area Type	Start Location (Sta. ft)	End Location (Sta. ft)	Length (ft)	Length(mi)	AADT
1	1EX	Urban	3+59.600	24+86.000	2,126.40	0.4027	2023: 1,300; 2024: 1,274; 2025: 1,248; 2026: 1,222; 2027: 1,197; 2028: 1,171; 2029: 1,145; 2030: 1,119; 2031: 1,094; 2032: 1,068; 2033: 1,042; 2034: 1,017; 2035: 991; 2036: 965; 2037: 939; 2038: 914; 2039: 888; 2040: 862; 2041: 836; 2042: 811; 2043: 785; 2044: 759; 2045: 734

Table 2. Expected Ramp Crash Rates and Frequencies (Freeway Ramp Sections)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.4027
Average Future Road AADT (vpd)	1,017
Expected Crashes	
Total Crashes	5.26
Fatal and Injury Crashes	2.49
Property-Damage-Only Crashes	2.77
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	47
Percent Property-Damage-Only Crashes (%)	53
Expected Crash Rate	
Crash Rate (crashes/mi/yr)	0.5675
Fatal and Injury Crash Rate (crashes/mi/yr)	0.2690
Property-Damage-Only Crash Rate (crashes/mi/yr)	0.2985
Expected Travel Crash Rate	
Total Travel (million veh-mi)	3.44
Travel Crash Rate (crashes/million veh-mi)	1.53
Travel Fatal and Injury Crash Rate (crashes/million veh-mi)	0.72
Travel Property-Damage-Only Crash Rate (crashes/million veh-mi)	0.80

Table 3. Expected Crash Frequencies and Rates by Ramp Segment (Freeway Ramp Sections)

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
1	3+59.600	24+86.000	0.4027	5.257	0.5675	1.53

Table 4. Expected Crash Frequencies and Rates by Horizontal Design Element (Freeway Ramp Sections)

Title	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Expected No. Crashes for Evaluation Period	Crash Rate (crashes/mi/yr)	Travel Crash Rate (crashes/million veh-mi)
Tangent	3+59.600	7+48.480	0.0737	0.961	0.5675	1.53
Simple Curve 1	7+48.480	15+01.540	0.1426	1.862	0.5675	1.53
Tangent	15+01.540	24+86.000	0.1865	2.434	0.5675	1.53

Table 5. Expected Crash Severity by Ramp Segment (Freeway Ramp Sections)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0778	0.2359	0.9810	1.1970	2.7648

Table 6. Expected Freeway Ramp Crash Type Distribution (Freeway Ramp Sections)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Highway Segment	Collision with Animal	0.01	0.2	0.06	1.1	0.07	1.3
Highway Segment	Collision with Fixed Object	1.73	33.0	1.91	36.4	3.65	69.4
Highway Segment	Collision with Other Object	0.12	2.3	0.37	7.1	0.49	9.4
Highway Segment	Other Single-vehicle Collision	0.50	9.5	0.29	5.4	0.79	14.9
Highway Segment	Collision with Parked Vehicle	0.04	0.7	0.04	0.8	0.08	1.5
Highway Segment	Total Single Vehicle Crashes	2.40	45.7	2.67	50.8	5.07	96.5
Highway Segment	Right-Angle Collision	0.00	0.1	0.00	0.0	0.00	0.1
Highway Segment	Head-on Collision	0.00	0.0	0.00	0.0	0.00	0.0
Highway Segment	Other Multi-vehicle Collision	0.00	0.1	0.00	0.0	0.01	0.1
Highway Segment	Rear-end Collision	0.07	1.3	0.06	1.2	0.13	2.5
Highway Segment	Sideswipe, Same Direction Collision	0.02	0.3	0.03	0.5	0.04	0.8
Highway Segment	Total Multiple Vehicle Crashes	0.09	1.7	0.09	1.8	0.18	3.5
Highway Segment	Total Highway Segment Crashes	2.49	47.4	2.77	52.6	5.26	100.0
	Total Crashes	2.49	47.4	2.77	52.6	5.26	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

Interactive Highway Safety Design Model

Crash Prediction Evaluation Report

June 14, 2018

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IHSDM Version: v13.1.0 (Mar 16, 2018)
Crash Prediction Module: v8.1.0 (Mar 16, 2018)

User Name: Garret Menard
Organization Name: HDR Engineering
Phone: 402-578-9254
E-Mail: garret.menard@hdrinc.com

Project Title: Benson Road Interchange Loop Ramp
Project Comment: Created Thu May 31 14:28:00 CDT 2018
Project Unit System: U.S. Customary

Intersection Title: NB Ramp Terminal
Intersection Comment: Created Thu Jun 14 09:23:41 CDT 2018
Intersection Version: v1

Evaluation Title: Evaluation 1
Evaluation Comment: Created Thu Jun 14 10:42:31 CDT 2018

Minimum Location: 10+00.000
Maximum Location: 31+00.000
Policy for Superelevation: AASHTO 2011 U.S. Customary
Calibration: HSM Configuration
Crash Distribution: HSM Configuration
Model/CMF: HSM Configuration
Empirical-Bayes Analysis: None
First Year of Analysis: 2023
Last Year of Analysis: 2045

Section Types

NB Ramp Terminal Evaluation

Intersection: NB Ramp Terminal
Evaluation Start Location: 10+00.000
Evaluation End Location: 31+00.000
Calibration Factor: RT_SG_FI=1.0; RT_SG_PDO=1.0;

Table 1. Evaluation Ramp Terminal - Site (NB Ramp Terminal)

Inter. No.	Ramp Terminal Type	Area Type	Legs	Location (Sta. ft)	Traffic Control	AADT
1	B4-Four-Leg Ramp Terminal at Four-Quad Parclo B	Urban	4	26+50.000	Signalized	Inside: 2023: 9,000; 2024: 9,559; 2025: 10,119; 2026: 10,678; 2027: 11,238; 2028: 11,797; 2029: 12,357; 2030: 12,917; 2031: 13,476; 2032: 14,036; 2033: 14,595; 2034: 15,155; 2035: 15,715; 2036: 16,274; 2037: 16,834; 2038: 17,393; 2039: 17,953; 2040: 18,513; 2041: 19,072; 2042: 19,632; 2043: 20,191; 2044: 20,751; 2045: 21,311; Outside: 2023: 9,000; 2024: 9,559; 2025: 10,119; 2026: 10,678; 2027: 11,238; 2028: 11,797; 2029: 12,357; 2030: 12,917; 2031: 13,476; 2032: 14,036; 2033: 14,595; 2034: 15,155; 2035: 15,715; 2036: 16,274; 2037: 16,834; 2038: 17,393; 2039: 17,953; 2040: 18,513; 2041: 19,072; 2042: 19,632; 2043: 20,191; 2044: 20,751; 2045: 21,311 :: Entrance: 2023: 1,900; 2024: 1,878; 2025: 1,857; 2026: 1,835; 2027: 1,814; 2028: 1,792; 2029: 1,771; 2030: 1,750; 2031: 1,728; 2032: 1,707; 2033: 1,685; 2034: 1,664; 2035: 1,643; 2036: 1,621; 2037: 1,600; 2038: 1,578; 2039: 1,557; 2040: 1,536; 2041: 1,514; 2042: 1,493; 2043: 1,471; 2044: 1,450; 2045: 1,429; Exit: 2023: 670; 2024: 989; 2025: 1,308; 2026: 1,628; 2027: 1,947; 2028: 2,267; 2029: 2,586; 2030: 2,905; 2031: 3,225; 2032: 3,544; 2033: 3,864; 2034: 4,183; 2035: 4,502; 2036: 4,822; 2037: 5,141; 2038: 5,461; 2039: 5,780; 2040: 6,099; 2041: 6,419; 2042: 6,738; 2043: 7,058; 2044: 7,377; 2045: 7,697

Table 2. Expected Ramp Terminal Crash Rates and Frequencies (NB Ramp Terminal)

First Year of Analysis	2023
Last Year of Analysis	2045
Evaluated Length (mi)	0.0000
Expected Crashes	
Total Crashes	55.62
Fatal and Injury Crashes	23.29
Property-Damage-Only Crashes	32.33
Percent of Total Expected Crashes	
Percent Fatal and Injury Crashes (%)	42
Percent Property-Damage-Only Crashes (%)	58

Table 3. Expected Crash Frequencies and Rates by Ramp Terminal (NB Ramp Terminal)

Segment Number/Intersection Name/Cross Road	Location (Sta. ft)	Expected No. Crashes for Evaluation Period	Expected No. Crashes/Year (crashes/million veh)	Expected Crash Rate (crashes/yr)
NB Ramp Terminal	26+50.000	55.617	0.37	2.4181

Table 4. Expected Crash Severity by Ramp Terminal (NB Ramp Terminal)

Seg. No.	Fatal (K) Crashes (crashes)	Incapacitating Injury (A) Crashes (crashes)	Non-Incapacitating Injury (B) Crashes (crashes)	Possible Injury (C) Crashes (crashes)	No Injury (O) Crashes (crashes)
1	0.0214	0.5338	3.4991	19.2307	32.3323

Table 5. Expected Ramp Terminal Crash Type Distribution (NB Ramp Terminal)

Element Type	Crash Type	Fatal and Injury		Property Damage Only		Total	
		Crashes	Crashes (%)	Crashes	Crashes (%)	Crashes	Crashes (%)
Ramp Terminal	Collision with Animal	0.00	0.0	0.00	0.0	0.00	0.0
Ramp Terminal	Collision with Fixed Object	0.77	1.4	1.62	2.9	2.38	4.3
Ramp Terminal	Collision with Other Object	0.02	0.0	0.07	0.1	0.09	0.2
Ramp Terminal	Other Single-vehicle Collision	0.42	0.8	0.23	0.4	0.65	1.2
Ramp Terminal	Collision with Parked Vehicle	0.02	0.0	0.07	0.1	0.09	0.2
Ramp Terminal	Total Single Vehicle Crashes	1.23	2.2	1.97	3.5	3.21	5.8
Ramp Terminal	Right-Angle Collision	6.05	10.9	7.11	12.8	13.17	23.7
Ramp Terminal	Head-on Collision	0.26	0.5	0.23	0.4	0.48	0.9
Ramp Terminal	Other Multi-vehicle Collision	0.21	0.4	0.65	1.2	0.86	1.5
Ramp Terminal	Rear-end Collision	14.55	26.2	17.56	31.6	32.11	57.7
Ramp Terminal	Sideswipe, Same Direction Collision	0.98	1.8	4.82	8.7	5.79	10.4
Ramp Terminal	Total Multiple Vehicle Crashes	22.05	39.6	30.36	54.6	52.41	94.2
Ramp Terminal	Total Ramp Terminal Crashes	23.29	41.9	32.33	58.1	55.62	100.0
	Total Crashes	23.29	41.9	32.33	58.1	55.62	100.0

Note: *Fatal and Injury Crashes* and *Property Damage Only Crashes* do not necessarily sum up to *Total Crashes* because the distribution of these three crashes had been derived independently.

SECTION 7

INTERCHANGE OPTIONS EVALUATION MEMORANDUM

Options Evaluation

I-229 Benson Road Interchange Modification Study

Sioux Falls, South Dakota

October 10, 2018

City of Sioux Falls
SOUTH DAKOTA

South Dakota DOT
Connecting South Dakota and the Nation

1.0 Background

As identified in the previously completed I-229 Major Investment Study, the I-229 Exit 9 (Benson Road) Interchange requires capacity improvements due to planned development of this area of Sioux Falls. It is the purpose of this memo to discuss the options that have been carried forward from the I-229 Major Investment Study as well as the refinements that have been made which caused additional options to be evaluated. Interchange Concept Build Options 1a to 1e and 4a and 4b are discussed in this memo, previous options 2 and 3 from the I-229 Major Investment Study were previously determined to not be carried forward. Due to the significant amount of work completed in that previous study it was determined that the option numbering would be used and updated as needed for consistency. Within this memo, 7 separate interchange options are evaluated.

The Interchange Build Options are provided in reduced size versions within the memo for visual purposes, full scale layouts are included in the appendix.

The purpose of this memo is to provide an evaluation of each of all the Options including the no-build and provide recommendations on which options to carry forward in the Interchange Modification Justification Report and within the environmental documents. A brief summary of the information in this memo is incorporated into the environmental document.

The main criteria used to evaluate the Build Options included (not necessarily in order of importance):

- Traffic operations
- Right of way acquisition
- Environmental impacts
- Comparative construction costs

The complete Interchange Options Comparison Matrix is provided on pages 17 and 18 of this memo. To allow the reviewers of this document to understand where the environmental impacts discussed in the matrix are located a figure of environmental resources is including in Appendix A.

2.0 Evaluation

2.1 No-Build Option

The No-Build Option will be carried forward as a base-line comparison for the build options. As noted in the Options Comparison Matrix, the No-Build Option does not:

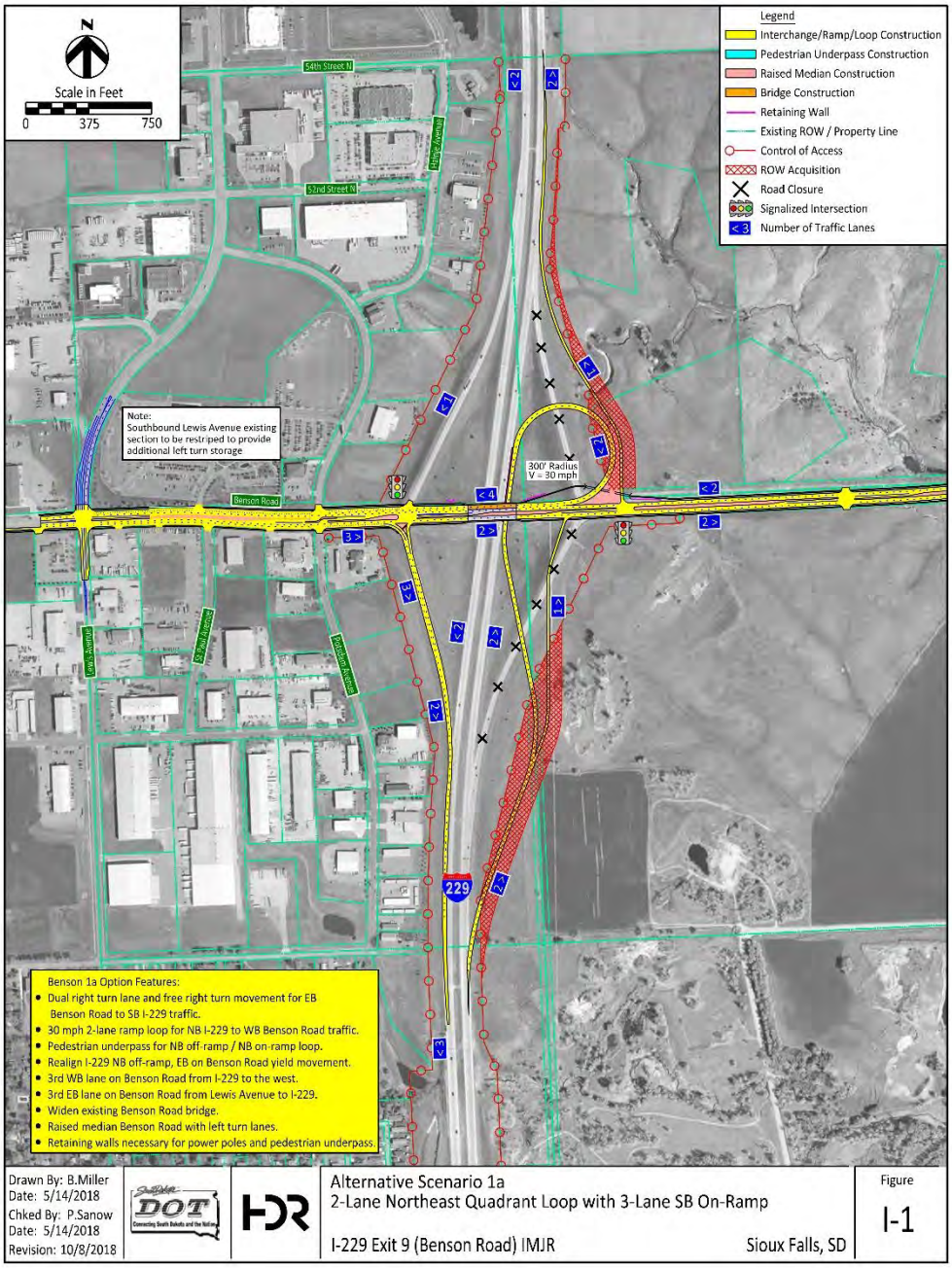
- Meet design criteria or policy for interchange configuration.
- Resolve the existing and future traffic congestion at the interchange.

2.2 Build Options

The following pages describe each build options including the benefits and drawbacks. Appendix B includes a larger scale version of each option.

Option 1a: 2 Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp

Option 1a (Figure 1) proposes a northbound off-ramp with separation of eastbound and westbound traffic on Benson Road. This separation reduces the amount of vehicles queued at the existing signal and the east-bound off ramp skew supports one-way eastbound turning movement. On Benson Road the additional proposed eastbound lane, increased to three total from Lewis Avenue to the east to I-229 and the three lane southbound on-ramp also reduces queuing significantly.



Benefits of Option 1a:

- Free flow northbound I-229 to westbound Benson Road due to loop and no signal.
- Traffic Level of Service (LOS) B is forecast at the interchange for year 2045 conditions.
- Pedestrian underpass reduces conflict with vehicles using the northbound on ramp and the larger volume of traffic on the loop ramp for the westbound Benson Road traffic.
- Free-flow dual rights on Benson Road eastbound to I-229 southbound reduces congestion/queuing on Benson Road between Lewis Avenue and I-229. Free-flow is only interrupted for pedestrian movement.
- Access management treatments considered with installation of raised median.

Drawbacks of Option 1a:

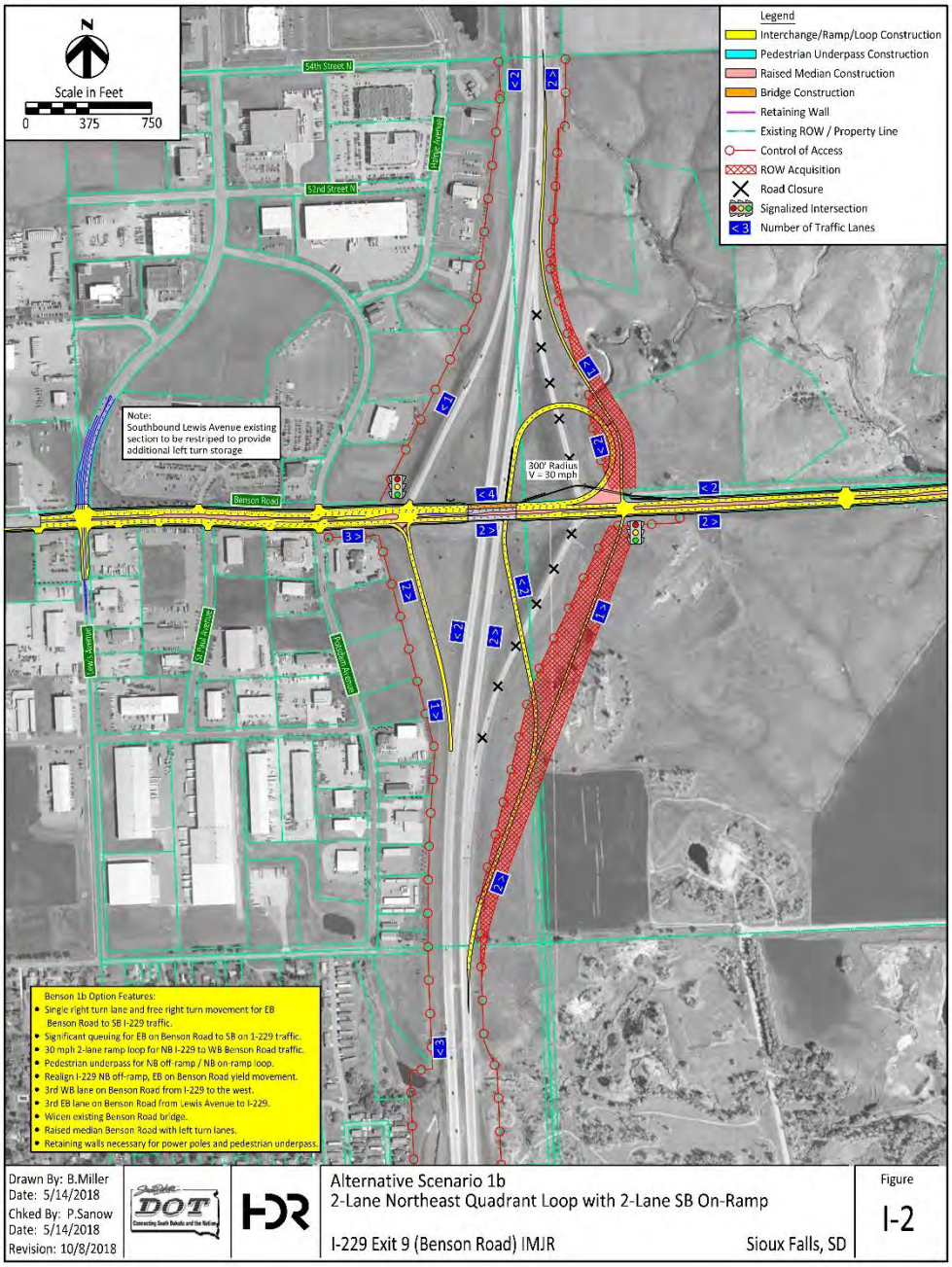
- The construction of the ramps requires substantial right of way acquisition and grading costs associated with constructing a new loop ramp and removal of the existing ramps.
- Option 1a could result in additional crashes compared to the no-build due to added lanes and additional length on some of the ramps.
- Although the pedestrian underpass in this option reduces conflict, the additional cost per pedestrian and bicycle user is high.
- Due to the increased right of way and grading impacts to environmental resources are higher with this option compared to non-loop ramp options.

It is recommended that Option 1a be eliminated from further evaluation for these reasons:

- *Total right of way necessary to be acquired.*
- *High construction cost*

Option 1b: 2 Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp

Option 1b (Figure 2) is very similar to Option 1a. Proposes a northbound off-ramp with separation of eastbound and westbound traffic on Benson Road. This separation reduces the amount of vehicles queued at the existing signal and the east-bound off ramp skew supports one-way eastbound turning movement. The proposed Benson Road eastbound lanes and two southbound on-ramp lanes from Lewis Avenue to the east to the southbound on-ramp also reduces queuing, however, not as efficient as Option 1a.



Benefits of Option 1b:

- Free flow northbound I-229 to westbound Benson Road due to loop and no signal.
- Traffic Level of Service (LOS) B is forecast at the interchange for year 2045 conditions.
- Pedestrian underpass reduces conflict with vehicles using the northbound on ramp and the larger volume of traffic on the loop ramp for the westbound Benson Road traffic.
- Single free-flow right turn lane on Benson Road eastbound to I-229 southbound reduces congestion/queuing on Benson between Lewis Avenue and I-229. Free-flow is only interrupted for pedestrian movement.
- Access management treatments considered with installation of raised median.

Drawbacks of Option 1b:

The construction of the ramps requires a substantial amount of right of way acquisition and grading costs associated with constructing a new loop ramp and removal of existing ramps.

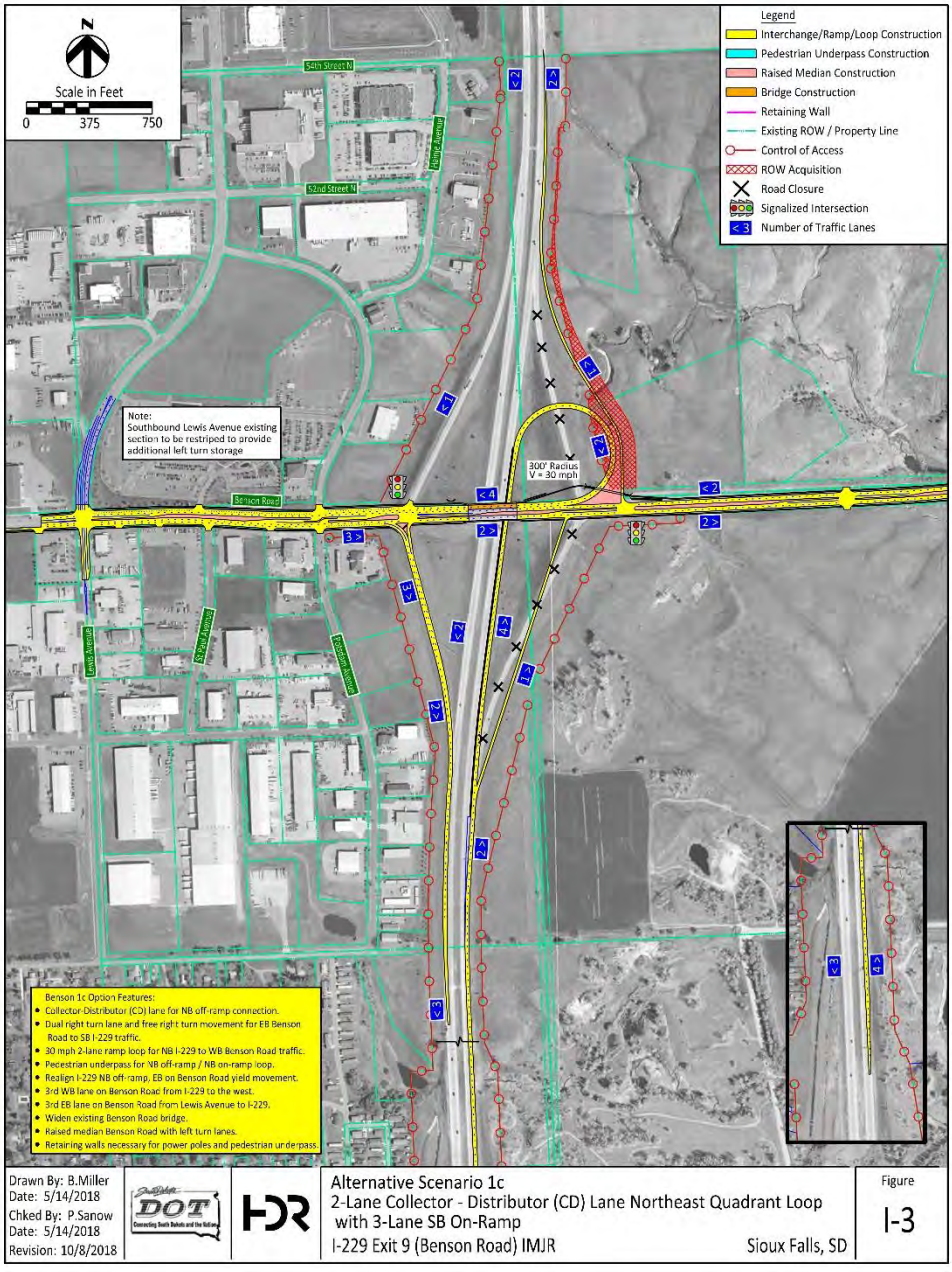
- Option 1b is anticipated to create more crashes compared to the no-build due to added lanes and additional length on some of the ramps.
- Although the pedestrian underpass in this option reduces conflict, the additional cost per pedestrian and bicycle user is high.

It is recommended that Option 1b be eliminated from further evaluation for these reasons:

- *Total right of way necessary to be acquired.*
- *High construction cost*

Option 1c: 2-Lane Collector – Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp

Option 1c (Figure 3) proposes a northbound off-ramp with separation of eastbound and westbound traffic on Benson Road while reducing the grading and right of way necessary by implementing a Collector-Distributor lane. The separation of eastbound and westbound vehicles on Benson Road is similar to Options 1a and 1b. The additional proposed eastbound lanes, totaling three, on Benson Road from Lewis Avenue to the east to the southbound on-ramp also reduces queuing significantly.



Benefits of Option 1c:

- The CD lane reduces the amount of right of way acquisition and grading costs associated with the northbound off-ramp.
- Free flow northbound I-229 to westbound Benson Road due to loop and no signal.
- Traffic Level of Service (LOS) B is forecast at the interchange for year 2045 conditions.
- Pedestrian underpass reduces conflict with vehicles using the northbound on ramp and the larger volume of traffic on the loop ramp for the westbound Benson Road traffic.
- Dual rights on Benson Road for eastbound to I-229 southbound reduces congestion/queuing on Benson Road eastbound between Lewis Avenue and I-229.
- CD lane enhances safety by allowing more distance and separation for vehicles slowing to exit and remain adjacent to the high-speed mainline.

Drawbacks of Option 1c:

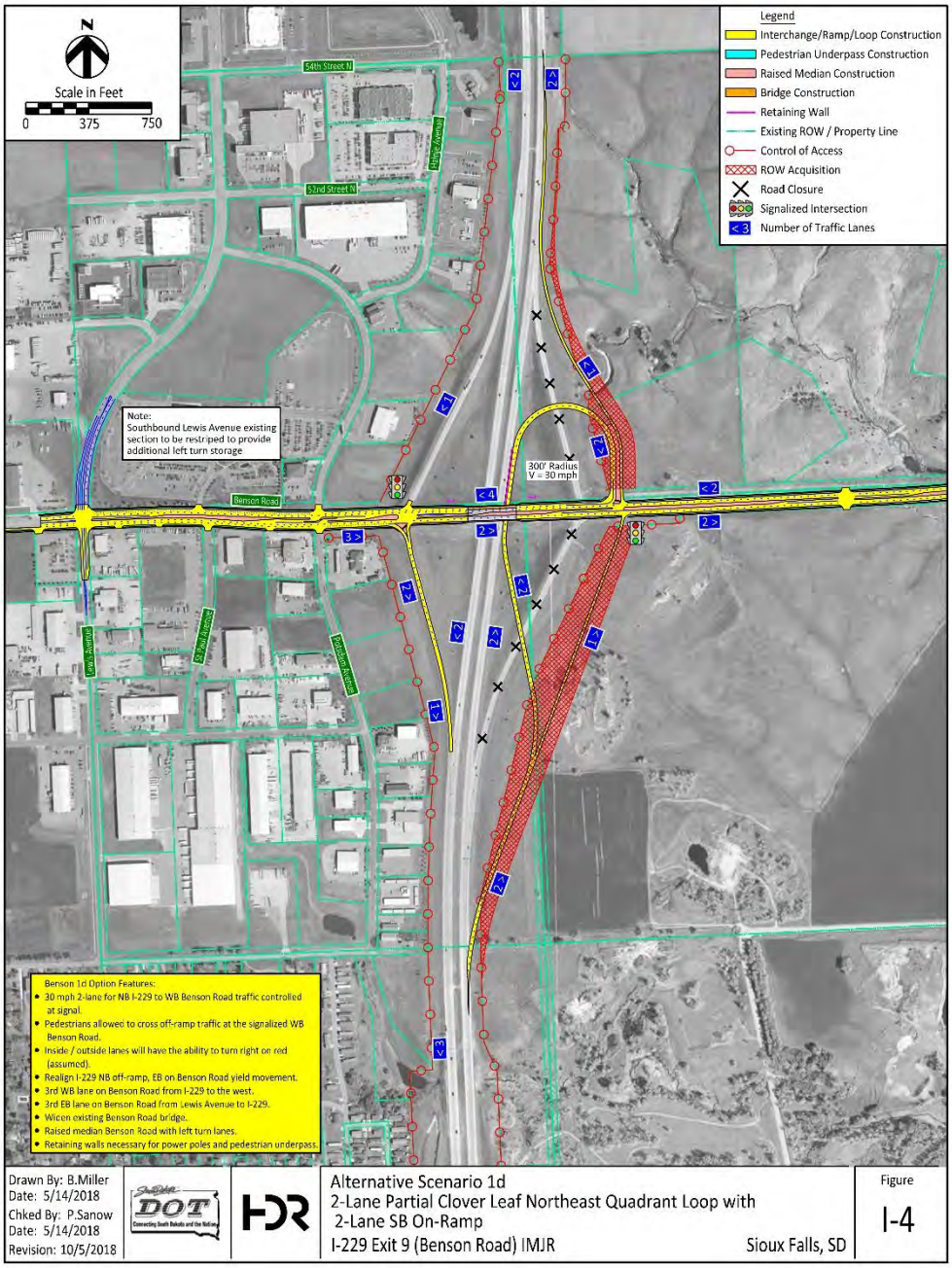
- Option 1c is anticipated to create more crashes compared to the no-build due to added lanes and additional length on some of the ramps.
- Although the pedestrian underpass in this option reduces conflict, the additional cost per pedestrian and bicycle user is high.

It is recommended that Option 1c be eliminated from further evaluation for this reason:

- *High construction cost.*

Option 1d: 2-Lane Partial Clover Leaf Northeast Quadrant Loop with 2-Lane SB On-Ramp

Option 1d (Figure 4) proposes a signalized loop at the intersection of Benson Road. Right-turn on red would not be allowed.



Benefits of Option 1d:

- Access Management treatments considered with installation of raised median

Drawbacks of Option 1d:

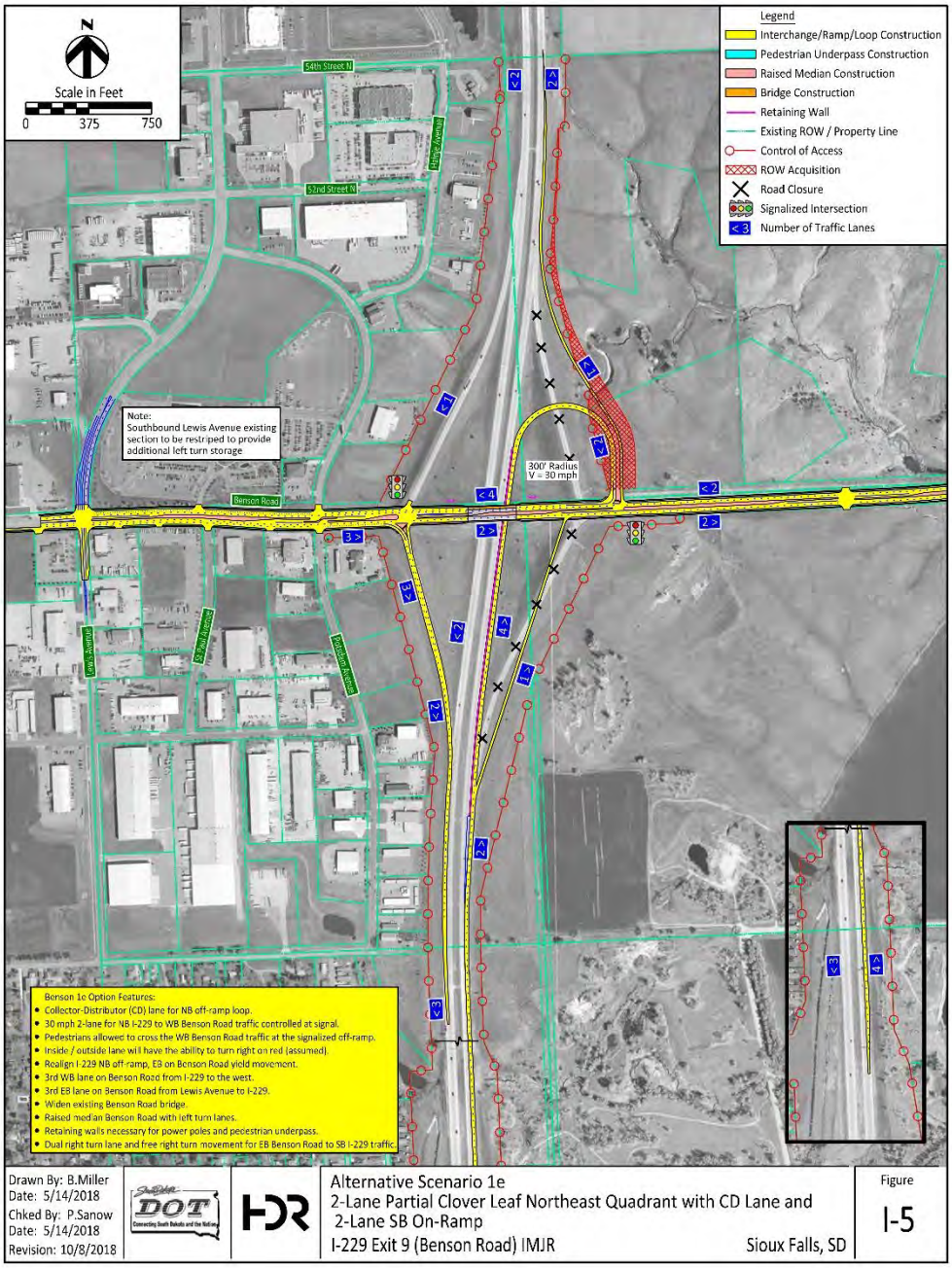
- Does not meet Purpose and Need. The Level of Service falls below the acceptable level C because the right turn on red movements would not be allowed to operate as a free-flow movement.
- The construction of the ramps requires substantial right of way acquisition and grading costs associated with constructing a new loop ramp and removal of the existing ramps.

It is recommended that Option 1d be eliminated from further evaluation for these reasons:

- *This option does not meet the acceptable Level of Service.*
- *Total right of way necessary to be acquired.*
- *High construction cost*

Option 1e: 2-Lane Partial Clover Leaf Northeast Quadrant Loop with CD Lane 2-Lane and 2-SB On-Ramp

Option 1e (Figure 5) proposes is similar to Option 1e with the exception of the CD lane. Right turn on red will not be allowed at the off-ramp for westbound traffic on Benson Road



Benefits of Option 1e:

- Access management treatments considered with installation of raised median.

Drawbacks of Option 1e:

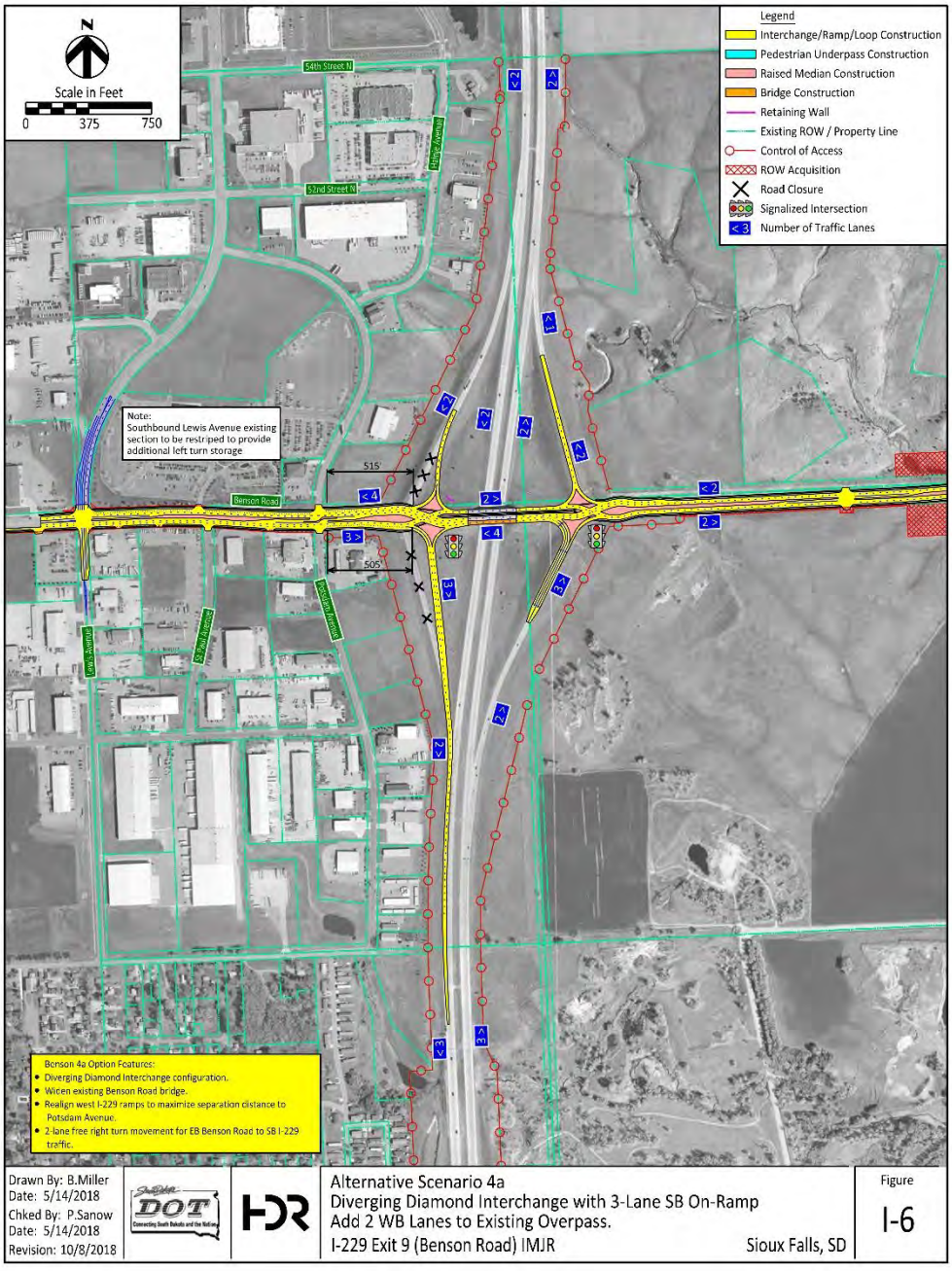
- Does not meet Purpose and Need. The Level of Service falls below the acceptable level C because the right turn on red movements would not be allowed to operate as a free-flow movement.
- The construction of the ramps requires substantial right of way acquisition.

It is recommended that Option 1e be eliminated from further evaluation for these reasons:

- *This option does not meet the acceptable Level of Service.*
- *Total right of way necessary to be acquired..*

Option 4a: Diverging Diamond Interchange (DDI) with 3-Lane SB On-Ramp; Add 2 WB Lanes to Existing Overpass

Option 4a (Figure 6) proposes a diverging diamond interchange with a three lane southbound on-ramp for eastbound traffic on Benson Road. This option proposes adding onto the existing structure and converting it to a DDI. The existing structure would be the four westbound lanes.



Benefits of Option 4a:

- Fewer crashes expected compared to the other build alternatives developed. The predicted annual traffic accidents reduces 25% from the no-build option.
- Traffic Level of Service (LOS) C is worst case forecast at the interchange in the morning for the northbound ramp for year 2045 conditions.
- Cost of construction reasonable due to limited amount of grading and reduced right of way acquisition.
- Requires no additional right of way on I-229.
- Fewer impacts to wildlife habitat, wetlands, and other environmental resources due to less grading and right of way.

Drawbacks of Option 4a:

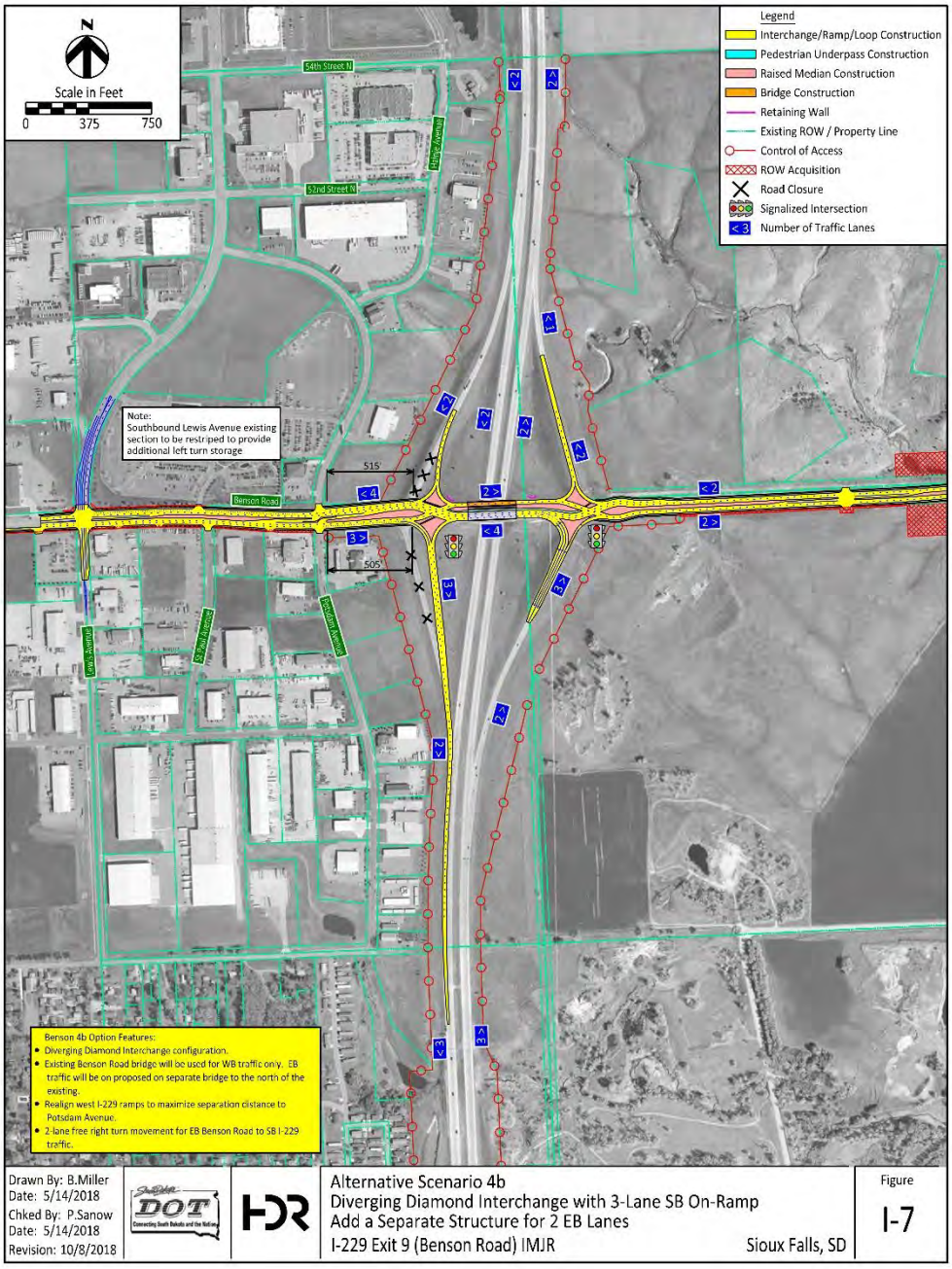
- Adding onto the existing overpass to accommodate the DDI adds cost compared to a new structure over I-229. Cost of this structure is similar but slightly lower compared to other options.
- Out of the two DDI's the construction costs for this option are the higher of the two.

It is recommended that Option 4a be carried forward for further evaluation and refinement for these reasons:

- *Expected reduction in annual total crash numbers resulting in improved safety*
- *Lower construction cost than the other options*
- *Fewer environmental impacts*

Option 4b: Diverging Diamond Interchange (DDI) with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB Lanes.

Option 4b (Figure 6) proposes a diverging diamond interchange with a three lane southbound on-ramp for eastbound traffic on Benson Road. This option proposes constructing a new and separate structure for the future two eastbound lanes of the DDI and converting the existing structure into the four lanes for the westbound traffic.



Benefits of Option 4b:

- Least amount of crashes expected compare to other build alternatives developed. The predicted annual traffic accidents reduces 25% from the no-build option.
- Traffic Level of Service (LOS) C is worst case forecast at the interchange in the morning for the northbound ramp for year 2045 conditions.
- This option has the lowest estimated construction cost due to limited amount of grading and reduced right of way lower structure costs.
- Requires no additional right of way on I-229.
- Fewer impacts to wildlife habitat, wetlands, and other environmental resources due to less grading and right of way.
- Out of the two DDI's, using the existing structure for maintenance of traffic creates the least amount of impact.

Drawbacks of Option 4b:

- Adding the proposed structure to the north of the existing structure may require additional coordination with private utilities.

It is recommended that Option 4b be carried forward for further evaluation and refinement for these reasons:

- *Reduced number of annual total crashes; increased safety*
- *Lower construction cost than the other options*
- *Fewer environmental impacts*

3.0 Conclusion

Table 3-1. Build Options Evaluation Summary

Options recommended to be carried forward for further refinement and evaluation

Option	Interchange Description	Main reason(s) for carrying forward
4a	Diverging Diamond Interchange (DDI) with 3-Lane SB On-Ramp. Add 2 WB Lanes to Existing Overpass	• Minimal cost and impacts compared to other options • Increase in safety compared to other options • Decrease in traffic accidents compared to no-build by 25% • Less impact to environmental resources
4b	Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB Lanes	• This option is the least expensive of all the options discussed • Increase in safety in compared to other options • Decrease in traffic accidents compared to no-build by 25% • Less impact to environmental resources

It is recommended that both options be justified within the Interchange Modification Study and final bridge option will be determined during preliminary and final design.

Options recommended to be eliminated from further evaluation

Option	Interchange Description	Main reason(s) for not carrying forward
1a	2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp	• Additional right of way acquisition • High construction cost
1b	2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp	• Additional right of way acquisition • High construction cost
1c	2-Lane Collector – Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp	• High construction cost • Greater impact to environmental resources
1d	2-Lane Partial Clover Leaf Northeast Quadrant Loop with 2-Lane SB On-Ramp	• This option does not meet the acceptable Level of Service • Additional right of way acquisition • High construction cost • Greater impact to environmental resources
4b	2-Lane Partial Clover Leaf Northeast Quadrant Loop with CD Lane 2-Lane and 2-SB On-Ramp	• This option does not meet the acceptable Level of Service. • High construction cost • Greater impact to environmental resources

		Meets Purpose and Need			Year 2045 Traffic Operations								Safety		Driver/ Public Perception	Construction Impacts		Comparative Costs								Potential Environmental Impacts		
Options	**Alternative**	**Improve Traffic Operations**	**Improves Multimodal Mobility**	**Provide Adequate Separations to Nearest Access (1)**	**Northbound Ramp Intersection**		**Southbound Ramp Intersections**		**Southbound Off Ramp**	**Northbound Off Ramp**	**Southbound Weaving**	**Northbound Weaving**	**Predicted Annual Total Crashes Year of Opening to 2045**	**Predicted Annual Facility and Injury Crashes Year of Opening to 2045**	**Driver Familiarity**	**Maintenance of Traffic During Construction**	**Allows for Phased Construction**	**Bridge(6)**	**Retaining Wall**	**Pedestrian Underpass**	**Benson Road**	**I-229 Ramps**	**20% Contingencies (not included on bridge)**	**ROW Acquisition**	**Total**	**Wetlands (4)**	**Potential Traditional Cultural Properties**	**Habitat**
					Worst LOS AM/ PM	Worst Delay AM/ PM	Worst LOS AM/ PM	Worst Delay AM/ PM	Worst LOS AM/ PM	Worst LOS AM/ PM	Worst LOS AM/ PM	Worst LOS AM/ PM	#	#				M $	M $	M $	M $	M $	M $	M $	M $	acre		
1A	2-Lane NE Quadrant Loop with 3-Lane SB On-Ramp. Widen Existing Structure	Yes	Yes	Yes	A/A	1.3/ 1.2	B/B	10.4/ 12.2	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	2.4	1.1	0.6	19.7	8.0	5.9	3.4	41.1	< 1.0	Yes	Moderate
1B	2-Lane NE Quadrant Loop with 2-Lane SB On-Ramp. Widen Existing Structure	Yes	Yes	Yes	B/A	10.5/ 7.6	B/B	10.5/ 12.9	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	2.4	1.1	0.6	19.7	6.5	5.6	4.4	40.3	<1.0	Yes	Moderate
1C	2-Lane Collector-Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp. Widen Existing Structure	Yes	Yes	Yes	A/A	1.3/ 1.2	B/B	10.4/ 12.2	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	2.4	0.5	0.6	19.7	8.9	5.9	2.0	40.0	<1.0	Yes	Moderate
1D	2-Lane Partial Clover Leaf Northeast Quadrant with 2-Lane SB On-Ramp. Widen Existing Structure	No	Yes	Yes	D/B	52.8/ 19.9	F/B	313.1/ 16.8	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	1.5	0.8	0.0	19.4	6.1	5.3	4.4	37.5	<1.0	Yes	Moderate

		Meets Purpose and Need			Year 2045 Traffic Operations								Safety		Driver/ Public Perception	Construction Impacts		Comparative Costs								Potential Environmental Impacts		
1E	2-Lane Partial Clover Leaf Northeast Quadrant with CD Lane and 2-Lane SB On-Ramp. Widen Existing Structure	No	Yes	Yes	E/B	64.9/ 15	F/B	244.3/ 12.1	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	1.5	0.2	0.0	19.4	6.7	5.3	2.0	35.1	<1.0	Yes	Moderate
4A	Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add 2 WB Lanes to Existing Overpass. Widen Existing Structure	Yes	Yes	Yes	C/B	26.1/ 14.6	B/A	10.9/ 6.4	B/B	A/B	B/C	B/A	17.2	6.1	Fair	Good	Yes	1.7	0.2	0.0	20.1	3.9	4.8	1.1	31.8	<1.0	No	Low
4B	Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB lanes	Yes	Yes	Yes	C/B	26.1/ 14.6	B/A	10.9/ 6.4	B/B	A/B	B/C	B/A	17.2	6.1	Fair	Good	Yes	1.8	0.2	0.0	16.9	3.9	4.2	1.1	28.1	<1.0	No	Low
No	No Build	No	No	No	F/B	255. 5/ 18.2	F/F	555.4/ 124.8	B/B	A/B	B/C	B/A	22.9	8.7	Good	N/A	N/A	0	0	0	0	0	0	0	0	0	No	None

N/A: Not Applicable

Does not meet purpose and need criteria or requirements in the Methods & Assumptions document

(1) SDDOT policy requires a minimum 100' separation from an interstate ramp junction/turn lane to the nearest access point.

(2) LOS and Delay applies to the single intersection associated with the SPI.

(3) While the DDI would be a new configuration for this area, drivers have become well-adapted to DDI interchanges where they have been implemented in other locations.

(4) Wetland impacts are similar due to a large percentage of the impacts being on Benson Road east of I-229. Each alternative involves more than 0.5 but less than 1.0 based on the conceptual level of design; there is a less than 0.05 acre difference between the alternatives

(5) Benson Road construction cost limits are based on estimated final Control of Access limits (per direction from SDDOT).

(6) Determination of bridge treatment with DDI alternative will be made during the final design process.

Options Evaluation Appendices

Appendix A Environmental Constraints

LEGEND

- Study Area
- Historical Recognized Environmental Conditions
- Recognized Environmental Conditions
- Sioux Falls Stormwater BMP
- Delineated Streams
- Delineated Wetlands

FEMA Floodplain

- 100 Year Floodplain
- Floodway

Other cultural resources were identified east of I-229 and near Benson Road east of I-229 and will be avoided.

Holiday Gas Station
Former Bott Machinery
Former Paul Harris Trucking
Midwest Coast Transport
Custom Truck Equipment
Truck and Tire Service Property
Food-N-Fuel
Great Dane Trailers
Pump-N-Pak Gas Station
Cliff Avenue
Lewis Avenue
Hall Avenue
Sycamore Avenue
Benson Road
229
Unnamed Tributary
Unnamed Tributary
Big Sioux River
Big Sioux River
Big Sioux River

0 Miles 0.4

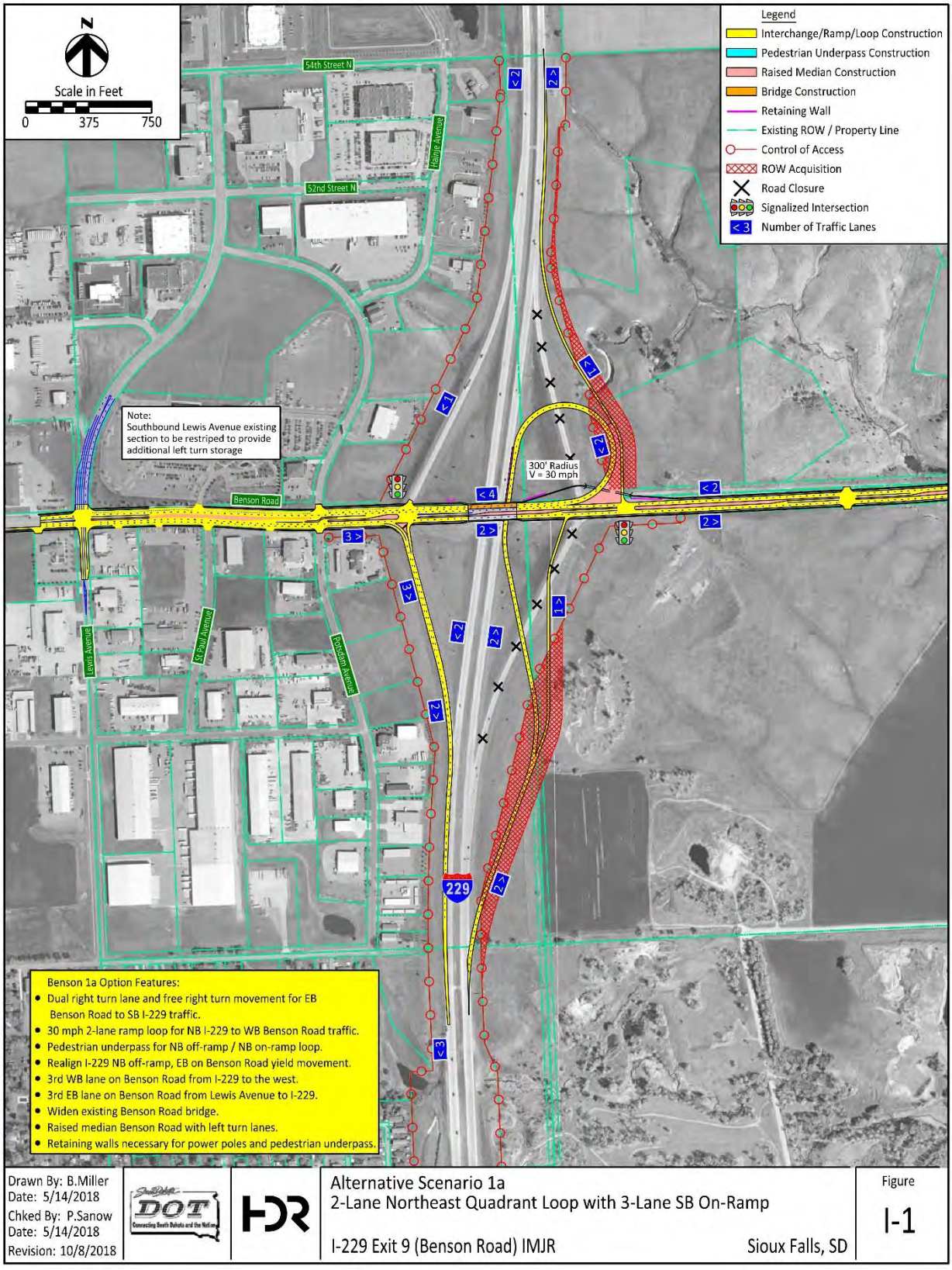
ENVIRONMENTAL CONSTRAINTS

I-229 BENSON ROAD INTERCHANGE MODIFICATION STUDY

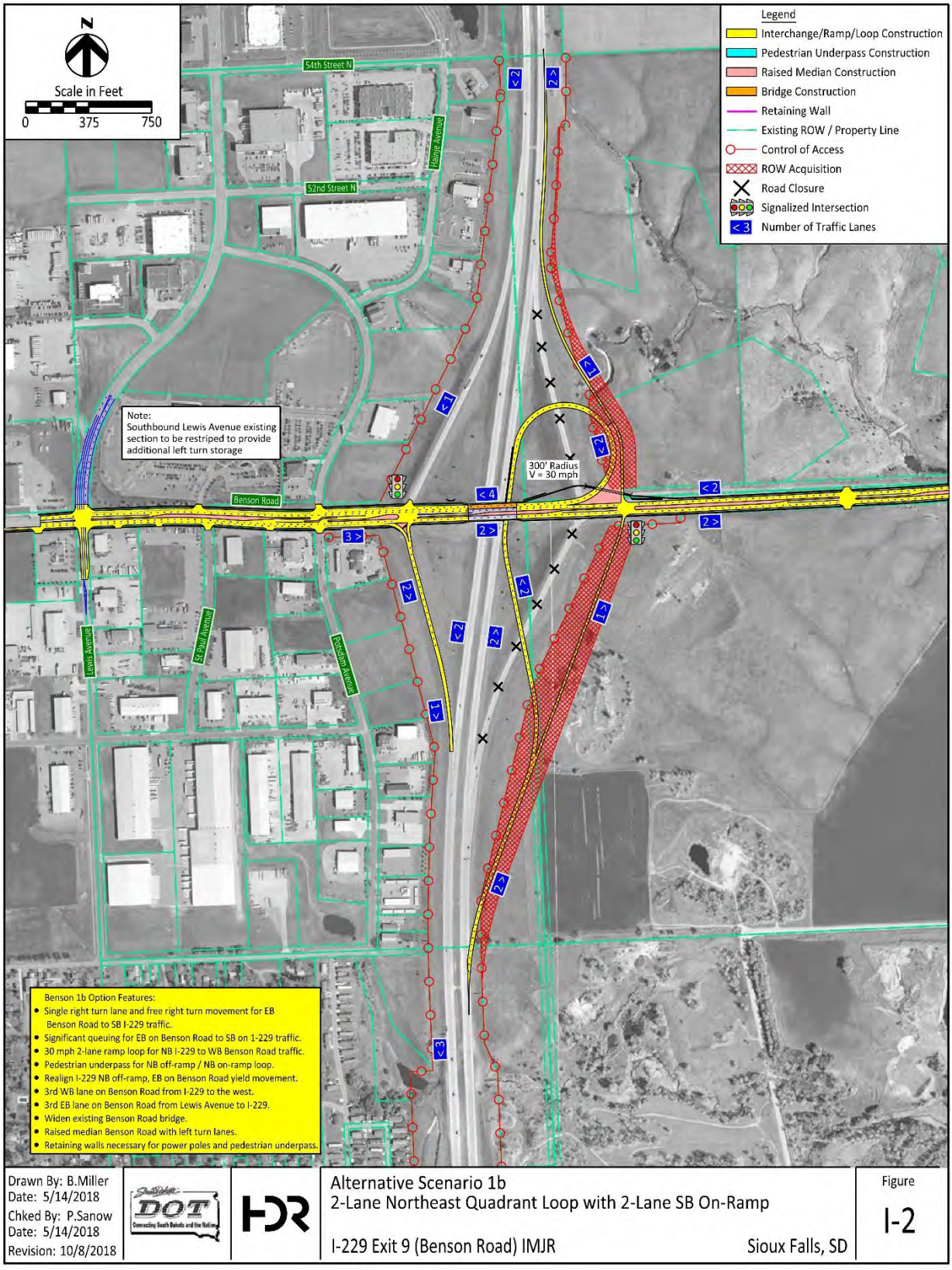
PATH: H:\GIS\PROJECTS\SDDOT\I229_BENSON\MAP_DOCS\DRAFT\ALTERNATIVES_ANALYSIS\FIG_ENV_CONSTRAINTS_11X17.MXD - USER: JBRISBOI - DATE: 10/16/2018

Appendix B Build Options

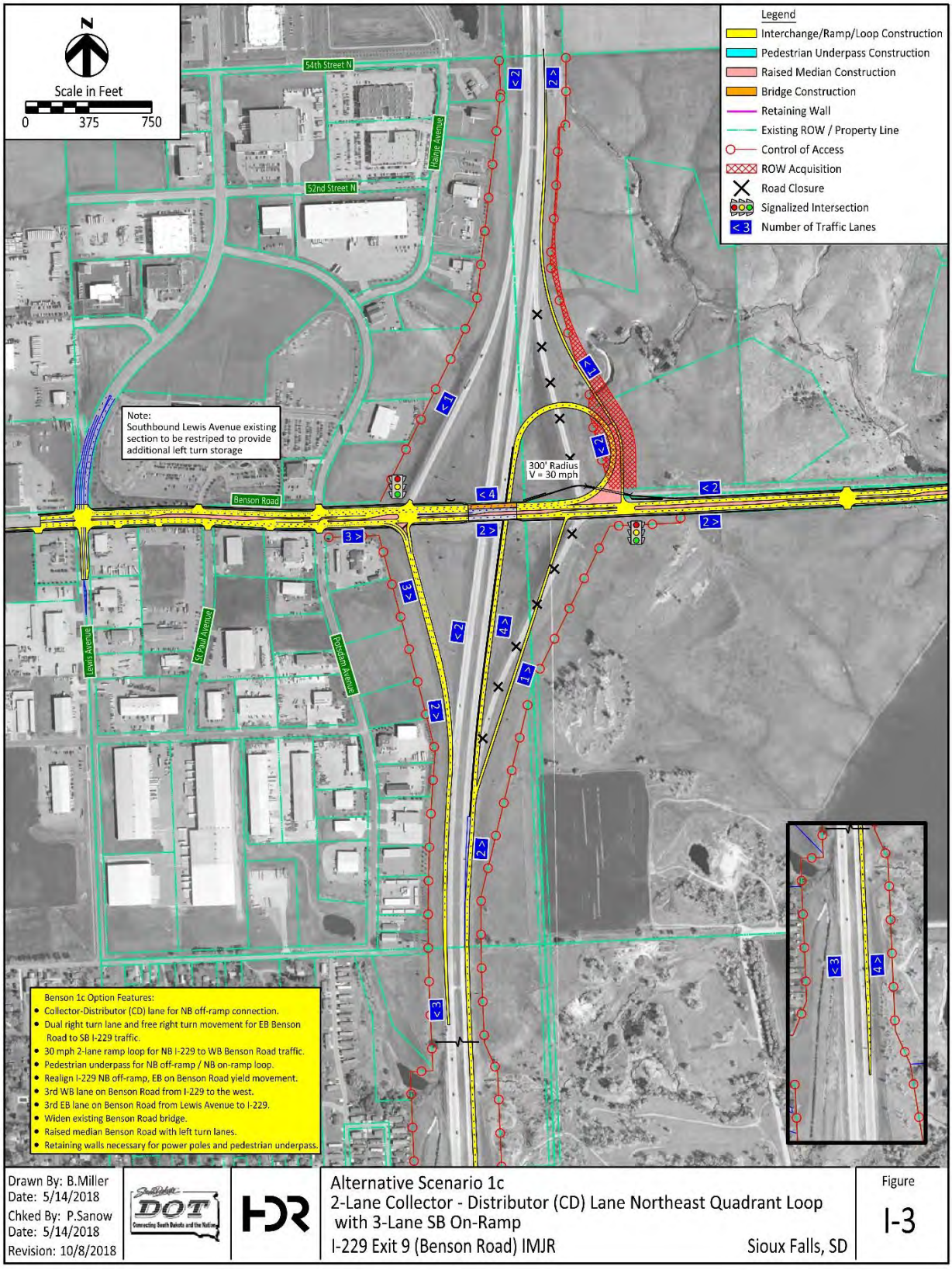
Option 1A 2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp



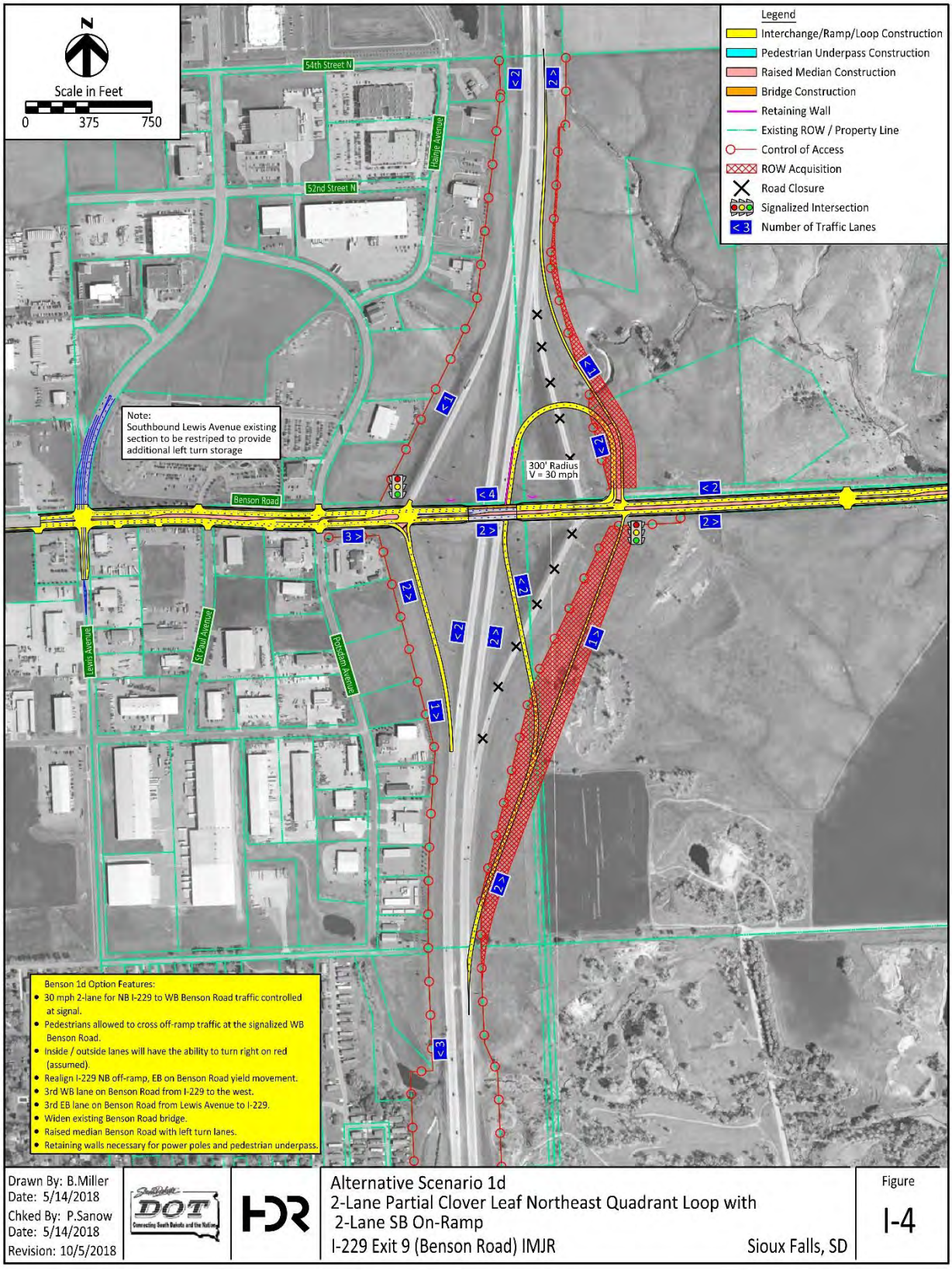
Option 1B 2-Lane Northeast Quadrant Loop with 2-land SB On-Ramp



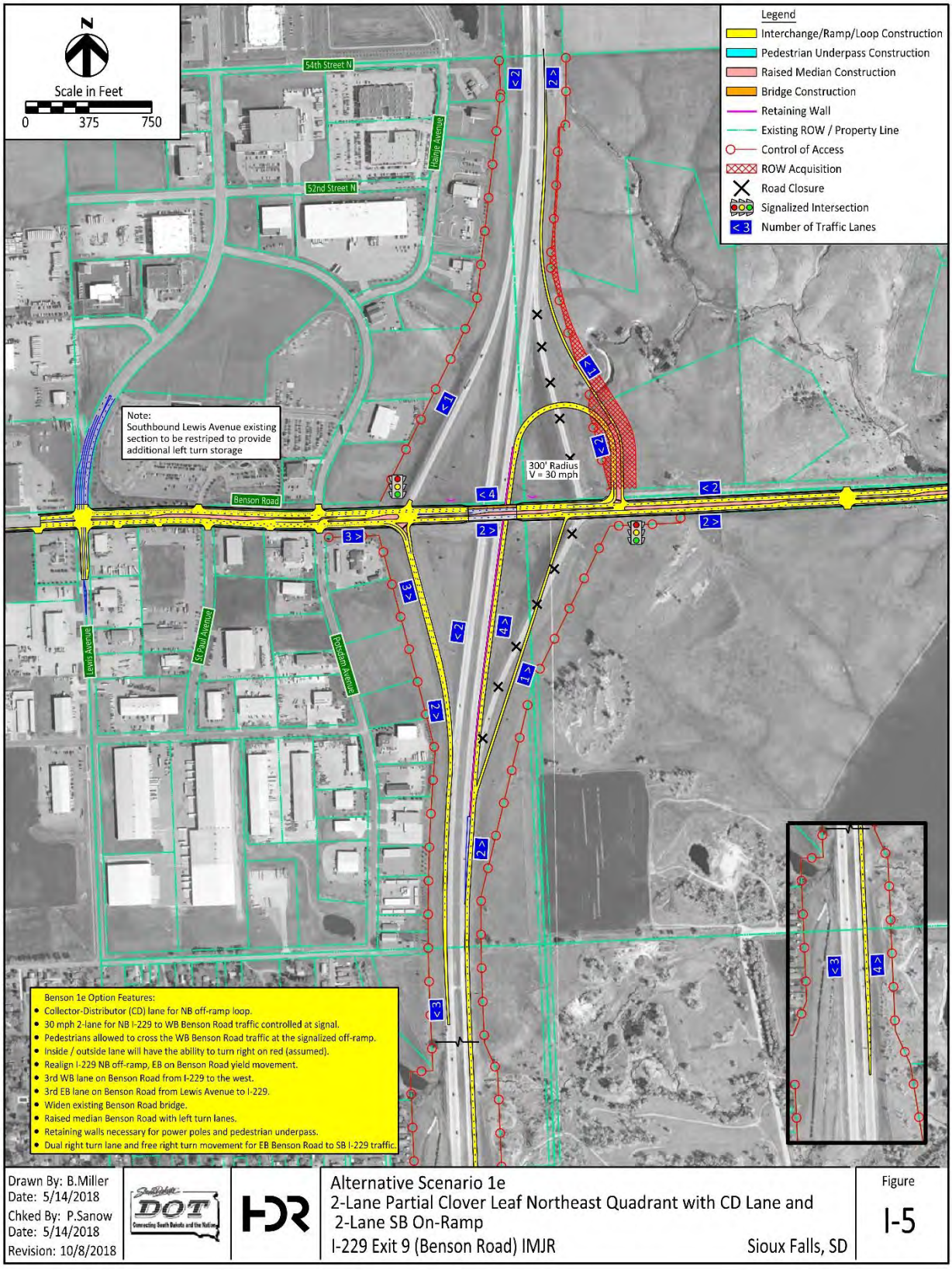
Option 1C 2-Collector-Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp



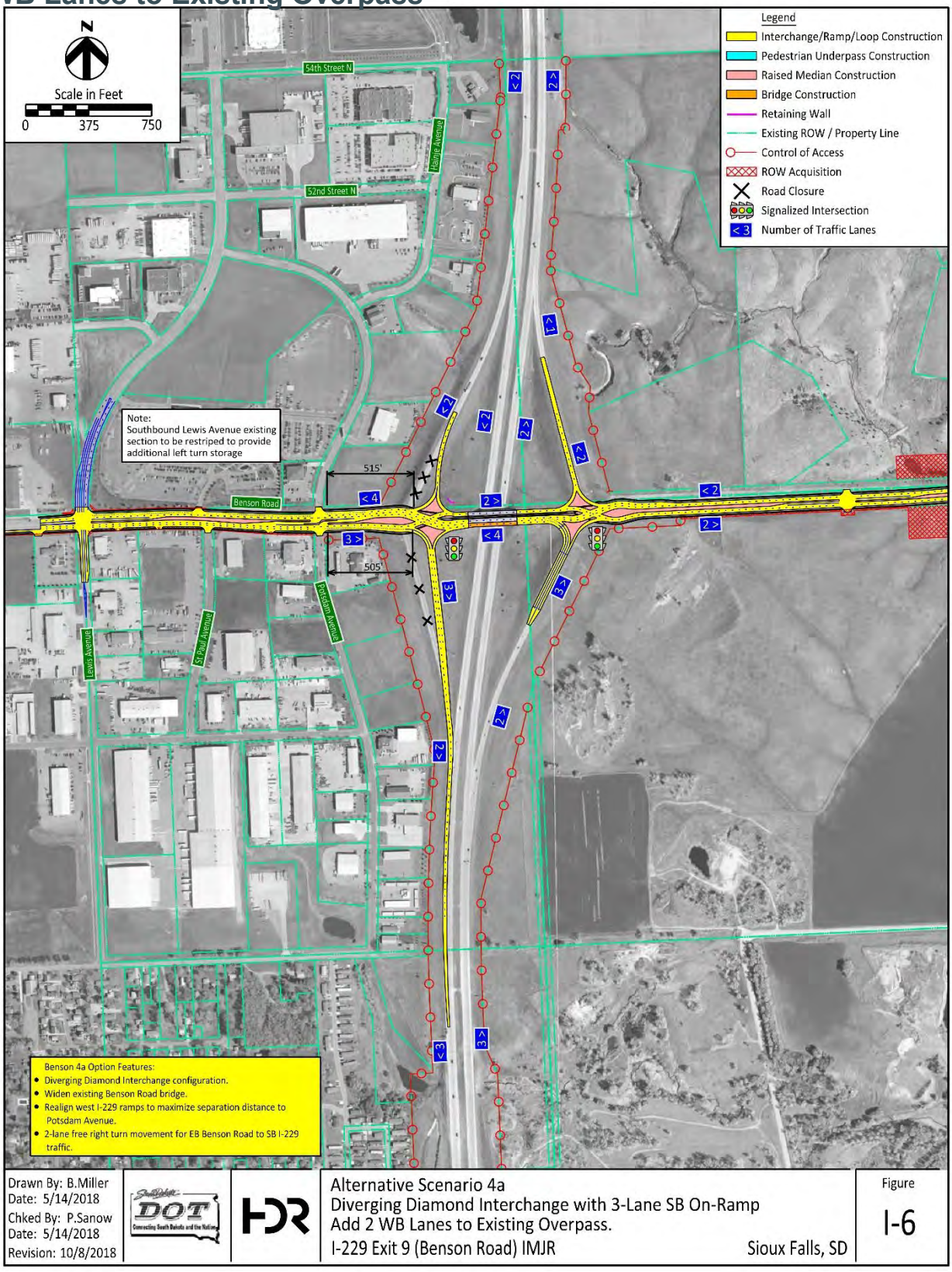
Option 1D 2-Lane Partial Clover Leaf Northeast Quadrant Loop with 2-Lane SB on-Ramp



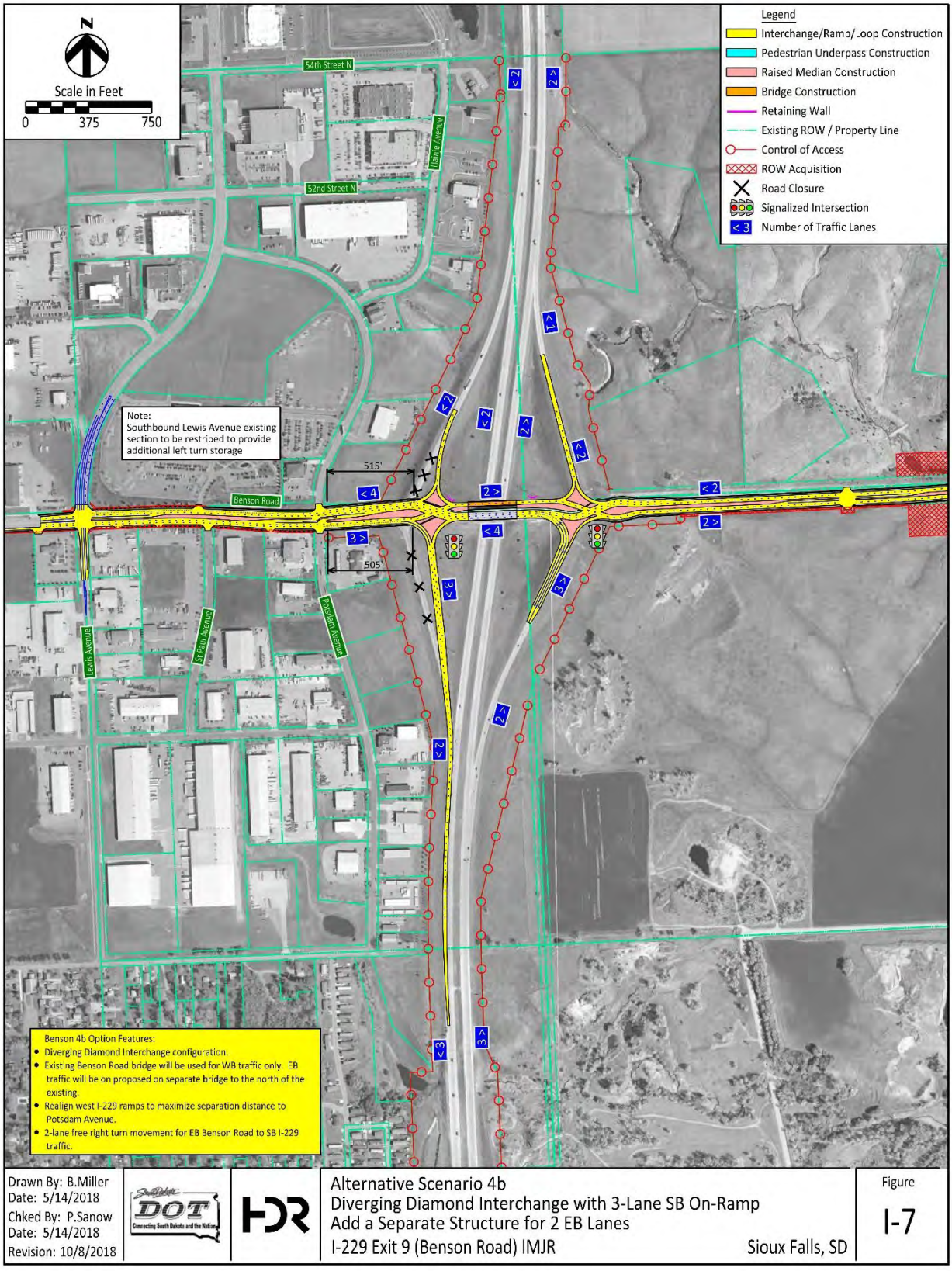
Option 1E 2-Lane Partial Clover Leaf Northeast with CD Lane and 2-lane SB On-Ramp



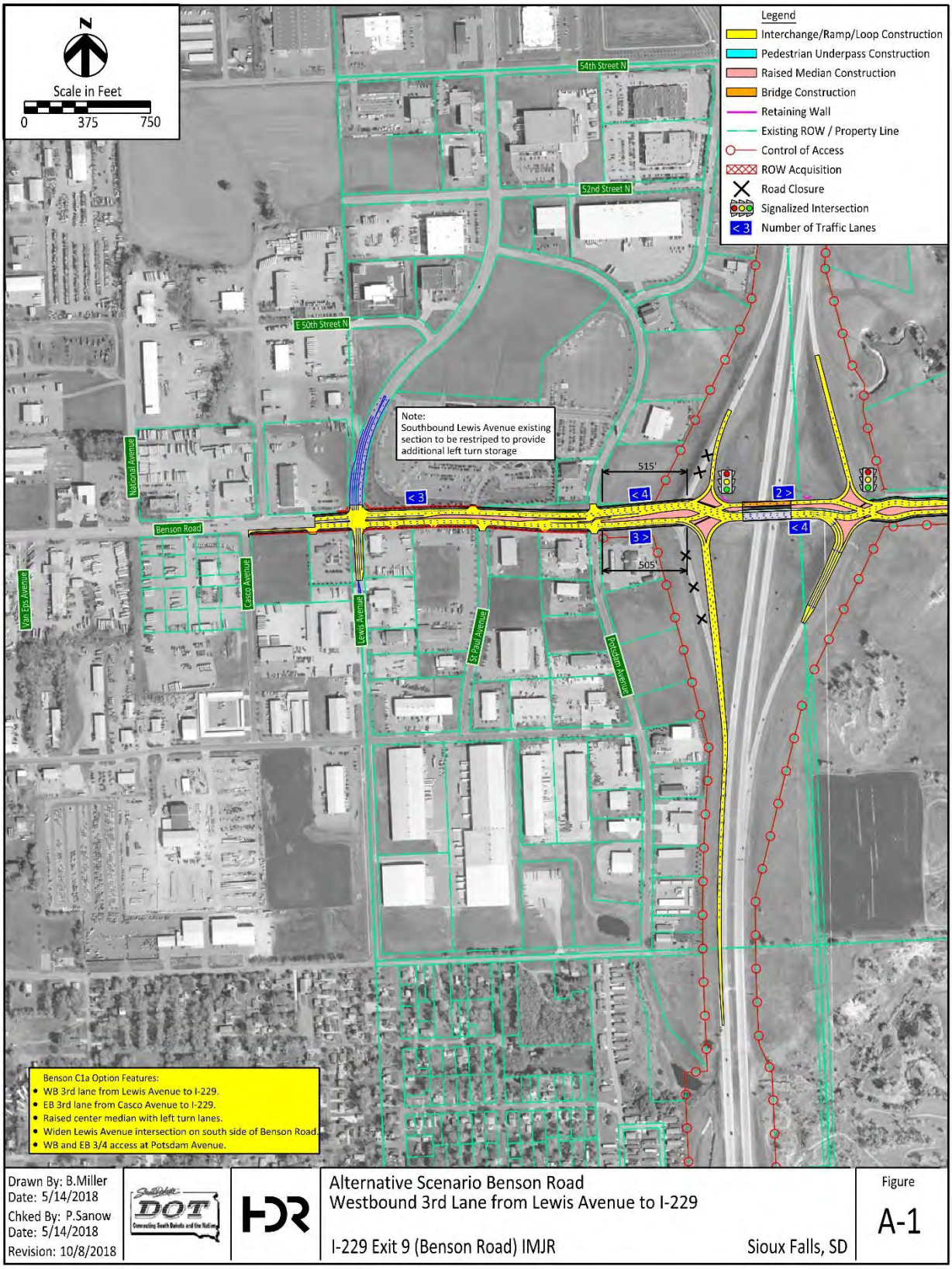
4A Diverging Diamond Interchange with 3-Lane SB On-Ramp Add 2 WB Lanes to Existing Overpass



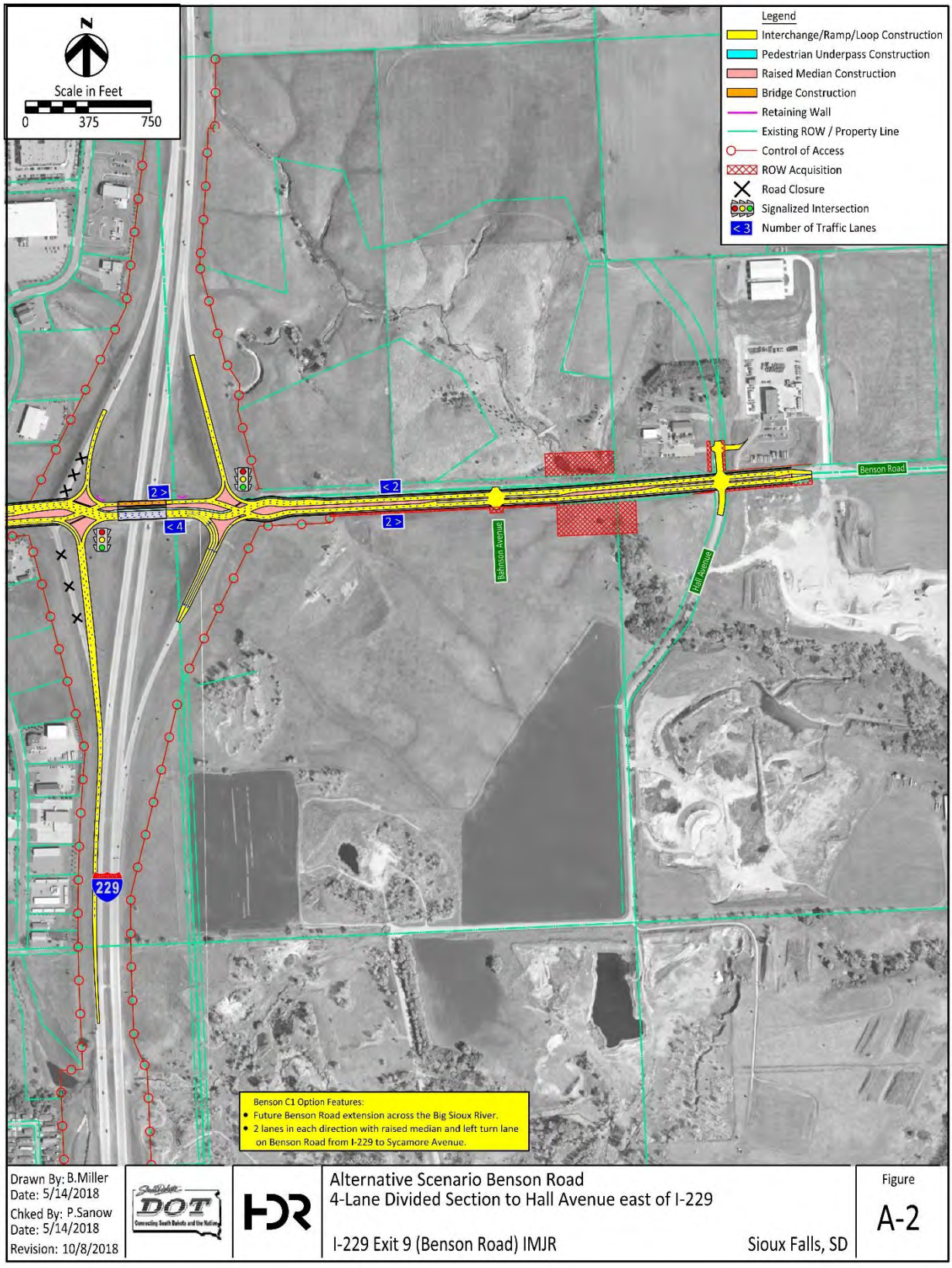
4B Diverging Diamond Interchange with 3-Lane SB On-Ramp Add Separate Structure for 2 EB Lanes



Benson Road: Westbound 3rd Lane from Lewis Avenue to I-229



Benson Road: 4-Lane Divided Section to Hall Avenue east of I-229



SECTION 8

CONCEPTUAL SIGNING PLANS

Legend

- Interchange/Ramp/Loop Construction
- Pedestrian Underpass Construction
- Raised Median Construction
- Bridge Construction
- Road Closure
- Signalized Intersection

N

Scale in Feet

0 200 400

St Paul Avenue

Benson Road

Potsdam Avenue

Hainje Avenue

52nd Street N

54th Street N

RIGHT LANE MUST TURN RIGHT

LEFT LANE MUST TURN LEFT

LEFT LANE MUST TURN LEFT

229 SOUTH

229 NORTH

229 NORTH

SOUTH 229

EXIT 9

EXIT ONLY

Benson Rd

EXIT 9

West Benson Rd

East Benson Rd

RAMP 30 MPH

YIELD

ONE WAY

229 NORTH

SOUTH 229

NORTH 229

229

Chevrons placed at 80' spacing along ramp (Typ.)

The existing ½ mile and 1 mile advance guide signs for I-229 SB Exit 9 to remain. The existing ½ mile and 1 mile advance guide signs to be relocated to corresponding location based upon new I-229 NB gore location for Exit 9.

Drawn By: B.Miller
Date: 7/27/2018
Chked By: P.Sanow
Date: 7/27/2018
Revision:

Alternative Scenario 1a
2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
S-I-1

Legend

- Interchange/Ramp/Loop Construction
- Pedestrian Underpass Construction
- Raised Median Construction
- Bridge Construction
- Road Closure
- Signalized Intersection

N

Scale in Feet

0 200 400

St Paul Avenue

Benson Road

Potsdam Avenue

54th Street N

52nd Street N

Hainje Avenue

RIGHT LANE MUST TURN RIGHT

LEFT LANE MUST TURN LEFT

LEFT LANE MUST TURN LEFT

SOUTH 229

NORTH 229

EXIT 9

EXIT ONLY

Benson Rd

EXIT 9

West Benson Rd

East Benson Rd

RAMP 30 MPH

Chevrons placed at 80' spacing along ramp (Typ.)

The existing ½ mile and 1 mile advance guide signs for I-229 SB Exit 9 to remain. The existing ½ mile and 1 mile advance guide signs to be relocated to corresponding location based upon new I-229 NB gore location for Exit 9.

Drawn By: B.Miller
Date: 7/27/2018
Chked By: P.Sanow
Date: 7/27/2018
Revision:

Alternative Scenario 1b
2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp.

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure
S-I-2

Legend

- Interchange/Ramp/Loop Construction
- Pedestrian Underpass Construction
- Raised Median Construction
- Bridge Construction
- Road Closure
- Signalized Intersection

N

Scale in Feet

0 200 400

St Paul Avenue

Benson Road

Potsdam Avenue

Hainje Avenue

52nd Street N

54th Street N

RIGHT LANE MUST TURN RIGHT

LEFT LANE MUST TURN LEFT

LEFT LANE MUST TURN LEFT

SOUTH 229 INTERSTATE

NORTH 229 INTERSTATE

EXIT 9

EXIT ONLY

Benson Rd

EXIT 9

West Benson Rd

East Benson Rd

RAMP 30 MPH

YIELD

ONE WAY

Chevrons placed at 80' spacing along ramp (Typ.)

The existing ½ mile and 1 mile advance guide signs for I-229 SB Exit 9 to remain. The existing ½ mile and 1 mile advance guide signs to be relocated to corresponding location based upon new I-229 NB gore location for Exit 9.

Drawn By: B.Miller
Date: 7/27/2018
Chked By: P.Sanow
Date: 7/27/2018
Revision:

Alternative Scenario 1c
2-Lane Collector - Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
S-I-3

Legend

- Interchange/Ramp/Loop Construction
- Pedestrian Underpass Construction
- Raised Median Construction
- Bridge Construction
- Road Closure
- Signalized Intersection

N

Scale in Feet

0 200 400

St Paul Avenue

Benson Road

Potsdam Avenue

Hainje Avenue

52nd Street N

54th Street N

RIGHT LANE MUST TURN RIGHT

LEFT LANE MUST TURN LEFT

LEFT LANE MUST TURN LEFT

SOUTH 229

NORTH 229

SOUTH 229

NORTH 229

SOUTH 229

NORTH 229

EXIT 9

EXIT 9

EXIT ONLY

Benson Rd

EXIT 9

West Benson Rd

East Benson Rd

RAMP 30 MPH

229

NORTH

SOUTH 229

NORTH 229

Chevrons placed at 80' spacing along ramp (Typ.)

The existing ½ mile and 1 mile advance guide signs for I-229 SB Exit 9 to remain. The existing ½ mile and 1 mile advance guide signs to be relocated to corresponding location based upon new I-229 NB gore location for Exit 9.

Drawn By: B.Miller
Date: 7/27/2018
Chked By: P.Sanow
Date: 7/27/2018
Revision:

Alternative Scenario 1d
2-Lane Partial Clover Leaf Northeast Quadrant with 2-Lane SB On-Ramp.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
S-I-4

Legend

- Interchange/Ramp/Loop Construction
- Pedestrian Underpass Construction
- Raised Median Construction
- Bridge Construction
- Road Closure
- Signalized Intersection

N

Scale in Feet
0 200 400

St Paul Avenue
Benson Road
Potsdam Avenue
Hainje Avenue
52nd Street N
54th Street N

RIGHT LANE MUST TURN RIGHT
LEFT LANE MUST TURN LEFT
LEFT LANE MUST TURN LEFT
SOUTH 229 INTERSTATE
NORTH 229 INTERSTATE
EXIT 9
EXIT ONLY Benson Rd EXIT 9
West Benson Rd
East Benson Rd
RAMP 30 MPH
YIELD
ONE WAY
Chevrons placed at 80' spacing along ramp (Typ.)

The existing ½ mile and 1 mile advance guide signs for I-229 SB Exit 9 to remain. The existing ½ mile and 1 mile advance guide signs to be relocated to corresponding location based upon new I-229 NB gore location for Exit 9.

Drawn By: B.Miller
Date: 7/27/2018
Chked By: P.Sanow
Date: 7/27/2018
Revision:

Alternative Scenario 1e
2-Lane Partial Clover Leaf Northeast Quadrant with CD Lane and 2-Lane SB On-Ramp.
I-229 Exit 9 (Benson Road) IMJR
Sioux Falls, SD

Figure
S-I-5

Legend

- Interchange/Ramp/Loop Construction
- Pedestrian Underpass Construction
- Raised Median Construction
- Bridge Construction
- Road Closure
- Signalized Intersection

N

Scale in Feet

0 200 400

St Paul Avenue

Benson Road

Potsdam Avenue

52nd Street N

54th Street N

Hainje Avenue

RIGHT LANE MUST TURN RIGHT

RIGHT LANE MUST TURN RIGHT

ONLY

ONLY

ONLY

SOUTH

229

SOUTH

229

NORTH

229

NORTH

229

EXIT 9

EXIT 9

West Benson Road

North Lewis Ave

North Potsdam Ave

East Benson Road

229

The existing ½ mile and 1 mile advance guide signs for I-229 SB Exit 9 to remain.

Drawn By: B.Miller
Date: 7/27/2018
Chked By: P.Sanow
Date: 7/27/2018
Revision: 11/15/2018

Alternative Scenario 4a

Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add 2 WB Lanes to Existing Overpass.

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure

S-I-6

Legend

- Interchange/Ramp/Loop Construction
- Pedestrian Underpass Construction
- Raised Median Construction
- Bridge Construction
- Road Closure
- Signalized Intersection

N

Scale in Feet

0 200 400

St Paul Avenue

Benson Road

Potsdam Avenue

52nd Street N

54th Street N

Hainje Avenue

RIGHT LANE MUST TURN RIGHT

RIGHT LANE MUST TURN RIGHT

SOUTH 229

SOUTH

229

ONLY

ONLY

ONLY

EXIT 9

EXIT 9

NORTH

229

NORTH

229

229

West Benson Road

North Lewis Ave

North Potsdam Ave

East Benson Road

The existing ½ mile and 1 mile advance guide signs for I-229 SB Exit 9 to remain.

Drawn By: B.Miller
Date: 7/30/2018
Chked By: P.Sanow
Date: 7/30/2018
Revision: 11/15/2018

Alternative Scenario 4b

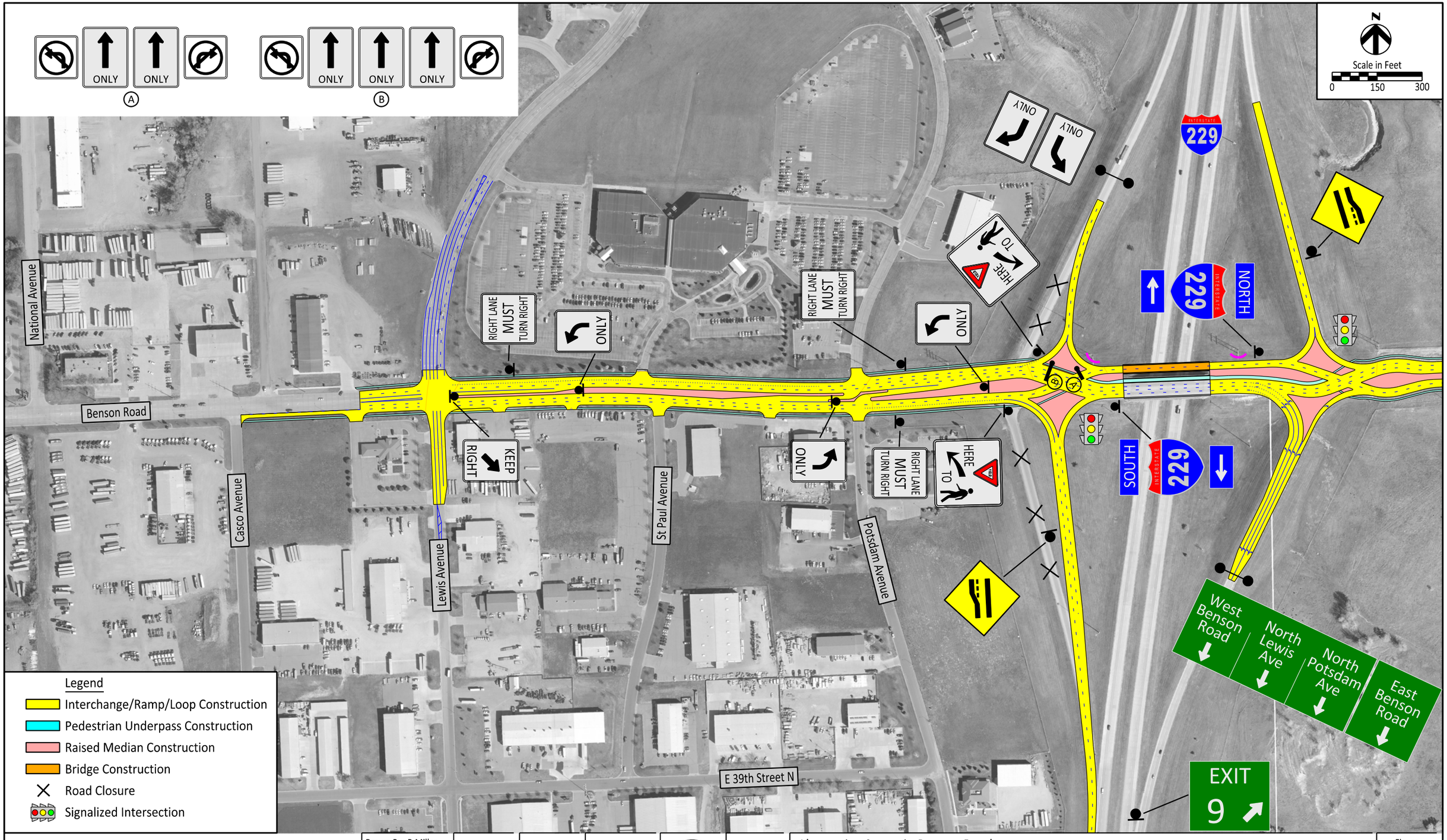
Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB Lanes.

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure

S-I-7



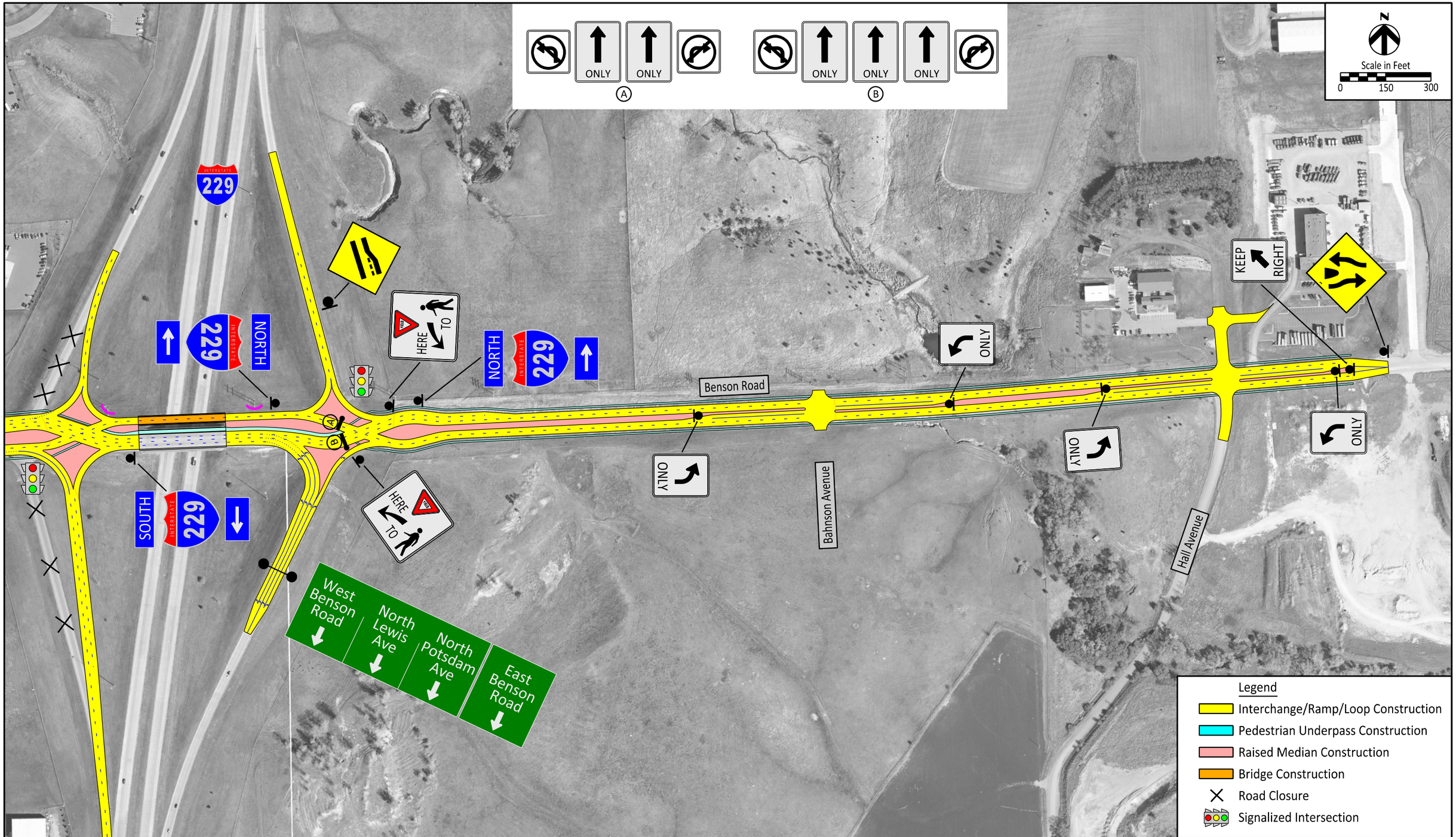
Drawn By: B.Miller
Date: 7/30/2018
Chked By: P.Sanow
Date: 7/30/2018
Revision: 11/15/2018

Alternative Scenario Benson Road
Westbound 3rd Lane from Lewis Avenue to I-229.

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure
S-A-1



Drawn By: B.Miller
Date: 7/30/2018
Chked By: P.Sanow
Date: 7/30/2018
Revision: 10/8/2018

Alternative Scenario Benson Road
4-Lane Divided Section to Hall Avenue east of I-229.

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure
S-A-2