I-90/I-29 Interchange Operations Analysis and Conceptual Layout Update

South Dakota Department of Transportation

Minnehaha County, SD

February 8, 2024

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Introduction

The current structure life of the I-90/I-29 system interchange (I-90 Exit 396, I-29 Exit 84) is requiring the interchange be programmed for reconstruction in approximately Year 2040. A three-year construction timeframe is anticipated.

The purpose of this report is to present:

1. Traffic operational analysis results for existing and future conditions of the I-90/I-29 system interchange, adjacent service interchanges, and connecting I-29 and I-90 mainline segments
2. Updated conceptual layouts to illustrate the long-range plan and guide future design projects

The traffic operations analysis identifies the planning-level year of need to reconstruct the existing interchange and analyzes long-range feasibility of Option #5 from *the I-90/I-29 Interchange Justification Study*[1] (March 2006) and subsequent updates in the *60th Street N Planning and Feasibility Study*[2] (May 2012) and *I-29 Exit 83 (60th Street N) Interchange Feasibility Study*[3] (April 2017). The original 2006 study recommendation (Option #5) and the 2017 study update recommendation (Scenario 10) geometrics are shown in **Figure 1** and **Figure 2**, respectively. All future-year interchange alternatives incorporated into this analysis are provided in **Appendix A**.

The study area is shown in **Figure 3** and includes the following service interchanges adjacent to the I-90/I-29 system interchange: I-90 Exit 395 (Marion Road), I-90 Exit 399 (Cliff Avenue), I-29 Exit 83 (60th Street N), and I-29 Exit 86 (258th Street).

Traffic Data

The following traffic data were obtained for this study:

- SDDOT interstate and interchange ramp daily segment volumes (collected as part of annual count program; 2022 most recent year)
- City of Sioux Falls interchange crossroad daily segment volumes (collected as part of annual count program; 2022 most recent year)
- *SDDOT I-29 Exit 86 Interchange Modification Study* daily and peak hour count (collected May 2022)
- Interchange ramp terminal intersection and I-90 mainline peak period counts (collected by HDR in June/July 2023)

Heavy vehicle percentages and peak hour factors (PHFs) were obtained from these counts.

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[1] South Dakota Department of Transportation. (March 2006). I-90/I-29 Interchange Justification Study. https://dot.sd.gov/media/documents/I90_I29_IJR_FINAL_31March2006.pdf

[2] City of Sioux Falls. (May 2012). 60th Street N Planning and Feasibility Study. Available upon request from City of Sioux Falls

[3] South Dakota Department of Transportation. (April 2017). I-29 Exit 83 (60th St. N.) Interchange Feasibility Study. https://dot.sd.gov/media/documents/60thStN-IFS.pdf

Figure 1: I-90/I-29 Interchange Justification Study (March 2006): Option #5

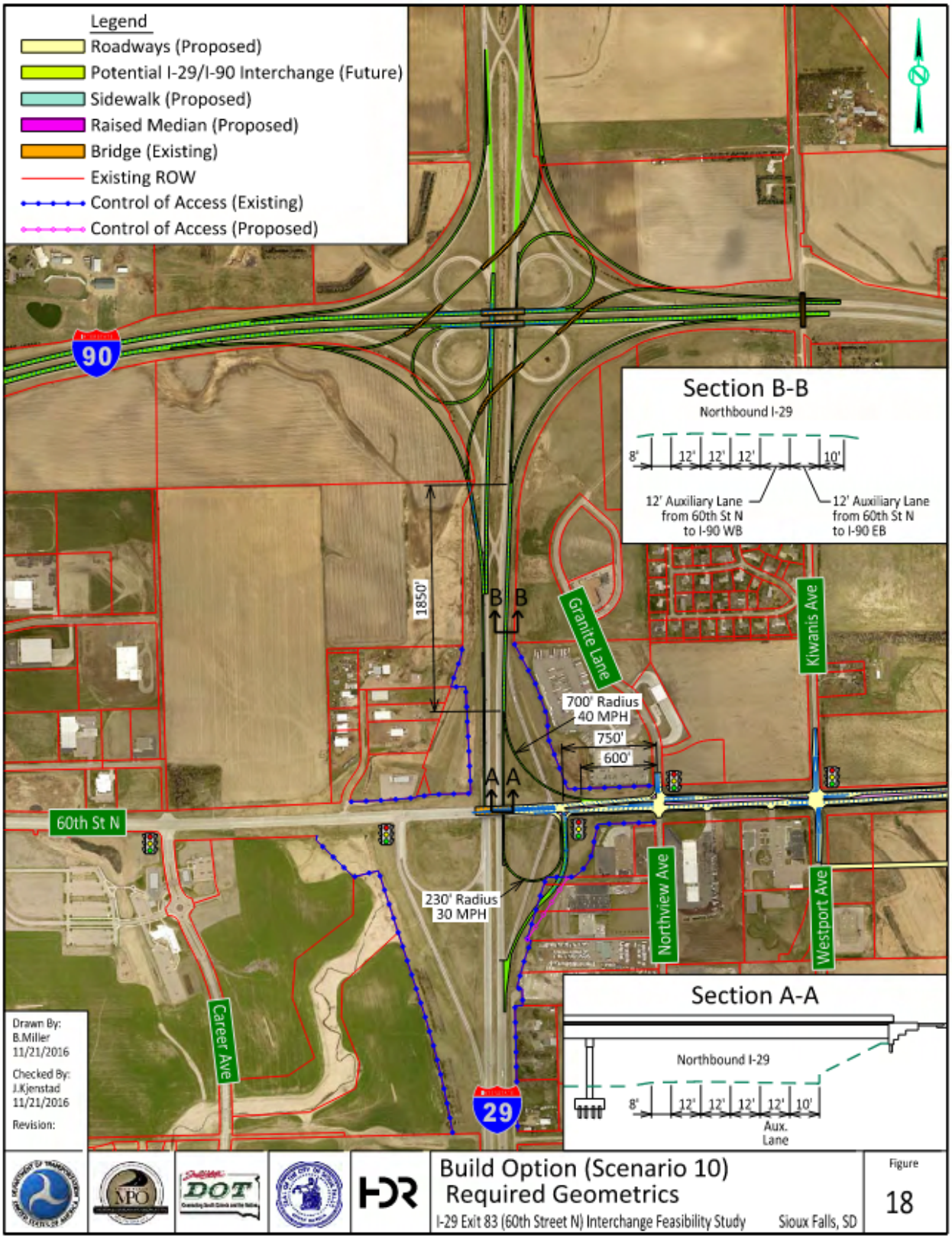

Figure 2: I-29 Exit 83 (60th Street N) Interchange Feasibility Study (April 2017): Scenario 10

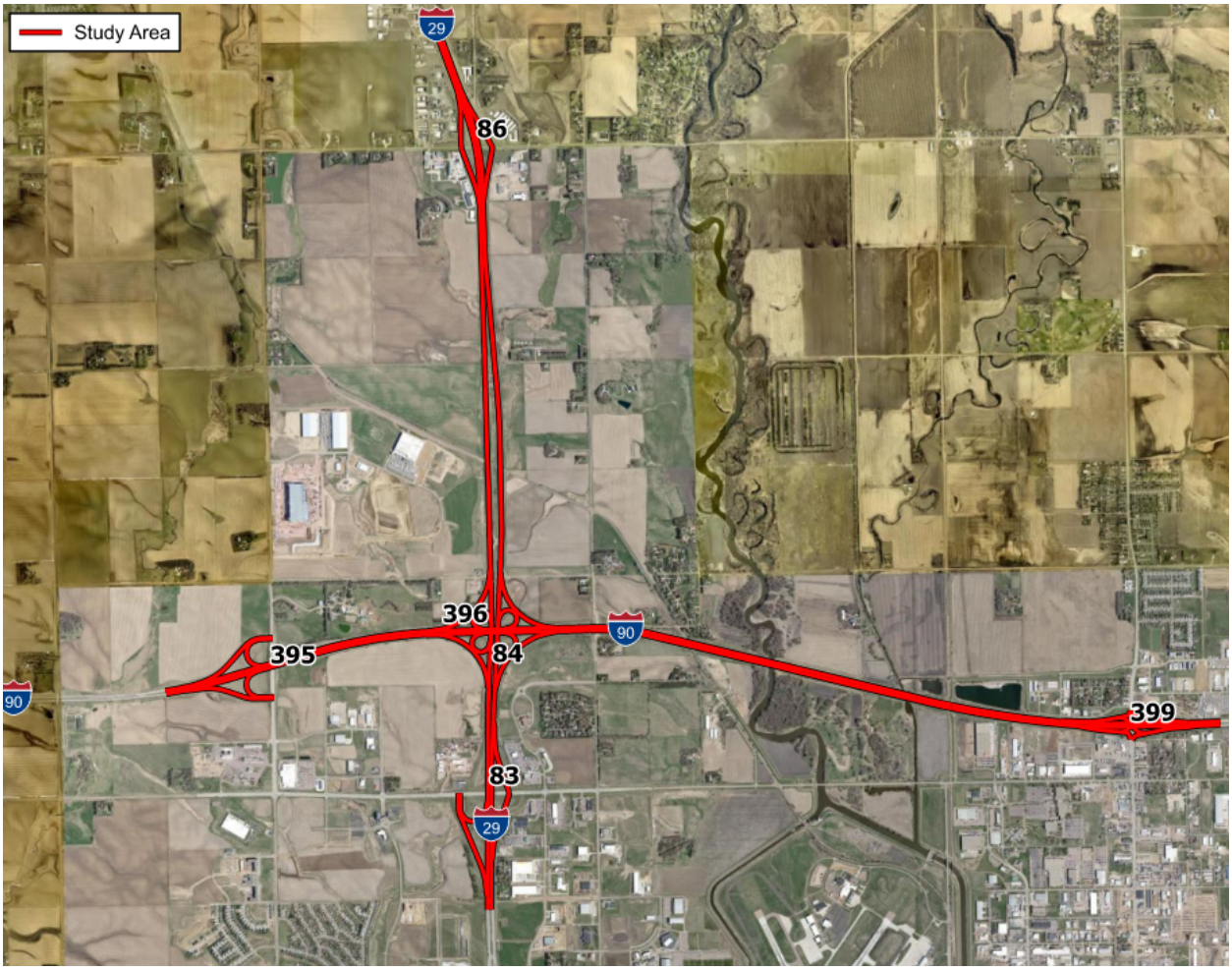

Figure 3: Study Area

Traffic Forecasts

Traffic forecasts were developed in accordance with the study *Methods and Assumptions* document provided in **Appendix B**. The forecasting process was based on *NCHRP 765: Analytical Travel Forecasting for Project-Level Planning and Design* methodology.

Future-year growth was based on the current Sioux Falls travel demand model (TDM), which reflects a 2021 Base Year and 2050 Planning Horizon. A special scenario was developed for the 2050 Planning Horizon to incorporate anticipated trip generation volumes similar to what was developed for and incorporated into the *2020 Foundation Park Traffic Impact Study – Project Stampede Update*.

For consistency with historical planning studies forecasts developed through other sources, the following future-year volumes were reviewed during the forecasting process:

- *I-29 Exit 86 Interchange Modification Justification Study*
- SDDOT inventory management traffic forecasts
- *2020 Foundation Park Traffic Impact Study – Project Stampede Update*

All daily and peak hour volumes analyzed as part of this study reflect a September design month based on seasonal factors developed by the SDDOT.

Counts collected prior to Year 2023 were factored forward to Year 2023 using TDM-derived growth rates. Daily and peak hour volumes between Years 2023 and 2050 (e.g., Year 2040) were derived from straight-line interpolation between the Existing condition and Year 2050 volumes. Daily and peak hour volumes beyond Year 2050 (e.g., Year 2065) were derived from straight-line extrapolation of Existing condition to Year 2050 growth.

Daily and peak hour traffic volumes are shown in the following figures:

- **Figure 4: Existing (2023) Daily Traffic Volumes**
- **Figure 5: Year 2040 Daily Traffic Volumes**
- **Figure 6: Year 2065 Daily Traffic Volumes**
- **Figure 7: Existing (2023) Peak Hour Traffic Volumes**
- **Figure 8: Year 2040 Peak Hour Traffic Volumes and Existing/No Build Condition Level of Service Summary**
- **Figure 9: Year 2065 Peak Hour Traffic Volumes and Build Condition Level of Service Summary**

LEGEND

Average Daily Traffic (ADT) Volumes

12,600 I-29 or I-90 Mainline

2,900 Interchange Ramps

ADT volumes factored to reflect a September analysis month

I-90 / I-29 Interchange Traffic Operations Analysis

Existing (2023) Daily Traffic Volumes

Figure 4

LEGEND

Average Daily Traffic (ADT) Volumes

12,600 I-29 or I-90 Mainline

2,900 Interchange Ramps

ADT volumes factored to reflect a September analysis month

I-90 / I-29 Interchange Traffic Operations Analysis

Year 2040 Daily Traffic Volumess

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Figure 5

LEGEND

Average Daily Traffic (ADT) Volumes

12,600 I-29 or I-90 Mainline

2,900 Interchange Ramps

ADT volumes factored to reflect a September analysis month

I-90 / I-29 Interchange Traffic Operations Analysis

Year 2065 Daily Traffic Volumes

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Figure 6

Analysis Years and Interchange Assumptions

The primary traffic operations analysis years include:

- Existing Conditions: 2023
- Opening Year: 2040
- Interchange Planning Horizon: 2065 (25-year horizon following Opening Year)

The traffic operations analysis was conducted using Highway Capacity Software 2023 (HCS2023) based on *Highway Capacity Manual (HCM) 7th Edition*.

The Build condition incorporated long-range build-out recommendations from previous interchange and corridor studies to include the following elements (layouts provided in **Appendix A**):

I-90/I-29 System Interchange

- *Layout: I-29 Exit 83 (60th Street N) Interchange Feasibility Study (2017)*
- Reflects updated *I-90/I-29 Interchange Justification Report (2006)* layout

I-29 Exit 83 (60th Street N)

- *Layout: I-29 Exit 83 (60th Street N) Interchange Feasibility Study (2017)*
- Reflects existing interchange configuration plus:
  - New loop on-ramp in southeast quadrant (for eastbound 60th Street N traffic) and
  - Modified diagonal ramp in northeast quadrant (for westbound 60th Street N traffic)

I-29 Exit 86 (258th Street)

- *Layout: I-29 Exit 86 Interchange Modification Study*
- Study still in progress
  - Initial reconstruction as diamond interchange with future transition to a Diverging Diamond Interchange (DDI)
  - DDI was the analyzed configuration in this study for Year 2040 and after

I-90 Exit 395 (Marion Road)

- *Layout: Marion Road Interchange Justification Study (2006)*
- Reflects existing interchange configuration plus:
  - Diagonal ramps in northeast and southeast quadrants
  - Foundation Park area traffic impact study turn lane recommendations

I-90 Exit 399

- No change to existing configuration

The focus of the traffic operations analysis is the I-90/I-29 system interchange, adjacent I-29 and I-90 mainline segments, and adjacent service interchange freeway segments. Service interchange ramp terminal intersections were incorporated as a cursory review to confirm forecasted traffic volumes being loaded onto or removed from the freeway network could be

accommodated by the identified long-range configurations. Signal timings were optimized as part of the analysis to validate that operations could achieve, or reasonably approach, minimum allowable LOS values but were not fine-tuned to levels typical of Interchange Modification Studies or design analyses.

Weave segment origin-destination data were not available for this study. For weave segments within the existing cloverleaf configuration, the ramp-to-ramp movement was assumed zero vehicles. For weave segments between I-29 Exit 83 and I-29 Exit 84, a select link analysis was conducted using the Sioux Falls MPO TDM's 2050 Planning Horizon scenario. This analysis identified origin-destination travel paths for each trip traveling through the respective weave segment and provided insight to potential travel patterns and the percentage of traffic completing a 'ramp to ramp' movement.

In the southbound direction, it was estimated that approximately 15 percent of the combined I-29 Exit 84 southbound on-ramp traffic (reflecting the combined I-90 westbound and eastbound traffic heading southbound to I-29 mainline or I-29 Exit 83 off-ramp) was destined for the I-29 Exit 83 off-ramp and completed a 'ramp to ramp' movement within the weave segment. In the northbound direction, approximately 10 percent of the I-29 Exit 84 northbound to I-90 eastbound off-ramp traffic originated from the I-29 Exit 83 on-ramp and completed a 'ramp to ramp' movement.

Traffic Operations Analysis

Freeway traffic operations are summarized in the following:

Existing and Year 2040 No Build Condition Comparison

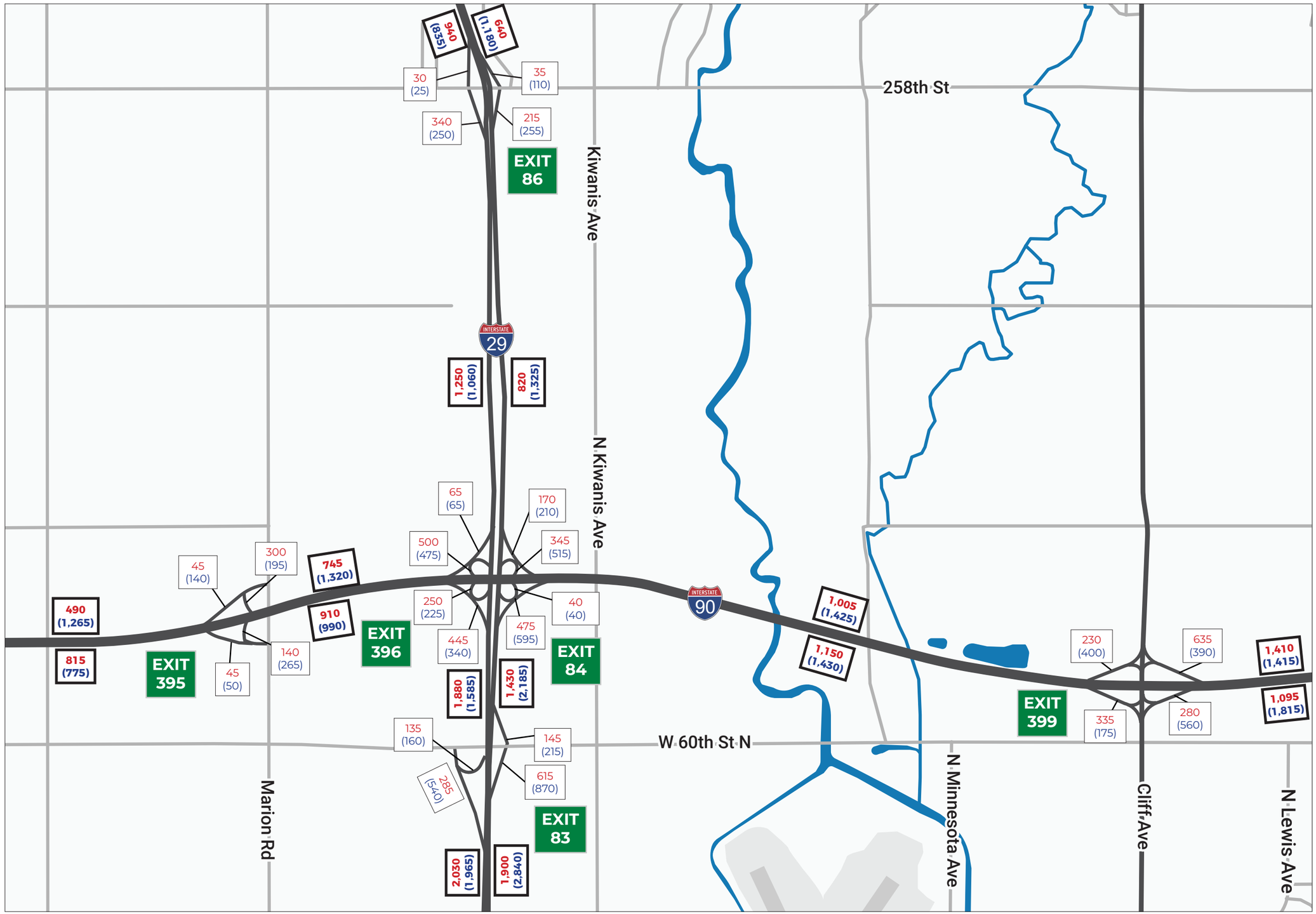
- I-90/I-29 system interchange summary: **Figure 8**
- I-90/I-29 system interchange and adjacent freeway mainline: **Table 1**
- Adjacent interchange and other freeway mainline: **Table 2**

Year 2040 and Year 2065 Build Condition Comparison

- I-90/I-29 system interchange summary: **Figure 9**
- I-90/I-29 system interchange and adjacent freeway mainline: **Table 3**
- Adjacent interchange and other freeway mainline: **Table 4**

Level of service results from the cursory review of interchange ramp terminal intersections are provided in **Appendix C**. HCS reports are provided in **Appendix D (Existing), E (2040 No Build), F (2040 Build), G (2065 Build), and H (Year of Need and No Build)**.

Per the *SDDOT Road Design Manual*, the minimum allowable I-29 and I-90 segment and interchange ramp terminal intersection Level of Service (LOS) is C.



LEGEND

Peak Hour Traffic Volumes

AM (PM) I-29 or I-90 Mainline

AM (PM) Interchange Ramps

ADT volumes factored to reflect a September analysis month

I-90 / I-29 Interchange Traffic Operations Analysis

Existing (2023) Peak Hour Traffic Volumes

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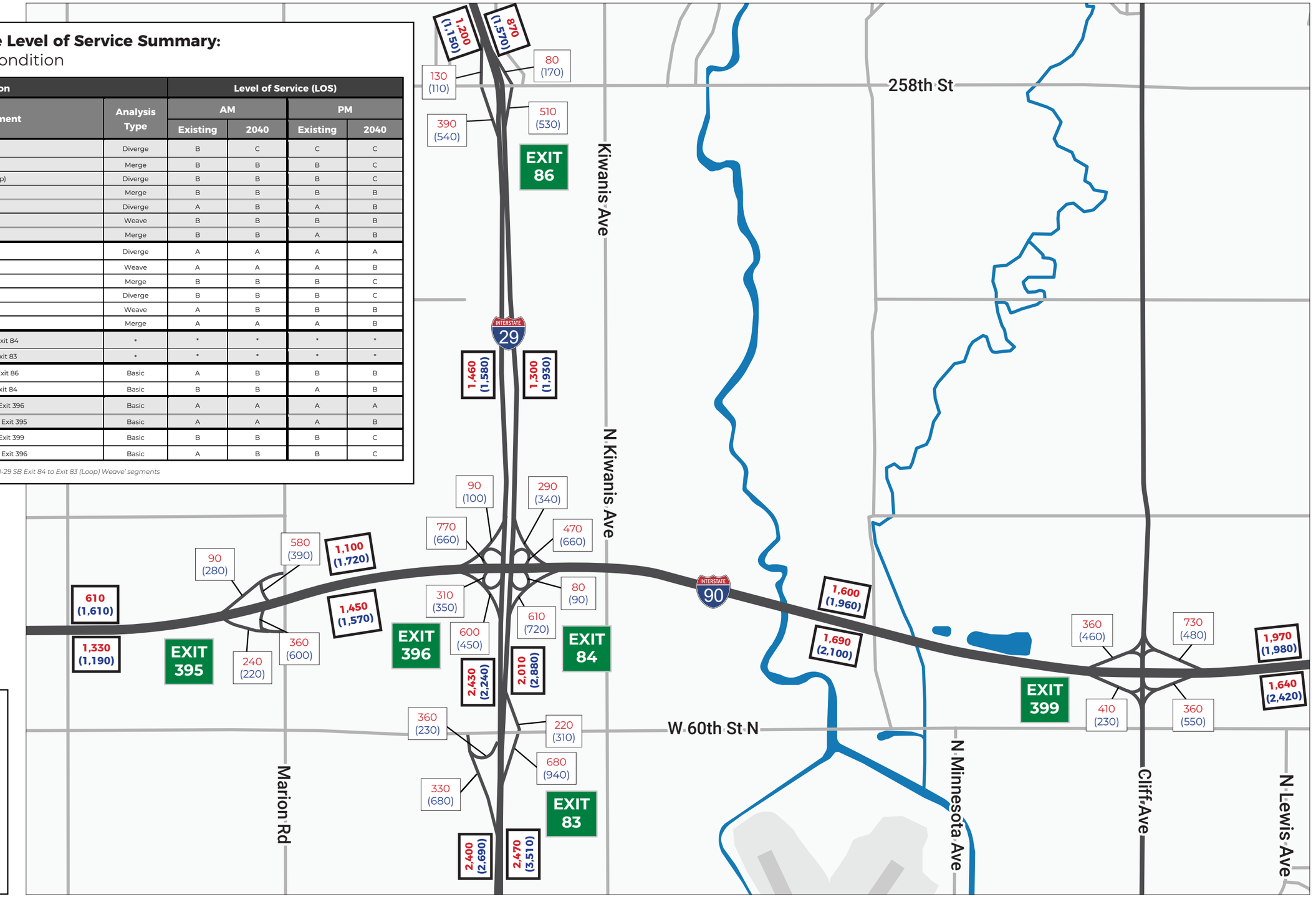
Figure 7

I-90/I-29 System Interchange Level of Service Summary:
Existing and 2040 No Build Condition

Analysis Location				Level of Service (LOS)			
Location		Segment	Analysis Type	AM		PM	
				Existing	2040	Existing	2040
I-29 Exit 84 *(I-90/I-29 Interchange)*	1	I-29 NB Exit 84 Off-Ramp	Diverge	B	C	C	C
	2	I-29 NB Exit 84 (Loop)	Merge	B	B	B	C
	3	I-29 NB Exit 84 Off-Ramp (Loop)	Diverge	B	B	B	C
	4	I-29 NB Exit 84 On-Ramp	Merge	B	B	B	B
	5	I-29 SB Exit 84 Off-Ramp	Diverge	A	B	A	B
	6	I-29 SB Exit 84 (Loops)	Weave	B	B	B	B
	7	I-29 SB Exit 84 On-Ramp	Merge	B	B	A	B
I-90 Exit 396 *(I-90/I-29 Interchange)*	1	I-90 EB Exit 396 Off-Ramp	Diverge	A	A	A	A
	2	I-90 EB Exit 396 (Loops)	Weave	A	A	A	B
	3	I-90 EB Exit 396 On-Ramp	Merge	B	B	B	C
	4	I-90 WB Exit 396 Off-Ramp	Diverge	B	B	B	C
	5	I-90 WB Exit 396 (Loops)	Weave	A	B	B	B
	6	I-90 WB Exit 396 On-Ramp	Merge	A	A	A	B
I-29 Mainline *(Exit 83 to Exit 84)*	1	I-29 NB between Exit 83 and Exit 84	*	*	*	*	*
	2	I-29 SB between Exit 84 and Exit 83	*	*	*	*	*
I-29 Mainline *(Exit 84 to Exit 86)*	1	I-29 NB between Exit 84 and Exit 86	Basic	A	B	B	B
	2	I-29 SB between Exit 86 and Exit 84	Basic	B	B	A	B
I-90 Mainline *(Exit 395 to Exit 396)*	1	I-29 EB between Exit 395 and Exit 396	Basic	A	A	A	A
	2	I-29 WB between Exit 396 and Exit 395	Basic	A	A	A	B
I-90 Mainline *(Exit 396 to Exit 399)*	1	I-29 EB between Exit 396 and Exit 399	Basic	B	B	B	C
	2	I-29 WB between Exit 399 and Exit 396	Basic	A	B	B	C

**No Basic Freeway segment; see 'I-29 NB Exit 83 On-Ramp Merge' and 'I-29 SB Exit 84 to Exit 83 (Loop) Weave' segments*



LEGEND

Peak Hour Traffic Volumes

AM (PM) — I-29 or I-90 Mainline

AM (PM) — Interchange Ramps

ADT volumes factored to reflect a September analysis month

I-90 / I-29 Interchange Traffic Operations Analysis

Year 2040 Peak Hour Traffic Volumes and Existing/No Build Condition Level of Service Summary

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Figure 8

Table 1: Existing and 2040 No-Build Conditions LOS - I-90/I-29 System Interchange

Analysis Location				Level of Service (LOS)				
Location		Segment	Analysis Type	AM			PM	
				Existing	2040		Existing	2040
I-29 Exit 84 *(I-90/I-29 Interchange)*	1	I-29 NB Exit 84 Off-Ramp	Diverge	B	C		C	C
	2	I-29 NB Exit 84 (Loop)	Merge	B	B		B	C
	3	I-29 NB Exit 84 Off-Ramp (Loop)	Diverge	B	B		B	C
	4	I-29 SB Exit 84 On-Ramp	Merge	B	B		B	B
	5	I-29 SB Exit 84 Off-Ramp	Diverge	A	B		A	B
	6	I-29 SB Exit 84 (Loops)	Weave	B	B		B	B
	7	I-29 SB Exit 84 On-Ramp	Merge	B	B		A	B
I-90 Exit 396 *(I-90/I-29 Interchange)*	1	I-90 EB Exit 396 Off-Ramp	Diverge	A	A		A	A
	2	I-90 EB Exit 396 (Loops)	Weave	A	A		A	B
	3	I-90 EB Exit 396 On-Ramp	Merge	B	B		B	C
	4	I-90 WB Exit 396 Off-Ramp	Diverge	B	B		B	C
	5	I-90 WB Exit 396 (Loops)	Weave	A	B		B	B
	6	I-90 WB Exit 396 On-Ramp	Merge	A	A		A	B
I-29 Mainline *(Exit 83 to Exit 84)*	1	I-29 NB between Exit 83 and Exit 84	*	*	*		*	*
	2	I-29 SB between Exit 84 and Exit 83	*	*	*		*	*
I-29 Mainline *(Exit 84 to Exit 86)*	1	I-29 NB between Exit 84 and Exit 86	Basic	A	B		B	B
	2	I-29 SB between Exit 86 and Exit 84	Basic	B	B		A	B
I-90 Mainline *(Exit 395 to Exit 396)*	1	I-29 EB between Exit 395 and Exit 396	Basic	A	A		A	A
	2	I-29 WB between Exit 396 and Exit 395	Basic	A	A		A	B
I-90 Mainline *(Exit 396 to Exit 399)*	1	I-29 EB between Exit 396 and Exit 399	Basic	B	B		B	C
	2	I-29 WB between Exit 399 and Exit 396	Basic	A	B		B	C

Note:
* No Basic Freeway segment; see I-29 Exit 83 and I-29 Exit 84 Merge/Diverge segments

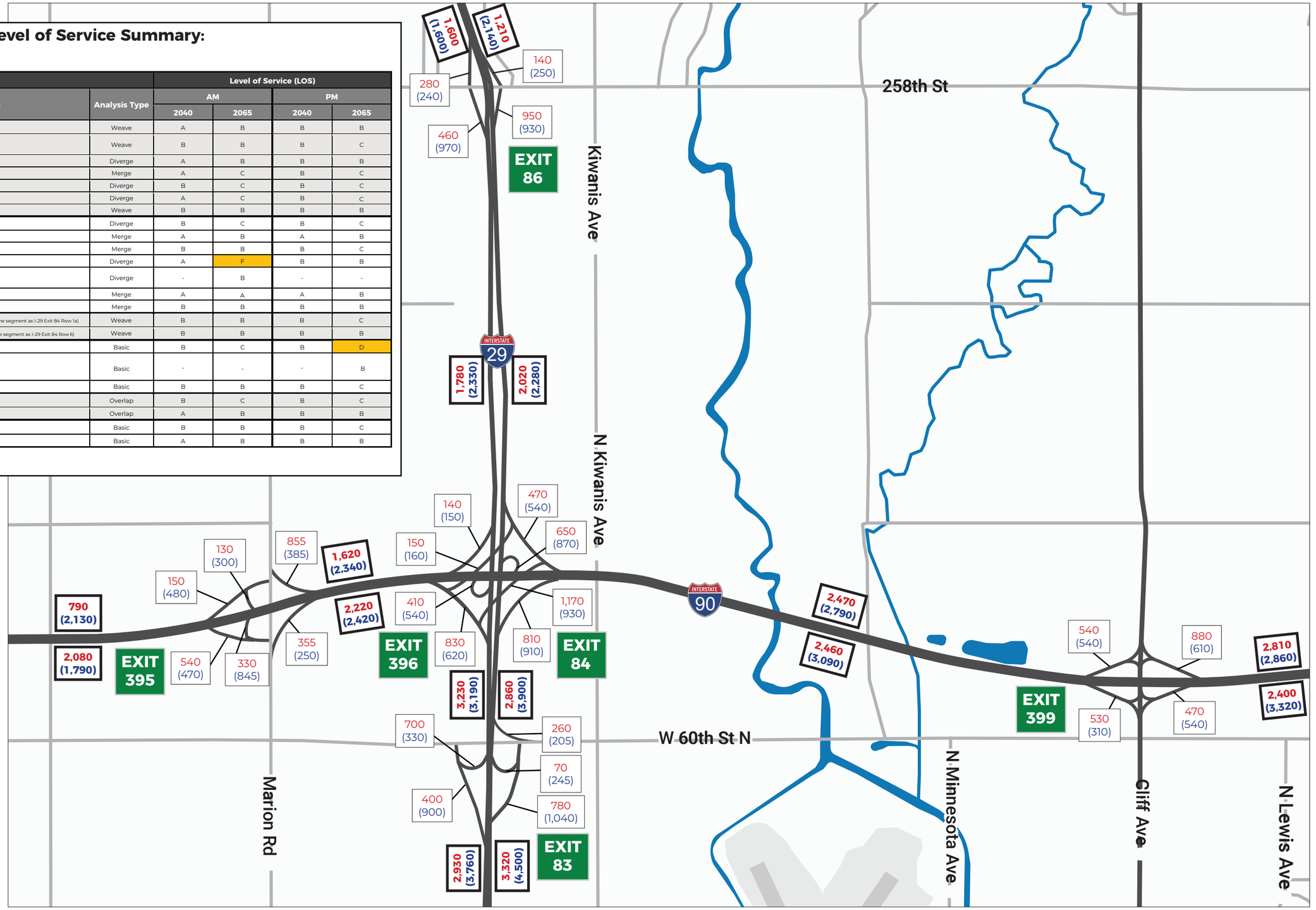
Table 2: Existing and 2040 No-Build Conditions LOS – Adjacent Interchanges

Analysis Location				Level of Service (LOS)				
Location		Segment	Analysis Type	AM			PM	
				Existing	2040		Existing	2040
I-29 Mainline *(North of Exit 86)*	1	I-29 NB North of Exit 86	Basic	A	A		A	B
	2	I-29 SB North of Exit 86	Basic	A	B		A	A
I-29 Exit 86 *(258th Street)*	1	I-29 NB Exit 86 Off-Ramp	Diverge	A	B		B	B
	2	I-29 NB Exit 86 On-Ramp	Merge	A	A		A	B
	3	I-29 SB Exit 86 Off-Ramp	Diverge	A	B		A	B
	4	I-29 SB Exit 86 On-Ramp	Merge	B	B		B	B
I-29 Exit 83 *(60th Street N)*	1	I-29 NB Exit 83 Off-Ramp	Diverge	A	B		B	B
	2	I-29 NB Exit 83 On-Ramp	Merge	B	B		B	C
	3	I-29 SB Exit 83 Off-Ramp (Loop)	Diverge	B	B		B	B
	4	I-29 SB Exit 83 On-Ramp	Merge	B	B		B	B
I-29 Mainline *(South of Exit 83)*	1	I-29 NB South of Exit 83	Basic	A	B		B	B
	2	I-29 SB South of Exit 83	Basic	B	B		B	B
I-90 Mainline *(West of Exit 395)*	1	I-90 EB West of Exit 395	Basic	A	B		A	B
	2	I-90 WB West of Exit 395	Basic	A	A		B	B
I-90 Exit 395 *(Marion Road)*	1	I-90 EB Exit 395 Off-Ramp	Diverge	B	B		B	B
	2	I-90 EB Exit 395 On-Ramp (Loop)	Merge	A	A		A	A
	3	I-90 WB Exit 395 Off-Ramp (Loop)	Diverge	A	A		A	B
	4	I-90 WB Exit 395 On-Ramp	Merge	A	A		B	B
I-90 Exit 399 *(Cliff Avenue)*	1	I-90 EB Exit 399 Off-Ramp	Diverge	B	C		B	C
	2	I-90 EB Exit 399 On-Ramp	Merge	A	A		A	B
	3	I-90 WB Exit 399 Off-Ramp	Diverge	A	B		A	B
	4	I-90 WB Exit 399 On-Ramp	Merge	A	B		B	B
I-90 Mainline *(East of Exit 399)*	1	I-90 EB East of Exit 399	Basic	A	A		B	B
	2	I-90 WB East of Exit 399	Basic	A	B		A	B

I-90/I-29 System Interchange Level of Service Summary:
2040 and 2065 Build Condition

Analysis Location				Level of Service (LOS)			
				AM		PM	
Location		Segment	Analysis Type	2040	2065	2040	2065
I-29 Exit 84 *(I-90/I-29 Interchange)*	1	I-29 NB Exit 83 (Diagonal) to Exit 84	Weave	A	B	B	B
	1a	I-29 NB Exit 83 (Loop) to Exit 84 *(60th Street N Planning and Feasibility Study)*	Weave	B	B	B	C
	2	I-29 NB Exit 84 Off-Ramp (Loop)	Diverge	A	B	B	B
	3	I-29 NB Exit 84 On-Ramp	Merge	A	C	B	C
	4	I-29 SB Exit 84 Off-Ramp	Diverge	B	C	B	C
	5	I-29 SB Exit 84 Off-Ramp (Loop)	Diverge	A	C	B	C
	6	I-29 SB Exit 84 to Exit 83 (Loop) Weave	Weave	B	B	B	B
I-90 Exit 396 *(I-90/I-29 Interchange)*	1	I-90 EB Exit 396 Off-Ramp	Diverge	B	C	B	C
	2	I-90 EB Exit 396 On-Ramp (Loop)	Merge	A	B	A	B
	3	I-90 EB Exit 396 On-Ramp	Merge	B	B	B	C
	4	I-90 WB Exit 396 Off-Ramp	Diverge	A	F	B	B
	4a	I-90 WB Exit 396 *2-Lane* Off-Ramp *(Addresses single-lane off-ramp LOS F)*	Diverge	-	B	-	-
	5	I-90 WB Exit 396 On-Ramp (Loop)	Merge	A	A	A	B
	6	I-90 WB Exit 396 On-Ramp	Merge	B	B	B	B
I-29 Mainline *(Exit 83 to Exit 84)*	1	I-29 NB between Exit 83 and Exit 84 (same segment as I-29 Exit 84 Row 1a)	Weave	B	B	B	C
	2	I-29 SB between Exit 84 and Exit 83 (same segment as I-29 Exit 84 Row 6)	Weave	B	B	B	B
I-29 Mainline *(Exit 84 to Exit 86)*	1	I-29 NB between Exit 84 and Exit 86	Basic	B	C	B	D
	1b	I-29 NB between Exit 84 and Exit 86 *(Addresses NB basic segment LOS D)*	Basic	-	-	-	B
	2	I-29 SB between Exit 86 and Exit 84	Basic	B	B	B	C
I-90 Mainline *(Exit 395 to Exit 396)*	1	I-29 EB between Exit 395 and Exit 396	Overlap	B	C	B	C
	2	I-29 WB between Exit 396 and Exit 395	Overlap	A	B	B	B
I-90 Mainline *(Exit 396 to Exit 399)*	1	I-29 EB between Exit 396 and Exit 399	Basic	B	B	B	C
	2	I-29 WB between Exit 399 and Exit 396	Basic	A	B	B	B

Locations not meeting minimum allowable LOS C highlighted in yellow.



LEGEND

Peak Hour Traffic Volumes

AM (PM) — I-29 or I-90 Mainline

AM (PM) — Interchange Ramps

ADT volumes factored to reflect a September analysis month

I-90 / I-29 Interchange Traffic Operations Analysis

Year 2065 Peak Hour Traffic Volumes and Build Condition Level of Service Summary

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Figure 9

Table 3: 2040 and 2065 Build Conditions LOS - I-90/I-29 Interchange

Analysis Location				Level of Service (LOS)				
Location		Segment	Analysis Type	AM			PM	
				2040	2065		2040	2065
I-29 Exit 84 *(I-90/I-29 Interchange)*	1	I-29 NB Exit 83 (Diagonal) to Exit 84	Weave	A	B		B	B
	1a	I-29 NB Exit 83 (Loop) to Exit 84 *(60th Street N Planning and Feasibility Study)*	Weave	B	B		B	C
	2	I-29 NB Exit 84 Off-Ramp (Loop)	Diverge	A	B		B	B
	3	I-29 NB Exit 84 On-Ramp	Merge	A	C		B	C
	4	I-29 SB Exit 84 Off-Ramp	Diverge	B	C		B	C
	5	I-29 SB Exit 84 Off-Ramp (Loop)	Diverge	A	C		B	C
	6	I-29 SB Exit 84 to Exit 83 (Loop) Weave	Weave	B	B		B	B
I-90 Exit 396 *(I-90/I-29 Interchange)*	1	I-90 EB Exit 396 Off-Ramp	Diverge	B	C		B	C
	2	I-90 EB Exit 396 On-Ramp (Loop)	Merge	A	B		A	B
	3	I-90 EB Exit 396 On-Ramp	Merge	B	B		B	C
	4	I-90 WB Exit 396 Off-Ramp	Diverge	A	F		B	B
	4a	I-90 WB Exit 396 *2-Lane* Off-Ramp *(Addresses single-lane off-ramp LOS F)*	Diverge	-	B		-	-
	5	I-90 WB Exit 396 On-Ramp (Loop)	Merge	A	A		A	B
	6	I-90 WB Exit 396 On-Ramp	Merge	B	B		B	B
I-29 Mainline *(Exit 83 to Exit 84)*	1	I-29 NB between Exit 83 and Exit 84 *(same segment as I-29 Exit 84 row 1a)*	Weave	B	B		B	C
	2	I-29 SB between Exit 84 and Exit 83 *(same segment as I-29 Exit 84 row 6)*	Weave	B	B		B	B
I-29 Mainline *(Exit 84 to Exit 86)*	1	I-29 NB between Exit 84 and Exit 86	Basic	B	C		B	D
	1b	I-29 NB between Exit 84 and Exit 86 *(Addresses NB basic segment LOS D)*	Basic	-	-		-	B
	2	I-29 SB between Exit 86 and Exit 84	Basic	B	B		B	C
I-90 Mainline *(Exit 395 to Exit 396)*	1	I-29 EB between Exit 395 and Exit 396	Overlap	B	C		B	C
	2	I-29 WB between Exit 396 and Exit 395	Overlap	A	B		B	B
I-90 Mainline *(Exit 396 to Exit 399)*	1	I-29 EB between Exit 396 and Exit 399	Basic	B	B		B	C
	2	I-29 WB between Exit 399 and Exit 396	Basic	A	B		B	B

Notes:

1a: reflects the *2012 60th Street N Planning and Feasibility Study* recommendation that removed the diagonal ramp in the northeast quadrant and constructed a loop ramp in the southeast quadrant. The northbound loop on-ramp is part of the weave movement with the I-29 Exit 84 interchange off-ramp.

4a: reflects a 2-lane I-90 Exit 396 westbound off-ramp (diverge) segment to address single-lane ramp LOS F. Adjacent I-90 segment LOS reflects this facility analysis.

1b: incorporates an auxiliary lane between I-29 Exit 84 and Exit 86 to provide three northbound lanes between interchanges and address the basic segment LOS D.

Locations not meeting minimum allowable LOS C highlighted in yellow

Table 4: 2040 and 2065 Build Conditions LOS – Adjacent Interchanges

Analysis Location				Level of Service (LOS)				
Location		Segment	Analysis Type	AM			PM	
				2040	2065		2040	2065
I-29 Mainline *(North of Exit 86)*	1	I-29 NB North of Exit 86	Basic	A	B		B	C
	2	I-29 SB North of Exit 86 (1)	Basic	B	B		A	B
I-29 Exit 86 *(258th Street)*	1	I-29 NB Exit 86 Off-Ramp	Diverge	B	B		B	C
	2	I-29 NB Exit 86 On-Ramp	Merge	A	A		B	B
	3	I-29 SB Exit 86 Off-Ramp (2)	Diverge	A	B		A	B
	4	I-29 SB Exit 86 On-Ramp (4)	Merge	B	B		B	B
I-29 Exit 83 *(60th Street N)*	1	I-29 NB Exit 83 Off-Ramp	Diverge	B	B		B	C
	2	I-29 NB Exit 83 On-Ramp (Loop)	Merge	-	-		-	B
	3	I-29 SB Exit 83 On-Ramp (12)	Merge	B	B		B	C
I-29 Mainline *(South of Exit 83)*	1	I-29 NB South of Exit 83	Basic	B	B		B	C
	2	I-29 SB South of Exit 83 (13)	Basic	B	C		B	C
I-90 Mainline *(West of Exit 395)*	1	I-90 EB West of Exit 395	Basic	B	C		B	B
	2	I-90 WB West of Exit 395	Basic	A	A		B	C
I-90 Exit 395 *(Marion Road)*	1	I-90 EB Exit 395 Off-Ramp	Diverge	B	C		B	C
	2	I-90 EB Exit 395 On-Ramp (Loop)	Merge	A	B		A	B
	3	I-90 EB Exit 395 On-Ramp	Merge	B	C		B	B
	4	I-90 WB Exit 395 Off-Ramp	Diverge	B	B		B	C
	5	I-90 WB Exit 395 Off-Ramp (Loop)	Diverge	A	A		A	B
	6	I-90 WB Exit 395 On-Ramp	Merge	A	A		B	B
I-90 Exit 399 *(Cliff Avenue)*	1	I-90 EB Exit 399 Off-Ramp	Diverge	B	C		B	C
	2	I-90 EB Exit 399 On-Ramp	Merge	A	B		B	B
	3	I-90 WB Exit 399 Off-Ramp	Diverge	B	C		B	C
	4	I-90 WB Exit 399 On-Ramp	Merge	A	B		B	B
I-90 Mainline *(East of Exit 399)*	1	I-90 EB East of Exit 399	Basic	A	B		B	C
	2	I-90 WB East of Exit 399	Basic	B	C		B	C

Traffic Operations Analysis Findings

Existing I-90/I-29 System Interchange

The existing interchange configuration accommodates forecasted traffic volumes through Year 2040 based on straight-line growth between Existing (2023) and Year 2050 Planning Horizon traffic volumes. Year 2040 LOS C values are most prevalent in the PM peak hour. It should be noted that pace and density of surrounding development in the area and along the I-29 or I-90 corridors may accelerate or slow long-range traffic growth.

Build Conditions

In the Build condition, the following freeway segments emerged as locations for further review and discussion (see **Figure 10** for findings reference figure):

1. I-29 southbound weave segment between I-90/I-29 system interchange and I-29 Exit 83 (60th Street N)
2. I-29 northbound weave segment between I-29 Exit 83 (60th Street N) and I-90/I-29 system interchange
3. I-90/I-29 system interchange westbound (I-90) diverge to I-29 southbound flyover and I-29 northbound directional ramps
4. I-29 northbound mainline segment between I-90/I-29 system interchange and I-29 Exit 86 (258th Street)
5. Service interchange ramp terminal intersections

1. I-29 southbound weave segment between I-90/I-29 system interchange and I-29 Exit 83 (60th Street N)

It will be important to obtain quality origin-destination data to estimate future-year ramp to freeway, freeway to ramp, and ramp to ramp movements within this weave segment. With high volumes entering the weave segment from the 2-lane I-90/I-29 system interchange on-ramp (accommodating I-90 westbound and eastbound traffic to I-29 southbound), an underestimated ramp to ramp movement will result in poor analysis LOS while an overestimated movement may present an over-optimistic analysis LOS.

Based on the Sioux Falls MPO TDM select link analysis, it was estimated that approximately 15 percent of the 2-lane I-90/I-29 system interchange on-ramp traffic is destined for the downstream I-29 Exit 83 loop off-ramp and completes a ramp-to-ramp movement within the weave segment. In the Year 2040 AM peak hour, for example, this equates to approximately 200 of the 1,370 forecasted southbound 2-lane I-90/I-29 system interchange on-ramp vehicles completing a ramp-to-ramp movement within this weave segment.

2. I-29 northbound weave segment between I-29 Exit 83 (60th Street N) diagonal ramp and I-90/I-29 system interchange

Similar to the I-29 southbound weave segment between the I-90/I-29 system interchange and I-29 Exit 83, it will be important to obtain quality origin-destination data to estimate future year movements. Based on the Sioux Falls MPO TDM select link analysis, it was estimated that 5 to

10 percent of the I-90/I-29 system interchange's I-29 northbound to I-90 eastbound directional ramp traffic originates from I-29 Exit 83 and completes a weave segment ramp-to-ramp movement. In the Year 2040 AM peak hour, this equates to approximately 40 of the 610 forecasted I-29 northbound to I-90 eastbound directional ramp traffic within the I-90/I-29 system interchange originating from I-29 Exit 83 and completing a ramp-to-ramp weave movement.

This area would benefit from microsimulation analysis to confirm Build condition weave segment operations, as there are two independent and overlapping weave patterns with required lane changes to/from I-29 mainline. This overlap includes I-29 Exit 83 northbound on-ramp traffic that requires two lane changes to the left to reach an I-29 mainline through lane. These lane changes are against I-29 mainline through traffic needing up to two lane changes to the right to reach one of the two consecutive off-ramps within the I-90/I-29 system interchange. These segments were analyzed in accordance with current HCM methodology, but microsimulation would be beneficial to consider the area as a whole and the overlapping weave movements.

The Build Conditions LOS **Table 3** includes a supplemental weave segment analysis without the I-29 Exit 83 northbound diagonal on-ramp and just the loop on-ramp weave segment (see row '1a' in the table), similar to what was analyzed in the *2012 60th Street N Planning and Feasibility Study*. In this supplemental weave analysis, all 60th Street N traffic turning to I-29 northbound would use the loop on-ramp, instead of being split between the loop and diagonal on-ramps.

3. I-90/I-29 system interchange westbound (I-90) diverge to I-29 southbound flyover and I-29 northbound directional ramps

The I-90 westbound to I-29 southbound movement is already a prominent, higher volume ramp movement within the I-90/I-29 system interchange. At the I-90 westbound diverge location, those volumes will be combined with notable future traffic growth for the I-90 westbound to I-29 northbound movement due to continued development around the I-29 Exit 86 interchange, 258th Street corridor, and other areas to the north. The Year 2065 AM peak hour traffic operations analysis shows a single-lane ramp diverge segment operating at LOS F due to oversaturated conditions (demand/capacity ratio > 1.0).

Based on these findings and the importance of the two system interchange ramp movements involved, it is recommended that a 2-lane ramp be considered at the diverge point to provide long-range capacity at this location. This may require a longer Kiwanis Avenue bridge, but it provides the opportunity for long-range capacity enhancements within the system interchange.

<u>Level of Service Summary (AM peak hour)</u>

- Year 2065 LOS with single lane (taper type) off-ramp: F
- Year of Need: 2057 (LOS B) / 2058 (LOS F)
- Year 2065 LOS with 2-lane (parallel type) off-ramp: A

4. I-29 northbound mainline segment between I-90/I-29 system interchange and I-29 Exit 86 (258th Street)

The I-29 northbound mainline segment between the I-90/I-29 system interchange and I-29 Exit 86 was measured at LOS D in the Year 2065 PM peak hour. With continued development north

of I-90 along the I-29 corridor (e.g., Foundation Park, Dell Rapids, Baltic, Crooks), it is expected that volumes will continue to grow and additional lanes should be considered.

When an auxiliary lane is added between the northbound I-29 Exit 84 on-ramp and I-29 Exit 86 off-ramp, the Year 2065 PM peak hour LOS improves to LOS B.

With attention to the anticipated traffic growth contributing to the long-range need of a third northbound lane through this segment, it is recommended that further consideration also be given to continuing both the I-90 eastbound to I-29 northbound ramp lane and I-90 westbound to I-29 northbound ramp lane northward from their convergence point as two parallel lanes within the system interchange and then sequentially dropping them while traveling northward to (or at) the I-29 Exit 86 interchange.

Level of Service Summary (PM peak hour)

- Year 2065 LOS: D
- Year of Need: 2062 (LOS C) / 2063 (LOS D)
- Year 2065 LOS with auxiliary lane between northbound I-29 Exit 84 on-ramp and I-29 Exit 86 off-ramp ramps: B

5. Service interchange ramp terminal intersections

The Year 2040 No Build condition analysis highlights the following system interchange needs to be addressed prior to, or in conjunction with, the I-90/I-29 system interchange improvements:

I-29 Exit 83 (60th Street N)

- Northbound ramp terminal intersection measures LOS D in the 2040 No Build conditions, with queues extending beyond existing turn lane lengths
- Northbound on-ramp merge segment measures LOS C in 2040 No Build conditions. While LOS C is acceptable, this segment reflects the lone I-29 Exit 83 interchange freeway segment measuring LOS C in Year 2040. Coupled with the closely spaced I-90/I-29 system interchange, improvements to the northbound I-29 Exit 83 ramps and ramp terminal intersection should be considered prior to or in conjunction with the I-90/I-29 system interchange improvements.

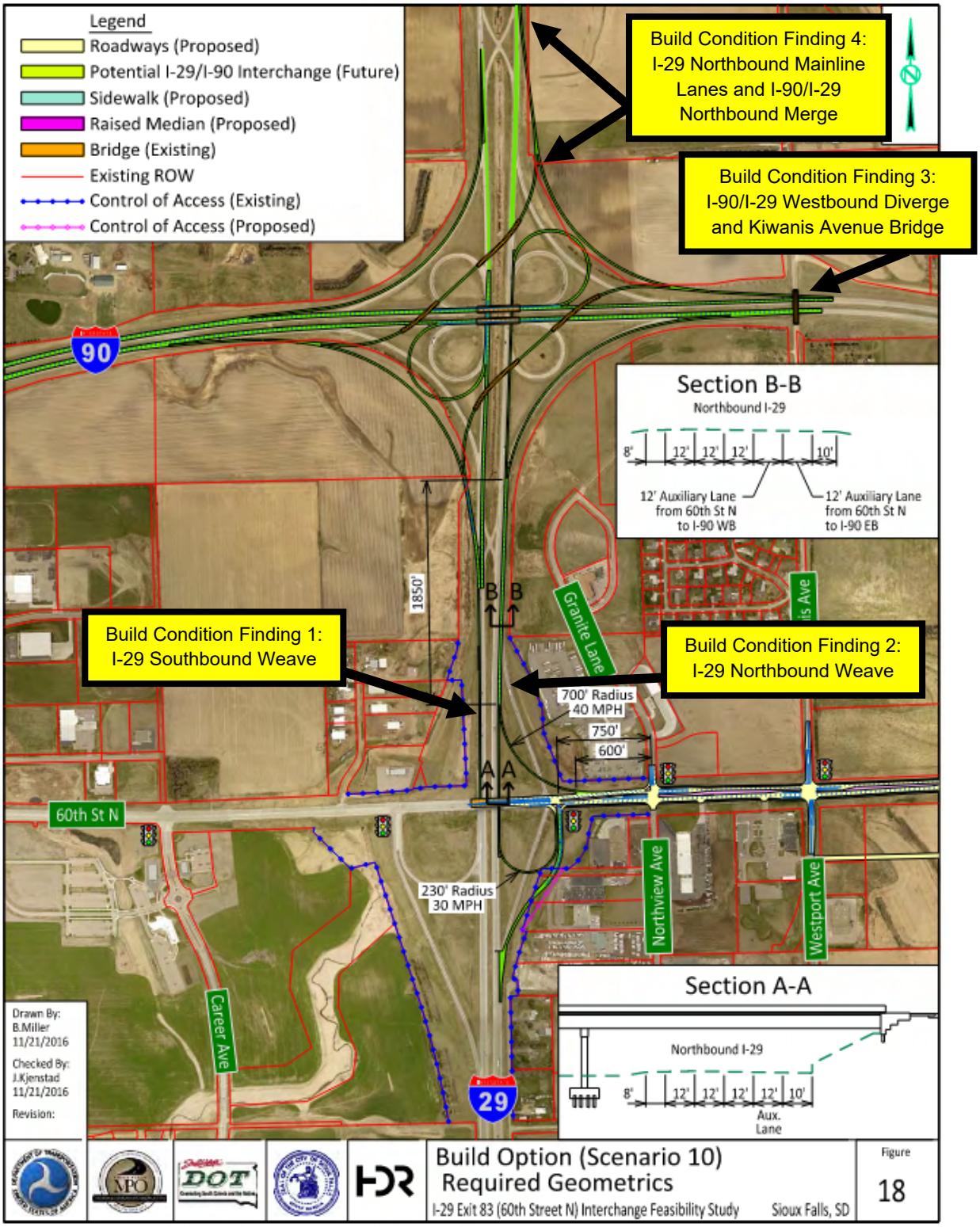
I-29 Exit 86 (258th Street)

- Existing two-way stop control ramp terminal intersections fail due to anticipated development throughout the area. Improvements are currently being planned through the *I-29 Exit 86 Interchange Modification Study*.

When future capacity improvements are required at a service interchange, an Interchange Modification Study will be conducted to determine specific improvements (e.g., approach lane configurations, turn lane lengths, traffic control) with respect to existing and forecasted traffic volumes developed at that time.

The cursory review of service interchange ramp terminal intersection LOS showed future Build condition interchange improvements manage anticipated traffic growth through Year 2065 (see **Appendix C**). While not uncommon at large intersections in urban areas, a couple intersections

reach LOS D and there are a few turn lanes that may need lengthened beyond what has been shown in previous interchange concepts to minimize blocking of adjacent lanes.



Source: I-29 Exit 83 (60th Street N) Interchange Feasibility Study (April 2017): Scenario 10

Figure 10: Findings Reference Figure

Traffic Operations Analysis Conclusions and Recommendations

Existing I-90/I-29 System Interchange

Traffic operations analysis does not show any significant capacity constraints with the existing interchange configuration and Year 2040 traffic forecasts developed through straight-line growth.

Build Conditions (Year 2040+)

The *2017 I-29 Exit 83 (60th Street N) Interchange Feasibility Study* Scenario 10 configuration is found to meet minimum allowable freeway segment LOS through Year 2065 with the following exceptions:

1. I-90/I-29 system interchange westbound (I-90) diverge to I-29 southbound flyover and I-29 northbound directional ramps
2. I-29 northbound mainline segment between I-90/I-29 system interchange and I-29 Exit 86 (258th Street)

Analysis recommendations for further consideration as part of future design and planning include:

- Consider width for two I-90/I-29 system interchange I-90 westbound off-ramp lanes under the Kiwanis Avenue bridge and adjacent to I-90 as part of future design projects
- Consider extending a third I-29 lane northward to I-29 Exit 86, through either a continuation of three mainline lanes or as an auxiliary lane between the I-90/I-29 system interchange and I-29 Exit 86 northbound off-ramp
- Consider continuing the I-90 eastbound to I-29 northbound ramp lane and I-90 westbound to I-29 northbound ramp lane northward from their convergence point as two parallel lanes within the system interchange and then sequentially dropping those lanes while traveling northward to (or at) the I-29 Exit 86 interchange.
- Monitor need for I-29 Exit 83, I-29 Exit 86, and I-90 Exit 395 interchange ramp and intersection improvements. Long-range configurations are shown to accommodate operational needs from a high-level review but will require further analysis during the respective Interchange Modification Study to fine-tune required improvements.
- Conduct origin-destination analysis for all weave segments to better understand current weave movements and forecast future weave movements
    - Consider microsimulation analysis for weave segments between I-29 Exit 83 and the I-90/I-29 system interchange to validate operational acceptability due to limitations within HCM methodology, lane change requirements, and spacing between merge and diverge points

I-90/I-29 System Interchange Concept Modifications

Based on the traffic operations analysis findings and study team discussions on August 3 and October 31, 2023, the 2017 I-90/I-29 system interchange concept was updated to accommodate long-range traffic volumes.

The recommended interchange concept is shown in **Figure 11**. A summary of modifications is below.

2-Lane I-90 westbound off-ramp (I-90/I-29 system interchange)

- Includes parallel type off-ramp where the second ramp lane is added (established) upstream of the exit terminal
- Diverge point located approximately 100 ft. east of the Kiwanis Avenue bridge to improve visibility (prior to reaching the bridge shadow) and shift the overhead sign location away from the bridge

I-29 number of lane options between Exit 84 and Exit 86 (4-lane or 6-lane section)

- 4-lane section
  - Two mainline lanes in each direction
  - I-29 northbound bridge over railroad tracks requires widening
- 6-lane section
  - Two mainline lanes in each direction plus auxiliary lane added/dropped at successive ramps
  - I-29 northbound and southbound bridges over the railroad tracks require widening

2-Lane I-29 northbound on-ramp (I-90/I-29 system interchange)

- I-90 eastbound to I-29 northbound and I-90 westbound to I-29 northbound ramp lanes are brought together to establish parallel ramp lanes prior to merging with I-29 northbound mainline

I-90 number of lanes between Exit 395 and Exit 396

- 8-lane section
  - Three mainline lanes in each direction plus auxiliary lane added/dropped at successive ramps

Parallel type ramp terminals

- Incorporates parallel type ramp terminals (in lieu of taper type ramp terminals) to reflect current SDDOT preference

Box culvert

- Adds a box culvert under the I-90 eastbound/westbound to I-29 southbound ramp (southwest quadrant)

Kiwanis Avenue Bridge

The conceptual bridge dimensions for Kiwanis Avenue over I-90 are approximately 44-feet wide by 300-feet long.

I-29 Bridges over Railroad Tracks between I-29 Exit 84 and I-29 Exit 86

Conceptual bridge dimensions for three I-29 lanes over the railroad tracks between I-29 Exit 84 and Exit 85 are:

- I-29 northbound: 62 feet wide by 172 feet long
- I-29 southbound: 57 feet wide by 172 feet long

Taper Type or Parallel Type Ramp Terminal at I-90 Westbound Off-Ramp

A review of *A Policy on Geometric Design of Highways and Streets* (American Association of State Highway and Transportation Officials, AASHTO) highlights key considerations when determining between taper type and parallel type two-lane exit terminals.

For single-lane taper type exit terminals, AASHTO Section 10.9.6.6 notes the following considerations (which are also applicable to two-lane exit terminals):

- Taper type exits tend to fit with the direct path of motorists and studies have shown motorists generally leave the mainline lane at relatively high speeds, which is a benefit to operations and safety.
- Parallel type exits provide an inviting exit area with added width for deceleration. Parallel type exits work best when motorists enter sufficiently in advance of the exit nose in order to decelerate in the added lane and not the mainline lane.
- Parallel type exits exhibit advantages during high-volume conditions by removing exiting traffic from the mainline through lanes.

For two-lane exit terminals, *AASHTO* Section 10.9.6.6.6 considerations include:

- With a taper type exit, drivers are not required to change lanes at the ramp terminal approach. A parallel type exit requires at least one lane change for the I-90 westbound to I-29 northbound movement.

Adjacent Interchange Updates

Updated tie-in with anticipated future improvements at I-90 Exit 395 and I-29 Exit 83 are also shown in the recommended layout **Figure 11**.

Additional Considerations

Additional design considerations noted during the concept refinement and review process include:

- Review fill section feasibility (fill section vs. bridge) between the I-90 westbound to I-29 southbound and I-90 eastbound to I-29 northbound flyover ramp bridges
- Review I-29 northbound to I-90 eastbound directional ramp and I-29 southbound to I-90 westbound directional ramp constructability, regarding whether they should be constructed on alignment or off-alignment and traffic control

A potential 259th Street overpass of I-29 (between I-29 Exit 84 and Exit 86) was discussed with the study team. The recommended interchange concept shown in **Figure 11** would require longer overpass bridges to span a future 6-lane I-29 section, compared to the existing 4-lane. Whether I-29 lanes are added to the inside or outside through this area would be further investigated during design. A service interchange at 259th Street would meet minimum spacing of one mile between interchange crossroads in an urban area. However, cost and constructability considerations include the length of system interchange ramps, bridge widening across the railroad tracks, and environmental and property impacts.

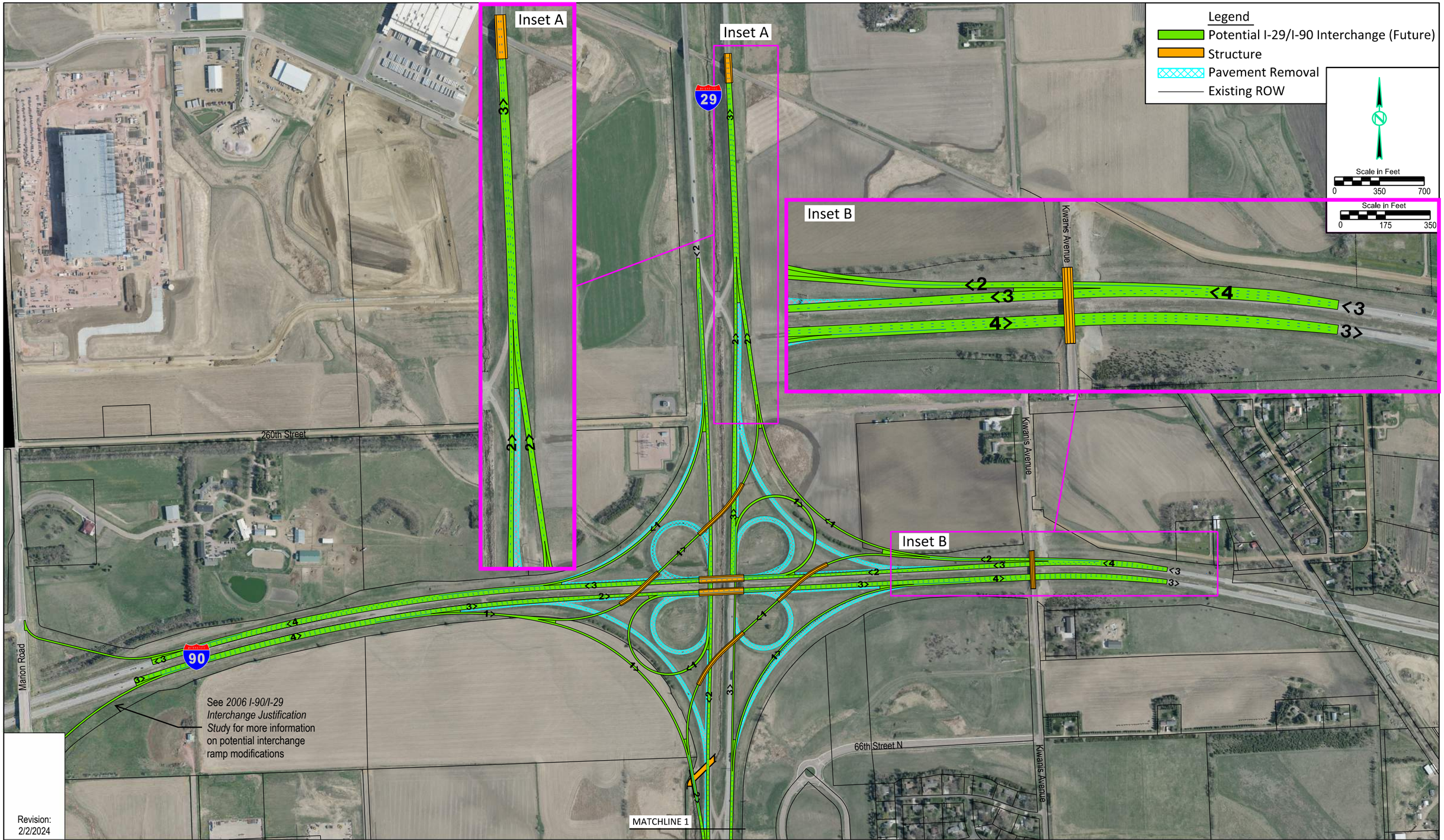
Potential I-90 service interchange locations between I-29 and Cliff Avenue were also discussed. The *2010 SDDOT Decennial Interstate Corridor Study*[4] reviewed feasibility of a potential interchange at I-90 and Minnesota Avenue (if Minnesota Avenue was extended northward). Notable constraints exist at this location, such as Big Sioux River floodway, railroad tracks, existing development, and proximity to the Cliff Avenue single point interchange. Recommendations suggested a more viable approach being to improve the local roadway network through enhanced connectivity and capacity improvements to facilitate improved access to existing interchange locations.

A service interchange at I-90 and Kiwanis Avenue is not feasible based on proximity to the I-90/I-29 system interchange. I-29 to Kiwanis Avenue spacing is less than ½-mile, which is considerably less than the minimum one-mile spacing in urban areas.

Recommendations

The recommended I-90/I-29 system interchange configuration is shown in **Figure 11**. The recommendation includes an option for either a 4-lane (two mainline lanes in each direction) or 6-lane (two mainline lanes plus auxiliary lane in each direction) I-29 section between I-29 Exit 84 and Exit 86. Updated concepts at the adjacent interchanges are also included.

[4] South Dakota Department of Transportation. (August 2010). 2010 South Dakota Decennial Interstate Corridor Study, Phase 2 Report. https://dot.sd.gov/media/documents/09_104Phase2finalreport.pdf



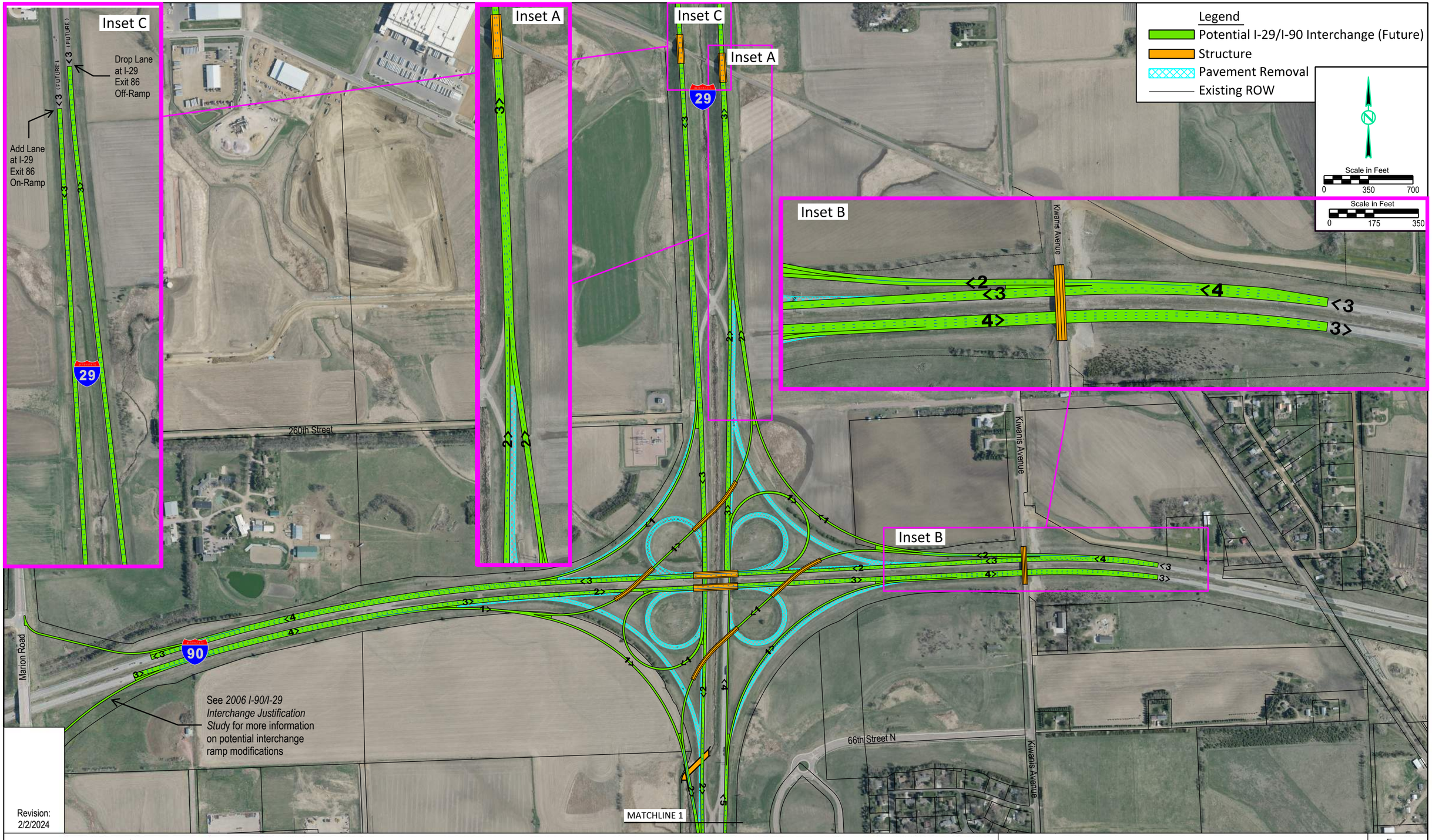
Revision:
2/2/2024

I-90/I-29 System Interchange (I-90 Exit 396, I-29 Exit 84)

I-29 4-Lane Section between Exit 84 and Exit 86

I-90/I-29 Interchange Traffic Operations Analysis *Sioux Falls, SD*

Figure
11a



Revision: 2/2/2024

I-90/I-29 System Interchange (I-90 Exit 396, I-29 Exit 84)

I-29 6-Lane Section between Exit 84 and Exit 86

I-90/I-29 Interchange Traffic Operations Analysis *Sioux Falls, SD*

Figure 11b

Revision:
2/2/2024

I-90/I-29 System Interchange (I-90 Exit 396, I-29 Exit 84)

I-29 Exit 83 Interchange

I-90/I-29 Interchange Traffic Operations Analysis *Sioux Falls, SD*

Figure
11c

Appendix

A. Interchange Layouts (Previous Studies)

I-90/I-29 Interchange

- *Layout: I-29 Exit 83 (60th Street N) Interchange Feasibility Study (2017)*
    - Reflects updated *I-90/I-29 Interchange Justification Report (2006) and 60th Street N Planning and Feasibility Study* (2012) layouts

I-29 Exit 83 (60th Street N)

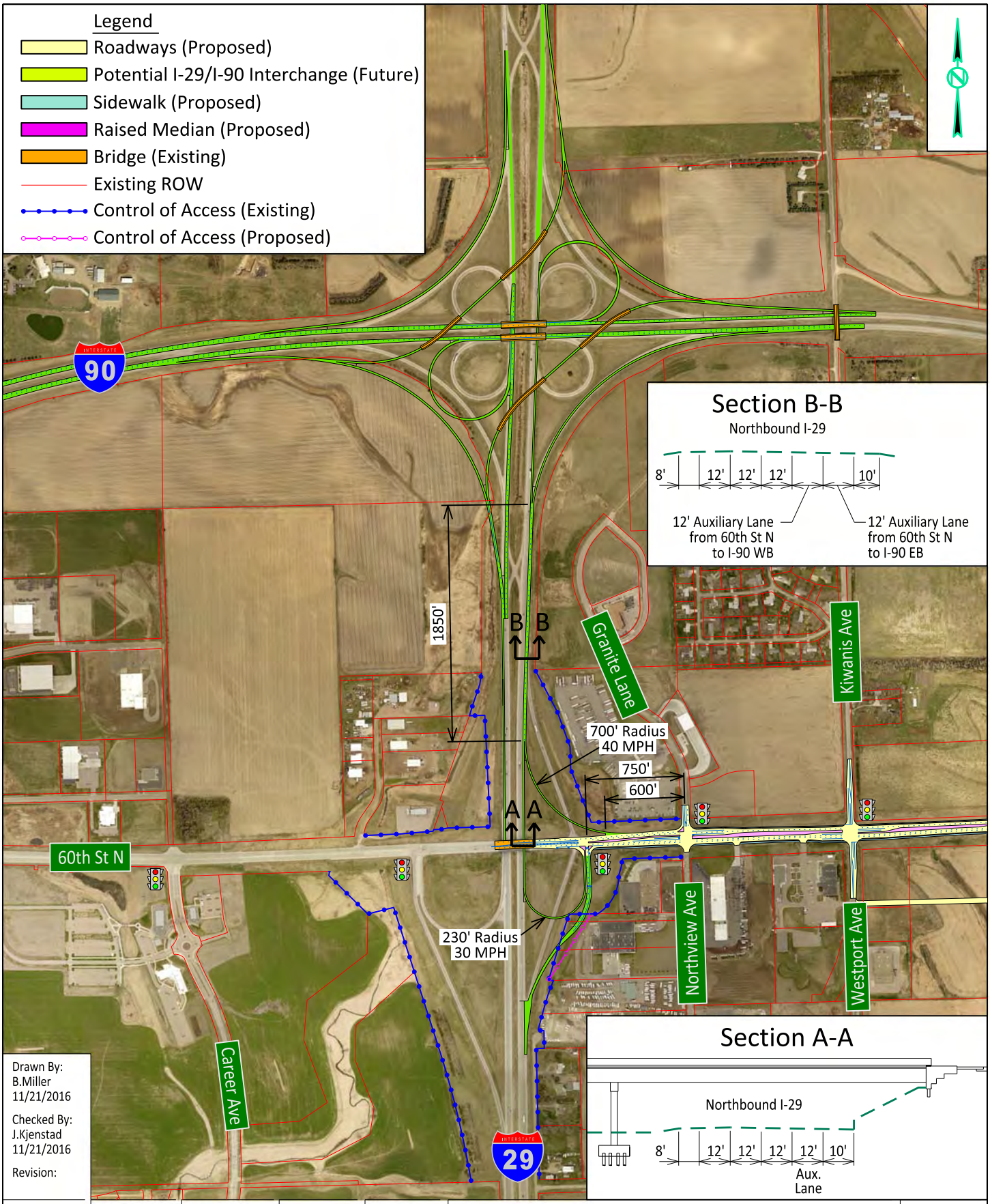
- *Layout: I-29 Exit 83 (60th Street N) Interchange Feasibility Study*

I-29 Exit 86 (258th Street)

- *Layouts: I-29 Exit 86 Interchange Modification Study*

I-90 Exit 395 (Marion Road)

- *Layout: Marion Road Interchange Justification Study (2006)*



Build Option (Scenario 10) Required Geometrics

I-29 Exit 83 (60th Street N) Interchange Feasibility Study — Sioux Falls, SD

Figure 18

PROPOSED INTERCHANGE

MINNEHAHA COUNTY, SOUTH DAKOTA
I-90/I-29 INTERCHANGE JUSTIFICATION REPORT

DATE
MAR. 2006

FIGURE
FIGURE 3

Legend
- Proposed Roadway
- Proposed Access Roads
- Proposed Sidewalk /Bike Path
- Proposed Bridge
- Proposed Median
- Work Limit Line
- Eliminate Existing Access /Driveway
- Proposed Roadway Outside Study Area

Potential I–29 /I–90 system interchange

Redstone Development

Granite Lane

Kiwanis Avenue

Limestone Lane

Redstone Access Road

61st Street N

Proposed future ROW line

Previously mitigated wetland

Flying "J"

2011 ADT = 6,300
2035 ADT = 14,900

2011 ADT = 12,700
2035 ADT = 38,000

60th Street N

2011 ADT = 10,600
2035 ADT = 19,200

2011 ADT = 14,900
2035 ADT = 37,300

J&L Harley Davidson

Midamerica Motoplex

58th Street N

Sidewalk /bike facility should be considered when bridge improvements are required at I–29. At that time the sidewalk shall be extended from I–29 NB Off Ramp to Marion Road along 60th Street N.

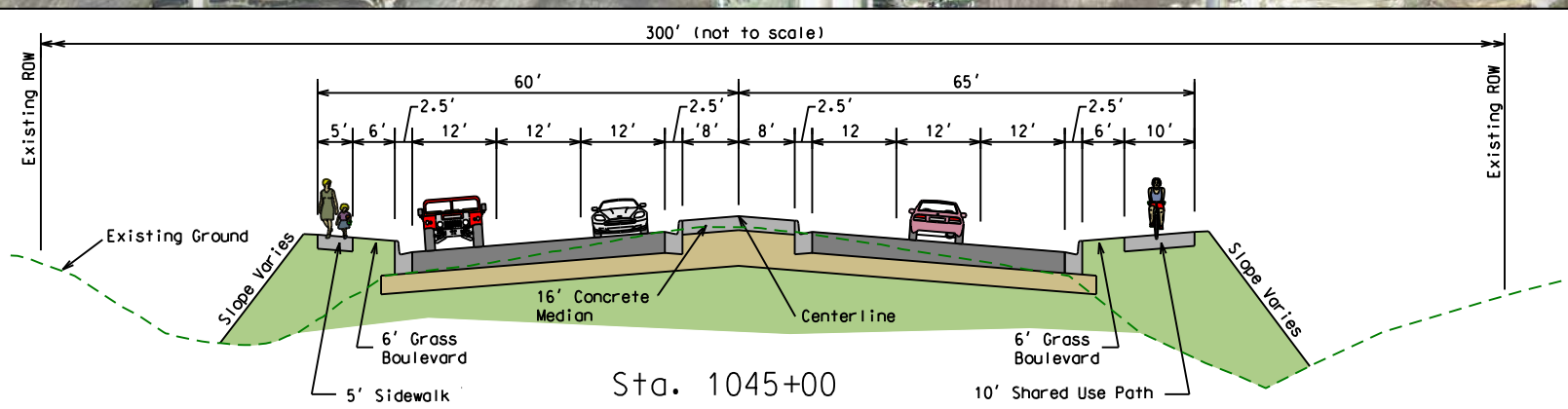
Review 250' loop radius to provide more separation north of intersection adjacent to truck stop.

Westport Avenue

56th Street N

Northview Avenue

Access to I–29 at Benson Road



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HDR

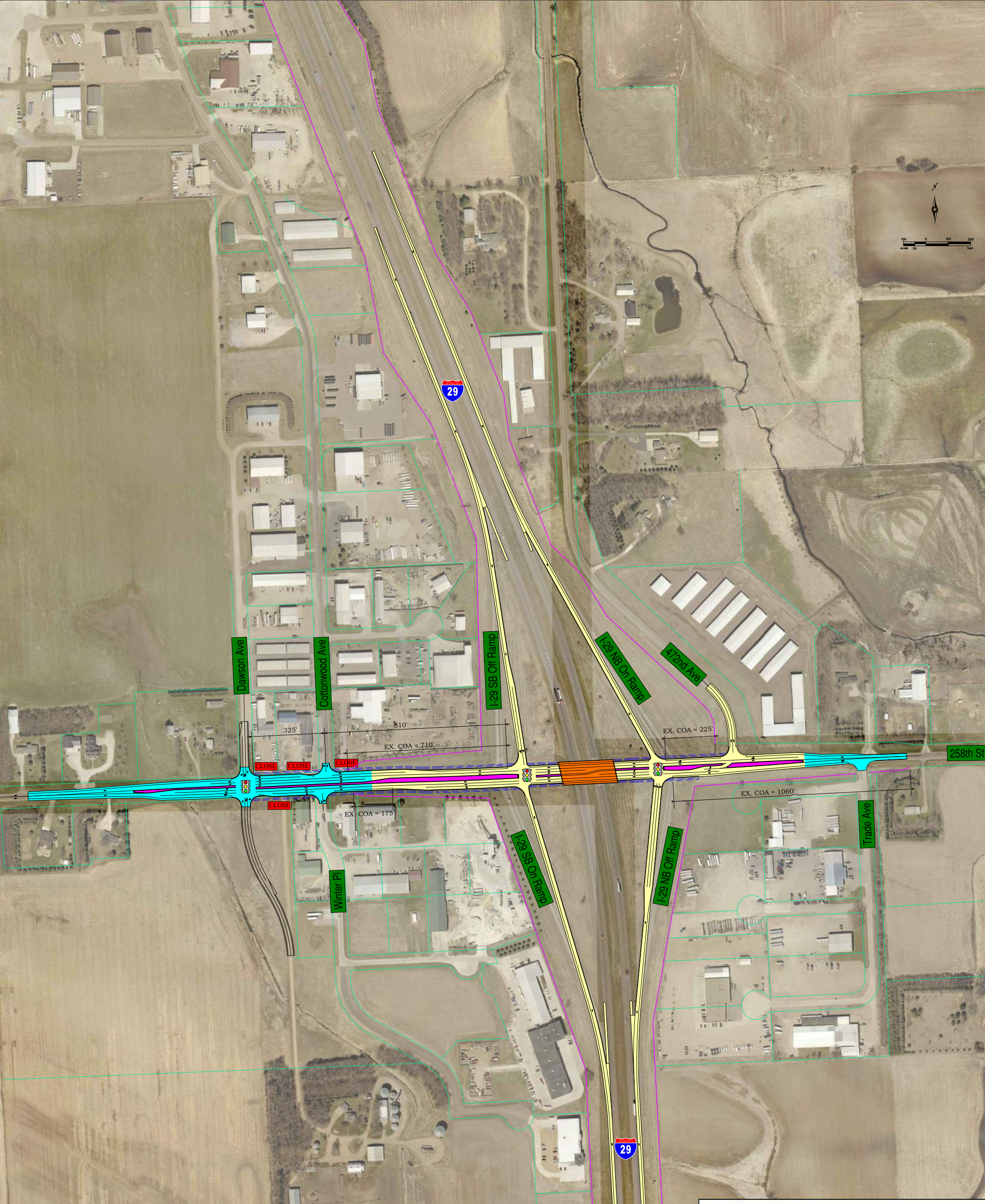
HRGreen

60th Street North Feasibility Study

Sioux Falls, South Dakota

Figure 3–1a

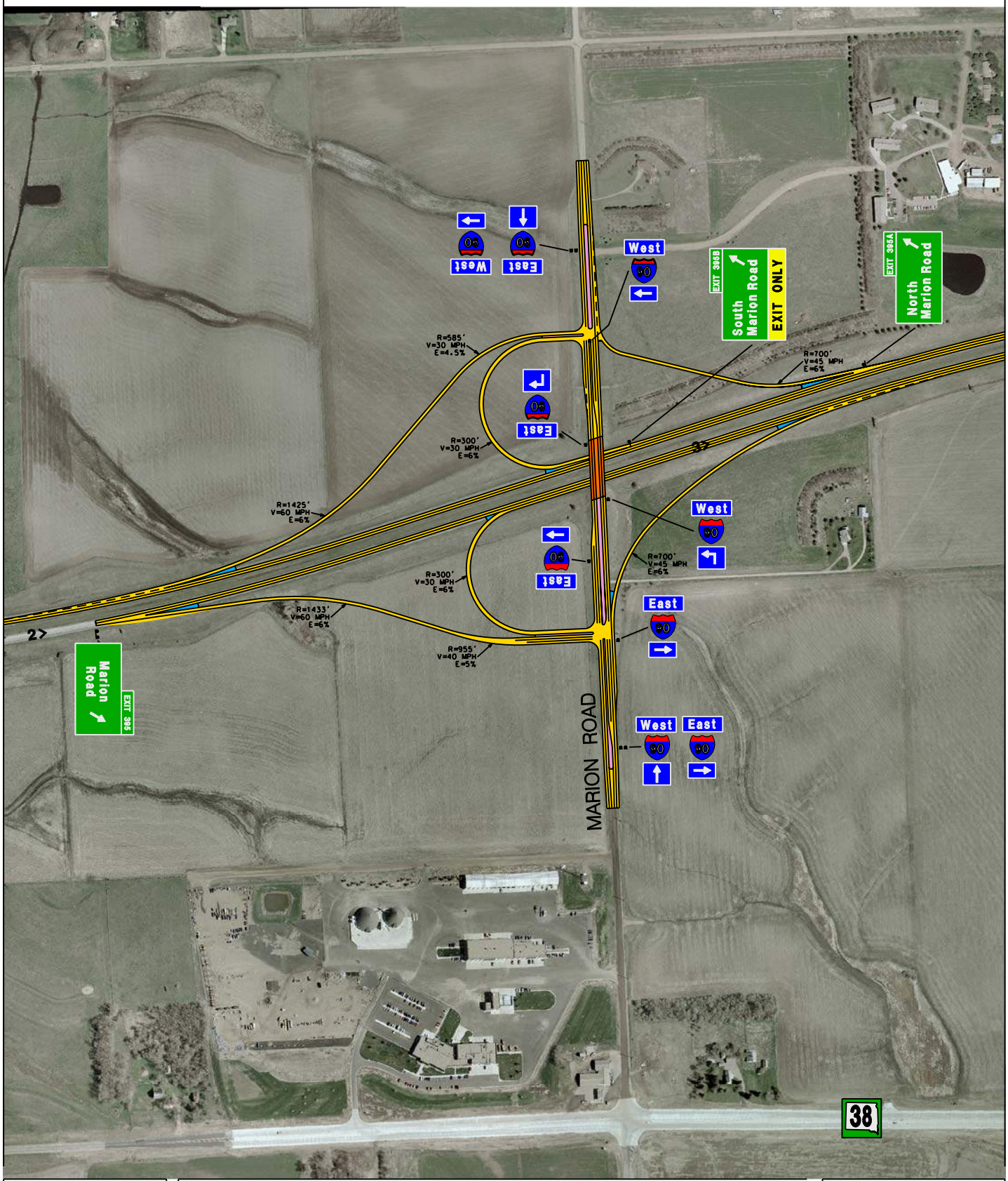
Segment 1 Concept Design – Option 1
I–29 to Westport Avenue (Kiwanis Ave)


29
Dawson Ave
Cottonwood Ave
I-29 SB Off Ramp
I-29 NB On Ramp
472nd Ave
258th St
Winter Pl
I-29 SB On Ramp
I-29 NB Off Ramp
Trade Ave
325'
810'
EX. COA = 710'
EX. COA = 225'
EX. COA = 1060'
EX. COA = 175'
CLOSE
CLOSE
CLOSE
CLOSE
N
100 0 100 200
scale 50 feet
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Bridge Construction
Sidewalk / Trail Construction
Retaining Wall Construction
Existing ROW/Property
Existing Control of Access
Existing Wetlands
CLOSE
Access Closure

Dawson Ave
Cottonwood Ave
I-29 SB Off Ramp
I-29 NB On Ramp
472nd Ave
258th St
Trade Ave
Winter Pl
I-29 SB On Ramp
I-29 NB Off Ramp
29
325'
770'
EX. COA = 670'
EX. COA = 225'
EX. COA = 1040'
EX. COA = 140'
CLOSE
CLOSE
CLOSE
CLOSE
N
100 0 100 200
scale 50 feet

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Bridge Construction
- Sidewalk / Trail Construction
- Retaining Wall Construction
- Existing ROW/Property
- Existing Control of Access
- Existing Wetlands
- CLOSE — Access Closure



PARTIAL CLOVERLEAF WITH NE AND SW QUADRANT LOOPS AT MARION ROAD

MINNEHAHA COUNTY, SOUTH DAKOTA
I-90/I-29 INTERCHANGE JUSTIFICATION REPORT

DATE
MAR. 2006

FIGURE
FIGURE 8

B. Methods and Assumptions Document

Methods and Assumptions Document

Date:	Tuesday, June 20, 2023
Project:	I-90 / I-29 Interchange Traffic Operations Analysis
To:	SDDOT
From:	HDR
Subject:	Traffic Analysis Methods and Assumptions Documentation REVISED

This Methods and Assumptions (M&A) document was developed to serve as a historical record of the process, dates, and decisions made by the study team representatives for the **I-90 / I-29 Interchange Traffic Operations Analysis**.

1. Stakeholder Acceptance

The undersigned parties concur with the Methods and Assumptions for the **I-90 / I-29 Traffic Operations Analysis** as presented in this document.

SDDOT:	FHWA:
_____	_____
Signature	Signature
_____	_____
Title	Title
_____	_____
Date	Date

Notes:

1. Participation on the Study Advisory Team (SAT) and/or signing of this document does not constitute approval of the traffic analysis final reports or conclusions.

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

2. Introduction and Project Description

Project Background, Understanding, and Need for Study

The current structure life of the I-90 / I-29 system interchange (Exit 84) is requiring the interchange be programmed for reconstruction in approximately Year 2040. A three-year construction timeframe is anticipated. The South Dakota Department of Transportation (SDDOT) has requested traffic forecasts and operations analysis be conducted for the interchange to help guide design. The operations analysis will identify a planning-level year of need and review feasibility of Option #5 from the *I-90/I-29 Interchange Justification Study* (March 2006). Option #5 is shown in Figure 1.

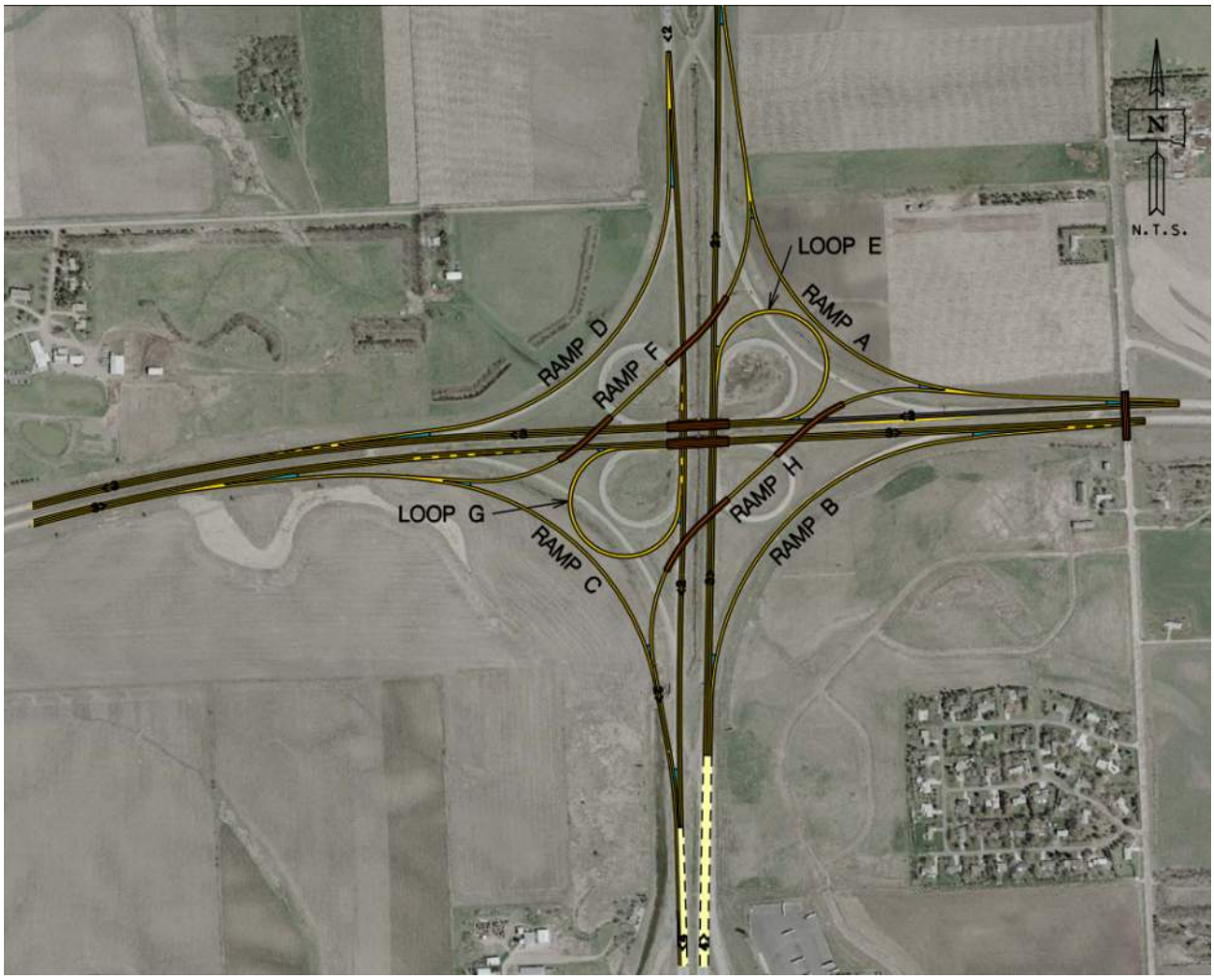


Figure 1: Option #5 from I-90/I-29 Interchange Justification Study (March 2006)

Location and Study Area

The operations analysis study area is shown in Figure 2.

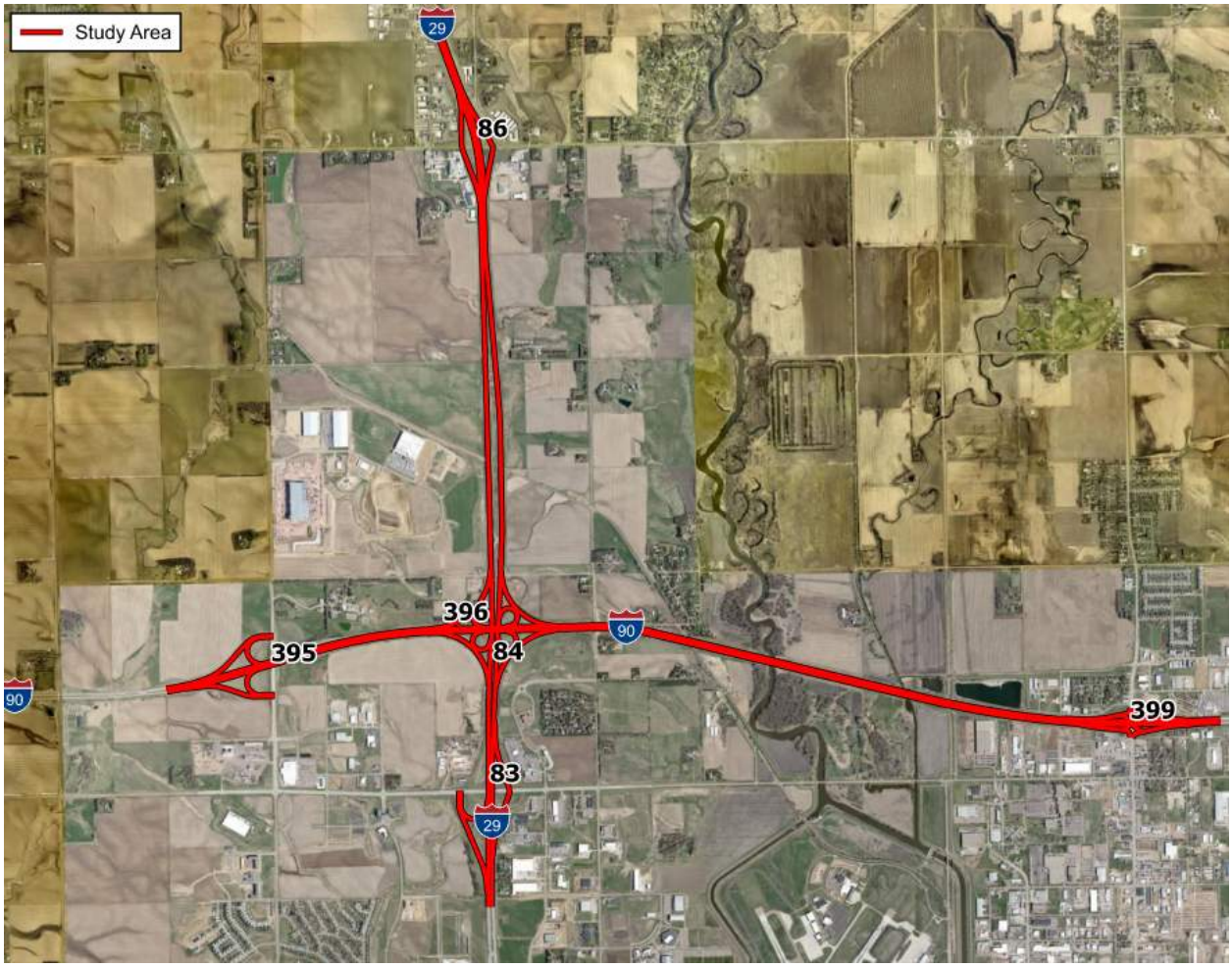


Figure 2: Study Area

Facilities Affected by the Study

The facilities affected by this project include the sections of roadway systems identified in the “Location and Study Area” section of this memo.

Study Schedule

- Notice to Proceed: June 6, 2023
- Kickoff and Methods and Assumptions Meeting: June 20, 2023
- Traffic Data Collection: June 20, 2023
- Draft Memo Submittal: July 31, 2023
- Findings Meeting: week of July 31, 2023
- Revisions and Follow-up Meeting (if needed): August / September 2023
- Work Order Completion Date: October 1, 2023

Previous Studies

Previous studies in the area will be referenced during the forecasting and analysis tasks, and may include:

- I-90/I-29 Interchange Justification Study
- I-29 Exit 86 Interchange Modification Justification Study (in progress)
- Foundation Park Traffic Impact Study (and amendments)
- 60th Street North Planning and Feasibility Study
- SDDOT 2020 Decennial Interstate Corridor Study

Study Advisory Team

Deliverables as part of this task will be submitted to SDDOT, City of Sioux Falls, Sioux Falls Metropolitan Planning Organization (MPO), and Federal Highway Administration (FHWA) SAT members for review.

3. Analysis Years/Periods

The study will evaluate traffic operations during the following time periods:

- Existing Conditions: 2023
- Future-Year Conditions
    - Opening Year – 2040, based on Existing Interchange Analysis findings
    - Interchange Planning Horizon: 2065, or based on 25-year horizon following Opening Year

Year 2040 is the assumed Opening Year based on the service life of the I-90 interchange bridges but may be adjusted to a year prior to 2040 based on operational findings from the Existing Interchange Analysis. Interchange Planning Horizon is assumed Year 2065 but may be adjusted to an earlier year based on the identified Opening Year (Opening Year + 25 years).

4. Data Collection

Traffic Data Collection Techniques

It is anticipated that SDDOT will provide all segment counts required for forecasts and analysis in this study. HDR will collect intersection turning movement counts (TMCs) at the adjacent service interchange ramp terminal intersections. This data were/will be collected using standard traffic data collection techniques, which may consist of digital count boards and/or video cameras at intersections and tube counters on roadway segments. Counts should be collected on a Tuesday, Wednesday, or Thursday.

Traffic Counts

Intersection turning movement and segment count locations and responsible party are summarized in Table 1.

Table 1: Intersection TMC and Segment Count Locations and Responsible Party

Location	SDDOT	HDR
I-90 / I-29 Interchange		
Ramps (segment)	24-hour*	
I-90 Exit 395 (Marion Road)		
Ramps (segment)	24-hour*	
Ramp terminals (2 intersections)		AM / PM peak period intersection TMC**
I-90 Exit 399 (Cliff Avenue)		
Ramps (segment)	24-hour*	
Ramp terminals (1 intersection)		AM / PM peak period intersection TMC**
I-29 Exit 83 (60th Street N)		
Ramps (segment)	24-hour*	
Ramp terminals (2 intersections)		AM / PM peak period intersection TMC**
I-29 Exit 86 (258th Street)		
Ramps (segment)	24-hour*	
Ramp terminals (2 intersections)		AM / PM peak period intersection TMC**
I-90 Mainline		
West of interchange (segment)	24-hour*	
East of interchange (segment)	24-hour*	
I-29 Mainline		
North of interchange (segment)	24-hour*	
South of interchange (segment)	24-hour*	

Traffic data collection:

** 24-hour segment counts to include per-vehicle records where available to aid in developing peak hour volume set and heavy vehicle percentages.*

***AM / PM peak period intersection turning movement counts (TMC) will encompass the morning and afternoon peak hours; four-hour counts (two hours in morning and two hours in afternoon) are anticipated.*

Free Flow Speeds

Free-flow speeds will be estimated using estimation procedures documented in the Highway Capacity Manual. Required data in this process, such as lane widths, speed limits, and lateral clearance, will be obtained from field visits, aerial imagery, available construction plans, and/or future concept geometrics.

If speed information collected using standard speed traffic data collection techniques (radar, tube counters, etc.) is available, free-flow speeds will be based on measured speeds.

5. Volume Development and Traffic Forecasting

Existing Volumes

The following process will be used to develop the study area Existing Conditions (2023) AM and PM peak hour traffic volumes:

- Identify AM and PM peak hours
- Factor counts to a design season (factor provided by SDDOT): September
- For counts that were collected prior to 2023, factor those counts forward to Year 2023 using growth rates obtained from the Sioux Falls MPO travel demand model (TDM) and SDDOT sources
- Balance and smooth volumes across study area intersections and roadway segments to 5-vehicle increments
    - For low-volume movements, presented movement volume may be less than 5 vehicles

Heavy vehicle percentages will be based on collected vehicle classification counts.

Traffic Forecasts

AVAILABLE DATA SOURCES

Multiple sources of data are available within the study area to aid in the development of traffic forecasts:

- Sioux Falls MPO TDM
- Historical Daily Traffic Counts – historical daily counts collected as part of SDDOT traffic data collection programs and previous studies.
- County Growth Factors – SDDOT-developed growth factors.

SIOUX FALLS MPO TRAVEL DEMAND MODEL

The Sioux Falls MPO TDM will be used in the development of traffic forecasts for this study. The current version of the model is as follows:

- Base Year: 2021
- Horizon Year: 2050

The 2050 Horizon Year TDM scenario will be reviewed to determine whether adjustments need to be made to the Foundation Park Transportation Analysis Zones (TAZs) to account for anticipated industrial development through Year 2050. Adjustments to the 2050 Horizon Year TDM will be documented.

The forecast scenario will not include a 259th Street overpass of I-29. A sensitivity scenario will be developed using the 2050 Horizon Year to assess and summarize changes in traffic patterns.

FORECASTING METHODOLOGY

The following methodology will be used to develop traffic forecasts:

A. Forecasts from the Sioux Falls MPO TDM will be used to develop daily and peak hour traffic forecasts, with consideration to SDDOT growth factors for I-90 and I-29 mainline.
B. Develop Year 2050 volumes reflective of the Sioux Falls MPO TDM 2050 Horizon Year using *NCHRP 765: Analytical Travel Forecasting for Project-Level Planning and Design* methodology.
C. Develop Year 2040 volumes to reflect the interchange Opening Year based on straight-line interpolation between existing volumes and Year 2050 volumes.
    a. Opening Year may be prior to 2040 as determined by the Year of Need analysis.

D. Develop Year 2065 volumes to reflect interchange Horizon Year based on straight-line extrapolation of existing volumes to Year 2050 volumes
    a. Year 2065 may be adjusted based on Opening Year

Where gaps in the TDM's estimation of future development are identified by the study team, estimated development-generated traffic (derived by ITE Trip Generation rates, traffic counts at similar sites, or other methods agreed-upon by the study team) may need to be assigned to the network based on an estimation of future development occurring within the planning horizon.

AM and PM peak hour traffic volumes will be balanced.

Heavy vehicle percentages will be based on traffic counts with consideration to future-year truck percentages identified by SDDOT and the Sioux Falls MPO TDM 2050 horizon year model.

6. Traffic Operations Analysis

Analysis of existing, future-year No-Build, and future-year Build conditions traffic operations will be conducted using the current Highway Capacity Software 2023 (HCS2023) release based on Highway Capacity Manual (HCM) 7th Edition methodology. The following HCM 7th Edition chapters may be applicable to this analysis:

- Freeway facilities (HCM Chapter 10)
    - HCS2023 Freeways Module
- Basic freeway, weave, and merge/diverge segments (HCM Chapters 12, 13, and 14)
    - HCS2023 Freeways Module
- Signalized intersections (HCM Chapter 19)
    - HCS2023 Streets Module
- Two-way stop-controlled (TWSC) Intersections (HCM Chapter 20)
    - HCS2023 TWSC Module
- All-way stop-controlled (AWSC) intersections (HCM Chapter 21)
    - HCS2023 AWSC Module
- Ramp terminals and alternative intersections (HCM Chapter 23)
    - HCS2023 Streets Module

Traffic Signal Warrants

A traffic signal warrant analysis will not be conducted with this study.

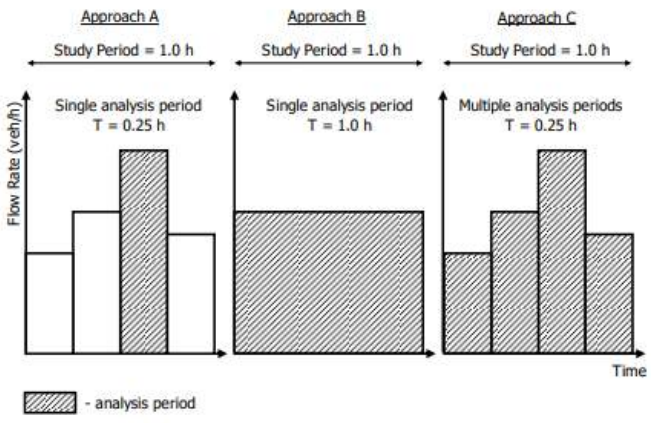
Turn Lane Warrants

A turn lane warrant analysis will not be conducted with this study.

Traffic Variables

Specific operational variables are listed below:

- Peak Hour Factor (PHF) –
  - Existing Conditions – traffic counts
  - Future Conditions –based on sampling of AM and PM intersection PHFs from collected traffic counts. Maximum future-year PHF is 0.90.
- Saturation Flow Rate –
  - SDDOT Design Manual (Chapter 15) requires the use of up to 1,700 vph in rural areas and up to 1,900 vph in urban and suburban areas
  - City of Sioux Falls Saturation Flow Rate study from 2019 indicated a city-wide range of 1,750 to 1,960 vph, with an average of 1,830 vph
  - 1,850 vph will be used for this study
- Right Turn on Red – Percentage based on sampling of actual operations or zero
- Heavy Vehicle Percentage – Based on traffic counts
- Heaviest Lane Volume (Lane Utilization) – Default values will be used except where uncommon lane utilization is documented during field review. Areas where lane utilization is of concern will be addressed on a case-by-case basis.
- Phase Change Intervals and Pedestrian Clearance Times – Based on existing timings or proposed modifications. For future-year conditions, phase change intervals will be calculated for existing and proposed signalized intersections using *MUTCD, NCHRP 731, and NCHRP Report 812* methodology.
- Left Turn Phasing –
  - Single left turn lanes on approaches with a posted speed greater than 45 mph will be analyzed as protected-only phasing
  - Dual left turn lanes will be analyzed as protected-only phasing
- Free Flow Speeds (FFS) –
  - Field measured where available.
  - If field measured speeds are not available, estimation based on HCM6 methodologies.
    - Base FFS based on design speed or an adjustment to posted speed limit.
- Study Period and Analysis Period –
  - Existing and Future-Year Conditions analyses will use a peak hour volume and PHF (1-hour demand volume divided by a peak hour factor, Approach A from HCM 7th Edition page 16-11)



Design input data for HCS analysis:

- Terrain Type – Level
- Area Type – Urban
- Driver Population Factor – Balanced Mix

7. Safety Issues

No crash history review or predictive safety analysis is planned as part of this study.

8. Selection of Measures of Effectiveness (MOE)

Minimum allowable I-29 and I-90 freeway segment Level of Service (LOS) is LOS C

- LOS C is desired for all movements within the interchange, but LOS D will be allowable. The approximate year of transition between LOS C and D will be identified.
- Freeway facility and basic, merge, diverge, and weave segments

While the focus of this operations analysis is the I-90 / I-29 interchange and freeway segments extending to/from the interchange, the ramp terminal intersections at adjacent service interchanges will be reviewed for potential capacity constraints with respect to the Opening Year and Interchange Planning Horizon years. This will help gauge feasibility of accommodating future traffic demand at the interchanges.

Minimum allowable ramp terminal intersection LOS is LOS C

- Individual movements will be allowed to operate at LOS D
- Individual movements will not be allowed to operate with v/c ratio greater than 1.0
- Queue storage ratio will not be allowed to exceed 1.0 for any movements

Two-way stop-control (TWSC) intersections will be reported from both an overall (weighted) and worst-case stop-controlled delay standpoint.

This analysis is not geared towards determining improvements to ramp terminal intersections at the four adjacent service interchanges. Potential future improvements identified in Section 10 Deviations/Justifications may be included, as needed. If the No Build condition results in a LOS worse than minimum allowable noted above, this LOS will be noted for consideration by the study team.

9. Data Provided

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

- Minnehaha County traffic seasonal factors – SDDOT
- Minnehaha County traffic growth factors – SDDOT
- Sioux Falls MPO travel demand model – Sioux Falls MPO/City of Sioux Falls
- Traffic Counts – SDDOT
    - Other counts, as available, may be requested from City of Sioux Falls for crossroad arterials
- SDDOT Road Design Manual – SDDOT
- Available site plans of future development within ½-mile radius of corridor – SAT agencies
- Available construction plans (as requested and available) – SDDOT

Historical studies in the area will be referenced as needed, which may include:

- I-90/I-29 Interchange Justification Study
- I-29 Exit 86 Interchange Modification Justification Study (in progress)
- Foundation Park Traffic Impact Study (and amendments)
- 60th Street North Planning and Feasibility Study
- SDDOT 2020 Decennial Interstate Corridor Study

10. Deviations/Justifications

The traffic operations analysis will incorporate potential or planned interchange improvements to meet operational goals at adjacent interchanges, including:

- I-90 Exit 395 (Marion Road) diagonal ramps
- I-29 Exit 86 (258th Street) improvements recommended in the I-29 Exit 86 Interchange Modification Justification Report
- 6-lane I-90 from the I-90 / I-29 interchange east to I-90 Exit 399 (Cliff Avenue) interchange
- I-29 Exit 83 (60th Street North) loop ramp (southeast quadrant)

Operations analysis may impact future Kiwanis Avenue bridge over I-90, which is planned for reconstruction as part of 2028/2029 I-90 project to add a third lane in each direction between I-29 and Cliff Avenue. SDDOT scope currently has Kiwanis Avenue as a 3-lane bridge.

No other 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.

11. Conclusion

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

12. Appendix

Methods and Assumptions were discussed at a meeting on June 20, 2023, and meeting minutes are attached. Study team comments from the first draft have been addressed in this version.

Meeting Minutes

Project:	I-90 / I-29 Interchange Traffic Operations Analysis
Subject:	Kickoff and Methods & Assumptions Meeting
Date:	Tuesday, June 20, 2023
Location:	Webex

Attendees:

- ☒ Mark Leiferman – SDDOT
- ☒ Steve Gramm – SDDOT
- ☐ Katrina Burckhard – SDDOT
- ☐ John Less – SDDOT
- ☒ Kelly VanDeWiele – FHWA
- ☐ Shannon Ausen – City of Sioux Falls
- ☒ Sam Trebilcock – City of Sioux Falls
- ☒ Fletcher Lacock – City of Sioux Falls
- ☒ Sean Hegyi – SECOG
- ☒ Jim Feeney – SECOG

- ☒ Jon Wiegand – HDR
- ☒ Tom Cook – HDR
- ☒ Jason Kjenstad – HDR
- ☒ Steve Hoff – HDR

Meeting Objectives

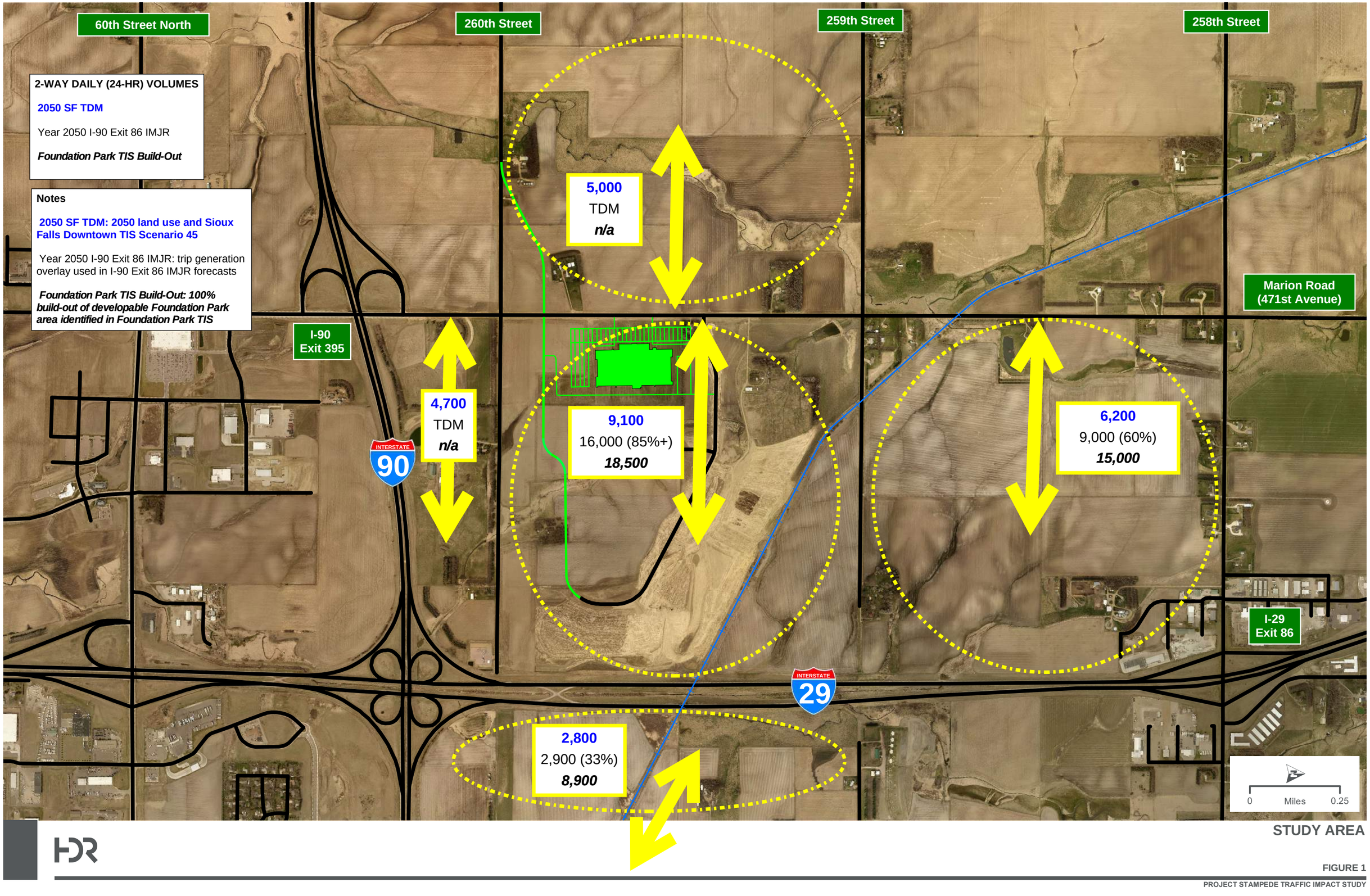
A. Introduce study and confirm expectations
B. Review M&A Document

Agenda

1. Study Scope and Schedule

2. Methods and Assumptions Document

    - *Include the 60th Street N Corridor Study and the 2020 Interstate Decennial Study in the 'Previous Studies' list.*
    - *2040 Opening Year was based on the structure life of interchange bridges.*
    - *Update 'Sioux Falls MPO Travel Demand Model' section to include model adjustment process to be conducted by City of Sioux Falls and HDR.*
    - *Create a sensitivity scenario with the 259th Street crossing of I-29 (no interchange, just an overpass).*
    - *Update Interchange and Freeway Segment LOS goals to:*
        - *LOS goal: **LOS C***
        - *Individual movement will be allowed to operate at: **LOS D***
            - *Note approximate timeframe of when LOS D would occur*
    - *Update ramp terminal intersection LOS goals to:*
        - *LOS goal: **LOS C***
        - *Individual movement will be allowed to operate at: **LOS D***
    - *Note consideration of ramp terminal intersections that exceed the minimum allowable LOS in the future No Build condition and the approach to address/incorporate in the analysis.*
    - *Note future Kiwanis Avenue bridge footprint may be impacted by findings from the traffic operations analysis.*
        - *Kiwanis bridge is scoped (planned 2028/2029 SDDOT project) to be a 3-lane section.*
    - *Revise the date in Section 12 Appendix.*



STUDY AREA

FIGURE 1

PROJECT STAMPEDE TRAFFIC IMPACT STUDY

C. Ramp Terminal Intersection LOS Summary Tables

Table C-1: Existing and 2040 No-Build Conditions LOS – Ramp Terminal Intersections

Analysis Location					Level of Service (LOS)				
Location		**Ramp Terminal Intersection**	**Analysis Type**	**Measure**	**AM** Delay / LOS			**PM** Delay / LOS	
					Existing	**2040**		**Existing**	**2040**
I-29 Exit 83 *(60th Street N)*	1	I-29 SB RTI	Signal	Overall:	15.0 / B	15.4 / B		19.2 / B	16.8 / B*
	2	I-29 NB RTI	Signal	Overall:	23.9 / C	31.2 / C		**40.4 / D**	**53.1 / D***
I-29 Exit 86 *(258th Street)*	1	I-29 SB RTI	TWSC	Overall: (WCSC):	3.0 / A (14.2 / B)	6.6 / A **(42.4 / E)**		1.6 / A (15.1 /C)	5.3 / A **(46.2 / E)**
	2	I-29 NB RTI	TWSC	Overall: (WCSC):	5.9 / A (12.2 / B)	**102.6 / F (196.2 / F)**		6.5 / A (15.0 / C)	**130.3 / F (282.6 / F)**
I-90 Exit 395 / *(Marion Road)*	1	I-90 EB RTI	Signal	Overall:	6.2 / A	8.9 / A		5.9 / A	8.8 / A
	2	I-90 WB RTI	Signal	Overall:	15.1 / B	16.9 / B		12.8 / B	14.6 / B
I-90 Exit 399 *(Cliff Avenue)*	1	I-29 SPI	Signal	Overall:	26.9 / C	29.4 / C		18.7 / B	21.0 / C

*Intersections that do not meet minimum allowable LOS noted by **Bold Orange***
** Indicates queue storage ratio exceeds 1.0*
TWSC: two-way stop-control

Table C-2: 2040 Build and 2065 Build Conditions LOS – Ramp Terminal Intersections

Analysis Location					Level of Service (LOS)				
Location		**Ramp Terminal Intersection**	**Analysis Type**	**Measure**	**AM** Delay / LOS			**PM** Delay / LOS	
					2040	**2065**		**2040**	**2065**
I-29 Exit 83 *(60th Street N)*	1	I-29 SB RTI	Signal	Overall:	17.5 / B	24.1 / C		12.8 / B	17.0 / B
	2	I-29 NB RTI	Signal	Overall:	6.7 / A	7.4 / A		8.1 / A	6.9 / A
I-29 Exit 86 *(258th Street)*	1	I-29 SB RTI	Signal	Overall:	7.3 / A	10.6 / B		7.7 / A	23.3 / C*
	2	I-29 NB RTI	Signal	Overall:	19.4 / B	19.0 / B		17.4 / B	23.3 / C*
I-90 Exit 395 / *(Marion Road)*	1	I-90 EB RTI	Signal	Overall:	7.5 / A	14.3 / B		5.7 / A	11.4 / B
	2	I-90 WB RTI	Signal	Overall:	8.7 / A	10.6 / B		13.5 / B	25.2 / C
I-90 Exit 399 *(Cliff Avenue)*	1	I-29 SPI	Signal	Overall:	28.4 / C	**47.0 / D**		21.4 / C	29.0 / C

*Intersections that do not meet minimum allowable LOS noted by **Bold Orange***
** Indicates queue storage ratio exceeds 1.0*

D. Highway Capacity Software (HCS) Reports – Existing Conditions

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Analyzed	AM Peak
Facility Name	I-29 NB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	3075	3
4	Merge	Merge	Exit 83 Merge	485	3
5	Diverge	Diverge	Exit 84A Diverge	485	3
6	Basic	Basic	I-29 Mainline Between Exit 84A Diverge/Merge	1020	3
7	Merge	Merge	Exit 84A Merge	340	3
8	Diverge	Diverge	Exit 84B Diverge	340	3
9	Basic	Basic	I-29 Mainline between Exit 84B Diverge/Merge	915	3
10	Merge	Merge	Exit 84B Merge	1500	3
11	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	6420	2
12	Diverge	Diverge	Exit 86 Diverge	1500	2
13	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
14	Merge	Merge	Exit 86 Merge	1500	2
15	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.847	2492	9014	0.28	68.4	9.1	A

Segment 2: Diverge

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.95	0.847	0.909	2492	712	9014	1878	0.28	0.38	68.4	68.4	9.1	9.1	A

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.847	1686	6761	0.25	68.4	8.2	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.95	0.847	0.909	1854	168	6620	1878	0.28	0.09	62.3	60.4	9.9	13.2	B

Segment 5: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.847	0.847	1876	623	6620	1878	0.28	0.33	57.6	55.0	10.9	16.4	B

Segment 6: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.847	1253	6761	0.19	65.2	6.1	A

Segment 7: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.60	0.847	0.847	1332	79	6620	1878	0.20	0.04	61.7	59.7	7.2	13.0	B

Segment 8: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.85	0.847	0.847	1305	479	6620	1878	0.20	0.26	57.8	55.3	7.5	13.1	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.847	853	6761	0.13	64.6	4.2	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.75	0.847	0.847	1121	268	6620	1878	0.17	0.14	62.4	60.0	6.0	10.2	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.847	1076	4507	0.24	68.4	7.9	A

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.75	0.847	0.935	1076	307	4413	1878	0.24	0.16	55.8	55.8	9.6	8.2	A

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.847	794	4507	0.18	67.9	5.8	A

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.55	0.847	0.943	861	67	4413	1878	0.20	0.04	61.6	61.6	7.0	5.4	A

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.847	840	4507	0.19	67.1	6.1	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1154	1017	0.70	17.45	65.7	7.6	6.5	3.90	A

Facility Overall Results

Space Mean Speed, mi/h	65.7	Average Density, veh/mi/ln	6.5
Average Travel Time, min	3.90	Average Density, pc/mi/ln	7.6
Total VMT, veh-mi	1154	Total VHD, veh-h	0.70
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	17.45

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Analyzed	AM Peak
Facility Name	I-29 SB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.46		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline north of Exit 86	500	2
2	Diverge	Diverge	Exit 86 Diverge	1500	2
3	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2650	2
4	Merge	Merge	Exit 86 Merge	1500	2
5	Basic	Basic	I-29 Mainline between Exit 86 Merge and Exit 84B Diverge	6160	2
6	Diverge	Diverge	Exit 84B Diverge	1500	2
7	Basic	Basic	I-29 Mainline between Exit 84B Diverge and Exit 84B Merge	650	2
8	Weaving	Weaving	Between Exit 84B Merge and Exit 84A Diverge	1620	3
9	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	250	2
10	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	230	2
11	Merge	Basic	Exit 84A Merge	1500	3
12	Diverge	Diverge	Exit 83 Diverge	1500	3
13	Basic	Basic	I-29 Mainline between Exit 83 Diverge/ Merge	2000	3
14	Merge	Merge	Exit 83 Merge	1500	3
15	Basic	Basic	I-29 Mainline south of Exit 82 Diverge	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1194	4507	0.26	68.4	8.7	A

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.55	0.926	0.917	1194	59	4413	1878	0.27	0.03	56.3	56.3	10.6	9.5	A

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1156	4507	0.26	68.0	8.5	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.80	0.926	0.935	1611	455	4413	1878	0.37	0.24	60.8	60.8	13.2	12.9	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1588	4507	0.35	68.4	11.6	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.75	0.926	0.926	1588	94	4413	1878	0.36	0.05	56.3	56.3	14.1	9.8	A

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1506	4507	0.33	66.3	11.0	A

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.80	0.926	2274	5064	0.45	56.0	13.5	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.80	0.926	1937	4507	0.43	65.7	14.2	B

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.80	0.926	1937	4507	0.43	66.6	14.2	B

Segment 11: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.80	0.80	0.926	0.926	2538	601	6761	1878	0.38	0.32	67.9	68.4	12.4	12.4	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.80	0.85	0.926	0.901	2538	176	6620	1878	0.38	0.09	60.5	56.1	14.0	13.2	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.80	0.926	2356	6761	0.35	67.9	11.5	B

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.80	0.85	0.926	0.901	2728	372	6620	1878	0.41	0.20	62.7	60.7	14.5	14.3	B

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.80	0.926	2740	6761	0.41	67.3	13.3	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1903	1454	1.95	48.87	63.9	12.1	11.0	4.20	B

Facility Overall Results

Space Mean Speed, mi/h	63.9	Average Density, veh/mi/ln	11.0
Average Travel Time, min	4.20	Average Density, pc/mi/ln	12.1
Total VMT, veh-mi	1903	Total VHD, veh-h	1.95
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	48.87

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/5/2023
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Analyzed	AM Peak Hour
Facility Name	I-90 EB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.53		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline West of Exit 395	500	2
2	Diverge	Diverge	Exit 395 Diverge	1500	2
3	Basic	Basic	I-90 Mainline between Exit 395 Merge/ Diverge	1710	2
4	Merge	Basic	Exit 395 Merge	1500	3
5	Basic	Basic	I-90 Mainline between Exits 395 and 396A	1700	3
6	Diverge	Basic	Exit 396A Diverge	1500	3
7	Basic	Basic	I-90 Mainline between Exit 396A Merge/Diverge	545	2
8	Weaving	Weaving	Between Exit 396A Merge and 396B Diverge	1675	3
9	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	620	2
10	Merge	Merge	Exit 396B Merge	1500	2
11	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 399 Diverge	10200	2
12	Diverge	Diverge	Exit 399 Diverge	1500	2
13	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2770	2
14	Merge	Basic	Exit 399 Merge	1500	3
15	Basic	Basic	I-90 Mainline West of Exit 395	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.840	1169	4507	0.26	68.3	8.6	A

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.97	0.840	0.917	1169	51	4413	1878	0.26	0.03	56.3	56.3	10.4	11.6	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.840	1104	4507	0.24	67.4	8.1	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.97	0.840	0.917	1261	157	6761	1878	0.19	0.08	68.2	68.3	6.2	6.2	A

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.840	1305	6761	0.19	68.3	6.4	A

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.75	0.840	0.847	1305	701	6761	1878	0.19	0.37	68.3	68.3	6.4	6.4	A

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.840	667	4507	0.15	68.3	4.9	A

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.855	1025	5358	0.19	61.7	5.5	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.855	951	4507	0.21	67.3	7.0	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.90	0.855	0.847	1574	623	4413	1878	0.36	0.33	60.6	60.6	13.0	12.9	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.855	1621	4507	0.36	68.3	11.9	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.90	0.855	0.870	1621	428	4413	1878	0.37	0.23	55.4	55.4	14.6	14.6	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.855	1148	4507	0.25	67.9	8.4	A

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.90	0.855	0.870	1506	358	6761	1878	0.22	0.19	68.3	68.3	7.3	7.3	A

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.855	1543	6761	0.23	68.3	7.5	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1632	1276	0.87	21.80	65.9	9.2	7.8	5.00	A

Facility Overall Results

Space Mean Speed, mi/h	65.9	Average Density, veh/mi/ln	7.8
Average Travel Time, min	5.00	Average Density, pc/mi/ln	9.2
Total VMT, veh-mi	1632	Total VHD, veh-h	0.87
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	21.80

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Analyzed	AM Peak Hour
Facility Name	I-90 WB	Units	U.S. Customary
Project Description	SDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.39		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline east of Exit 399 Diverge	500	3
2	Diverge	Basic	Exit 399 Diverge	1500	3
3	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2840	2
4	Merge	Merge	Exit 399 Merge	1500	2
5	Basic	Basic	I-90 Mainline between Exit 399 Merge and Exit 396B Diverge	9830	2
6	Diverge	Diverge	Exit 396B Diverge	1500	2
7	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	550	2
8	Weaving	Weaving	Between Exit 396B Merge and Exit 396A Diverge	1710	3
9	Basic	Basic	I-90 Mainline between Exit 396A Diverge/Merge	595	2
10	Merge	Basic	Exit 396A Merge	1500	3
11	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 395 Diverge	1385	3
12	Diverge	Basic	Exit 395 Diverge	1500	3
13	Basic	Basic	Between Exit 395 Diverge/Merge	1565	2
14	Merge	Merge	Exit 395 Merge	1500	2
15	Basic	Basic	I-90 Mainline west of Exit 395 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.855	1987	6761	0.29	68.3	9.7	A

Segment 2: Diverge

AP	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

					(pc/h)		(pc/h)		Ratio		(mi/h)		(pc/mi/ln)		
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.90	0.855	0.870	1987	811	6761	1878	0.29	0.43	68.3	68.3	9.7	9.7	A

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.855	1092	4507	0.24	68.3	8.0	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.90	0.855	0.870	1386	294	4413	1878	0.31	0.16	61.5	61.5	11.3	9.0	A

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.855	1416	4507	0.31	68.3	10.4	A

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.80	0.855	0.926	1416	229	4413	1878	0.32	0.12	55.9	55.9	12.7	11.0	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.855	1177	4507	0.26	65.9	8.6	A

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.855	1613	3188	0.51	54.9	9.8	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.840	975	4507	0.22	66.2	7.1	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.75	0.840	0.926	1069	94	6761	1878	0.16	0.05	67.9	68.3	5.2	5.2	A

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.840	1069	6761	0.16	68.3	5.2	A

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.80	0.840	0.917	1069	409	6761	1878	0.16	0.22	68.3	68.3	5.2	5.2	A

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.840	638	4507	0.14	68.3	4.7	A

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.83	0.80	0.840	0.917	699	61	4413	1878	0.16	0.03	61.8	61.8	5.7	3.2	A

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.83	0.840	703	4507	0.16	67.0	5.2	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1470	1167	0.94	23.41	65.5	8.5	7.2	4.90	A

Facility Overall Results

Space Mean Speed, mi/h	65.5	Average Density, veh/mi/ln	7.2
Average Travel Time, min	4.90	Average Density, pc/mi/ln	8.5
Total VMT, veh-mi	1470	Total VHD, veh-h	0.94
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	23.41

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Analyzed	PM Peak
Facility Name	I-29 NB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	3075	3
4	Merge	Merge	Exit 83 Merge	485	3
5	Diverge	Diverge	Exit 84A Diverge	485	3
6	Basic	Basic	I-29 Mainline Between Exit 84A Diverge/Merge	1020	3
7	Merge	Merge	Exit 84A Merge	340	3
8	Diverge	Diverge	Exit 84B Diverge	340	3
9	Basic	Basic	I-29 Mainline between Exit 84B Diverge/Merge	915	3
10	Merge	Merge	Exit 84B Merge	1500	3
11	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	6420	2
12	Diverge	Diverge	Exit 86 Diverge	1500	2
13	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
14	Merge	Merge	Exit 86 Merge	1500	2
15	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	3441	9014	0.38	68.4	12.6	B

Segment 2: Diverge

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.94	0.917	0.826	3441	1120	9014	1878	0.38	0.60	68.4	68.4	12.6	12.6	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2387	6761	0.35	68.4	11.6	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.94	0.917	0.826	2664	277	6620	1878	0.40	0.15	61.6	60.0	14.4	18.6	B

Segment 5: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.85	0.917	0.917	2648	763	6620	1878	0.40	0.41	58.5	54.7	15.1	20.2	C

Segment 6: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	1927	6761	0.29	65.5	9.4	A

Segment 7: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.75	0.917	0.917	1985	58	6620	1878	0.30	0.03	61.0	59.5	10.8	17.7	B

Segment 8: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.85	0.917	0.917	1975	661	6620	1878	0.30	0.35	58.1	54.9	11.3	17.3	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	1351	6761	0.20	64.7	6.6	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.85	0.917	0.917	1620	269	6620	1878	0.24	0.14	62.6	60.0	8.6	12.5	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	1605	4507	0.36	68.4	11.7	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.75	0.917	0.962	1605	353	4413	1878	0.36	0.19	55.6	55.6	14.4	12.7	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	1308	4507	0.29	67.9	9.6	A

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.85	0.909	0.885	1454	146	4413	1878	0.33	0.08	61.4	61.4	11.8	10.0	A

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	1442	4507	0.32	67.0	10.5	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1847	1632	1.13	28.35	65.6	11.3	10.3	3.90	B

Facility Overall Results

Space Mean Speed, mi/h	65.6	Average Density, veh/mi/ln	10.3
Average Travel Time, min	3.90	Average Density, pc/mi/ln	11.3
Total VMT, veh-mi	1847	Total VHD, veh-h	1.13
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	28.35

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Analyzed	PM Peak
Facility Name	I-29 SB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.46		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline north of Exit 86	500	2
2	Diverge	Diverge	Exit 86 Diverge	1500	2
3	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2650	2
4	Merge	Merge	Exit 86 Merge	1500	2
5	Basic	Basic	I-29 Mainline between Exit 86 Merge and Exit 84B Diverge	6160	2
6	Diverge	Diverge	Exit 84B Diverge	1500	2
7	Basic	Basic	I-29 Mainline between Exit 84B Diverge and Exit 84B Merge	650	2
8	Weaving	Weaving	Between Exit 84B Merge and Exit 84A Diverge	1620	3
9	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	250	2
10	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	230	2
11	Merge	Basic	Exit 84A Merge	1500	3
12	Diverge	Diverge	Exit 83 Diverge	1500	3
13	Basic	Basic	I-29 Mainline between Exit 83 Diverge/ Merge	2000	3
14	Merge	Merge	Exit 83 Merge	1500	3
15	Basic	Basic	I-29 Mainline south of Exit 82 Diverge	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.862	1076	4507	0.24	68.4	7.9	A

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.85	0.862	0.962	1076	31	4413	1878	0.24	0.02	56.4	56.4	9.5	8.5	A

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.862	1044	4507	0.23	68.0	7.6	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.75	0.862	0.980	1384	340	4413	1878	0.31	0.18	60.9	60.9	11.4	11.2	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	1319	4507	0.29	68.4	9.6	A

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.81	0.893	0.893	1319	90	4413	1878	0.30	0.05	56.3	56.3	11.7	7.5	A

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	1238	4507	0.27	66.3	9.0	A

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	1892	4561	0.41	56.8	11.1	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	1549	4507	0.34	65.8	11.3	B

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	1549	4507	0.34	66.7	11.3	B

Segment 11: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.75	0.893	0.893	2057	508	6761	1878	0.30	0.27	68.0	68.4	10.0	10.0	A

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.96	0.893	0.943	1972	177	6620	1878	0.30	0.09	59.6	56.1	11.0	10.7	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	1773	6761	0.26	67.9	8.6	A

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.96	0.893	0.943	2370	597	6620	1878	0.36	0.32	62.7	60.8	12.6	13.2	B

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	2445	6761	0.36	67.3	11.9	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1515	1242	1.56	39.01	63.9	10.1	8.9	4.20	A

Facility Overall Results

Space Mean Speed, mi/h	63.9	Average Density, veh/mi/ln	8.9
Average Travel Time, min	4.20	Average Density, pc/mi/ln	10.1
Total VMT, veh-mi	1515	Total VHD, veh-h	1.56
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	39.01

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/5/2023
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Analyzed	PM Peak Hour
Facility Name	I-90 EB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.53		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline West of Exit 395	500	2
2	Diverge	Diverge	Exit 395 Diverge	1500	2
3	Basic	Basic	I-90 Mainline between Exit 395 Merge/ Diverge	1710	2
4	Merge	Basic	Exit 395 Merge	1500	3
5	Basic	Basic	I-90 Mainline between Exits 395 and 396A	1700	3
6	Diverge	Basic	Exit 396A Diverge	1500	3
7	Basic	Basic	I-90 Mainline between Exit 396A Merge/Diverge	545	2
8	Weaving	Weaving	Between Exit 396A Merge and 396B Diverge	1675	3
9	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	620	2
10	Merge	Merge	Exit 396B Merge	1500	2
11	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 399 Diverge	10200	2
12	Diverge	Diverge	Exit 399 Diverge	1500	2
13	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2770	2
14	Merge	Basic	Exit 399 Merge	1500	3
15	Basic	Basic	I-90 Mainline West of Exit 395	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.840	992	4507	0.22	68.3	7.3	A

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.72	0.840	0.935	992	74	4413	1878	0.22	0.04	56.3	56.3	8.8	10.1	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.840	928	4507	0.21	67.4	6.8	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.72	0.840	0.935	1322	394	6761	1878	0.20	0.21	68.2	68.3	6.5	6.5	A

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.840	1267	6761	0.19	68.3	6.2	A

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.85	0.840	0.917	1267	436	6761	1878	0.19	0.23	68.3	68.3	6.2	6.2	A

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.840	832	4507	0.18	68.3	6.1	A

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.855	1114	5609	0.20	62.8	5.9	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.855	1050	4507	0.23	67.4	7.7	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.85	0.855	0.917	1813	763	4413	1878	0.41	0.41	60.5	60.5	15.0	14.7	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.855	1798	4507	0.40	68.3	13.2	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.94	0.855	0.870	1798	214	4413	1878	0.41	0.11	55.9	55.9	16.1	16.1	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.855	1578	4507	0.35	67.9	11.6	B

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.94	0.855	0.870	2263	685	6761	1878	0.33	0.36	68.3	68.3	11.0	11.0	A

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.855	2283	6761	0.34	68.3	11.1	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1826	1575	0.88	21.99	66.1	10.3	8.7	5.00	A

Facility Overall Results

Space Mean Speed, mi/h	66.1	Average Density, veh/mi/ln	8.7
Average Travel Time, min	5.00	Average Density, pc/mi/ln	10.3
Total VMT, veh-mi	1826	Total VHD, veh-h	0.88
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	21.99

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2023
Jurisdiction	SDDOT	Time Analyzed	PM Peak Hour
Facility Name	I-90 WB	Units	U.S. Customary
Project Description	SDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.39		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline east of Exit 399 Diverge	500	3
2	Diverge	Basic	Exit 399 Diverge	1500	3
3	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2840	2
4	Merge	Merge	Exit 399 Merge	1500	2
5	Basic	Basic	I-90 Mainline between Exit 399 Merge and Exit 396B Diverge	9830	2
6	Diverge	Diverge	Exit 396B Diverge	1500	2
7	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	550	2
8	Weaving	Weaving	Between Exit 396B Merge and Exit 396A Diverge	1710	3
9	Basic	Basic	I-90 Mainline between Exit 396A Diverge/Merge	595	2
10	Merge	Basic	Exit 396A Merge	1500	3
11	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 395 Diverge	1385	3
12	Diverge	Basic	Exit 395 Diverge	1500	3
13	Basic	Basic	Between Exit 395 Diverge/Merge	1565	2
14	Merge	Merge	Exit 395 Merge	1500	2
15	Basic	Basic	I-90 Mainline west of Exit 395 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.855	1780	6761	0.26	68.3	8.7	A

Segment 2: Diverge

AP	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

					(pc/h)		(pc/h)		Ratio		(mi/h)		(pc/mi/ln)		
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.94	0.855	0.870	1780	477	6761	1878	0.26	0.25	68.3	68.3	8.7	8.7	A

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.855	1289	4507	0.29	68.3	9.4	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.94	0.855	0.870	1778	489	4413	1878	0.40	0.26	61.3	61.3	14.5	12.0	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.855	1792	4507	0.40	68.3	13.1	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.75	0.855	0.893	1792	314	4413	1878	0.41	0.17	55.7	55.7	16.1	14.3	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.855	1528	4507	0.34	65.9	11.2	B

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.855	2298	3787	0.61	53.4	14.3	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.840	1607	4507	0.36	66.0	11.8	B

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.81	0.840	0.893	1697	90	6761	1878	0.25	0.05	67.9	68.3	8.3	8.3	A

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.840	1690	6761	0.25	68.3	8.2	A

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.68	0.840	0.952	1690	301	6761	1878	0.25	0.16	68.3	68.3	8.2	8.2	A

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.840	1440	4507	0.32	68.3	10.5	A

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.93	0.68	0.840	0.952	1656	216	4413	1878	0.38	0.12	61.5	61.5	13.5	10.6	B

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.93	0.840	1619	4507	0.36	67.0	11.9	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1973	1737	1.42	35.62	65.1	11.5	9.7	5.00	B

Facility Overall Results

Space Mean Speed, mi/h	65.1	Average Density, veh/mi/ln	9.7
Average Travel Time, min	5.00	Average Density, pc/mi/ln	11.5
Total VMT, veh-mi	1973	Total VHD, veh-h	1.42
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	35.62

E. Highway Capacity Software (HCS) Reports – 2040 No Build Conditions

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	AM No Build
Facility Name	I-29 NB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	3075	3
4	Merge	Merge	Exit 83 Merge	485	3
5	Diverge	Diverge	Exit 84A Diverge	485	3
6	Basic	Basic	I-29 Mainline Between Exit 84A Diverge/Merge	1020	3
7	Merge	Merge	Exit 84A Merge	340	3
8	Diverge	Diverge	Exit 84B Diverge	340	3
9	Basic	Basic	I-29 Mainline between Exit 84B Diverge/Merge	915	3
10	Merge	Merge	Exit 84B Merge	1500	3
11	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	6420	2
12	Diverge	Diverge	Exit 86 Diverge	1500	2
13	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
14	Merge	Merge	Exit 86 Merge	1500	2
15	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	3431	9014	0.38	68.4	12.5	B

Segment 2: Diverge

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.909	3431	880	9014	1878	0.38	0.47	68.4	68.4	12.5	12.5	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	2486	6761	0.37	68.4	12.1	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.909	2771	285	6620	1878	0.42	0.15	61.3	59.8	15.1	19.7	B

Segment 5: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	2792	847	6620	1878	0.42	0.45	58.4	54.5	15.9	21.1	C

Segment 6: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1945	6761	0.29	65.4	9.5	A

Segment 7: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	2056	111	6620	1878	0.31	0.06	61.0	59.5	11.2	18.2	B

Segment 8: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	2056	653	6620	1878	0.31	0.35	57.7	54.9	11.9	18.2	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1403	6761	0.21	64.5	6.8	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	1806	403	6620	1878	0.27	0.21	62.3	59.9	9.7	13.7	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1806	4507	0.40	68.4	13.2	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.935	1806	642	4413	1878	0.41	0.34	55.0	55.0	16.4	14.4	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1097	4507	0.24	67.9	8.0	A

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.943	1197	100	4413	1878	0.27	0.05	61.5	61.5	9.7	8.0	A

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1208	4507	0.27	67.0	8.8	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1763	1467	1.13	28.31	65.5	11.7	9.9	3.90	B

Facility Overall Results

Space Mean Speed, mi/h	65.5	Average Density, veh/mi/ln	9.9
Average Travel Time, min	3.90	Average Density, pc/mi/ln	11.7
Total VMT, veh-mi	1763	Total VHD, veh-h	1.13
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	28.31

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	AM No Build
Facility Name	I-29 SB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.46		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline north of Exit 86	500	2
2	Diverge	Diverge	Exit 86 Diverge	1500	2
3	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2650	2
4	Merge	Merge	Exit 86 Merge	1500	2
5	Basic	Basic	I-29 Mainline between Exit 86 Merge and Exit 84B Diverge	6160	2
6	Diverge	Diverge	Exit 84B Diverge	1500	2
7	Basic	Basic	I-29 Mainline between Exit 84B Diverge and Exit 84B Merge	650	2
8	Weaving	Weaving	Between Exit 84B Merge and Exit 84A Diverge	1620	3
9	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	250	2
10	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	230	2
11	Merge	Basic	Exit 84A Merge	1500	3
12	Diverge	Diverge	Exit 83 Diverge	1500	3
13	Basic	Basic	I-29 Mainline between Exit 83 Diverge/ Merge	2000	3
14	Merge	Merge	Exit 83 Merge	1500	3
15	Basic	Basic	I-29 Mainline south of Exit 82 Diverge	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1525	4507	0.34	68.4	11.1	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.917	1525	167	4413	1878	0.35	0.09	56.1	56.1	13.6	12.4	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1359	4507	0.30	68.0	9.9	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.935	1850	491	4413	1878	0.42	0.26	60.7	60.7	15.2	14.7	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1855	4507	0.41	68.4	13.6	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.926	1855	114	4413	1878	0.42	0.06	56.2	56.2	16.5	12.1	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1741	4507	0.39	66.3	12.7	B

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	2719	4463	0.61	53.0	17.1	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	2325	4507	0.52	65.0	17.0	B

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	2325	4507	0.52	66.1	17.0	B

Segment 11: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.926	3087	762	6761	1878	0.46	0.41	67.8	68.4	15.0	15.0	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.901	3087	470	6620	1878	0.47	0.25	59.9	55.4	17.2	16.6	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	2630	6761	0.39	67.9	12.8	B

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.901	3061	431	6620	1878	0.46	0.23	62.5	60.6	16.3	16.0	B

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	3049	6761	0.45	67.2	14.9	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2233	1745	2.59	64.78	63.4	14.4	13.1	4.20	B

Facility Overall Results

Space Mean Speed, mi/h	63.4	Average Density, veh/mi/ln	13.1
Average Travel Time, min	4.20	Average Density, pc/mi/ln	14.4
Total VMT, veh-mi	2233	Total VHD, veh-h	2.59
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	64.78

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/5/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	AM No Build
Facility Name	I-90 EB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.53		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline West of Exit 395	500	2
2	Diverge	Diverge	Exit 395 Diverge	1500	2
3	Basic	Basic	I-90 Mainline between Exit 395 Merge/ Diverge	1710	2
4	Merge	Basic	Exit 395 Merge	1500	3
5	Basic	Basic	I-90 Mainline between Exits 395 and 396A	1700	3
6	Diverge	Basic	Exit 396A Diverge	1500	3
7	Basic	Basic	I-90 Mainline between Exit 396A Merge/Diverge	545	2
8	Weaving	Weaving	Between Exit 396A Merge and 396B Diverge	1675	3
9	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	620	2
10	Merge	Merge	Exit 396B Merge	1500	2
11	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 399 Diverge	10200	2
12	Diverge	Diverge	Exit 399 Diverge	1500	2
13	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2770	2
14	Merge	Basic	Exit 399 Merge	1500	3
15	Basic	Basic	I-90 Mainline West of Exit 395	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1863	4507	0.41	68.3	13.6	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1863	308	4413	1878	0.42	0.16	55.7	55.7	16.7	17.6	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1527	4507	0.34	67.4	11.2	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1989	462	6761	1878	0.29	0.25	68.2	68.3	9.7	9.7	A

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	2031	6761	0.30	68.3	9.9	A

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.847	2031	833	6761	1878	0.30	0.44	68.3	68.3	9.9	9.9	A

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1190	4507	0.26	68.3	8.7	A

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1602	5546	0.29	60.5	8.8	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1486	4507	0.33	67.1	10.9	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.847	2333	847	4413	1878	0.53	0.45	60.1	60.1	19.4	18.7	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2325	4507	0.52	68.3	17.0	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	2325	554	4413	1878	0.53	0.30	55.1	55.1	21.1	20.6	C

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1761	4507	0.39	67.9	12.9	B

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	2248	487	6761	1878	0.33	0.26	68.3	68.3	11.0	11.0	A

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2257	6761	0.33	68.3	11.0	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2423	1943	1.40	35.05	65.7	13.7	11.5	5.10	B

Facility Overall Results

Space Mean Speed, mi/h	65.7	Average Density, veh/mi/ln	11.5
Average Travel Time, min	5.10	Average Density, pc/mi/ln	13.7
Total VMT, veh-mi	2423	Total VHD, veh-h	1.40
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	35.05

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	AM No Build
Facility Name	I-90 WB	Units	U.S. Customary
Project Description	SDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.39		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline east of Exit 399 Diverge	500	3
2	Diverge	Basic	Exit 399 Diverge	1500	3
3	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2840	2
4	Merge	Merge	Exit 399 Merge	1500	2
5	Basic	Basic	I-90 Mainline between Exit 399 Merge and Exit 396B Diverge	9830	2
6	Diverge	Diverge	Exit 396B Diverge	1500	2
7	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	550	2
8	Weaving	Weaving	Between Exit 396B Merge and Exit 396A Diverge	1710	3
9	Basic	Basic	I-90 Mainline between Exit 396A Diverge/Merge	595	2
10	Merge	Basic	Exit 396A Merge	1500	3
11	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 395 Diverge	1385	3
12	Diverge	Basic	Exit 395 Diverge	1500	3
13	Basic	Basic	Between Exit 395 Diverge/Merge	1565	2
14	Merge	Merge	Exit 395 Merge	1500	2
15	Basic	Basic	I-90 Mainline west of Exit 395 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2711	6761	0.40	68.3	13.2	B

Segment 2: Diverge

AP	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

					(pc/h)		(pc/h)		Ratio		(mi/h)		(pc/mi/ln)		
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	2711	987	6761	1878	0.40	0.53	68.3	68.3	13.2	13.2	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1706	4507	0.38	68.3	12.5	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	2193	487	4413	1878	0.50	0.26	60.9	60.9	18.0	15.2	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2202	4507	0.49	68.3	16.1	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.926	2202	368	4413	1878	0.50	0.20	55.5	55.5	19.8	17.8	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1803	4507	0.40	65.9	13.2	B

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2318	3319	0.70	51.9	14.9	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1415	4507	0.31	65.8	10.4	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.926	1529	114	6761	1878	0.23	0.06	67.8	68.3	7.5	7.5	A

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1541	6761	0.23	68.3	7.5	A

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1541	744	6761	1878	0.23	0.40	68.3	68.3	7.5	7.5	A

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	728	4507	0.16	68.3	5.3	A

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	843	115	4413	1878	0.19	0.06	61.8	61.8	6.8	4.3	A

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	854	4507	0.19	67.0	6.3	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2183	1780	1.61	40.15	65.0	12.7	10.7	5.00	B

Facility Overall Results

Space Mean Speed, mi/h	65.0	Average Density, veh/mi/ln	10.7
Average Travel Time, min	5.00	Average Density, pc/mi/ln	12.7
Total VMT, veh-mi	2183	Total VHD, veh-h	1.61
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	40.15

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	PM No Build
Facility Name	I-29 NB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	3075	3
4	Merge	Merge	Exit 83 Merge	485	3
5	Diverge	Diverge	Exit 84A Diverge	485	3
6	Basic	Basic	I-29 Mainline Between Exit 84A Diverge/Merge	1020	3
7	Merge	Merge	Exit 84A Merge	340	3
8	Diverge	Diverge	Exit 84B Diverge	340	3
9	Basic	Basic	I-29 Mainline between Exit 84B Diverge/Merge	915	3
10	Merge	Merge	Exit 84B Merge	1500	3
11	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	6420	2
12	Diverge	Diverge	Exit 86 Diverge	1500	2
13	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
14	Merge	Merge	Exit 86 Merge	1500	2
15	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	4253	9014	0.47	68.4	15.5	B

Segment 2: Diverge

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	4253	1264	9014	1878	0.47	0.67	68.4	68.4	15.5	15.5	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	3114	6761	0.46	68.4	15.2	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	3531	417	6620	1878	0.53	0.22	60.5	59.0	19.5	24.6	C

Segment 5: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	3490	872	6620	1878	0.53	0.46	58.9	54.4	19.8	24.7	C

Segment 6: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2617	6761	0.39	65.6	12.7	B

Segment 7: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	2726	109	6620	1878	0.41	0.06	60.0	58.9	15.1	23.5	C

Segment 8: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	2726	800	6620	1878	0.41	0.43	57.8	54.6	15.7	22.4	C

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	1927	6761	0.29	64.6	9.4	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	2339	412	6620	1878	0.35	0.22	62.2	59.8	12.5	16.2	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2339	4507	0.52	68.4	17.1	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.962	2339	612	4413	1878	0.53	0.33	55.0	55.0	21.3	19.0	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	1711	4507	0.38	67.9	12.5	B

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.909	0.885	1924	213	4413	1878	0.44	0.11	61.1	61.1	15.7	13.6	B

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	1919	4507	0.43	67.0	14.0	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2508	2211	1.66	41.55	65.4	15.4	14.1	3.90	B

Facility Overall Results

Space Mean Speed, mi/h	65.4	Average Density, veh/mi/ln	14.1
Average Travel Time, min	3.90	Average Density, pc/mi/ln	15.4
Total VMT, veh-mi	2508	Total VHD, veh-h	1.66
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	41.55

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	PM No Build
Facility Name	I-29 SB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.46		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline north of Exit 86	500	2
2	Diverge	Diverge	Exit 86 Diverge	1500	2
3	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2650	2
4	Merge	Merge	Exit 86 Merge	1500	2
5	Basic	Basic	I-29 Mainline between Exit 86 Merge and Exit 84B Diverge	6160	2
6	Diverge	Diverge	Exit 84B Diverge	1500	2
7	Basic	Basic	I-29 Mainline between Exit 84B Diverge and Exit 84B Merge	650	2
8	Weaving	Weaving	Between Exit 84B Merge and Exit 84A Diverge	1620	3
9	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	250	2
10	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	230	2
11	Merge	Basic	Exit 84A Merge	1500	3
12	Diverge	Diverge	Exit 83 Diverge	1500	3
13	Basic	Basic	I-29 Mainline between Exit 83 Diverge/ Merge	2000	3
14	Merge	Merge	Exit 83 Merge	1500	3
15	Basic	Basic	I-29 Mainline south of Exit 82 Diverge	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.862	1482	4507	0.33	68.4	10.8	A

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.862	0.962	1482	127	4413	1878	0.34	0.07	56.2	56.2	13.2	12.0	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.862	1341	4507	0.30	68.0	9.8	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.862	0.980	1953	612	4413	1878	0.44	0.33	60.6	60.6	16.1	15.5	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	1966	4507	0.44	68.4	14.4	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.893	0.893	1966	124	4413	1878	0.45	0.07	56.2	56.2	17.5	13.1	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	1841	4507	0.41	66.3	13.5	B

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	2662	4775	0.56	53.8	16.5	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	2227	4507	0.49	65.2	16.3	B

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	2227	4507	0.49	66.2	16.3	B

Segment 11: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.893	0.893	2787	560	6761	1878	0.41	0.30	67.9	68.4	13.6	13.6	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.893	0.943	2787	271	6620	1878	0.42	0.14	59.6	55.8	15.6	15.6	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	2501	6761	0.37	67.9	12.2	B

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.893	0.943	3302	801	6620	1878	0.50	0.43	62.1	60.3	17.7	18.1	B

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	3347	6761	0.50	67.2	16.3	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2146	1769	2.45	61.34	63.4	14.4	12.7	4.20	B

Facility Overall Results

Space Mean Speed, mi/h	63.4	Average Density, veh/mi/ln	12.7
Average Travel Time, min	4.20	Average Density, pc/mi/ln	14.4
Total VMT, veh-mi	2146	Total VHD, veh-h	2.45
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	61.34

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/5/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	PM No Build
Facility Name	I-90 EB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.53		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline West of Exit 395	500	2
2	Diverge	Diverge	Exit 395 Diverge	1500	2
3	Basic	Basic	I-90 Mainline between Exit 395 Merge/ Diverge	1710	2
4	Merge	Basic	Exit 395 Merge	1500	3
5	Basic	Basic	I-90 Mainline between Exits 395 and 396A	1700	3
6	Diverge	Basic	Exit 396A Diverge	1500	3
7	Basic	Basic	I-90 Mainline between Exit 396A Merge/Diverge	545	2
8	Weaving	Weaving	Between Exit 396A Merge and 396B Diverge	1675	3
9	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	620	2
10	Merge	Merge	Exit 396B Merge	1500	2
11	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 399 Diverge	10200	2
12	Diverge	Diverge	Exit 399 Diverge	1500	2
13	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2770	2
14	Merge	Basic	Exit 399 Merge	1500	3
15	Basic	Basic	I-90 Mainline West of Exit 395	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	1574	4507	0.35	68.3	11.5	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.935	1574	261	4413	1878	0.36	0.14	55.8	55.8	14.1	15.1	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	1283	4507	0.28	67.4	9.4	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.935	1996	713	6761	1878	0.30	0.38	68.2	68.3	9.7	9.7	A

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2077	6761	0.31	68.3	10.1	A

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.917	2077	545	6761	1878	0.31	0.29	68.3	68.3	10.1	10.1	A

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	1481	4507	0.33	68.3	10.8	A

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	1872	5668	0.33	60.5	10.3	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	1793	4507	0.40	67.1	13.1	B

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.917	2665	872	4413	1878	0.60	0.46	59.7	59.7	22.3	21.3	C

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2729	4507	0.61	67.4	20.2	C

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	2729	294	4413	1878	0.62	0.16	55.7	55.7	24.5	24.1	C

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2430	4507	0.54	67.9	17.8	B

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	3132	702	6761	1878	0.46	0.37	68.3	68.3	15.3	15.3	B

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	3145	6761	0.47	68.3	15.3	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2783	2353	1.72	42.96	65.5	15.7	13.3	5.10	B

Facility Overall Results

Space Mean Speed, mi/h	65.5	Average Density, veh/mi/ln	13.3
Average Travel Time, min	5.10	Average Density, pc/mi/ln	15.7
Total VMT, veh-mi	2783	Total VHD, veh-h	1.72
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	42.96

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	PM No Build
Facility Name	I-90 WB	Units	U.S. Customary
Project Description	SDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.39		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline east of Exit 399 Diverge	500	3
2	Diverge	Basic	Exit 399 Diverge	1500	3
3	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2840	2
4	Merge	Merge	Exit 399 Merge	1500	2
5	Basic	Basic	I-90 Mainline between Exit 399 Merge and Exit 396B Diverge	9830	2
6	Diverge	Diverge	Exit 396B Diverge	1500	2
7	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	550	2
8	Weaving	Weaving	Between Exit 396B Merge and Exit 396A Diverge	1710	3
9	Basic	Basic	I-90 Mainline between Exit 396A Diverge/Merge	595	2
10	Merge	Basic	Exit 396A Merge	1500	3
11	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 395 Diverge	1385	3
12	Diverge	Basic	Exit 395 Diverge	1500	3
13	Basic	Basic	Between Exit 395 Diverge/Merge	1565	2
14	Merge	Merge	Exit 395 Merge	1500	2
15	Basic	Basic	I-90 Mainline west of Exit 395 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2573	6761	0.38	68.3	12.6	B

Segment 2: Diverge

AP	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

					(pc/h)		(pc/h)		Ratio		(mi/h)		(pc/mi/ln)		
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	2573	613	6761	1878	0.38	0.33	68.3	68.3	12.6	12.6	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	1949	4507	0.43	68.3	14.3	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	2536	587	4413	1878	0.57	0.31	60.6	60.6	20.9	17.8	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2547	4507	0.57	68.0	18.7	C

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.893	2547	423	4413	1878	0.58	0.23	55.4	55.4	23.0	20.8	C

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2105	4507	0.47	65.8	15.4	B

Segment 8: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2890	3968	0.73	51.2	18.8	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2143	4507	0.48	65.7	15.7	B

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.893	2267	124	6761	1878	0.34	0.07	67.8	68.3	11.1	11.1	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2275	6761	0.34	68.3	11.1	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.952	2275	455	6761	1878	0.34	0.24	68.3	68.3	11.1	11.1	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	1759	4507	0.39	68.3	12.9	B

Segment 14: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.952	2086	327	4413	1878	0.47	0.17	61.2	61.2	17.0	13.9	B

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2130	4507	0.47	66.9	15.6	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2730	2347	2.18	54.44	64.8	16.0	13.5	5.00	B

Facility Overall Results

Space Mean Speed, mi/h	64.8	Average Density, veh/mi/ln	13.5
Average Travel Time, min	5.00	Average Density, pc/mi/ln	16.0
Total VMT, veh-mi	2730	Total VHD, veh-h	2.18
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	54.44

F. Highway Capacity Software (HCS) Reports – 2040 Build Conditions

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	AM Build
Facility Name	I-29 NB - 2017 Layout	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	14
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	880	3
4	Merge	Basic	Exit 83 Loop Merge (Lane Add)	650	4
5	Weaving	Weaving	Exit 83 to Exit 84 Weave	2850	5
6	Diverge	Diverge	Exit 84 Diverge	1280	3
7	Basic	Basic	I-29 Mainline (3-Lane)	1500	3
8	Basic	Basic	I-29 Mainline (2-Lane)	700	2
9	Merge	Merge	Exit 84B Merge	1500	2
10	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	5220	2
11	Diverge	Diverge	Exit 86 Diverge	1500	2
12	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
13	Merge	Merge	Exit 86 Merge	1500	2
14	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	3431	9014	0.38	68.1	12.6	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.909	3431	880	9014	1878	0.38	0.47	68.1	68.1	12.6	12.6	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	2486	6761	0.37	68.1	12.2	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.909	2564	78	9014	1878	0.28	0.04	68.1	68.1	9.4	9.4	A

Segment 5: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	2793	6570	0.43	58.1	9.6	A

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	1945	653	6620	1878	0.29	0.35	58.1	54.8	11.2	5.9	A

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1292	6761	0.19	67.0	6.3	A

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1292	4507	0.29	67.9	9.5	A

Segment 9: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	1806	514	4413	1878	0.41	0.27	61.7	61.7	14.6	10.0	A

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1806	4507	0.40	68.1	13.3	B

Segment 11: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.935	1806	642	4413	1878	0.41	0.34	54.8	54.8	16.5	10.4	B

Segment 12: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1097	4507	0.24	67.6	8.0	A

Segment 13: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.943	1197	100	4413	1878	0.27	0.05	62.0	62.0	9.7	5.4	A

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1208	4507	0.27	66.9	8.9	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1762	1443	1.76	43.91	63.8	11.0	9.1	4.00	A

Facility Overall Results

Space Mean Speed, mi/h	63.8	Average Density, veh/mi/ln	9.1
Average Travel Time, min	4.00	Average Density, pc/mi/ln	11.0
Total VMT, veh-mi	1762	Total VHD, veh-h	1.76
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	43.91

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	AM Build
Facility Name	I-29 NB - 2012 Layout (Loop Only)	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	12
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	700	3
4	Weaving	Weaving	Exit 83 Merge	3680	4
5	Diverge	Basic	Exit 84B Diverge	1280	3
6	Basic	Basic	I-29 Mainline between Exit 84B Diverge/Merge	2200	2
7	Merge	Merge	Exit 84B Merge	1500	2
8	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	5220	2
9	Diverge	Diverge	Exit 86 Diverge	1500	2
10	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
11	Merge	Merge	Exit 86 Merge	1500	2
12	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	3431	9014	0.38	68.4	12.5	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.909	3431	880	9014	1878	0.38	0.47	68.4	68.4	12.5	12.5	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	2486	6761	0.37	68.4	12.1	B

Segment 4: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	2791	6295	0.44	57.9	12.1	B

Segment 5: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	1945	653	6761	1878	0.29	0.35	68.2	68.4	9.5	9.5	A

Segment 6: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1292	4507	0.29	68.4	9.4	A

Segment 7: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	1806	514	4413	1878	0.41	0.27	61.9	61.9	14.6	10.0	A

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1806	4507	0.40	68.4	13.2	B

Segment 9: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.935	1806	642	4413	1878	0.41	0.34	55.0	55.0	16.4	10.4	B

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1097	4507	0.24	67.9	8.0	A

Segment 11: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.943	1197	100	4413	1878	0.27	0.05	62.2	62.2	9.6	5.4	A

Segment 12: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1208	4507	0.27	67.2	8.8	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1770	1435	1.78	44.43	64.0	11.8	9.6	4.00	B

Facility Overall Results

Space Mean Speed, mi/h	64.0	Average Density, veh/mi/ln	9.6
Average Travel Time, min	4.00	Average Density, pc/mi/ln	11.8
Total VMT, veh-mi	1770	Total VHD, veh-h	1.78
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	44.43

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	10/23/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	AM Build
Facility Name	I-29 SB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.46		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline north of Exit 86	500	2
2	Diverge	Diverge	Exit 86 Diverge	1500	2
3	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2650	2
4	Merge	Merge	Exit 86 Merge	1500	2
5	Basic	Basic	I-29 Mainline between Exit 86 Merge and Exit 84B Diverge	5695	2
6	Diverge	Diverge	Exit 84B Diverge	1500	2
7	Basic	Basic	I-29 Mainline between Exit 84B Diverge and Exit 84B Merge	215	2
8	Diverge	Diverge	Loop G	1500	2
9	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	1860	2
10	Weaving	Weaving	Exit 84 to Exit 83 Weave	3130	4
11	Basic	Basic	I-29 Mainline between Exit 83 Diverge/ Merge	1510	3
12	Merge	Merge	Exit 83 Merge	1500	3
13	Basic	Basic	I-29 Mainline south of Exit 82 Diverge	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1525	4507	0.34	68.4	11.1	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.917	1525	167	4413	1878	0.35	0.09	56.1	56.1	13.6	8.0	A

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1359	4507	0.30	68.0	9.9	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.935	1850	491	4413	1878	0.42	0.26	61.9	61.9	14.9	10.3	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1855	4507	0.41	68.4	13.6	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.926	1855	114	4413	1878	0.42	0.06	56.2	56.2	16.5	10.8	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1741	4507	0.39	65.4	12.7	B

Segment 8: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.926	1741	394	4413	1878	0.39	0.21	55.5	55.5	15.7	9.9	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1347	4507	0.30	67.6	9.9	A

Segment 10: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	3141	5943	0.53	60.6	13.0	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	2630	6761	0.39	68.2	12.8	B

Segment 12: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.901	3061	431	6620	1878	0.46	0.23	63.2	61.7	16.1	12.0	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	3049	6761	0.45	67.4	14.9	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2105	1535	2.39	59.83	63.5	13.3	12.0	4.20	B

Facility Overall Results

Space Mean Speed, mi/h	63.5	Average Density, veh/mi/ln	12.0
Average Travel Time, min	4.20	Average Density, pc/mi/ln	13.3
Total VMT, veh-mi	2105	Total VHD, veh-h	2.39
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	59.83

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/5/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	AM Build
Facility Name	I-90 EB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	17
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.53		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline West of Exit 395	500	2
2	Diverge	Diverge	Exit 395 Diverge	1500	2
3	Basic	Basic	I-90 Mainline between Exit 395 Merge/ Diverge	1710	2
4	Merge	Basic	Exit 395 Merge (Loop)	1500	3
5	Merge	Merge	Exit 395 Merge (Diagonal)	220	3
6	Overlap	Overlap	Exit 395 to 396 Overlap	1280	3
7	Diverge	Diverge	Exit 396A Diverge	220	3
8	Basic	Basic	I-90 Mainline 3 lanes (w/in 396)	1320	3
9	Basic	Basic	I-90 Mainline 2 lanes (w/in 396)	880	2
10	Merge	Basic	Exit 396 Loop G Merge	1500	3
11	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	900	3
12	Merge	Merge	Exit 396 Merge (Diagonal)	1500	3
13	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 399 Diverge	9920	3
14	Diverge	Diverge	Exit 399 Diverge	1500	3
15	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2770	3
16	Merge	Merge	Exit 399 Merge	1500	3
17	Basic	Basic	I-90 Mainline West of Exit 395	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1863	4507	0.41	68.3	13.6	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1863	308	4413	1878	0.42	0.16	55.7	55.7	16.7	17.6	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1527	4507	0.34	67.4	11.2	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1739	212	6761	1878	0.26	0.11	68.2	68.3	8.5	8.5	A

Segment 5: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	2008	250	6620	1878	0.30	0.13	61.8	59.8	10.8	15.5	B

Segment 6: Overlap

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	2031	6761	0.30	56.5	12.0	B

Segment 7: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.847	2031	945	6620	1878	0.31	0.50	56.5	54.2	12.0	17.2	B

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1078	6761	0.16	64.9	5.3	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1078	4507	0.24	67.7	7.9	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.847	1509	431	6761	1878	0.22	0.23	68.2	68.3	7.4	7.4	A

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1486	6761	0.22	68.3	7.2	A

Segment 12: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.847	2333	847	6620	1878	0.35	0.45	62.3	60.6	12.5	13.9	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2325	6761	0.34	68.3	11.3	B

Segment 14: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	2325	554	6620	1878	0.35	0.30	58.9	55.1	13.2	15.7	B

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1761	6761	0.26	68.0	8.6	A

Segment 16: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	2248	487	6620	1878	0.34	0.26	63.6	62.0	11.8	8.2	A

Segment 17: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2257	6761	0.33	67.4	11.0	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2330	1877	1.54	38.44	65.4	10.6	9.1	5.10	A

Facility Overall Results

Space Mean Speed, mi/h	65.4	Average Density, veh/mi/ln	9.1
Average Travel Time, min	5.10	Average Density, pc/mi/ln	10.6
Total VMT, veh-mi	2330	Total VHD, veh-h	1.54
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	38.44

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	AM Build
Facility Name	I-90 WB	Units	U.S. Customary
Project Description	SDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	16
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.39		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline east of Exit 399 Diverge	500	3
2	Diverge	Basic	Exit 399 Diverge	1500	3
3	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2840	2
4	Merge	Basic	Exit 399 Merge	1500	3
5	Basic	Basic	I-90 Mainline between Exit 399 Merge and Exit 396B Diverge	9030	3
6	Diverge	Basic	Exit 396B Diverge	1500	3
7	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	2150	2
8	Merge	Basic	Exit 396 Loop E Merge	1500	3
9	Basic	Basic	I-90 Mainline between Exit 396A Diverge/Merge	1050	3
10	Merge	Merge	Exit 396A Merge (Diagonal)	670	3
11	Overlap	Overlap	Exit 396 to Exit 395	830	3
12	Diverge	Diverge	Exit 395A Diverge (Diagonal)	670	3
13	Diverge	Basic	Exit 395B Diverge (Loop)	1170	3
14	Basic	Basic	I-90 Mainline between Exit 395 Diverge/Merge	1565	2
15	Merge	Merge	Exit 395 Merge	1500	2
16	Basic	Basic	I-90 Mainline west of Exit 395 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2711	6761	0.40	68.3	13.2	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	2711	987	6761	1878	0.40	0.53	68.3	68.3	13.2	13.2	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1706	4507	0.38	68.3	12.5	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	2193	487	6761	1878	0.32	0.26	68.3	68.3	10.7	10.7	A

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2202	6761	0.33	68.3	10.7	A

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.926	2202	1347	6761	1878	0.33	0.72	68.3	68.3	10.7	10.7	A

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	743	4507	0.16	68.3	5.4	A

Segment 8: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.926	1340	597	6761	1878	0.20	0.32	68.3	68.3	6.5	6.5	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1415	6761	0.21	68.3	6.9	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.926	1529	114	6620	1878	0.23	0.06	62.7	60.1	8.1	11.4	B

Segment 11: Overlap

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1541	6761	0.23	57.9	8.9	A

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1541	597	6620	1878	0.23	0.32	57.9	55.0	8.9	12.9	B

Segment 13: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	889	148	6761	1878	0.13	0.08	66.0	68.3	4.3	4.3	A

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	728	4507	0.16	68.0	5.3	A

Segment 15: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	843	115	4413	1878	0.19	0.06	61.8	61.8	6.8	4.3	A

Segment 16: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	854	4507	0.19	67.0	6.3	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	1979	1618	0.40	10.03	67.4	9.4	8.0	4.80	A

Facility Overall Results

Space Mean Speed, mi/h	67.4	Average Density, veh/mi/ln	8.0
Average Travel Time, min	4.80	Average Density, pc/mi/ln	9.4
Total VMT, veh-mi	1979	Total VHD, veh-h	0.40
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	10.03

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	PM Build
Facility Name	I-29 NB - 2017 Layout	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	14
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	880	3
4	Merge	Basic	Exit 83 Loop Merge (Lane Add)	650	4
5	Weaving	Weaving	Exit 83 to Exit 84 Weave	2850	5
6	Diverge	Basic	Exit 84 Diverge	1280	4
7	Basic	Basic	I-29 Mainline (3-Lane)	1500	3
8	Basic	Basic	I-29 Mainline (2-lane)	700	2
9	Merge	Merge	Exit 84B Merge	1500	2
10	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	5220	2
11	Diverge	Diverge	Exit 86 Diverge	1500	2
12	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
13	Merge	Merge	Exit 86 Merge	1500	2
14	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	4253	9014	0.47	68.1	15.6	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	4253	1264	9014	1878	0.47	0.67	68.1	68.1	15.6	15.6	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	3114	6761	0.46	68.1	15.2	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	3296	182	9014	1878	0.37	0.10	68.1	68.1	12.1	12.1	B

Segment 5: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	3514	7964	0.44	57.4	12.2	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	2617	800	9014	1878	0.29	0.43	68.1	68.5	9.5	9.5	A

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	1.000	1667	6761	0.25	68.1	8.2	A

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	1818	4507	0.40	68.1	13.3	B

Segment 9: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	2339	521	4413	1878	0.53	0.28	61.3	61.3	19.1	14.1	B

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2339	4507	0.52	68.1	17.2	B

Segment 11: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.962	2339	612	4413	1878	0.53	0.33	54.9	54.9	21.3	15.0	B

Segment 12: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	1711	4507	0.38	67.6	12.6	B

Segment 13: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.909	0.885	1924	213	4413	1878	0.44	0.11	61.6	61.6	15.6	11.1	B

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	1919	4507	0.43	66.8	14.1	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2513	2190	2.21	55.22	64.3	14.1	12.7	4.00	B

Facility Overall Results

Space Mean Speed, mi/h	64.3	Average Density, veh/mi/ln	12.7
Average Travel Time, min	4.00	Average Density, pc/mi/ln	14.1
Total VMT, veh-mi	2513	Total VHD, veh-h	2.21
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	55.22

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	PM Build
Facility Name	I-29 NB - 2012 Layout (Exit 83 Loop On Only)	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	12
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	700	3
4	Weaving	Weaving	Exit 83 Merge	3680	4
5	Diverge	Basic	Exit 84B Diverge	1280	3
6	Basic	Basic	I-29 Mainline between Exit 84B Diverge/Merge	2200	2
7	Merge	Merge	Exit 84B Merge	1500	2
8	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	5220	2
9	Diverge	Diverge	Exit 86 Diverge	1500	2
10	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
11	Merge	Merge	Exit 86 Merge	1500	2
12	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	4253	9014	0.47	68.4	15.5	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	4253	1264	9014	1878	0.47	0.67	68.4	68.4	15.5	15.5	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	3114	6761	0.46	68.4	15.2	B

Segment 4: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	3531	7341	0.48	56.7	15.6	B

Segment 5: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	2617	800	6761	1878	0.39	0.43	68.2	68.4	12.7	12.7	B

Segment 6: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	1818	4507	0.40	68.4	13.3	B

Segment 7: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	2339	521	4413	1878	0.53	0.28	61.5	61.5	19.0	14.1	B

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2339	4507	0.52	68.4	17.1	B

Segment 9: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.962	2339	612	4413	1878	0.53	0.33	55.0	55.0	21.3	15.0	B

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	1711	4507	0.38	67.9	12.5	B

Segment 11: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.909	0.885	1924	213	4413	1878	0.44	0.11	61.9	61.9	15.5	11.1	B

Segment 12: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	1919	4507	0.43	67.1	14.0	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2521	2172	2.71	67.71	63.7	15.7	14.0	4.00	B

Facility Overall Results

Space Mean Speed, mi/h	63.7	Average Density, veh/mi/ln	14.0
Average Travel Time, min	4.00	Average Density, pc/mi/ln	15.7
Total VMT, veh-mi	2521	Total VHD, veh-h	2.71
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	67.71

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	10/23/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	PM Build
Facility Name	I-29 SB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.46		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline north of Exit 86	500	2
2	Diverge	Diverge	Exit 86 Diverge	1500	2
3	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2650	2
4	Merge	Merge	Exit 86 Merge	1500	2
5	Basic	Basic	I-29 Mainline between Exit 86 Merge and Exit 84B Diverge	5695	2
6	Diverge	Diverge	Exit 84B Diverge	1500	2
7	Basic	Basic	I-29 Mainline between Exit 84B Diverge and Exit 84B Merge	215	2
8	Diverge	Diverge	Loop G	1500	2
9	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	1860	2
10	Weaving	Weaving	Exit 84 to Exit 83 Weave	3130	4
11	Basic	Basic	I-29 Mainline between Exit 83 Diverge/ Merge	1510	3
12	Merge	Merge	Exit 83 Merge	1500	3
13	Basic	Basic	I-29 Mainline south of Exit 82 Diverge	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.862	1482	4507	0.33	68.4	10.8	A

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.862	0.962	1482	127	4413	1878	0.34	0.07	56.2	56.2	13.2	7.6	A

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.862	1341	4507	0.30	68.0	9.8	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.862	0.980	1953	612	4413	1878	0.44	0.33	61.8	61.8	15.8	11.1	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	1966	4507	0.44	68.4	14.4	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.893	0.893	1966	124	4413	1878	0.45	0.07	56.2	56.2	17.5	11.8	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	1841	4507	0.41	65.4	13.5	B

Segment 8: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.893	0.893	1841	435	4413	1878	0.42	0.23	55.4	55.4	16.6	10.7	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	1406	4507	0.31	67.5	10.3	A

Segment 10: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	2787	7287	0.38	62.7	11.1	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	2501	6761	0.37	68.3	12.2	B

Segment 12: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.893	0.943	3302	801	6620	1878	0.50	0.43	62.9	61.5	17.5	14.1	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	3347	6761	0.50	67.3	16.3	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2037	1589	2.10	52.43	63.9	13.3	11.6	4.20	B

Facility Overall Results

Space Mean Speed, mi/h	63.9	Average Density, veh/mi/ln	11.6
Average Travel Time, min	4.20	Average Density, pc/mi/ln	13.3
Total VMT, veh-mi	2037	Total VHD, veh-h	2.10
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	52.43

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/5/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	PM Build
Facility Name	I-90 EB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	17
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.53		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline West of Exit 395	500	2
2	Diverge	Diverge	Exit 395 Diverge	1500	2
3	Basic	Basic	I-90 Mainline between Exit 395 Merge/ Diverge	1710	2
4	Merge	Basic	Exit 395 Merge (Loop)	1500	3
5	Merge	Merge	Exit 395 Merge (Diagonal)	220	3
6	Overlap	Overlap	Exit 395 to Exit 396	1280	3
7	Diverge	Diverge	Exit 396A Diverge	220	3
8	Basic	Basic	I-90 Mainline 3 lanes (w/in 396)	1320	3
9	Basic	Basic	I-90 Mainline 2 lanes (w/in 396)	880	2
10	Merge	Basic	Exit 396 Loop G Merge	1500	3
11	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	900	3
12	Merge	Merge	Exit 396 Merge (Diagonal)	1500	3
13	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 399 Diverge	9920	3
14	Diverge	Diverge	Exit 399 Diverge	1500	3
15	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2770	3
16	Merge	Merge	Exit 399 Merge	1500	3
17	Basic	Basic	I-90 Mainline West of Exit 395	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	1574	4507	0.35	68.3	11.5	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.935	1574	261	4413	1878	0.36	0.14	55.8	55.8	14.1	15.1	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	1283	4507	0.28	67.4	9.4	A

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.935	1758	475	6761	1878	0.26	0.25	68.2	68.3	8.6	8.6	A

Segment 5: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.935	2050	238	6620	1878	0.31	0.13	62.1	59.8	11.0	15.1	B

Segment 6: Overlap

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2077	6761	0.31	57.9	12.0	B

Segment 7: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.917	2077	654	6620	1878	0.31	0.35	57.9	54.9	12.0	16.7	B

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	1362	6761	0.20	65.3	6.6	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	1362	4507	0.30	67.8	10.0	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.917	1763	424	6761	1878	0.26	0.23	68.2	68.3	8.6	8.6	A

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	1793	6761	0.27	68.3	8.8	A

Segment 12: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.917	2665	872	6620	1878	0.40	0.46	62.2	60.5	14.3	15.5	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2729	6761	0.40	68.3	13.3	B

Segment 14: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	2729	294	6620	1878	0.41	0.16	60.1	55.7	15.1	17.4	B

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2430	6761	0.36	68.0	11.9	B

Segment 16: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	3132	702	6620	1878	0.47	0.37	63.0	61.5	16.6	13.0	B

Segment 17: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	3145	6761	0.47	67.3	15.3	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2701	2294	1.56	39.04	65.7	12.2	10.4	5.10	B

Facility Overall Results

Space Mean Speed, mi/h	65.7	Average Density, veh/mi/ln	10.4
Average Travel Time, min	5.10	Average Density, pc/mi/ln	12.2
Total VMT, veh-mi	2701	Total VHD, veh-h	1.56
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	39.04

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2040
Jurisdiction	SDDOT	Time Analyzed	PM Build
Facility Name	I-90 WB	Units	U.S. Customary
Project Description	SDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	16
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.39		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline east of Exit 399 Diverge	500	3
2	Diverge	Basic	Exit 399 Diverge	1500	3
3	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2840	2
4	Merge	Basic	Exit 399 Merge	1500	3
5	Basic	Basic	I-90 Mainline between Exit 399 Merge and Exit 396B Diverge	9030	3
6	Diverge	Basic	Exit 396B Diverge	1500	3
7	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	2150	2
8	Merge	Basic	Exit 396 Loop E Merge	1500	3
9	Basic	Basic	I-90 Mainline between Exit 396A Diverge/Merge	1050	3
10	Merge	Merge	Exit 396A Merge (Diagonal)	670	3
11	Overlap	Overlap	Exit 396 to Exit 395	830	3
12	Diverge	Diverge	Exit 395A Diverge (Diagonal)	670	3
13	Diverge	Basic	Exit 395B Diverge (Loop)	1170	3
14	Basic	Basic	I-90 Mainline between Exit 395 Diverge/Merge	1565	2
15	Merge	Merge	Exit 395 Merge	1500	2
16	Basic	Basic	I-90 Mainline west of Exit 395 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2573	6761	0.38	68.3	12.6	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	2573	613	6761	1878	0.38	0.33	68.3	68.3	12.6	12.6	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	1949	4507	0.43	68.3	14.3	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	2536	587	6761	1878	0.38	0.31	68.3	68.3	12.4	12.4	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2547	6761	0.38	68.3	12.4	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.893	2547	1244	6761	1878	0.38	0.66	68.3	68.3	12.4	12.4	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	1248	4507	0.28	68.3	9.1	A

Segment 8: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.893	2069	821	6761	1878	0.31	0.44	68.3	68.3	10.1	10.1	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2143	6761	0.32	68.3	10.5	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.893	2267	124	6620	1878	0.34	0.07	62.5	60.0	12.1	14.4	B

Segment 11: Overlap

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2275	6761	0.34	60.1	12.6	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.952	2275	222	6620	1878	0.34	0.12	60.1	55.9	12.6	16.3	B

Segment 13: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.952	2024	233	6761	1878	0.30	0.12	66.5	68.3	9.9	9.9	A

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	1759	4507	0.39	68.1	12.9	B

Segment 15: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.952	2086	327	4413	1878	0.47	0.17	61.2	61.2	17.0	13.9	B

Segment 16: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2130	4507	0.47	66.9	15.6	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2563	2209	0.62	15.52	67.2	12.3	10.5	4.80	B

Facility Overall Results

Space Mean Speed, mi/h	67.2	Average Density, veh/mi/ln	10.5
Average Travel Time, min	4.80	Average Density, pc/mi/ln	12.3
Total VMT, veh-mi	2563	Total VHD, veh-h	0.62
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	15.52

G. Highway Capacity Software (HCS) Reports – 2065 Build Conditions

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	AM Build
Facility Name	I-29 NB - 2017 Layout	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	14
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	880	3
4	Merge	Basic	Exit 83 Loop Merge (Lane Add)	650	4
5	Weaving	Weaving	Exit 83 to Exit 84 Weave	2850	5
6	Diverge	Diverge	Exit 84B Diverge	1280	3
7	Basic	Basic	I-29 Mainline (3-lane)	1500	3
8	Basic	Basic	I-29 Mainline (2-lane)	700	2
9	Merge	Merge	Exit 84B Merge	1500	2
10	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	5220	2
11	Diverge	Diverge	Exit 86 Diverge	1500	2
12	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
13	Merge	Merge	Exit 86 Merge	1500	2
14	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	4611	9014	0.51	68.1	16.9	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.909	4611	1010	9014	1878	0.51	0.54	68.1	68.1	16.9	16.9	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	3528	6761	0.52	68.1	17.3	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.909	3619	91	9014	1878	0.40	0.05	68.1	68.1	13.3	13.3	B

Segment 5: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	3972	6934	0.57	55.3	14.4	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	2847	903	6620	1878	0.43	0.48	58.0	54.2	16.4	11.3	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1945	6761	0.29	67.0	9.5	A

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1945	4507	0.43	67.9	14.3	B

Segment 9: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	2806	861	4413	1878	0.64	0.46	59.4	59.4	23.6	22.2	C

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	2806	4507	0.62	67.0	20.9	C

Segment 11: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.935	2806	1195	4413	1878	0.64	0.64	53.5	53.5	26.2	19.0	B

Segment 12: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1486	4507	0.33	67.5	10.9	A

Segment 13: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.943	1661	175	4413	1878	0.38	0.09	61.8	61.8	13.4	9.0	A

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1681	4507	0.37	66.9	12.3	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2565	2091	3.31	82.63	62.6	16.3	13.4	4.10	B

Facility Overall Results

Space Mean Speed, mi/h	62.6	Average Density, veh/mi/ln	13.4
Average Travel Time, min	4.10	Average Density, pc/mi/ln	16.3
Total VMT, veh-mi	2565	Total VHD, veh-h	3.31
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	82.63

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	AM Build
Facility Name	I-29 NB - 2012 Layout (Exit 83 Loop On Only)	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	12
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	700	3
4	Weaving	Weaving	Exit 83 Merge	3680	4
5	Diverge	Basic	Exit 84B Diverge	1280	3
6	Basic	Basic	I-29 Mainline between Exit 84B Diverge/Merge	2200	2
7	Merge	Merge	Exit 84B Merge	1500	2
8	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	5220	2
9	Diverge	Diverge	Exit 86 Diverge	1500	2
10	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
11	Merge	Merge	Exit 86 Merge	1500	2
12	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	4611	9014	0.51	68.4	16.9	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.909	4611	1010	9014	1878	0.51	0.54	68.4	68.4	16.9	16.9	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	3528	6761	0.52	68.3	17.2	B

Segment 4: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	3972	6647	0.60	54.8	18.1	B

Segment 5: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	2847	903	6761	1878	0.42	0.48	68.2	68.4	13.9	13.9	B

Segment 6: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1945	4507	0.43	68.4	14.2	B

Segment 7: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.847	2806	861	4413	1878	0.64	0.46	59.6	59.6	23.5	22.2	C

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	2806	4507	0.62	67.2	20.9	C

Segment 9: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.935	2806	1195	4413	1878	0.64	0.64	53.6	53.6	26.2	19.0	B

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1486	4507	0.33	67.8	10.9	A

Segment 11: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.847	0.943	1661	175	4413	1878	0.38	0.09	62.0	62.0	13.4	9.0	A

Segment 12: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.847	1681	4507	0.37	67.1	12.3	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2577	2082	3.52	87.90	62.6	17.6	14.3	4.10	B

Facility Overall Results

Space Mean Speed, mi/h	62.6	Average Density, veh/mi/ln	14.3
Average Travel Time, min	4.10	Average Density, pc/mi/ln	17.6
Total VMT, veh-mi	2577	Total VHD, veh-h	3.52
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	87.90

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	10/23/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	AM Build
Facility Name	I-29 SB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.46		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline north of Exit 86	500	2
2	Diverge	Diverge	Exit 86 Diverge	1500	2
3	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2650	2
4	Merge	Merge	Exit 86 Merge	1500	2
5	Basic	Basic	I-29 Mainline between Exit 86 Merge and Exit 84B Diverge	5695	2
6	Diverge	Diverge	Exit 84B Diverge	1500	2
7	Basic	Basic	I-29 Mainline between Exit 84B Diverge and Exit 84B Merge	215	2
8	Diverge	Diverge	Loop G	1500	2
9	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	1860	2
10	Weaving	Weaving	Exit 84 to Exit 83 Weave	3130	4
11	Basic	Basic	I-29 Mainline between Exit 83 Diverge/ Merge	1510	3
12	Merge	Merge	Exit 83 Merge	1500	3
13	Basic	Basic	I-29 Mainline south of Exit 82 Diverge	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	2033	4507	0.45	68.4	14.9	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.917	2033	359	4413	1878	0.46	0.19	55.6	55.6	18.3	12.4	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1677	4507	0.37	68.0	12.3	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.935	2256	579	4413	1878	0.51	0.31	61.6	61.6	18.3	13.5	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	2261	4507	0.50	68.4	16.5	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.926	2261	178	4413	1878	0.51	0.09	56.1	56.1	20.2	20.7	C

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	2084	4507	0.46	65.3	15.2	B

Segment 8: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.926	2084	521	4413	1878	0.47	0.28	55.3	55.3	18.8	20.1	C

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	1563	4507	0.35	67.5	11.4	B

Segment 10: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	4188	4995	0.84	57.2	18.3	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	3214	6761	0.48	68.1	15.7	B

Segment 12: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.926	0.901	3736	522	6620	1878	0.56	0.28	62.7	61.3	19.9	15.5	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.926	3723	6761	0.55	67.3	18.2	C

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2622	1871	3.67	91.75	62.4	16.9	15.1	4.30	B

Facility Overall Results

Space Mean Speed, mi/h	62.4	Average Density, veh/mi/ln	15.1
Average Travel Time, min	4.30	Average Density, pc/mi/ln	16.9
Total VMT, veh-mi	2622	Total VHD, veh-h	3.67
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	91.75

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/5/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	AM Build
Facility Name	I-90 EB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	17
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.53		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline West of Exit 395	500	2
2	Diverge	Diverge	Exit 395 Diverge	1500	2
3	Basic	Basic	I-90 Mainline between Exit 395 Merge/ Diverge	1710	2
4	Merge	Basic	Exit 395 Merge (Loop)	1500	3
5	Merge	Merge	Exit 395 Merge (Diagonal)	220	3
6	Overlap	Overlap	Exit 395 to Exit 396	1280	3
7	Diverge	Diverge	Exit 396A Diverge	220	3
8	Basic	Basic	I-90 Mainline 3 lanes (w/in 396)	1320	3
9	Basic	Basic	I-90 Mainline 2 lanes (w/in 396)	880	2
10	Merge	Basic	Exit 396 Loop G Merge	1500	3
11	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	900	3
12	Merge	Merge	Exit 396 Merge (Diagonal)	1500	3
13	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 399 Diverge	9920	3
14	Diverge	Diverge	Exit 399 Diverge	1500	3
15	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2770	3
16	Merge	Merge	Exit 399 Merge	1500	3
17	Basic	Basic	I-90 Mainline West of Exit 395	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	2913	4507	0.65	66.7	21.8	C

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	2913	693	4413	1878	0.66	0.37	54.8	54.8	26.6	26.6	C

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	2157	4507	0.48	67.3	15.8	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	2580	423	6761	1878	0.38	0.23	68.2	68.3	12.6	12.6	B

Segment 5: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	3068	449	6620	1878	0.46	0.24	60.7	59.1	16.8	22.9	C

Segment 6: Overlap

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	3109	6761	0.46	56.7	18.3	C

Segment 7: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.847	3109	1361	6620	1878	0.47	0.72	56.7	53.2	18.3	23.3	C

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1737	6761	0.26	65.0	8.5	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1737	4507	0.39	67.7	12.7	B

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.847	2306	569	6761	1878	0.34	0.30	68.2	68.3	11.3	11.3	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2270	6761	0.34	68.3	11.1	B

Segment 12: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.847	3395	1125	6620	1878	0.51	0.60	61.7	60.0	18.3	19.6	B

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	3385	6761	0.50	68.3	16.5	B

Segment 14: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	3385	717	6620	1878	0.51	0.38	59.2	54.7	19.1	21.5	C

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2656	6761	0.39	68.0	13.0	B

Segment 16: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	3292	636	6620	1878	0.50	0.34	63.0	61.5	17.4	13.7	B

Segment 17: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	3302	6761	0.49	67.3	16.1	B

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	3453	2790	2.43	60.76	65.2	15.8	13.4	5.10	B

Facility Overall Results

Space Mean Speed, mi/h	65.2	Average Density, veh/mi/ln	13.4
Average Travel Time, min	5.10	Average Density, pc/mi/ln	15.8
Total VMT, veh-mi	3453	Total VHD, veh-h	2.43
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	60.76

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	AM Build
Facility Name	I-90 WB	Units	U.S. Customary
Project Description	SDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	16
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.39		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline east of Exit 399 Diverge	500	3
2	Diverge	Basic	Exit 399 Diverge	1500	3
3	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2840	2
4	Merge	Basic	Exit 399 Merge	1500	3
5	Basic	Basic	I-90 Mainline between Exit 399 Merge and Exit 396B Diverge	9030	3
6	Diverge	Basic	Exit 396B Diverge	1500	3
7	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	2150	2
8	Merge	Basic	Exit 396 Loop E Merge	1500	3
9	Basic	Basic	I-90 Mainline between Exit 396A Diverge/Merge	1050	3
10	Merge	Merge	Exit 396A Merge (Diagonal)	670	3
11	Overlap	Overlap	Exit 396 to Exit 395	830	3
12	Diverge	Diverge	Exit 395A Diverge (Diagonal)	670	3
13	Diverge	Basic	Exit 395B Diverge (Loop)	1170	3
14	Basic	Basic	I-90 Mainline between Exit 395 Diverge/Merge	1565	2
15	Merge	Merge	Exit 395 Merge	1500	2
16	Basic	Basic	I-90 Mainline west of Exit 395 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	3867	6761	0.57	67.9	19.0	C

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	3867	1190	6620	1878	0.58	0.63	58.0	58.0	22.2	22.2	C

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2677	4507	0.59	67.6	19.8	C

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	3407	730	6620	1878	0.51	0.39	62.8	62.8	18.1	18.1	C

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	3407	6761	0.50	68.3	16.6	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.926	3407	2084	6620	1878	0.51	1.11	54.3	54.3	20.9	20.9	F

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1323	4507	0.25	67.6	9.7	A

Segment 8: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.926	2149	826	6620	1878	0.30	0.44	63.3	63.3	11.3	11.3	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	2149	6761	0.31	67.7	10.5	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.926	2327	178	6620	1878	0.34	0.09	62.0	59.9	12.5	16.4	B

Segment 11: Overlap

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	2327	6761	0.34	56.5	13.7	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	2327	1091	6620	1878	0.34	0.58	56.5	53.8	13.7	18.8	B

Segment 13: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1236	167	6620	1878	0.16	0.09	59.6	59.6	6.9	6.9	A

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1069	4507	0.20	67.4	7.8	A

Segment 15: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1261	192	4413	1878	0.25	0.10	61.7	61.7	10.2	7.5	A

Segment 16: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1261	4507	0.25	67.0	9.2	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	3041	2427	2.67	66.76	64.4	15.2	13.0	5.00	F

Facility Overall Results

Space Mean Speed, mi/h	64.4	Average Density, veh/mi/ln	13.0
Average Travel Time, min	5.00	Average Density, pc/mi/ln	15.2
Total VMT, veh-mi	3041	Total VHD, veh-h	2.67
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	66.76

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	PM Build
Facility Name	I-29 NB - 2017 Layout	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	14
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	880	3
4	Merge	Basic	Exit 83 Loop Merge (Lane Add)	650	4
5	Weaving	Weaving	Exit 83 to Exit 84 Weave	2850	5
6	Diverge	Basic	Exit 84 Diverge	1280	4
7	Basic	Basic	I-29 Mainline (3-lane)	1500	3
8	Basic	Basic	I-29 Mainline (taper to 2-lane)	700	2
9	Merge	Merge	Exit 84B Merge	1500	2
10	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	5220	2
11	Diverge	Diverge	Exit 86 Diverge	1500	2
12	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
13	Merge	Merge	Exit 86 Merge	1500	2
14	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	5453	9014	0.60	67.3	20.3	C

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	5453	1399	9014	1878	0.60	0.74	67.3	67.3	20.3	20.3	C

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	4192	6761	0.62	67.1	20.8	C

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	4508	316	9014	1878	0.50	0.17	67.8	68.1	16.5	16.5	B

Segment 5: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	4753	8568	0.55	54.8	17.3	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	3623	1054	9014	1878	0.40	0.56	67.6	68.1	13.3	13.3	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2569	6761	0.38	68.1	12.6	B

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2569	4507	0.57	67.7	19.0	C

Segment 9: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	3417	848	4413	1878	0.77	0.45	57.9	57.9	29.5	27.0	C

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	3417	4507	0.76	63.3	27.0	D

Segment 11: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.962	3417	1074	4413	1878	0.77	0.57	53.8	53.8	31.8	24.3	C

Segment 12: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	2310	4507	0.51	67.5	17.0	B

Segment 13: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.909	0.885	2624	314	4413	1878	0.59	0.17	60.9	60.9	21.5	16.5	B

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	2616	4507	0.58	66.7	19.3	C

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	3481	3029	4.89	122.19	62.2	20.2	18.2	4.10	C

Facility Overall Results

Space Mean Speed, mi/h	62.2	Average Density, veh/mi/ln	18.2
Average Travel Time, min	4.10	Average Density, pc/mi/ln	20.2
Total VMT, veh-mi	3481	Total VHD, veh-h	4.89
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	122.19

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	PM Build
Facility Name	I-29 NB - 2012 Layout (Exit 83 Loop On Only)	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	12
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	700	3
4	Weaving	Weaving	Exit 83 Merge	3680	4
5	Diverge	Basic	Exit 84B Diverge	1280	3
6	Basic	Basic	I-29 Mainline between Exit 84B Diverge/Merge	2200	2
7	Merge	Merge	Exit 84B Merge	1500	2
8	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	5220	2
9	Diverge	Diverge	Exit 86 Diverge	1500	2
10	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
11	Merge	Merge	Exit 86 Merge	1500	2
12	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	5453	9014	0.60	67.5	20.2	C

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	5453	1399	9014	1878	0.60	0.74	67.5	67.5	20.2	20.2	C

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	4192	6761	0.62	67.3	20.8	C

Segment 4: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	4784	7639	0.63	53.5	22.4	C

Segment 5: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	3623	1054	6761	1878	0.54	0.56	68.1	68.3	17.7	17.7	B

Segment 6: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2569	4507	0.57	68.0	18.9	C

Segment 7: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	3417	848	4413	1878	0.77	0.45	58.1	58.1	29.4	27.0	C

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	3417	4507	0.76	63.4	26.9	D

Segment 9: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.962	3417	1074	4413	1878	0.77	0.57	53.9	53.9	31.7	24.3	C

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	2310	4507	0.51	67.8	16.9	B

Segment 11: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.909	0.885	2624	314	4413	1878	0.59	0.17	61.1	61.1	21.5	16.5	B

Segment 12: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	2616	4507	0.58	67.0	19.3	C

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	3491	2997	5.92	147.98	61.3	22.6	20.1	4.20	C

Facility Overall Results

Space Mean Speed, mi/h	61.3	Average Density, veh/mi/ln	20.1
Average Travel Time, min	4.20	Average Density, pc/mi/ln	22.6
Total VMT, veh-mi	3491	Total VHD, veh-h	5.92
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	147.98

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	PM Build
Facility Name	I-29 SB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.46		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline north of Exit 86	500	2
2	Diverge	Diverge	Exit 86 Diverge	1500	2
3	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2650	2
4	Merge	Merge	Exit 86 Merge	1500	2
5	Basic	Basic	I-29 Mainline between Exit 86 Merge and Exit 84B Diverge	5695	2
6	Diverge	Diverge	Exit 84B Diverge	1500	2
7	Basic	Basic	I-29 Mainline between Exit 84B Diverge and Exit 84B Merge	215	2
8	Diverge	Diverge	Loop G	1500	2
9	Basic	Basic	I-29 Mainline between Exit 84A Diverge/Merge	1860	2
10	Weaving	Weaving	Exit 84 to Exit 83 Weave	3130	4
11	Basic	Basic	I-29 Mainline between Exit 83 Diverge/ Merge	1510	3
12	Merge	Merge	Exit 83 Merge	1500	3
13	Basic	Basic	I-29 Mainline south of Exit 82 Diverge	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.862	2062	4507	0.46	68.4	15.1	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.862	0.962	2062	277	4413	1878	0.47	0.15	55.8	55.8	18.5	12.6	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.862	1753	4507	0.39	68.0	12.8	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.862	0.980	2853	1100	4413	1878	0.65	0.59	60.8	60.8	23.5	17.9	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	2899	4507	0.64	66.8	21.7	C

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.893	0.893	2899	187	4413	1878	0.66	0.10	56.0	56.0	25.9	26.2	C

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	2712	4507	0.60	65.3	20.1	C

Segment 8: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.893	0.893	2712	672	4413	1878	0.61	0.36	54.9	54.9	24.7	25.5	C

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	2041	4507	0.45	67.5	14.9	B

Segment 10: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	3968	7386	0.54	61.1	16.2	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	3559	6761	0.53	68.2	17.4	B

Segment 12: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.893	0.943	4619	1060	6620	1878	0.70	0.56	61.3	59.8	25.1	21.1	C

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.893	4678	6761	0.69	65.6	23.8	C

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2916	2274	3.74	93.58	62.9	19.4	16.9	4.30	C

Facility Overall Results

Space Mean Speed, mi/h	62.9	Average Density, veh/mi/ln	16.9
Average Travel Time, min	4.30	Average Density, pc/mi/ln	19.4
Total VMT, veh-mi	2916	Total VHD, veh-h	3.74
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	93.58

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/5/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	PM Build
Facility Name	I-90 EB	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	17
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.53		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline West of Exit 395	500	2
2	Diverge	Diverge	Exit 395 Diverge	1500	2
3	Basic	Basic	I-90 Mainline between Exit 395 Merge/ Diverge	1710	2
4	Merge	Basic	Exit 395 Merge (Loop)	1500	3
5	Merge	Merge	Exit 395 Merge (Diagonal)	220	3
6	Overlap	Overlap	Exit 395 to Exit 396	1280	3
7	Diverge	Diverge	Exit 396A Diverge	220	3
8	Basic	Basic	I-90 Mainline 3 lanes (w/in 396)	1320	3
9	Basic	Basic	I-90 Mainline 2 lanes (w/in 396)	880	2
10	Merge	Basic	Exit 396 Loop G Merge	1500	3
11	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	900	3
12	Merge	Merge	Exit 396 Merge (Diagonal)	1500	3
13	Basic	Basic	I-90 Mainline between Exit 396A Merge and Exit 399 Diverge	9920	3
14	Diverge	Diverge	Exit 399 Diverge	1500	3
15	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2770	3
16	Merge	Merge	Exit 399 Merge	1500	3
17	Basic	Basic	I-90 Mainline West of Exit 395	500	3

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2368	4507	0.53	68.2	17.4	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.935	2368	559	4413	1878	0.54	0.30	55.1	55.1	21.5	21.9	C

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	1746	4507	0.39	67.3	12.8	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.935	2750	1004	6761	1878	0.41	0.53	68.2	68.3	13.4	13.4	B

Segment 5: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.935	3167	303	6620	1878	0.48	0.16	61.2	59.2	17.2	21.9	C

Segment 6: Overlap

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	3201	6761	0.47	57.6	18.5	C

Segment 7: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.917	3201	945	6620	1878	0.48	0.50	57.6	54.2	18.5	24.0	C

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2169	6761	0.32	65.2	10.6	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2169	4507	0.48	67.8	15.9	B

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.917	2785	654	6761	1878	0.41	0.35	68.2	68.3	13.6	13.6	B

Segment 11: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2833	6761	0.42	68.3	13.8	B

Segment 12: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.917	3936	1103	6620	1878	0.59	0.59	61.2	59.5	21.4	22.1	C

Segment 13: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	4016	6761	0.59	67.6	19.8	C

Segment 14: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	4016	396	6620	1878	0.61	0.21	60.3	55.5	22.2	24.0	C

Segment 15: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	3613	6761	0.53	68.0	17.7	B

Segment 16: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	4303	690	6620	1878	0.65	0.37	62.0	60.6	23.1	18.7	B

Segment 17: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	4314	6761	0.64	66.9	21.5	C

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	4002	3411	2.74	68.56	65.3	18.3	15.6	5.10	C

Facility Overall Results

Space Mean Speed, mi/h	65.3	Average Density, veh/mi/ln	15.6
Average Travel Time, min	5.10	Average Density, pc/mi/ln	18.3
Total VMT, veh-mi	4002	Total VHD, veh-h	2.74
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	68.56

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	PM Build
Facility Name	I-90 WB	Units	U.S. Customary
Project Description	SDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	16
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.39		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline east of Exit 399 Diverge	500	3
2	Diverge	Basic	Exit 399 Diverge	1500	3
3	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2840	2
4	Merge	Basic	Exit 399 Merge	1500	3
5	Basic	Basic	I-90 Mainline between Exit 399 Merge and Exit 396B Diverge	9030	3
6	Diverge	Basic	Exit 396B Diverge	1500	3
7	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	2150	2
8	Merge	Basic	Exit 396 Loop E Merge	1500	3
9	Basic	Basic	I-90 Mainline between Exit 396A Diverge/Merge	1050	3
10	Merge	Merge	Exit 396A Merge (Diagonal)	670	3
11	Overlap	Overlap	Exit 396 to Exit 395	830	3
12	Diverge	Diverge	Exit 395A Diverge (Diagonal)	670	3
13	Diverge	Basic	Exit 395B Diverge (Loop)	1170	3
14	Basic	Basic	I-90 Mainline between Exit 395 Diverge/Merge	1565	2
15	Merge	Merge	Exit 395 Merge	1500	2
16	Basic	Basic	I-90 Mainline west of Exit 395 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	3717	6761	0.55	68.1	18.2	C

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	3717	779	6761	1878	0.55	0.41	68.1	68.1	18.2	18.2	C

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	2924	4507	0.65	66.6	22.0	C

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.870	3614	690	6761	1878	0.53	0.37	68.2	68.2	17.7	17.7	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	3626	6761	0.54	68.2	17.7	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.893	3626	1829	6761	1878	0.54	0.97	68.2	68.2	17.7	17.7	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.855	1715	4507	0.38	68.3	12.6	B

Segment 8: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.855	0.893	2797	1082	6761	1878	0.41	0.58	68.3	68.3	13.7	13.7	B

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2897	6761	0.43	68.3	14.1	B

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.893	3084	187	6620	1878	0.47	0.10	61.9	59.7	16.6	18.7	B

Segment 11: Overlap

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	3095	6761	0.46	59.9	17.2	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.952	3095	455	6620	1878	0.47	0.24	59.9	55.4	17.2	21.1	C

Segment 13: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.952	2579	350	6761	1878	0.38	0.19	66.4	68.3	12.6	12.6	B

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2183	4507	0.48	68.1	16.0	B

Segment 15: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.840	0.952	2743	560	4413	1878	0.62	0.30	60.4	60.4	22.7	18.9	B

Segment 16: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.840	2817	4507	0.63	66.7	21.0	C

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	3585	3095	1.07	26.72	66.9	17.3	14.7	4.80	B

Facility Overall Results

Space Mean Speed, mi/h	66.9	Average Density, veh/mi/ln	14.7
Average Travel Time, min	4.80	Average Density, pc/mi/ln	17.3
Total VMT, veh-mi	3585	Total VHD, veh-h	1.07
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	26.72

H. Highway Capacity Software (HCS) Reports – Year of Need and Modifications

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2057
Jurisdiction	SDDOT	Time Analyzed	AM Build - LOS C/D
Facility Name	I-90 WB	Units	U.S. Customary
Project Description	SDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	16
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.39		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline east of Exit 399 Diverge	500	3
2	Diverge	Basic	Exit 399 Diverge	1500	3
3	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2840	2
4	Merge	Basic	Exit 399 Merge	1500	3
5	Basic	Basic	I-90 Mainline between Exit 399 Merge and Exit 396B Diverge	9030	3
6	Diverge	Basic	Exit 396B Diverge	1500	3
7	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	2150	2
8	Merge	Basic	Exit 396 Loop E Merge	1500	3
9	Basic	Basic	I-90 Mainline between Exit 396A Diverge/Merge	1050	3
10	Merge	Merge	Exit 396A Merge (Diagonal)	670	3
11	Overlap	Overlap	Exit 396 to Exit 395	830	3
12	Diverge	Diverge	Exit 395A Diverge (Diagonal)	670	3
13	Diverge	Basic	Exit 395B Diverge (Loop)	1170	3
14	Basic	Basic	I-90 Mainline between Exit 395 Diverge/Merge	1565	2
15	Merge	Merge	Exit 395 Merge	1500	2
16	Basic	Basic	I-90 Mainline west of Exit 395 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	3495	6761	0.52	68.3	17.1	B

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	3495	1122	6761	1878	0.52	0.60	68.3	68.3	17.1	17.1	B

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2353	4507	0.52	68.3	17.2	B

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	3002	649	6761	1878	0.44	0.35	68.3	68.3	14.7	14.7	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	3013	6761	0.45	68.3	14.7	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.926	3013	1842	6761	1878	0.45	0.98	68.3	68.3	14.7	14.7	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1018	4507	0.23	68.3	7.5	A

Segment 8: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.926	1768	750	6761	1878	0.26	0.40	68.3	68.3	8.6	8.6	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1863	6761	0.28	68.3	9.1	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.926	2015	152	6620	1878	0.30	0.08	62.2	60.0	10.8	14.4	B

Segment 11: Overlap

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	2031	6761	0.30	56.9	11.9	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	2031	937	6620	1878	0.31	0.50	56.9	54.2	11.9	16.6	B

Segment 13: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1008	154	6761	1878	0.15	0.08	65.7	68.3	4.9	4.9	A

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	840	4507	0.19	68.0	6.1	A

Segment 15: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1007	167	4413	1878	0.23	0.09	61.8	61.8	8.1	5.6	A

Segment 16: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1022	4507	0.23	67.0	7.5	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2648	2167	0.56	14.02	67.3	12.7	10.8	4.80	B

Facility Overall Results

Space Mean Speed, mi/h	67.3	Average Density, veh/mi/ln	10.8
Average Travel Time, min	4.80	Average Density, pc/mi/ln	12.7
Total VMT, veh-mi	2648	Total VHD, veh-h	0.56
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	14.02

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2062
Jurisdiction	SDDOT	Time Analyzed	PM Build LOS C/D
Facility Name	I-29 NB - 2017 Layout	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	14
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	880	3
4	Merge	Basic	Exit 83 Loop Merge (Lane Add)	650	4
5	Weaving	Weaving	Exit 83 to Exit 84 Weave	2850	5
6	Diverge	Basic	Exit 84 Diverge	1280	4
7	Basic	Basic	I-29 Mainline (3-lane)	1500	3
8	Basic	Basic	I-29 Mainline (taper to 2-lane)	700	2
9	Merge	Merge	Exit 84B Merge	1500	2
10	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	5220	2
11	Diverge	Diverge	Exit 86 Diverge	1500	2
12	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
13	Merge	Merge	Exit 86 Merge	1500	2
14	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	5319	9014	0.59	67.5	19.7	C

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	5319	1386	9014	1878	0.59	0.74	67.5	67.5	19.7	19.7	C

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	4071	6761	0.60	67.3	20.2	C

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	4367	296	9014	1878	0.48	0.16	67.9	68.1	16.0	16.0	B

Segment 5: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	4607	8504	0.54	55.1	16.7	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	3502	1018	9014	1878	0.39	0.54	67.6	68.1	12.9	12.9	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2484	6761	0.37	68.1	12.2	B

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2484	4507	0.55	67.9	18.3	C

Segment 9: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	3296	812	4413	1878	0.75	0.43	58.3	58.3	28.3	26.1	C

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	3296	4507	0.73	64.2	25.7	C

Segment 11: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.962	3296	1016	4413	1878	0.75	0.54	53.9	53.9	30.6	23.2	C

Segment 12: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	2249	4507	0.50	67.5	16.5	B

Segment 13: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.909	0.885	2550	301	4413	1878	0.58	0.16	61.0	61.0	20.9	15.9	B

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	2542	4507	0.56	66.7	18.7	C

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	3372	2935	4.44	110.90	62.5	19.5	17.5	4.10	C

Facility Overall Results

Space Mean Speed, mi/h	62.5	Average Density, veh/mi/ln	17.5
Average Travel Time, min	4.10	Average Density, pc/mi/ln	19.5
Total VMT, veh-mi	3372	Total VHD, veh-h	4.44
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	110.90

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	AM Build: 2-Lane Exit 396 Off-Ramp
Facility Name	I-90 WB	Units	U.S. Customary
Project Description	SDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	16
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.39		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline east of Exit 399 Diverge	500	3
2	Diverge	Basic	Exit 399 Diverge	1500	3
3	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2840	2
4	Merge	Basic	Exit 399 Merge	1500	3
5	Basic	Basic	I-90 Mainline between Exit 399 Merge and Exit 396B Diverge	9030	3
6	Diverge	Diverge	Exit 396B Diverge	1500	2
7	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	2150	2
8	Merge	Basic	Exit 396 Loop E Merge	1500	3
9	Basic	Basic	I-90 Mainline between Exit 396A Diverge/Merge	1050	3
10	Merge	Merge	Exit 396A Merge (Diagonal)	670	3
11	Overlap	Overlap	Exit 396 to Exit 395	830	3
12	Diverge	Diverge	Exit 395A Diverge (Diagonal)	670	3
13	Diverge	Basic	Exit 395B Diverge (Loop)	1170	3
14	Basic	Basic	I-90 Mainline between Exit 395 Diverge/Merge	1565	2
15	Merge	Merge	Exit 395 Merge	1500	2
16	Basic	Basic	I-90 Mainline west of Exit 395 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	3867	6761	0.57	67.9	19.0	C

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	3867	1190	6761	1878	0.57	0.63	67.9	67.9	19.0	19.0	C

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2656	4507	0.59	67.7	19.6	C

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	3386	730	6761	1878	0.50	0.39	68.3	68.3	16.5	16.5	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	3399	6761	0.50	68.3	16.6	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.926	3399	2084	4413	3756	0.77	0.55	51.5	51.5	33.0	20.0	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1142	4507	0.25	67.4	8.4	A

Segment 8: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.926	1968	826	6761	1878	0.29	0.44	68.3	68.3	9.6	9.6	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	2073	6761	0.31	68.3	10.1	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.926	2251	178	6620	1878	0.34	0.09	62.0	59.9	12.1	16.0	B

Segment 11: Overlap

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	2269	6761	0.34	56.5	13.4	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	2269	1091	6620	1878	0.34	0.58	56.5	53.8	13.4	18.4	B

Segment 13: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1078	167	6761	1878	0.16	0.09	65.6	68.3	5.3	5.3	A

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	896	4507	0.20	68.0	6.6	A

Segment 15: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1088	192	4413	1878	0.25	0.10	61.7	61.7	8.8	6.2	A

Segment 16: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1106	4507	0.25	67.0	8.1	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2967	2427	1.72	42.94	65.7	14.8	12.7	4.90	B

Facility Overall Results

Space Mean Speed, mi/h	65.7	Average Density, veh/mi/ln	12.7
Average Travel Time, min	4.90	Average Density, pc/mi/ln	14.8
Total VMT, veh-mi	2967	Total VHD, veh-h	1.72
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	42.94

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	AM Build: 2-Lane Exit 396 Off-Ramp
Facility Name	I-90 WB	Units	U.S. Customary
Project Description	SDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	16
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	5.39		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-90 Mainline east of Exit 399 Diverge	500	3
2	Diverge	Basic	Exit 399 Diverge	1500	3
3	Basic	Basic	I-90 Mainline between Exit 399 Diverge/Merge	2840	2
4	Merge	Basic	Exit 399 Merge	1500	3
5	Basic	Basic	I-90 Mainline between Exit 399 Merge and Exit 396B Diverge	9030	3
6	Diverge	Diverge	Exit 396B Diverge	1500	3
7	Basic	Basic	I-90 Mainline between Exit 396B Diverge/Merge	2150	2
8	Merge	Basic	Exit 396 Loop E Merge	1500	3
9	Basic	Basic	I-90 Mainline between Exit 396A Diverge/Merge	1050	3
10	Merge	Merge	Exit 396A Merge (Diagonal)	670	3
11	Overlap	Overlap	Exit 396 to Exit 395	830	3
12	Diverge	Diverge	Exit 395A Diverge (Diagonal)	670	3
13	Diverge	Basic	Exit 395B Diverge (Loop)	1170	3
14	Basic	Basic	I-90 Mainline between Exit 395 Diverge/Merge	1565	2
15	Merge	Merge	Exit 395 Merge	1500	2
16	Basic	Basic	I-90 Mainline west of Exit 395 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	3867	6761	0.57	67.9	19.0	C

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	3867	1190	6761	1878	0.57	0.63	67.9	67.9	19.0	19.0	C

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	2656	4507	0.59	67.7	19.6	C

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.870	3386	730	6761	1878	0.50	0.39	68.3	68.3	16.5	16.5	B

Segment 5: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	3399	6761	0.50	68.3	16.6	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.926	3399	2084	6620	3756	0.51	0.55	55.2	51.5	20.5	13.8	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.855	1142	4507	0.25	67.6	8.4	A

Segment 8: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.855	0.926	1968	826	6761	1878	0.29	0.44	68.3	68.3	9.6	9.6	A

Segment 9: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	2073	6761	0.31	68.3	10.1	A

Segment 10: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.926	2251	178	6620	1878	0.34	0.09	62.0	59.9	12.1	16.0	B

Segment 11: Overlap

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	2269	6761	0.34	56.5	13.4	B

Segment 12: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	2269	1091	6620	1878	0.34	0.58	56.5	53.8	13.4	18.4	B

Segment 13: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1078	167	6761	1878	0.16	0.09	65.6	68.3	5.3	5.3	A

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	896	4507	0.20	68.0	6.6	A

Segment 15: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.85	0.85	0.840	0.917	1088	192	4413	1878	0.25	0.10	61.7	61.7	8.8	6.2	A

Segment 16: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.85	0.840	1106	4507	0.25	67.0	8.1	A

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	2967	2427	1.44	36.11	66.1	14.5	12.3	4.90	B

Facility Overall Results

Space Mean Speed, mi/h	66.1	Average Density, veh/mi/ln	12.3
Average Travel Time, min	4.90	Average Density, pc/mi/ln	14.5
Total VMT, veh-mi	2967	Total VHD, veh-h	1.44
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	36.11

HCS Freeway Facilities Report

Project Information

Analyst	HDR	Date	7/6/2023
Agency	HDR	Analysis Year	2065
Jurisdiction	SDDOT	Time Analyzed	PM Build: 3-Lane Exit 84-86
Facility Name	I-29 NB - 2017 Layout	Units	U.S. Customary
Project Description	SDDOT I-90 / I-29 Interchange Operations Analysis		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	14
Total Analysis Periods	1	Analysis Period Duration, min	15
Facility Length, mi	4.27		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	I-29 Mainline south of Exit 83	500	4
2	Diverge	Basic	Exit 83 Diverge	1500	4
3	Basic	Basic	I-29 Mainline Between Exit 83 Diverge/ Merge	880	3
4	Merge	Basic	Exit 83 Loop Merge (Lane Add)	650	4
5	Weaving	Weaving	Exit 83 to Exit 84 Weave	2850	5
6	Diverge	Basic	Exit 84 Diverge	1280	4
7	Basic	Basic	I-29 Mainline (3-lane)	1500	3
8	Basic	Basic	I-29 Mainline (taper to 2-lane)	700	2
9	Merge	Basic	Exit 84B Merge	1500	3
10	Basic	Basic	I-29 Mainline between Exit 84B Merge and Exit 86 Merge	5220	3
11	Diverge	Basic	Exit 86 Diverge	1500	3
12	Basic	Basic	I-29 Mainline between Exit 86 Diverge/ Merge	2445	2
13	Merge	Merge	Exit 86 Merge	1500	2
14	Basic	Basic	I-29 north of Exit 86 Merge	500	2

Facility Segment Data

Segment 1: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	5453	9014	0.60	67.3	20.3	C

Segment 2: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	5453	1399	9014	1878	0.60	0.74	67.3	67.3	20.3	20.3	C

Segment 3: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	4192	6761	0.62	67.1	20.8	C

Segment 4: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.826	4508	316	9014	1878	0.50	0.17	67.8	68.1	16.5	16.5	B

Segment 5: Weaving

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	4753	8568	0.55	54.8	17.3	B

Segment 6: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	3623	1054	9014	1878	0.40	0.56	67.6	68.1	13.3	13.3	B

Segment 7: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2569	6761	0.38	68.1	12.6	B

Segment 8: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	2569	4507	0.57	67.7	19.0	C

Segment 9: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.917	3417	848	6761	1878	0.51	0.45	68.0	68.1	16.7	16.7	B

Segment 10: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.917	3417	6761	0.51	68.1	16.7	B

Segment 11: Diverge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.917	0.962	3417	1074	6761	1878	0.51	0.57	68.1	68.1	16.7	16.7	B

Segment 12: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	2310	4507	0.51	68.1	17.0	B

Segment 13: Merge

AP	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R Infl.	F	R Infl.	
1	0.90	0.90	0.909	0.885	2624	314	4413	1878	0.59	0.17	60.9	60.9	21.5	16.5	B

Segment 14: Basic

AP	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.90	0.909	2616	4507	0.58	66.7	19.3	C

Facility Analysis Results

AP	VMT veh-mi/AP	VMT-Demand veh-mi/AP	VHD veh-h/AP	Total Delay Cost $/AP	Speed mi/h	Density pc/mi/ln	Density veh/mi/ln	TT min	LOS
1	3481	3029	2.55	63.84	64.9	17.2	15.4	3.90	B

Facility Overall Results

Space Mean Speed, mi/h	64.9	Average Density, veh/mi/ln	15.4
Average Travel Time, min	3.90	Average Density, pc/mi/ln	17.2
Total VMT, veh-mi	3481	Total VHD, veh-h	2.55
Vehicle Value of Time (VOT), $/h	25.00	Total Delay Cost, $	63.84

I. Study Team Meeting Minutes

Meeting Minutes

Project:	I-90 / I-29 Interchange Traffic Operations Analysis
Subject:	Kickoff and Methods & Assumptions Meeting
Date:	Tuesday, June 20, 2023
Location:	Webex

Attendees:

- ☒ Mark Leiferman – SDDOT
- ☒ Steve Gramm – SDDOT
- ☐ Katrina Burckhard – SDDOT
- ☐ John Less – SDDOT
- ☒ Kelly VanDeWiele – FHWA
- ☐ Shannon Ausen – City of Sioux Falls
- ☒ Sam Trebilcock – City of Sioux Falls
- ☒ Fletcher Lacock – City of Sioux Falls
- ☒ Sean Hegyi – SECOG
- ☒ Jim Feeney – SECOG

- ☒ Jon Wiegand – HDR
- ☒ Tom Cook – HDR
- ☒ Jason Kjenstad – HDR
- ☒ Steve Hoff – HDR

Meeting Objectives

A. Introduce study and confirm expectations
B. Review M&A Document

Agenda

1. Study Scope and Schedule

2. Methods and Assumptions Document

    - *Include the 60th Street N Corridor Study and the 2020 Interstate Decennial Study in the 'Previous Studies' list.*
    - *2040 Opening Year was based on the structure life of interchange bridges.*
    - *Update 'Sioux Falls MPO Travel Demand Model' section to include model adjustment process to be conducted by City of Sioux Falls and HDR.*
    - *Create a sensitivity scenario with the 259th Street crossing of I-29 (no interchange, just an overpass).*
    - *Update Interchange and Freeway Segment LOS goals to:*
        - *LOS goal: **LOS C***
        - *Individual movement will be allowed to operate at: **LOS D***
            - *Note approximate timeframe of when LOS D would occur*
    - *Update ramp terminal intersection LOS goals to:*
        - *LOS goal: **LOS C***
        - *Individual movement will be allowed to operate at: **LOS D***
    - *Note consideration of ramp terminal intersections that exceed the minimum allowable LOS in the future No Build condition and the approach to address/incorporate in the analysis.*
    - *Note future Kiwanis Avenue bridge footprint may be impacted by findings from the traffic operations analysis.*
        - *Kiwanis bridge is scoped (planned 2028/2029 SDDOT project) to be a 3-lane section.*
    - *Revise the date in Section 12 Appendix.*

Meeting Minutes

Project:	I-90 / I-29 Interchange Traffic Operations Analysis
Subject:	Preliminary Findings Meeting
Date:	Thursday, August 03, 2023
Location:	Webex

Attendees:

- ☒ Mark Leiferman – SDDOT
- ☒ Steve Gramm – SDDOT
- ☒ Katrina Burckhard – SDDOT
- ☒ John Less – SDDOT
- ☒ Harry Johnston – SDDOT
- ☒ Travis Dressen – SDDOT
- ☒ Kelly VanDeWiele – FHWA
- ☐ Shannon Ausen – City of Sioux Falls
- ☐ Sam Trebilcock – City of Sioux Falls
- ☒ Fletcher Lacock – City of Sioux Falls
- ☒ Danaca Schettler – City of Sioux Falls
- ☒ Sean Hegyi – SECOG

- ☒ Jon Wiegand – HDR
- ☒ Tom Cook – HDR
- ☒ Jason Kjenstad – HDR
- ☒ Steve Hoff – HDR

Meeting Objectives

A. Review preliminary findings from DRAFT memo
B. Identify next steps

Minutes

HDR provided an overview of the DRAFT I-90/I-29 Interchange traffic Operations memo and preliminary findings.

SDDOT requested an update to the 2017 I-90/I-29 interchange layout with recommendations in the traffic operations memo for:

- I-90 westbound dual off-ramp
    - Identify conceptual, planning-level structure length to accommodate width for two westbound ramp lanes (2017 configuration shows a single free-flow lane); it is anticipated that the required structure length will be determined through the I-90 design project following completion of topo survey
- I-29 northbound dual on-ramp with northbound I-29 auxiliary lane between I-90/I-29 system interchange and I-29 Exit 86 northbound off-ramp

The need for 2-D or 3-D layouts will be confirmed with SDDOT through the amendment process.

Action Items:

SDDOT/City of Sioux Falls/SECOG

- Memo and HCS comments to HDR by August 18, 2023

HDR

- Provide memo with HCS reports and HCS files as part of this review
- Draft amendment for conceptual layout updates
- Schedule follow-up meeting to discuss comments and conceptual layout updates

Agenda

Project:	I-90 / I-29 Interchange Traffic Operations Analysis
Subject:	Layout Review
Date:	Tuesday, October 31, 2023
Location:	Microsoft Teams

Attendees:

- ☒ Mark Leiferman – SDDOT
- ☒ Steve Gramm – SDDOT
- ☒ Katrina Burckhard – SDDOT
- ☐ John Less – SDDOT
- ☒ Harry Johnston – SDDOT
- ☒ Travis Dressen – SDDOT
- ☒ Kelly VanDeWiele – FHWA
- ☒ Shannon Ausen – City of Sioux Falls
- ☒ Sam Trebilcock – City of Sioux Falls
- ☒ Fletcher Lacock – City of Sioux Falls
- ☒ Danaca Schettler – City of Sioux Falls
- ☒ Sean Hegyi – SECOG

- ☒ Jon Wiegand – HDR
- ☒ Tom Cook – HDR
- ☒ Jason Kjenstad – HDR
- ☒ Steve Hoff – HDR

Meeting Objectives

A. Review and discuss I-90/I-29 interchange layout options

Agenda

1. Study update
    a. Memo

2. Operations analysis update
    a. Sioux Falls travel demand model select-link analysis

Approximately 15% of the EB/WB I-90 to SB I-29 ramp traffic is destined for the 60th Street N off-ramp. Approximately 10% of the NB I-29 to EB I-29 ramp traffic originated from 60th Street N on-ramp.

3. Layouts
    a. Concepts
        i. A) I-29 4-Lane Section between Exit 84 and Exit 86
        ii. B) I-29 6-Lane Section between Exit 84 and Exit 86
            1. 3 lanes northbound/southbound between Exit 84 and Exit 86
    b. Westbound I-90 2-lane off-ramp (applicable to both concepts)
        i. Options
            1. Parallel type off-ramp
            2. Taper type off-ramp
        ii. Overhead sign and gore location considerations
        iii. Volume lane distribution considerations
        iv. Recovery lane or future 3-lane I-90?
    c. HDR preliminary recommendation: *modified 1a*
        i. Extend WB '3rd lane' west through diverge point and merge before loop ramp (before WB to SB flyover)
        ii. Shift gore area east to locate diverge point away from bridge for visibility and overhead sign location

Add brief discussion of items to be considered in conjunction with future design to memo:

- *Prompt to review fill section feasibility (fill section vs. bridge) between WB to SB and EB to NB flyover ramp bridges in design (shown as fill section in figures)*
- *Prompt to review constructability of the NB to EB and SB to WB ramps, regarding whether they should be constructed on or off alignment*

Add brief discussion regarding feasibility of new interchanges/overpass between I-90/I-29 system interchange and adjacent service interchanges:

- *Reference Decennial Interstate study feasibility findings for a new I-90 interchange between I-29 and Cliff Avenue (Decennial 2010?).*
- *Note potential 259th Street overpass and whether the recommended concept has any impact on that (just wider pavement footprint with a 6-lane section) and challenges with constructing an interchange at this location.*

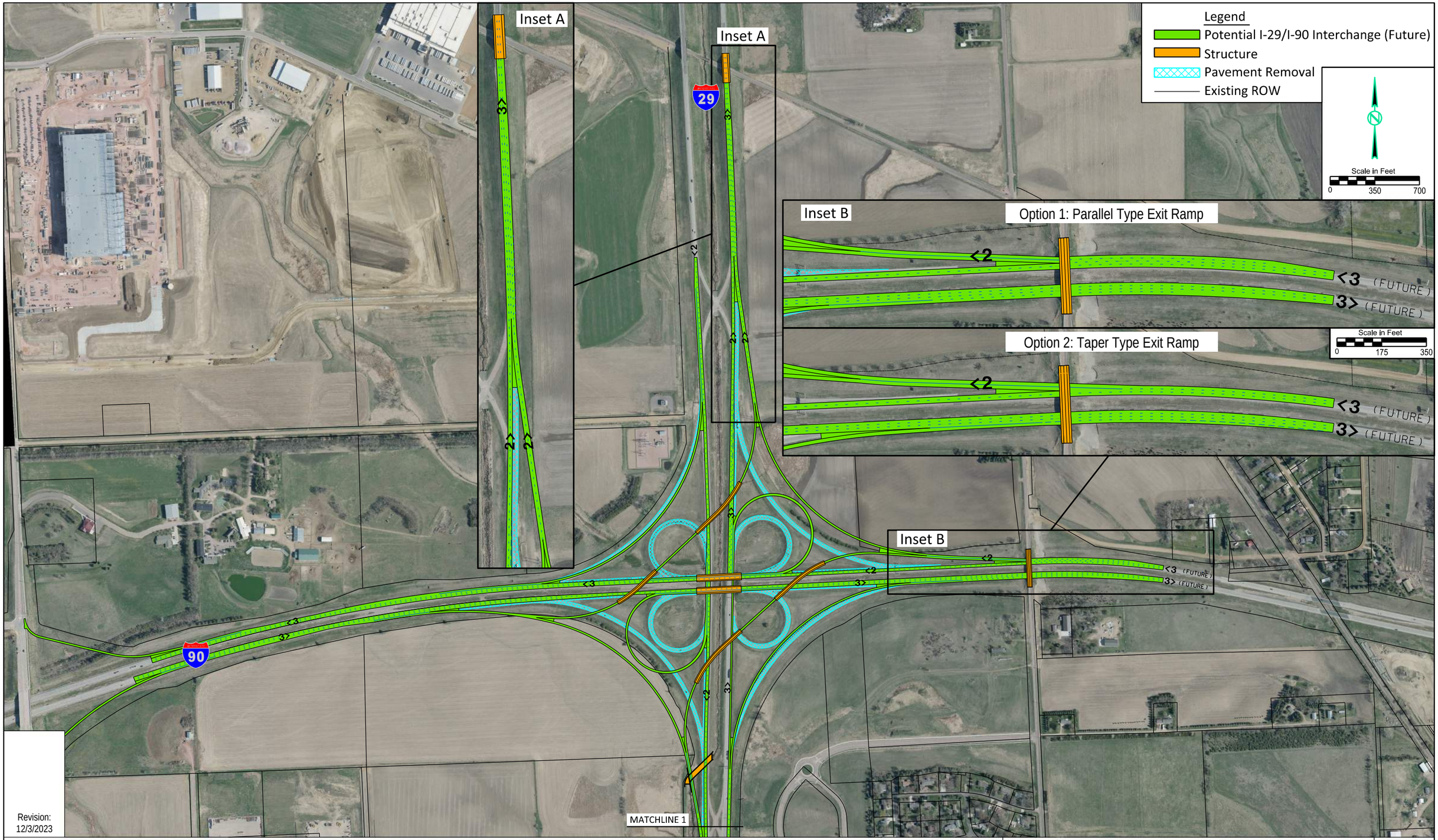
I-90/I-29 system interchange layout modifications

- *Add red X's to the layouts to show loop ramps being removed.*
- *Adjust how culvert is shown in SW quadrant to align with creek flow. Extend box culvert under I-29 SB lanes as it would likely be reconstructed.*
- *Incorporate recommendation items (extension of WB lane, gore shifted east)*
- *Misc. clean-up items (EB I-90 horizontal curve)*

General layout updates

- *Show recommended system interchange layout with (future build-out of) 60th St N interchange and Marion Road interchange*

4. Next Steps
    a. Update layout(s)
    b. Finalize DRAFT memo and distribute for review
    c. Provide design files to SDDOT as part of deliverables



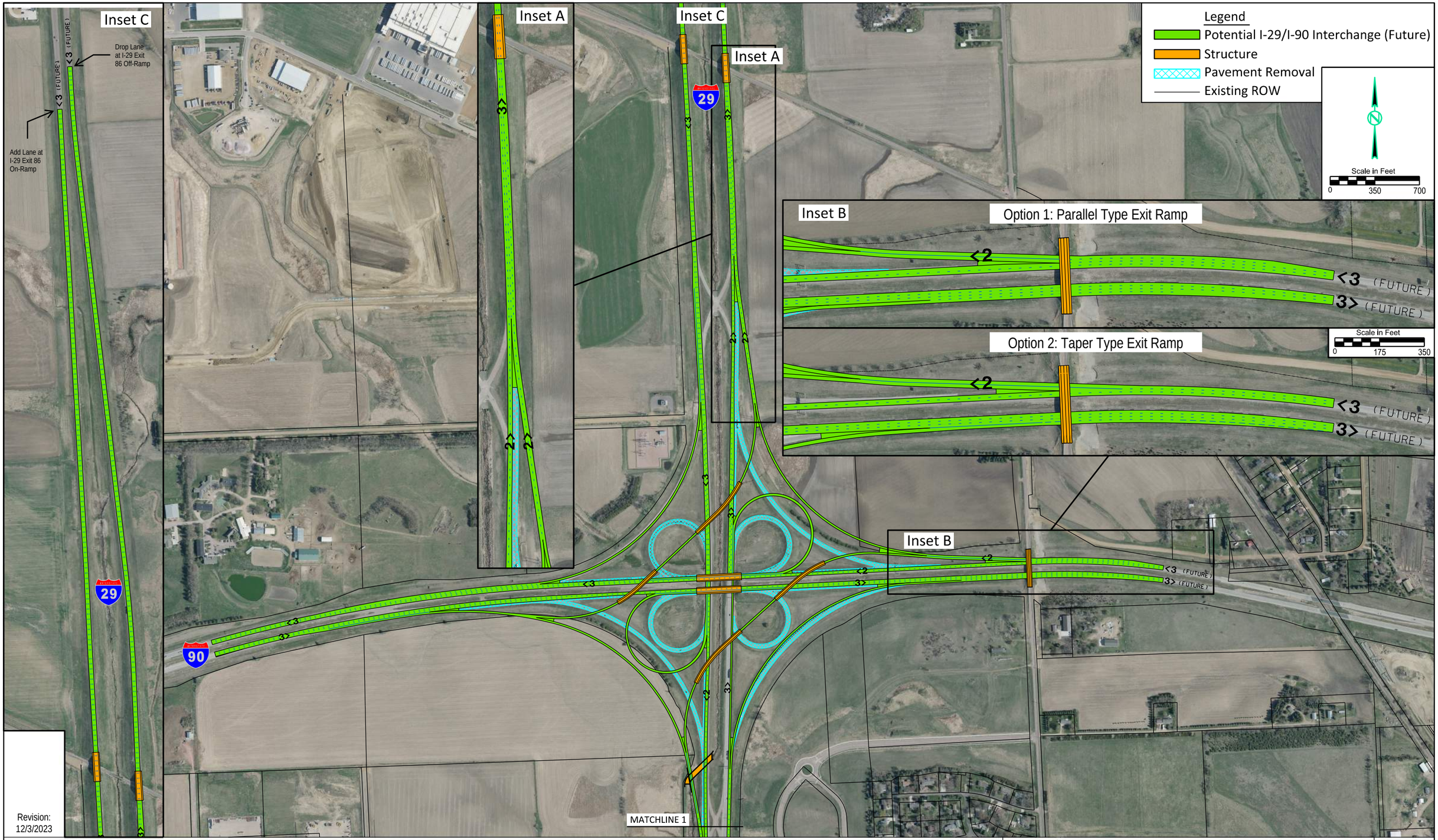
Revision:
12/3/2023

I-90/I-29 System Interchange (I-90 Exit 396, I-29 Exit 84)

Concept A: I-29 4-Lane Section between Exit 84 and Exit 86

I-90/I-29 Interchange Operations Analysis *Sioux Falls, SD*

Figure
11



Revision:
12/3/2023

I-90/I-29 System Interchange (I-90 Exit 396, I-29 Exit 84)

Concept B: I-29 6-Lane Section between Exit 84 and Exit 86

I-90/I-29 Interchange Operations Analysis *Sioux Falls, SD*

Figure
11