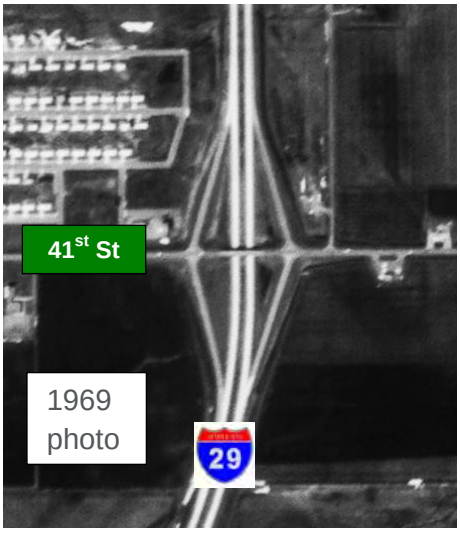
Technical Memo

Date:	April 12, 2017
Project:	I-29 Exit 77 (41st Street) Interchange Modification Justification Report, Project # PL0100(84) 3616P, PCN 05MH
To:	Study Advisory Team
From:	HDR
Subject:	I-29 Exit 77 (41st Street) Interchange Alternatives Evaluation and Recommendation

1. Backgound

The original I-29/41st Street interchange was constructed in 1960 along with I-29 on the west side of Sioux Falls. At that time, most of the property in the vicinity of the interchange was undeveloped as shown in the photo at right. As shown in the 2014 photo at lower right, the area around the interchange has fully developed.



I-29 and 41st Street improvements over the years included (see photo at lower left):

- widening and raising the interchange bridge in 1979
- realigning and widening the southbound off-ramp to a 2-lane exit ramp with dual right-turn lanes and dual left-turn lanes at 41st Street in 2011
- reconstructing I-29 to three through lanes in each direction with auxiliary lanes between the 41st Street and 26th Street interchanges in 2011

Despite these improvements, traffic backups and high crash rates have remained a consistent problem at the interchange.[1, 2]

Since 1996, seven other I-29 interchanges from I-229 to I-90 have been added or reconstructed. The I-29/41st Street interchange is the last interchange along this stretch of the I-29 corridor scheduled for improvement.

[1] HDR, April 2017. Technical Memo 2 Crash Analysis for I-29 Exit 77
[2] HDR, June 2012. I-29 Exit 77 (41st Street) Crossroad Corridor Study

2. Purpose

As part of the current I-29 Exit 77 (41st Street) interchange study, two build alternatives for the I-29 Exit 77(41st Street) interchange are proposed:

- Single Point Interchange (SPI)
- Diverging Diamond Interchange (DDI)

Previous studies have also shown these as the only feasible build alternatives for this interchange.[3] , [4]

Attachment A to this memo provides the proposed build alternatives, as well as a graphic depicting the existing conditions. Reduced size versions of the alternatives are also provided with the discussion of each alternative.

The purpose of this memo is to provide a brief evaluation of each of the build alternatives and provide recommendations on:

- Which alternative(s) to carry forward for further evaluation.
- Which alternative(s) to eliminate from further evaluation.

3. Evaluation Criteria

The main criteria used to evaluate the interchange alternatives are:

3.1 Fulfillment of the Project Purpose and Need [5]

For each item, the evaluation is either yes or no.

- For traffic capacity, is an acceptable LOS provided at signalized intersections?
- Is vehicular safety improved?
- Are safe pedestrian facilities provided that comply with the Americans with Disabilities Act?
- Is adequate separation provided between the interchange ramps and the nearest 41st Street access points?

3.2 Traffic Operations

Year 2045 level of service and delay [6] is a measurement of traffic conditions at the:

- northbound and southbound ramp terminals
- ramps sections between 41st Street and I-29
- I-29 mainline, including weaving

[3] Felsburg Holt & Ullevig, August 2010. SDDOT Decennial Interstate Corridor Study Phase 2 Report
[4] HDR, June 2012. I-29 Exit 77 (41st Street) Crossroad Corridor Study
[5] HDR, April 2017. Purpose and Need Memo for I-29 Exit 77
[6] HDR, April 2017. Technical Memo 3 Future Traffic Conditions I-29 Exit 77

3.3 Safety

Based on available predictive crash methodology, [7] what is the anticipated number of annual crashes from the time that the facilities are open to traffic to year 2045? Parameters listed are for:

- Total number of predicted annual crashes
- Fatality and injury crashes only

3.4 Driver/Public Perception

This is a subjective estimation of Sioux Falls/South Dakota area driver familiarity for the interchange type.

3.5 Construction Impacts

The main construction impacts associated with proposed improvements are:

- How difficult will it be to maintain traffic during construction? Considering the high traffic volumes on 41st Street and on I-29, impacts to traffic during construction must be kept to a minimum. The evaluations are explained in the context of each alternative discussion.
- Can construction be phased? This is critical considering the need to keep at least one set of ramps open during construction. This is a yes or no evaluation.

3.6 Costs

The various major cost considerations are:

- ROW acquisitions – Since the proposed interchange alternatives concepts fit within the existing I-29 ROW, specific property impacts are not applicable as an evaluation measurement.
- Bridge – For the DDI alternative, a determination on treatment of the existing bridge will be made during the final design phase of the project. Estimated construction costs are provided for:
  - widening the existing 41st Street bridge (DDI only)
  - widening the bridge and overlaying the existing deck (DDI only)
  - constucting a new bridge (DDI and SPI)
- Retaining wall
- Roadway
- Addition of these

3.7 Environmental Impacts

The environmental impacts applicable in this analysis are:

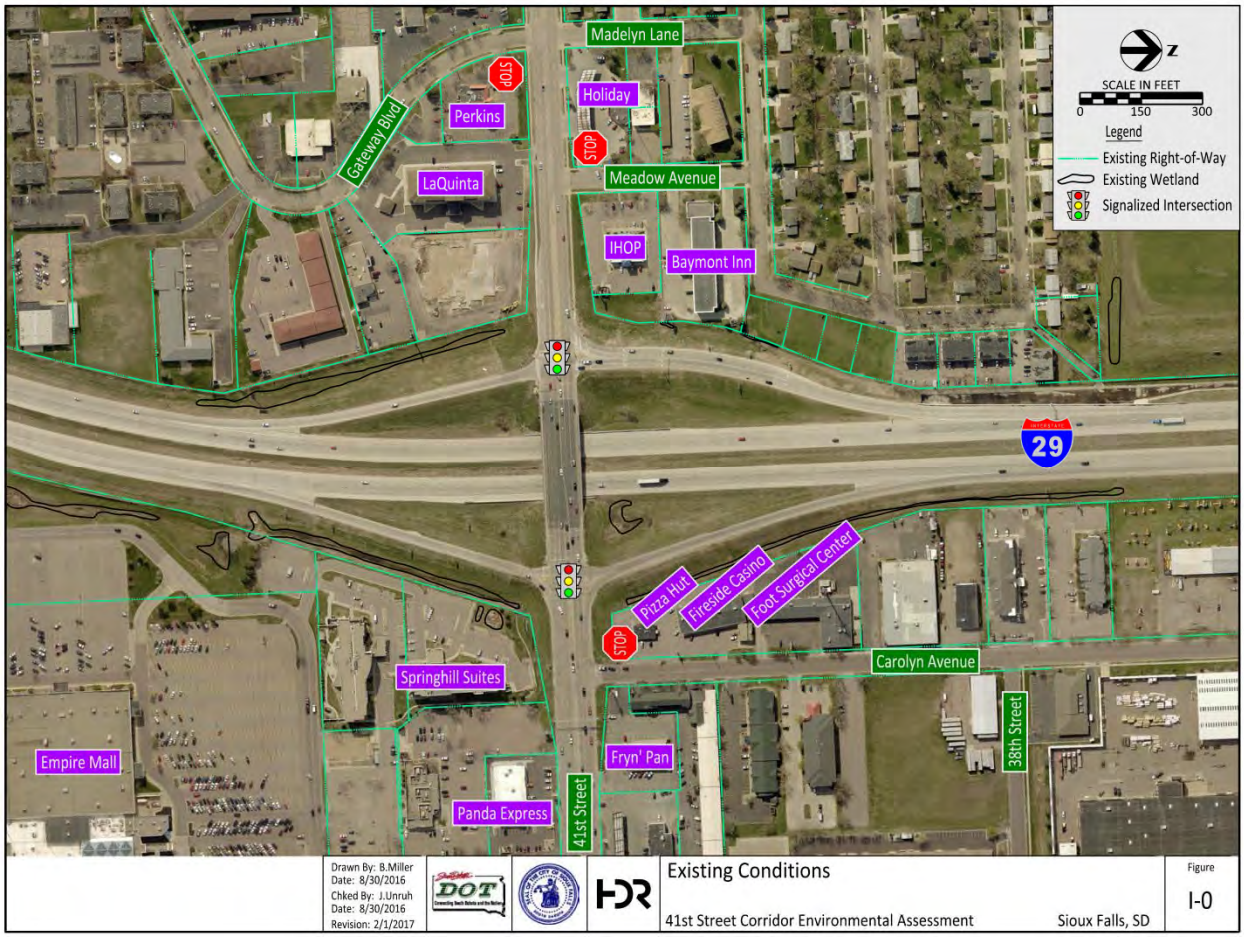
- Wetlands
- Floodplain

[7] HDR, April 2017. Technical Memo 4 Predictive Crash Analysis I-29 Exit 77

4. No-Build Alternative

The No-Build Alternative (**Figure I-0**) will be carried forward as a base-line comparison for the build alternatives. However, as noted in the Alternatives Comparison Matrix, the No-Build Alternative does not meet the Project Purpose and Need for:

- Meeting traffic capacity criteria
- Improving safety
- Improving pedestrian facilities – Landowners have specifically expressed concern over the lack of adequate wheelchair accommodations along 41st Street and at the interchange since there is a relatively high concentration of handicapped and assisted living facilities near 41st Street west of I-29. Access to the Empire Mall shopping area is difficult because of these pedestrian facility limitations.
- Providing adequate separation from the I-29 ramps to the nearest access point, especially Carolyn Avenue



5. Build Alternatives Evaluation

Single Point Interchange

The Single Point Interchange (SPI) alternative (**Figure I-1**) at this location would be similar to the interchange at I-229/10th Street because the crossroad (41st Street or 10th Street) is above the interchange. Other than that feature, this alternative would be similar to the many single point interchanges already in use in the Sioux Falls area.

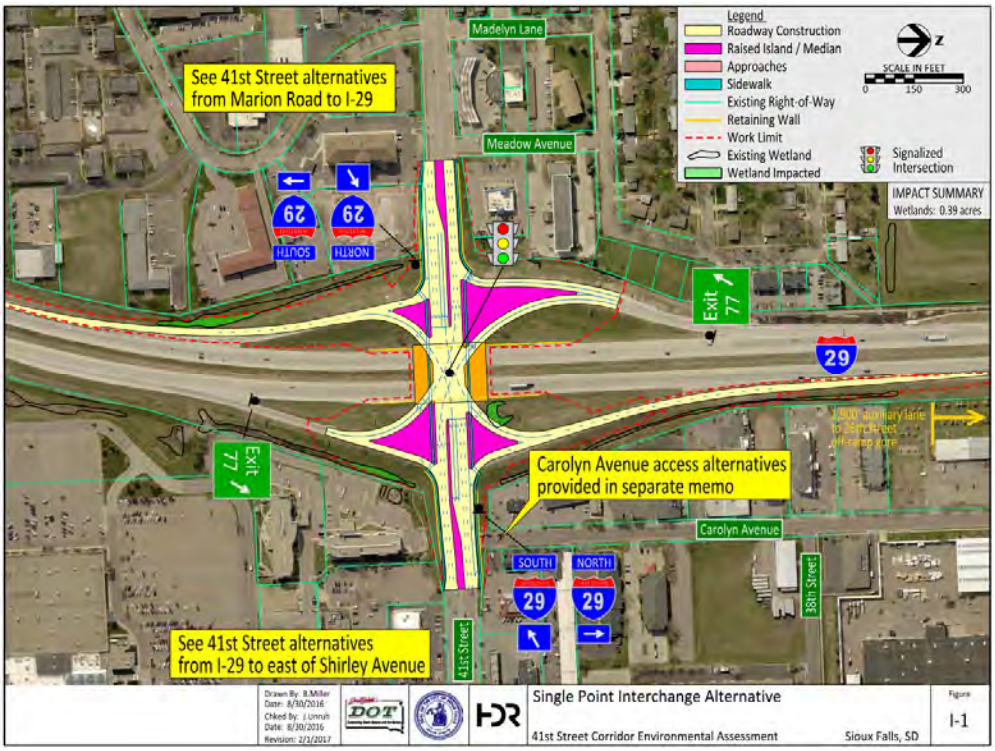
Main benefits of the SPI include:

- Level of service criteria are met at the single signalized intersection.
- Drivers in the area are familiar and comfortable with this type of interchange.

Main drawbacks of SPI include:

- With 41st Street above I-29, the bridge width will require a raised profile of 41st Street of several feet to meet vertical clearance criteria above I-29. This raised 41st Street profile will make maintenance of traffic during construction difficult and expensive with the need to use sheet piling, temporary traffic diversions, and lengthy duration ramp closures.
- The construction cost of the SPI is significantly higher than the anticipated cost of the DDI. This is due mainly to the additional bridge (regardless of whether the existing bridge is replaced or not with the DDI) and retaining wall costs associated with the SPI.

It is recommended that the SPI be dropped from further evaluation because of its high construction cost since another alternative with a significantly lower cost is available and because of the difficulty in maintaining traffic during construction. The SPI also has a higher predictive crash rate than the DDI alternative.



Diverging Diamond Interchange

The Diverging Diamond Interchange (DDI) alternative (**Figure I-2**) represents a relatively new type of interchange. Approximately 60 DDIs have been constructed in the United States since 2011 and many more are in the study or design phase. DDIs have generally resulted in higher traffic capacities and lower crash rates where implemented in place of an existing standard diamond interchange.

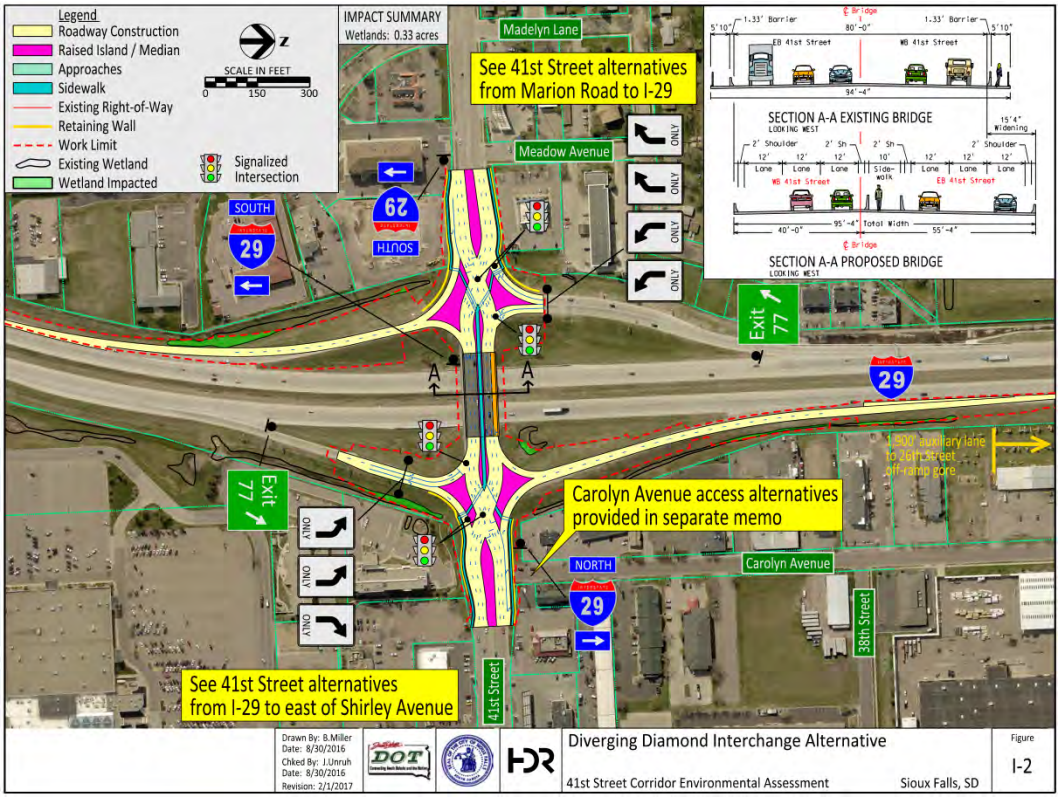
Main benefits of the DDI include:

- Level of service criteria are met at the signalized intersections.
- The predictive crash analysis determined that the DDI would have lowest number of crashes to year 2045 in comparison to the No-Build and SPI alternatives.
- Since the profile of 41st Street remains the same as existing, maintenance of traffic during construction is simpler than the SPI. One of the benefits of the DDI at other locations has been the ease of maintaining traffic during construction.
- The construction cost is significantly lower than the SPI regardless of whether the existing bridge is widened, widened and overlaid, or replaced with a new bridge.

Main drawbacks of DDI include:

- A DDI has not yet been constructed in the Sioux Falls/South Dakota area so driver familiarity would initially be a concern. In other locations, DDI installations have been widely accepted by drivers and the public.

It is recommended that the DDI be carried forward for further evaluation because of its lower construction cost than the SPI, better maintenance of traffic during construction, and lower predicted crash rate.



6. Build Alternatives Evaluation Summary

Alternatives recommended to be carried forward for further consideration:

Alternative	Main reason(s) for carrying forward
Diverging Diamond Interchange	• Significantly lower construction cost than SPI (regardless of treatment of the existing bridge) • Allows for better maintenance of traffic during construction than SPI • Lower predictive crash rate than SPI

Alternatives recommended to be eliminated from further consideration:

Alternative	Main reason(s) for elimination
Single Point Interchange	• Significantly higher construction cost than DDI • Difficulty in maintaining traffic during construction • Higher predictive crash rate than DDI

Comparison Matrix
Interchange Alternatives

I-29 Exit 77 (41st Street) Interchange Study
Project # PL0100(84) 3616P, PCN 05MH

4/12/17

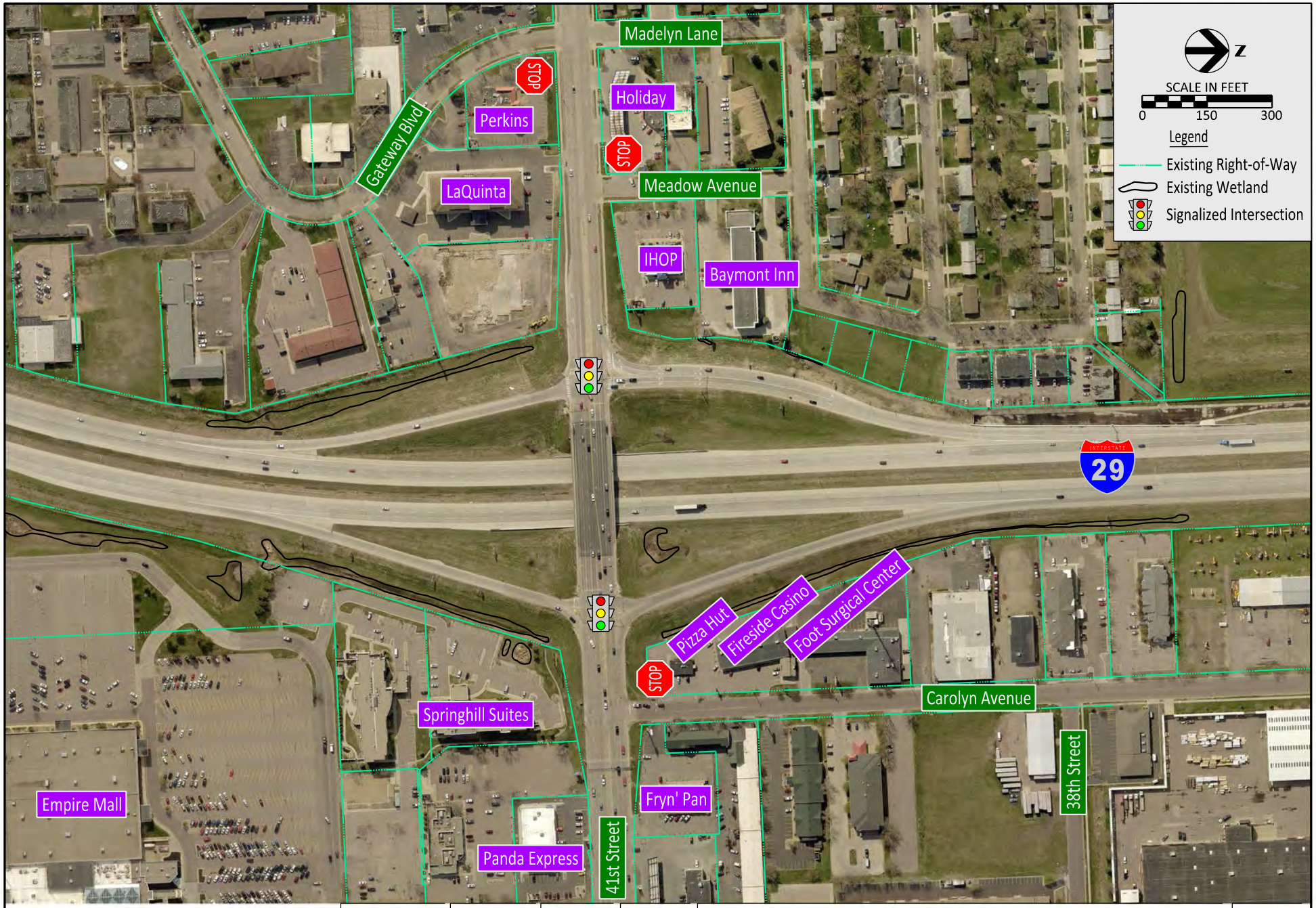
Alternative		Purpose and Need				Year 2045 Traffic Operations						Safety		Driver/ Public Perception	Construction Impacts		Comparative Costs (5)					Applicable Env. Impacts	
		Meets SDDOT and City LOS Criteria	Improves Safety	Improves Pedestrian Facilities	Provides Adequate Separation to Nearest Access (1)	Northbound Ramp Intersection		Southbound Ramp Intersection		Ramps	Mainline Weaving	Predicted Annual Total Crashes Year of opening to 2045	Predicted Annual Fatality and Injury Crashes Year of opening to 2045	Driver Familiarity	Maintenance of Traffic during Construction	Allows for Phased Construction	ROW Acquisition	Bridge (6)	Retaining Wall	Roadway	Total	Wetlands	Floodplain
						Worst LOS AM/PM	Worst Delay AM/PM	Worst LOS AM/PM	Worst Delay AM/PM	Worst LOS AM/PM	Worst LOS AM/PM	#	#				M $	M $	M $	#	#	acres	acres
Single Point Interchange (SPI)		yes	yes	yes	yes	B/C (2)	20/24 (2)	(2)	(2)	C/C	C/B	41.2	16.4	good	poor	yes	(4)	7.8	4.1	9.3	21.2	0.39	0
Diverging Diamond Interchange (DDI)	Widen existing bridge	yes	yes	yes	yes	C/C	26/23	C/C	26/25	C/C	C/B	32.9	11.5	(3)	good	yes	(4)	1.0	2.0	7.7	10.7	0.33	0
	Widen and overlay existing bridge																	1.3			11.0		
	New bridge																	5.5			15.2		
No-Build		no	no	no	no	C/E	28/76	C/F	34/85	C/C	C/B	57.0	23.1	good	0	NA	0	0	0	0	0	0	0

NA: Not Applicable
(1) SDDOT policy requires a minimum 100' separation from an interstate ramp junction/turn lane to the nearest access point.
(2) LOS and Delay applies to the single intersection associated with the SPI.
(3) While the DDI would be a new configuration for this area, drivers have become well-adapted to DDI interchanges where they have been implemented in other locations.
(4) Interchange alternatives are designed to fit within the existing I-29 ROW.
(5) 41st Street construction cost limits are based on estimated final Control of Access limits (per direction from SDDOT).
(6) Determination of bridge treatment with DDI alternative will be made during the final design process
Options recommended for elimination from further evaluation

Attachment A

I-29 Exit 77 (41st Street) Interchange Alternatives

Figures I-0 to I-2



Drawn By: B.Miller
Date: 8/30/2016
Chked By: J.Unruh
Date: 8/30/2016
Revision: 2/1/2017

Existing Conditions

41st Street Corridor Environmental Assessment Sioux Falls, SD

Figure I-0

Drawn By: B.Miller
Date: 8/30/2016
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Date: 8/30/2016
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Single Point Interchange Alternative

41st Street Corridor Environmental Assessment — Sioux Falls, SD

Figure I-1

Drawn By: B.Miller
Date: 8/30/2016
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Date: 8/30/2016
Revision: 2/1/2017

Diverging Diamond Interchange Alternative

41st Street Corridor Environmental Assessment — Sioux Falls, SD

Figure I-2