



I-29 Exit 71 Interchange Modification Justification Report

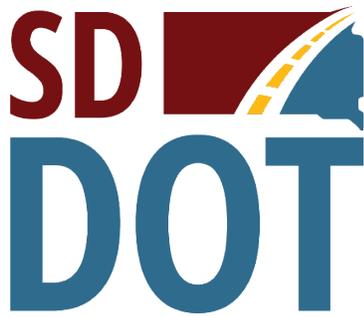
Lincoln County, South Dakota
September 27, 2023

I-29 Exit 71 Interchange Modification Justification Report

Lincoln County, SD

September 27, 2023

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Contents

1.	Executive Summary	1
1.1	Interchange Alternatives and Recommendation	1
1.2	I-29 Mainline Alternatives and Recommendation	2
1.3	Recommendation Layout	3
1.4	FHWA Policy Points	3
2.	Introduction	10
2.1	Background	10
2.2	Project Purpose and Need	10
2.3	Project Location	11
3.	Methodology	18
4.	Existing Conditions	18
4.1	Demographics	18
4.2	Land Use	19
4.3	Existing Roadway Network	21
4.4	Alternative Travel Modes	21
4.5	Existing Interchanges	21
4.6	Existing Data	22
4.7	Operational Performance	23
4.8	Existing Safety Conditions	28
4.9	Existing Environmental Constraints	34
5.	Need	37
5.1	Traffic Operations (Primary Need)	37
5.2	Road Surface Condition (Primary Need)	37
5.3	Safety (Secondary Need)	37
5.4	Current Design Standards (Secondary Need)	38
5.5	Goals	38
6.	Alternatives	38
6.1	Exit 71 Interchange Alternatives	38
6.2	I-29 Mainline Alternatives	49
7.	Future Year Traffic	58
8.	Alternatives Analysis	62
8.1	Conformance with Transportation Plans	62
8.2	Compliance with Policies and Engineering Standards	62
8.3	Exit 71 Interchange Operational Performance	63
8.4	I-29 Freeway Interchange Operational Performance	71
8.5	Safety	76
8.6	Environmental Impacts	79
8.7	Constructability and Maintenance of Traffic During Construction	80
8.8	Other Traffic Considerations	86
8.9	Evaluation of Interchange Alternatives	88
8.10	Evaluation of I-29 Mainline Alternatives	100

9. Coordination 102

10. Funding Plan 104

11. Recommendation 104

12. Appendix..... 113

Appendix

A. Methods and AssumptionsA

B. Existing and Future No Build Condition Traffic Operations Analysis MemoB

C. Crash History Review Memo.....C

D. Traffic Forecast MemoD

E. Build Condition Traffic Operations Analysis MemoE

F. Interchange Year of Level of Service ‘D’ Memo.....F

G. Future Condition Reliability Analysis MemoG

H. Predictive Safety Analysis MemoH

I. Median Barrier Warrant Review MemoI

J. Conceptual Construction Phasing and Sequencing for Maintenance of Traffic MemoJ

K. WAPA Coordination Summary MemoK

L. I-29 Exit 71/Ninemile Creek Preliminary Hydrologic and Hydraulic Review MemoL

M. Work Zone Maintenance of Traffic Analysis MemoM

N. Conceptual Interchange Signing PlansN

O. I-29 Exit 71 Interchange Build Option Evaluation ReportO

P. Compressed Diamond – 3-Lane vs. 5-Lane 273rd Street Crossroad Summary MemoP

Q. FAA Coordination Summary MemoQ

R. Public Meeting Summary Reports.....R

Tables

Table 1: Study Area Analysis Intersections.....	12
Table 2: Population History	19
Table 3: Level of Service Measures	25
Table 4: Minimum Allowable Level of Service by Facility	25
Table 5: I-29 Freeway Facility Operations – Existing Conditions	26
Table 6: 273 rd Street Unsignalized Intersection Crash Summary (2016-2020) – Injury Severity and Manner of Collision.....	30
Table 7: 273 rd Street Unsignalized Intersection Crash Rates (2016-2020).....	30
Table 8: 273 rd Street Segment Crash Summary (2016-2020) – Injury Severity and Manner of Collision.....	31
Table 9: 273 rd Street Segment Crash Rates (2016-2020).....	31
Table 10: Exit 71 Freeway Crash Summary (2016-2020) – Injury Severity and Manner of Collision.....	32
Table 11: Exit 71 Ramp Crash Summary (2016-2020) – Injury Severity and Manner of Collision	32
Table 12: Exit 71 Freeway Segment Crash Rates (2016-2020).....	33
Table 13: Exit 71 Interchange Ramp Segment Crash Rates (2016-2020).....	33
Table 14: I-29 Cross-Median Crash Summary (2016 – 2020)	34
Table 15: Exit 71 Ramp Terminal Intersection Operations – 2028 Conditions.....	63
Table 16: I-29 Exit 71 Interchange Operations – 2028 Conditions.....	63
Table 17: 273 rd Street Intersection Operations – 2028 Build Condition	64
Table 18: 273 rd Street Intersection Operations – 2028 No Build Condition.....	64
Table 19: Exit 71 Ramp Terminal Intersection Operations – 2050 Conditions.....	65
Table 20: Exit 71 Interchange Operations – 2050 Conditions.....	65
Table 21: 273 rd Street Intersection Operations – 2050 Build Condition	65
Table 22: 273 rd Street Local Network Intersection Operations – 2050 No Build Condition	66
Table 23: Exit 71 Compressed Diamond Interchange TWSC Year of Need (LOS D).....	68
Table 24: 273 rd Street Volume-Based Turn Lane Warrant Review	69
Table 25: Exit 71 Year of LOS C/D Threshold Analysis	69
Table 26: I-29 Freeway Scenario Number of Lanes.....	71
Table 27: I-29 Freeway Operations – 2040 Partial Build Condition	74
Table 28: Predicted I-29 Exit 71 Interchange Total Crashes (2028-2050).....	77
Table 29: Predicted I-29 Mainline Total Crashes, Exit 68 to Exit 71 (2028-2040).....	78
Table 30: Exit 71 Interchange Alternatives Environmental Impacts	79
Table 31: Summary of I-29 Exit 71 Interchange Closures During Construction.....	80
Table 32: Summary of I-29 Exit 71 Interchange Construction Duration and MOT Score.....	81
Table 33: Exit 71 Interchange Alternative Evaluation Matrix.....	89
Table 34: Interchange Type (I-29 Under) Screening Summary	93
Table 35: 273 rd Street Alignment Screening Summary	95
Table 36: Compressed Diamond – 1a (3L) vs. 1a (5L) Comparison.....	98
Table 37: Anticipated Funding Allocation	104

Figures

Figure ES-1: IMJR Recommendation (I-29 Exit 71 Interchange and I-29 Mainline)	8
Figure 1: Study Area	13
Figure 2: Existing I-29 Exit 68 Interchange Configuration	14
Figure 3: Existing I-29 Exit 71 Interchange Configuration	15
Figure 4: Existing I-29 Exit 73 Interchange Configuration	16
Figure 5: I-29 Mainline and Study Area Intersection Lane Configurations	17
Figure 6: Growth Areas Within Sioux Falls MPO	19
Figure 7: City of Tea Future Land Use	20
Figure 8: City of Harrisburg Future Land Use	20
Figure 9: LOS Descriptions	24
Figure 10: 2021 Existing Conditions Traffic Volumes and LOS	27
Figure 11: Environmental Constraints	35
Figure 12: Alternative 1a: Compressed Diamond Interchange (I-29 Under)	40
Figure 13: Alternative 1b: Compressed Diamond Interchange (I-29 Over)	41
Figure 14: Alternative 1a: SPI (I-29 Under)	42
Figure 15: Alternative 2b: SPI (I-29 Over)	43
Figure 16: Alternative 3a: DDI (I-29 Under)	44
Figure 17: Alternative 3b: DDI (I-29 Over)	45
Figure 18: 273 rd Street Alignment Option 6-foot Offset	46
Figure 19: Street Alignment Option 55-foot Offset	47
Figure 20: Street Alignment Option 88-foot Offset	48
Figure 21: I-29 Mainline Alternatives	50
Figure 22: Airport RPZ Avoidance Option 1 – On Alignment (36-foot Median)	55
Figure 23: Airport RPZ Avoidance Option 2 – East Alignment (36-foot Median)	56
Figure 24: Airport RPZ Avoidance Option 3 – East Alignment (60-foot Median)	57
Figure 25: 2028 No Build Condition Traffic Volumes	59
Figure 26: 2040 No Build Condition I-29 Traffic Volumes	60
Figure 27: 2050 No Build Condition Traffic Volumes	61
Figure 28: Exit 71 Interchange and 273 rd Street Traffic Operations Summary	67
Figure 29: I-29 Future Year No Build Condition Traffic Operations Summary	72
Figure 30: I-29 Future Year Build Condition Traffic Operations Summary	73
Figure 31: Future Year Northbound AM Reliability Cumulative Frequency	75
Figure 32: Future Year Southbound PM Reliability Cumulative Frequency	75
Figure 33: Predicted I-29 Exit 71 Interchange Average Annual Crash Frequency (2028-2050)	77
Figure 34: Median Barrier Warrant Matrix	79
Figure 35: I-29 Mainline Construction Phasing	84
Figure 36: 5-Lane Bridge Phasing Option to Maintain Traffic during Construction	97
Figure 37: Recommended Interchange Alternative 1a (5L): Compressed Diamond (I-29 Under) with 273 rd Street 5-Lane Section	99
Figure 38: Study Website (www.i29exit71.com)	103
Figure 39: IMJR Recommendation (I-29 Exit 71 Interchange and I-29 Mainline)	110
Figure 40: Recommended I-29 Exit 71 Interchange Signing Plan	112

Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AWSC	All-Way Stop-Control
CH	County Highway
COA	Control of Access
DDI	Diverging Diamond Interchange
ETT	Experienced Travel Time
F&I	Fatal and Injury
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
HCM6	Highway Capacity Manual 6 th Edition
HCS	Highway Capacity Software
I-29	Interstate 29
IHSDM	Interactive Highway Safety Design Model
IMJR	Interchange Modification Justification Report
LOS	Level of Service
M&A	Methods and Assumptions
MEV	Million Entering Vehicles
MOT	Maintenance of Traffic
MPO	Metropolitan Planning Organization
MRM	Mileage Reference Marker
MSA	Metropolitan Statistical Area
MUTCD	Manual on Uniform Traffic Control Devices
MVMT	Million Vehicle Miles Traveled
NEPA	National Environmental Policy Act
NPMRDS	National Performance Management Research Data Set
O-D	Origin-Destination
PCN	(SDDOT) Project Control Number
PDO	Property Damage Only
RPZ	Runway Protection Zone
RTI	Ramp Terminal Intersection
SAT	Study Advisory Team
SDDOT	South Dakota Department of Transportation
SPI	Single Point Interchange
STIP	Statewide Transportation Improvement Program
TDM	Travel Demand Model
TWSC	Two-Way Stop-Control
WAPA	Western Area Power Administration

1. Executive Summary

The South Dakota Department of Transportation (SDDOT) initiated an Interchange Modification Study of the I-29 Exit 71 interchange, the 273rd Street corridor between 470th Avenue and 471st Avenue, and I-29 mainline between Exit 68 and Exit 73 to further evaluate and refine alternatives developed as part of the 2018 *I-29 Exit 62 to 73 Corridor Study*. This study is also an extension of established needs and timelines developed as part of the SDDOT's *Decennial Interstate Corridor* studies.

This Interchange Modification Justification Report (IMJR) was developed to satisfy requirements presented in the Federal Highway Administration (FHWA) *Policy on Access to the Interstate System*, dated May 22, 2017, and presents a technical evaluation of the operational feasibility of the proposed improvements compared to a No Build condition.

The Project purpose is to preserve transportation assets, provide for the reliability and efficiency of the transportation system, and provide consistency with transportation planning along I-29 mainline from Exit 68 to Exit 73 and on 273rd Street/Lincoln County Highway 110 (CH110) through the Exit 71 interchange. Needs to be addressed by the proposed Project include:

- Traffic operations
- Road surface conditions
- Safety
- Current design standards

1.1 Interchange Alternatives and Recommendation

The following interchange alternatives were carried forward and refined from the previous corridor study or developed specific to this Interchange Modification Study:

1. No Build
2. Alternative 1a: Compressed Diamond Interchange (I-29 Under)
3. Alternative 1b: Compressed Diamond Interchange (I-29 Over)
4. Alternative 2a: SPI (I-29 Under)
5. Alternative 2b: SPI (I-29 Over)
6. Alternative 3a: DDI (I-29 Under)
7. Alternative 3b: DDI (I-29 Over)

Each alternative reflects intersection lane configuration and traffic control needs established in the traffic operations analysis.

The interchange alternative screening followed a 3-step process to compare and eliminate alternatives from further consideration:

1. **'I-29 Under' or 'I-29 Over'**: determine whether I-29 goes under or over 273rd Street
2. **Interchange type**: determine interchange type
3. **273rd Street alignment**: determine whether 273rd Street is constructed on- or off-alignment and to what degree of offset

Following the 3-step evaluation process, the finalist alternative was further refined based on:

- 273rd Street number of lanes
- Westbound 273rd Street right turn needs at the northbound ramp terminal intersection
- 273rd Street alignment
- Bicycle and pedestrian facilities

The IMJR recommended interchange alternative for PCN 3167 is **Alternative 1a (5L) Compressed Diamond (I-29 Under) with 273rd Street 5-Lane Section**, which includes:

- 1a Compressed Diamond (I-29 Under)
- 273rd Street 5-lane section through interchange
- Free westbound right turn movement at northbound ramp terminal intersection

1.2 I-29 Mainline Alternatives and Recommendation

I-29 mainline alternatives were developed for 4-lane and 6-lane configurations, plus auxiliary lanes north of Exit 73. The evaluation and screening of alternatives focused on I-29 number of lanes and alignment between Exit 71 and Exit 73 through the Marv Skie/Lincoln County Airport runway protection zone (RPZ).

It was found that capacity improvements were most needed from Exit 71 northward to the future 85th Street interchange. South of Exit 71, traffic volumes are considerably lower and the need for additional lanes was further into the study's planning horizon. However, when time to reconstruct segments of I-29 within the study area, it was found that reconstructing to the full 6-lane section (in lieu of deferring construction of the third lane in each direction to a later project) exhibited notable constructability, maintenance of traffic, and cost benefits.

Through coordination with FAA, it was determined that I-29 does not need to be realigned outside of the Marv Skie/Lincoln County Airport RPZ if I-29 is widened to the inside and does not encroach any further to the west towards the airport.

The IMJR recommended I-29 mainline reconstruction alternatives and timeline are as follows:

PCN 3167 Recommendation

- **Exit 73 to 85th Street:** 8-lane section
 - 3 through lanes plus 1 auxiliary lane in each direction
 - Tie into planned 85th Street interchange (PCN 06JQ)
- **Exit 73:** 6-lane section
 - 3 through lanes in each direction
- **Exit 71 through Exit 73:** 6-lane section
 - 3 through lanes in each direction
 - Airport RPZ alignment option: 'Reconstruct on Alignment, Widen to the Inside'
- **Exit 71:** 6-lane section
 - Pavement width for 3 through lanes in each direction
 - Open with 2 through lanes in each direction
 - Northern ramp junctions: northbound lane-add and southbound lane-drop

Defer to Future Project

- **Exit 68 to Exit 71:** 6-lane section
 - Grade and construct 3 through lanes in each direction
- **Exit 68:** 2 through lanes (existing)
 - Northern ramp junctions: northbound lane-add and southbound lane-drop

Supporting Recommendations

- I-29 widening (median width)
 - Widen to inside (36-foot median width)
 - Within and north of Marv Skie/Lincoln County Airport RPZ
 - Widen to outside (60-foot median width)
 - South of Marv Skie/Lincoln County Airport RPZ
 - Transition to begin south of RPZ (no widening within RPZ)
- Coordinate design with planned 85th Street interchange project (PCN 06JQ)
- When I-29 mainline is to be reconstructed from Exit 71 southward, construct the full 6-lane section based on constructability, maintenance of traffic, and cost benefits
- Consider median barrier from Exit 68 northward

1.3 Recommendation Layout

The recommended modifications as part of PCN 3167 for Exit 71 and I-29 mainline are shown in **Figure ES-1**.

1.4 FHWA Policy Points

The response to the two requirements presented in FHWA's Policy on Access to the Interstate System, dated May 22, 2017, is as follows:

1. **An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).**

The operational and safety analysis contained in this study shows that the recommended 1a (5L) Compressed Diamond (I-29 Under) interchange alternative is not expected to adversely affect the safety or efficiency of the Interstate system.

The study area extends from south of I-29 Exit 68 interchange to north of the I-29 Exit 73 interchange, approximately 5.75 miles. The local street network corridors of 271st Street, 273rd Street, and 276th Street between 470th Avenue and 471st Avenue are also included in the study.

The No Build alternative, six interchange Build alternatives (plus sub-options), and two I-29 mainline alternatives (plus sub-options) were reviewed for operational capacity using Highway Capacity Manual 6th Edition methodology and Highway Capacity Software, version 7. All interchange Build alternatives achieve LOS C in the 2050 Planning Horizon at all intersections, along all arterial corridor segments, and along all Interstate segments with the study area. The No Build condition does not meet LOS C at the Exit 71 southbound ramp terminal intersection (which also results in overall interchange LOS degrading beyond LOS C) or along eight I-29 segments within the study area within the 2050 Planning Horizon.

I-29 Exit 71 Interchange Recommendation

The interchange alternative screening followed a 3-step process to compare and eliminate alternatives from further consideration:

1. **'I-29 Under' or 'I-29 Over'**: determine whether I-29 goes under or over 273rd Street
2. **Interchange type**: determine interchange type
3. **273rd Street alignment**: determine whether 273rd Street is constructed on- or off-alignment and to what degree of offset

In Step 1, all interchange alternatives with I-29 traversing under 273rd Street were carried forward. Interchange alternatives where I-29 went over 273rd Street were eliminated from further consideration due to potential WAPA transmission line conflicts that may require reconstruction of up to four towers, high construction costs, constructability impacts, and environmental impacts.

In Step 2, the Compressed Diamond interchange type was carried forward based on a comparison of benefits and drawbacks. All other interchange types, the SPI and DDI, were eliminated from further consideration. The Compressed Diamond was found to provide differentiating benefits, when compared to other interchange types, for the following criteria:

- Operational performance (traffic operations)
 - Best ramp terminal intersection operations
 - Best overall interchange operations
 - Best long-range operations when considering bridge design life
- Constructability and maintenance of traffic
 - Shortest construction duration
 - Best maintenance of traffic score (comparison)

- *Other traffic considerations*
 - *Allows over height trucks to use interchange ramps to bypass the 273rd Street bridge conflict, while other interchange types require a detour*
 - *Public support*

In Step 3, the No Offset or 6-foot Bridge Offset options for 273rd Street alignment were carried forward contingent upon refining the Compressed Diamond alternative to provide the minimum 100-foot control of access and maintain the Ironworks Avenue & 273rd Street intersection. All rearage road and frontage road (55-foot and 80-foot offset alignment) options were eliminated from further consideration. Key drawbacks to the rearage road options included right-of-way impacts, property acquisition, and potential additional costs to upgrade Kenworth Place. Key drawbacks to the frontage road options included a notable skew to 273rd Street alignment on both sides of the interchange and right-of-way impacts. The No Offset and 6-foot Bridge Offset options best managed right-of-way impacts and 273rd Street alignment skew on either side of the interchange.

The interchange alternative coming out of the 3-step process was the Alternative 1a: Compressed Diamond (I-29 Under) to be constructed on-alignment or with a 6-foot bridge offset to maintain traffic during construction. From there, the Study Advisory Team identified the following items to include as part of further refinement:

- *5-lane section for 273rd Street interchange to align with 75-year bridge design life and provide flexibility to address potential future development surrounding the interchange*
- *Free westbound right turn lane at the northbound ramp terminal intersection to:*
 - *Maintain Ironworks Avenue & 273rd Street intersection while providing the full 100-feet control of access and*
 - *Benefit intersection operations by removing a high-volume movement from the potential signalized intersection through a free, or uncontrolled, movement expected to experience zero or minimal delay*

The recommended interchange alternative is Alternative 1a (5L): Compressed Diamond (I-29 Under) with 273rd Street 5-Lane Section.

Minimum required control of access (100 feet) is provided in all four interchange quadrants.

Local network improvements consist of constructing a 5-lane section on 273rd Street through the Ponderosa Circle, interchange ramp terminals, Ironworks Avenue, and Kenworth Place intersections. The 5-lane section will transition back to the existing 2-lane section prior to the 470th Avenue and 471st Avenue intersections west and east of the interchange, respectively.

Conceptual signing plans for the recommended interchange alternative, and the other two interchange types, are provided in this report.

I-29 Mainline Recommendation

The I-29 mainline evaluation focused on number of lanes through the study area and alignment between Exit 71 and Exit 73.

The traffic operations analysis of future-year volumes established the long-range 2050 Planning Horizon number of lanes to meet LOS requirements:

- Exit 73 to 85th Street (planned interchange): 8-lane section
- Exit 71 through Exit 73: 6-lane section
- Exit 68 through Exit 71: 6-lane section

Higher volumes from Exit 71 northward illustrate a short-range need for capacity improvements and reconstruction to the recommended long-range number of lanes as part of the Exit 71 interchange project.

Within and south of Exit 71, volumes are lower and capacity improvement needs to the long-range lane configuration (6-lane section) are less urgent. However, it is recommended that when I-29 mainline within Exit 71 and south is reconstructed (which may be deferred to a future project due to pavement needs), it is constructed as a 6-lane section based on constructability, maintenance of traffic, and cost considerations presented in this IMJR.

Through coordination with FAA, it was determined that I-29 be reconstructed on existing alignment and widened to the inside through the Marv Skie/Lincoln County Airport runway protection zone (RPZ). I-29 driving lanes will not be allowed to encroach any further west towards the airport without a new RPZ analysis.

I-29 mainline recommendations for this IMJR are as follows:

PCN 3167 Recommendation

- **Exit 73 to 85th Street:** 8-lane section
 - 3 through lanes plus 1 auxiliary lane in each direction
 - Tie into planned 85th Street interchange (PCN 06JQ)
- **Exit 73:** 6-lane section
 - 3 through lanes in each direction
- **Exit 71 through Exit 73:** 6-lane section
 - 3 through lanes in each direction
 - Airport RPZ alignment option: 'Reconstruct on Alignment, Widen to the Inside'
- **Exit 71:** 6-lane section
 - Pavement width for 3 through lanes in each direction
 - Open with 2 through lanes in each direction
 - Northern ramp junctions: northbound lane-add and southbound lane-drop

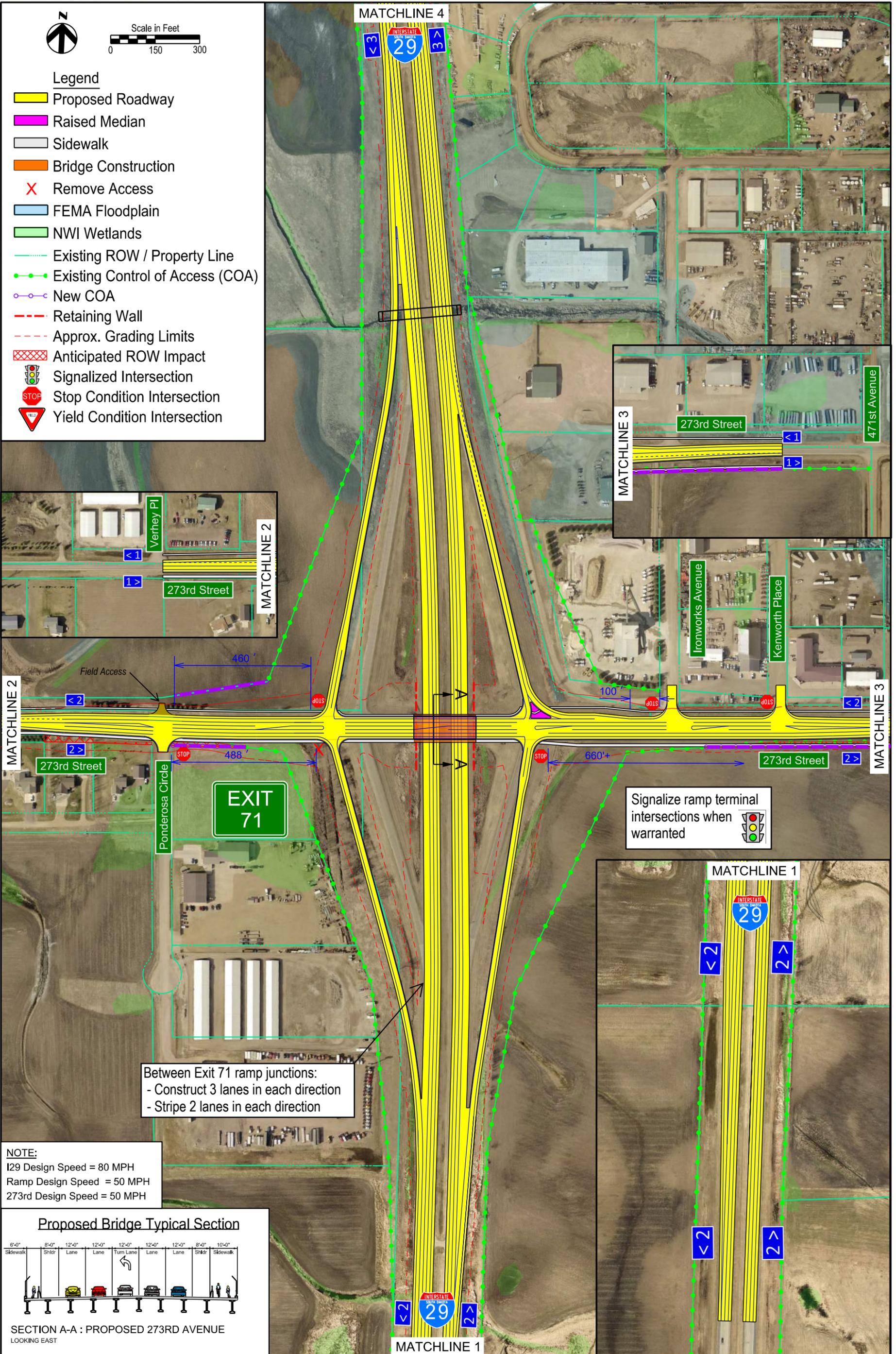
Defer to Future Project

- **Exit 68 to Exit 71:** 6-lane section
 - Grade and construct 3 through lanes in each direction
- **Exit 68:** 2 through lanes (existing)
 - Northern ramp junctions: northbound lane-add and southbound lane-drop

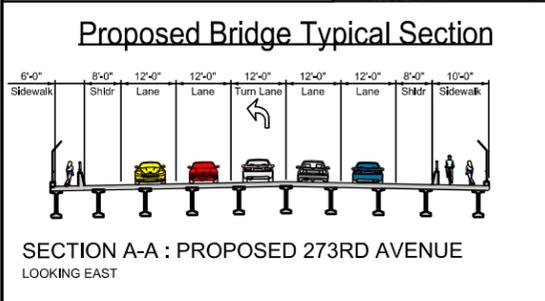
Supporting Recommendations

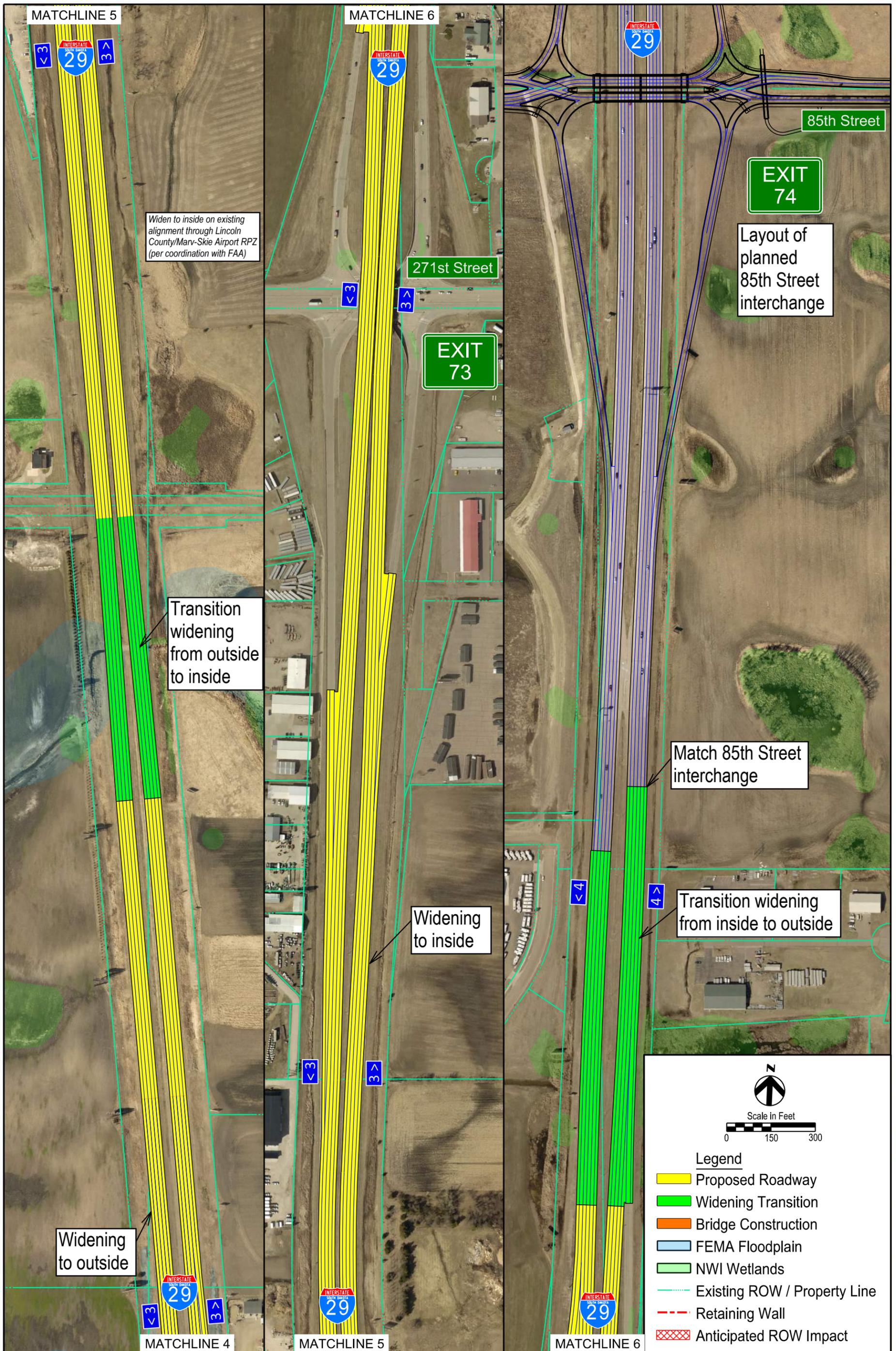
- *I-29 widening (median width)*
 - *Widen to inside (36-foot median width)*
 - *Within and north of Marv Skie/Lincoln County Airport RPZ*
 - *Widen to outside (60-foot median width)*
 - *South of Marv Skie/Lincoln County Airport RPZ; transition to begin south of RPZ*
 - *Coordinate design with planned 85th Street interchange project (PCN 06JQ)*
 - *When I-29 mainline is to be reconstructed from Exit 71 southward, construct the full 6-lane section based on constructability, maintenance of traffic, and cost benefits*
 - *Consider median barrier from Exit 68 northward*
2. **The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.**

The proposed access action is a modification to an existing interchange with full access to a public street. All movements will continue to be served by the modified interchange. The conceptual drawings have been prepared using current standards. Further design using current standards is anticipated.



NOTE:
 I29 Design Speed = 80 MPH
 Ramp Design Speed = 50 MPH
 273rd Design Speed = 50 MPH





2. Introduction

The South Dakota Department of Transportation (SDDOT) initiated an Interchange Modification Study of the I-29 Exit 71 interchange, the 273rd Street corridor between 470th Avenue and 471st Avenue, and I-29 mainline between Exit 68 and Exit 73 to further evaluate and refine alternatives developed as part of the 2018 *I-29 Exit 62 to 73 Corridor Study*. This study is also an extension of established needs and timelines developed as part of the SDDOT's *Decennial Interstate Corridor* studies.

This Interchange Modification Justification Report (IMJR) was developed to satisfy requirements presented in the Federal Highway Administration (FHWA) *Policy on Access to the Interstate System*, dated May 22, 2017, and presents a technical evaluation of the operational feasibility of the proposed improvements compared to a No Build condition. The IMJR methodology and approach is in accordance with section 3.5.3 of FHWA's *Interstate System Access Informational Guide* (August 2010, Figure 3).

2.1 Background

The *I-29 Exit 62 to Exit 73 Corridor Study* provided a holistic look at needs and potential improvements to I-29 mainline and interchanges between and including Exit 62 and Exit 73. Pertinent to this Interchange Modification Study, the corridor study identified operational and safety needs at the Exit 71 interchange and capacity needs along the I-29 mainline, and recommended the following alternatives be carried forward for further consideration:

- **I-29 Exit 71 Interchange**
 - Compressed Diamond
 - Single Point Interchange (SPI) with I-29 under 273rd Street
 - Single Point Interchange (SPI) with I-29 over 273rd Street
- **I-29 mainline**
 - 6-lane section (three lanes in each direction) with potential phased build-out

The SDDOT currently has a project identified as part of the 2027-2030 developmental Statewide Transportation Improvement Program (STIP), PCN 3167, to reconstruct the Exit 71 interchange and I-29 mainline from the planned 85th Street interchange southward to Exit 68.

2.2 Project Purpose and Need

The project purpose is to preserve transportation assets, provide for the reliability and efficiency of the transportation system, and provide consistency with transportation planning along I-29 mainline from Exit 68 to Exit 73 and on 273rd Street/Lincoln County Highway 110 (CH110) through the Exit 71 interchange. Needs to be addressed by the proposed project include:

- Traffic operations
- Road surface conditions
- Safety
- Current design standards

2.3 Project Location

The I-29 Exit 71 interchange is located near I-29 mileage reference marker (MRM) 71 in the southwest Sioux Falls metropolitan area. Adjacent I-29 interchanges include:

- **I-29 Exit 73 (Tea) interchange**
 - 271st Street/CH106/Gateway Boulevard
 - 2 miles north of Exit 71
- **I-29 Exit 68 (Lennox) interchange**
 - 276th Street/CH116
 - 3 miles south of Exit 71

Study corridors are located entirely within Lincoln County and include:

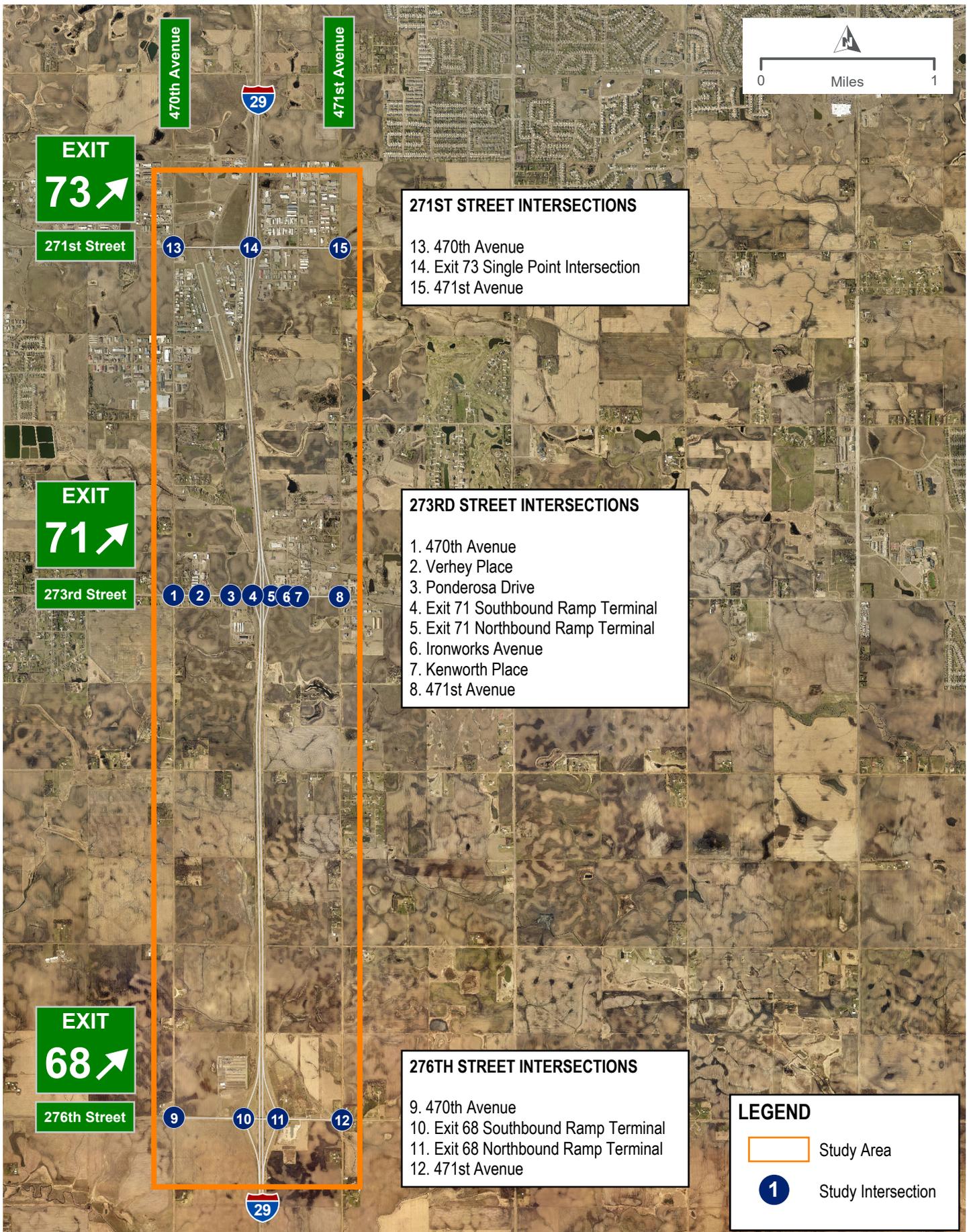
- **I-29 Mainline**
 - Study limits: from south of I-29 Exit 68 interchange to north of the I-29 Exit 73 interchange, approximately 5.75 miles
- **273rd Street (CH110)**
 - Cross-section: 2-lane rural highway
 - Study limits: from the intersection with 470th Avenue to the intersection with 471st Avenue, approximately 0.96 miles
- **271st Street/Lincoln County 106 (CH106)**
 - Study limits: from the intersection with 470th Avenue / Sundowner Avenue to the intersection with 471st Avenue / Tallgrass Avenue, approximately 0.97 miles
- **276th Street/Lincoln County 116 (CH116)**
 - Study limits: from the intersection with 470th Avenue to the intersection with 471st Avenue, approximately 0.98 miles
- **I-29 Interchange Ramps** at Exit 68, Exit 71, and Exit 73

Study analysis intersections are summarized in **Table 1**.

Table 1: Study Area Analysis Intersections

Ref #	Street #1	Street #2
1	273 rd Street (CH110)	470 th Avenue
2	273 rd Street (CH110)	Verhey Place
3	273 rd Street (CH110)	Ponderosa Drive
4	273 rd Street (CH110)	I-29 SB Ramp Terminal
5	273 rd Street (CH110)	I-29 NB Ramp Terminal
6	273 rd Street (CH110)	Ironworks Avenue
7	273 rd Street (CH110)	Kenworth Place
8	273 rd Street (CH110)	471 st Avenue
9	276 th Street (CH116)	470 th Avenue
10	276 th Street (CH116)	I-29 SB Ramp Terminal
11	276 th Street (CH116)	I-29 NB Ramp Terminal
12	276 th Street (CH116)	471 st Avenue
13	271 st Street (CH106)	470 th Avenue
14	271 st Street (CH106)	I-29 Single Point Ramp Terminal
15	271 st Street (CH106)	471 st Avenue

A map of the study area and analysis intersections is provided in **Figure 1**. The existing Exit 68, Exit 71, and Exit 73 interchange configurations and study area lane configurations are shown in **Figure 2** through **Figure 5**.



271ST STREET INTERSECTIONS

13. 470th Avenue
14. Exit 73 Single Point Intersection
15. 471st Avenue

273RD STREET INTERSECTIONS

1. 470th Avenue
2. Verhey Place
3. Ponderosa Drive
4. Exit 71 Southbound Ramp Terminal
5. Exit 71 Northbound Ramp Terminal
6. Ironworks Avenue
7. Kenworth Place
8. 471st Avenue

276TH STREET INTERSECTIONS

9. 470th Avenue
10. Exit 68 Southbound Ramp Terminal
11. Exit 68 Northbound Ramp Terminal
12. 471st Avenue

LEGEND

- Study Area
- 1 Study Intersection



470th Avenue

471st Avenue

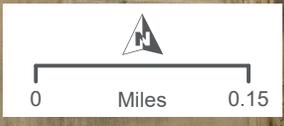
EXIT
68 ↗

276th Street



EXISTING EXIT 68 INTERCHANGE CONFIGURATION





470th Avenue

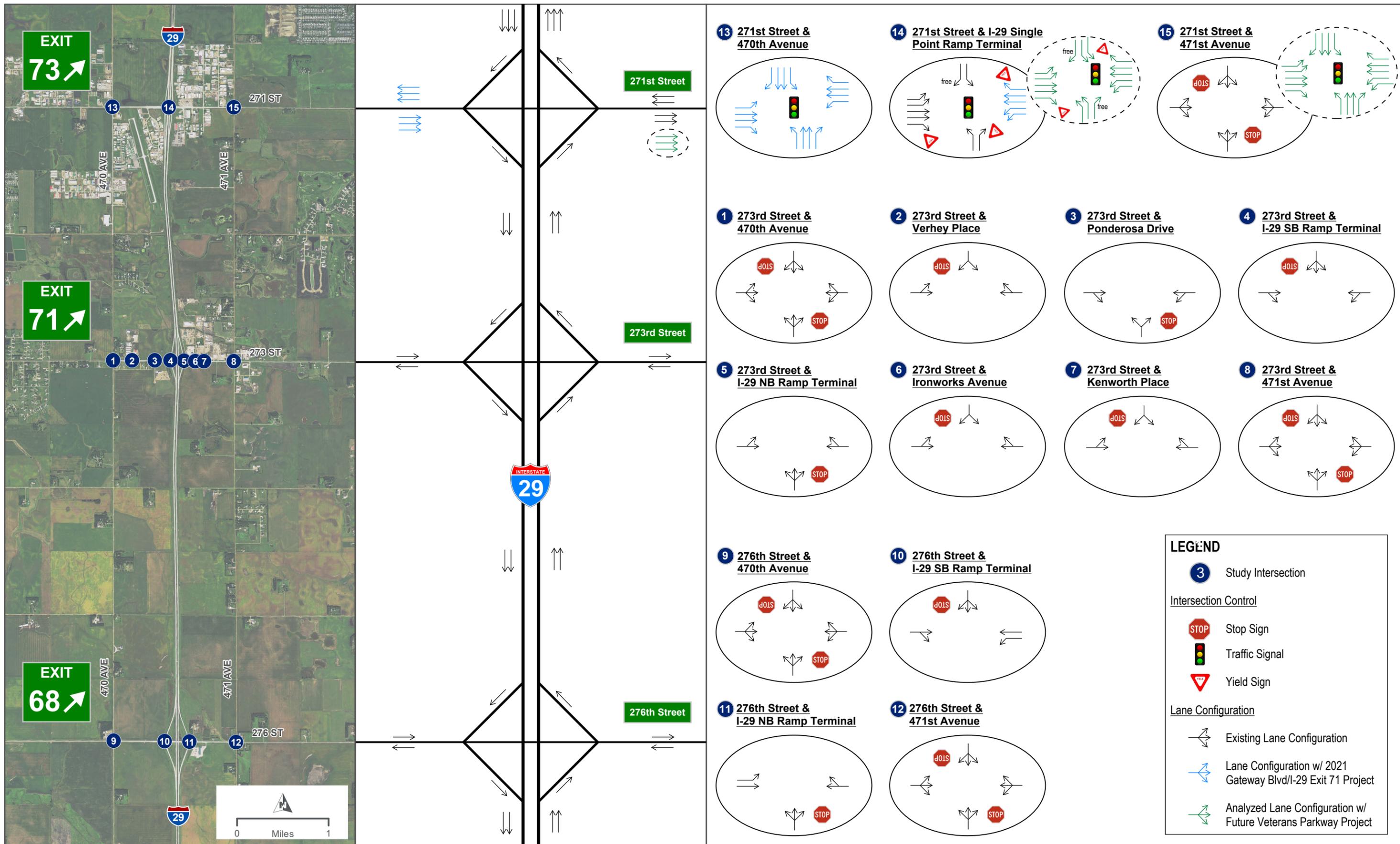
471st Avenue

EXIT
73 ↗

271st Street



EXISTING EXIT 73 INTERCHANGE CONFIGURATION



EXISTING AND FUTURE NO BUILD CONDITION LANE CONFIGURATIONS



3. Methodology

This IMJR was developed to satisfy requirements presented in the FHWA *Policy on Access to the Interstate System*, dated May 22, 2017, and in accordance with the outline presented in Figure 3 of FHWA's *Interstate System Access Informational Guide* section 3.5.3.

The Interchange Modification Study process entailed:

- Methods and Assumptions document
- Data collection
- Baseline conditions analysis
- Existing and future-year traffic forecasts
- Existing and future-year No Build condition traffic analysis
- Build condition traffic operations analysis
- Predictive safety analysis
- Constructability analysis
- Refinement of concepts to Build Options
- Environmental analysis (Environmental Document)
- Public involvement

At the onset of the study, a *Methods and Assumptions* (M&A) document was developed to help guide the study analyses. The final, signed version of the document is provided in **Appendix A**.

The study was guided by a Study Advisory Team (SAT) throughout the process, consisting of representatives from:

- SDDOT
- FHWA
- Sioux Falls Area Metropolitan Planning Organization (MPO)
- Lincoln County
- City of Tea
- City of Harrisburg

4. Existing Conditions

4.1 Demographics

The study area is in the Sioux Falls Metropolitan Statistical Area (MSA) and includes the cities of Sioux Falls, Tea, and Harrisburg and Lincoln County. The area has seen notable growth, particularly in the last decade, as shown in **Table 2**.

Unemployment in the Sioux Falls MSA was approximately 2.5 percent in August 2021¹.

Table 2: Population History

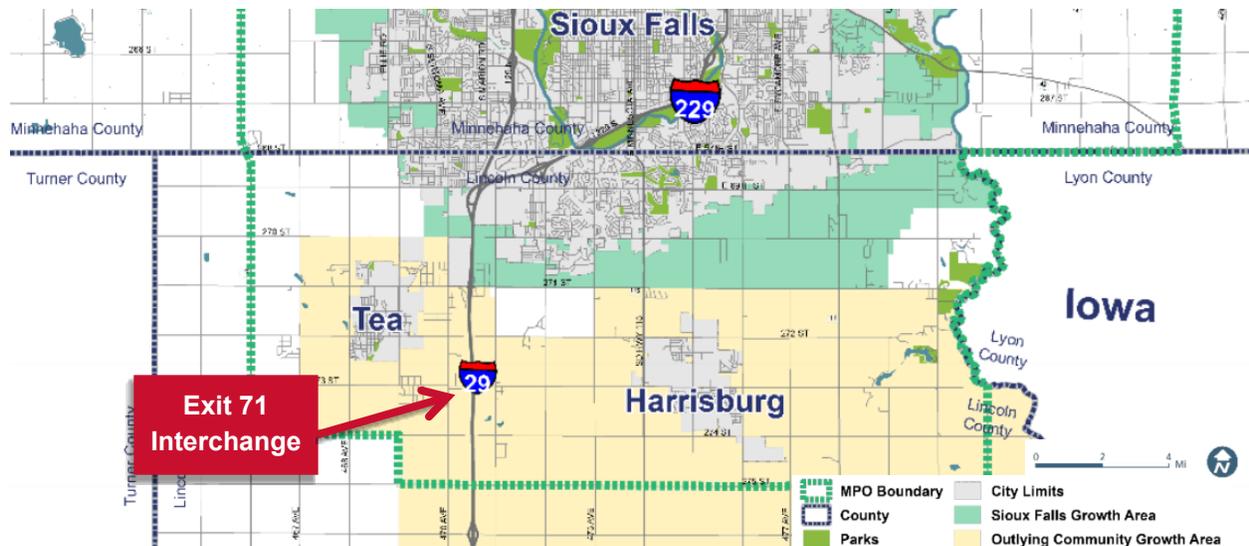
Year	Sioux Falls MSA	Lincoln County	South Dakota
2000	187,093	24,131	754,844
2010	228,261	44,828	814,180
2020	276,730	65,161	886,667
2000-2020 % Increase	+ 47.9%	+ 170.0%	+ 17.5%

United States Census Bureau (www.census.gov)

4.2 Land Use

Surrounding land use is primarily agricultural with pockets of rural industrial and low-density residential development.

The study area is within the growth areas of Sioux Falls, Tea, and Harrisburg, as shown in **Figure 6**. Future land use surrounding the interchange and along the I-29 corridor is identified in both the Tea and Harrisburg comprehensive plans, in **Figure 7** and **Figure 8** respectively. Employment center and commercial development is identified surrounding the interchange and extending east/west beyond the section line roads of 470th Avenue and 471st Avenue. Employment Center, Industrial and Office/Business Park development is identified beyond the Exit 71 interchange area along the I-29 and 273rd Street corridors. Beyond the corridor, Residential and Low Density Residential are the primary land uses.



Source: Adapted from Sioux Falls MPO 2045 Long Range Transportation Plan, Figure 12
https://siouxfallsmo.org/files/1616/0504/0635/SiouxFalls_2045_LRTP_FINAL.pdf

Figure 6: Growth Areas Within Sioux Falls MPO

¹ South Dakota Department of Labor and Regulation, Labor Market Information Center Economic Snapshot.
https://dlr.sd.gov/lmic/economic_snapshot.aspx

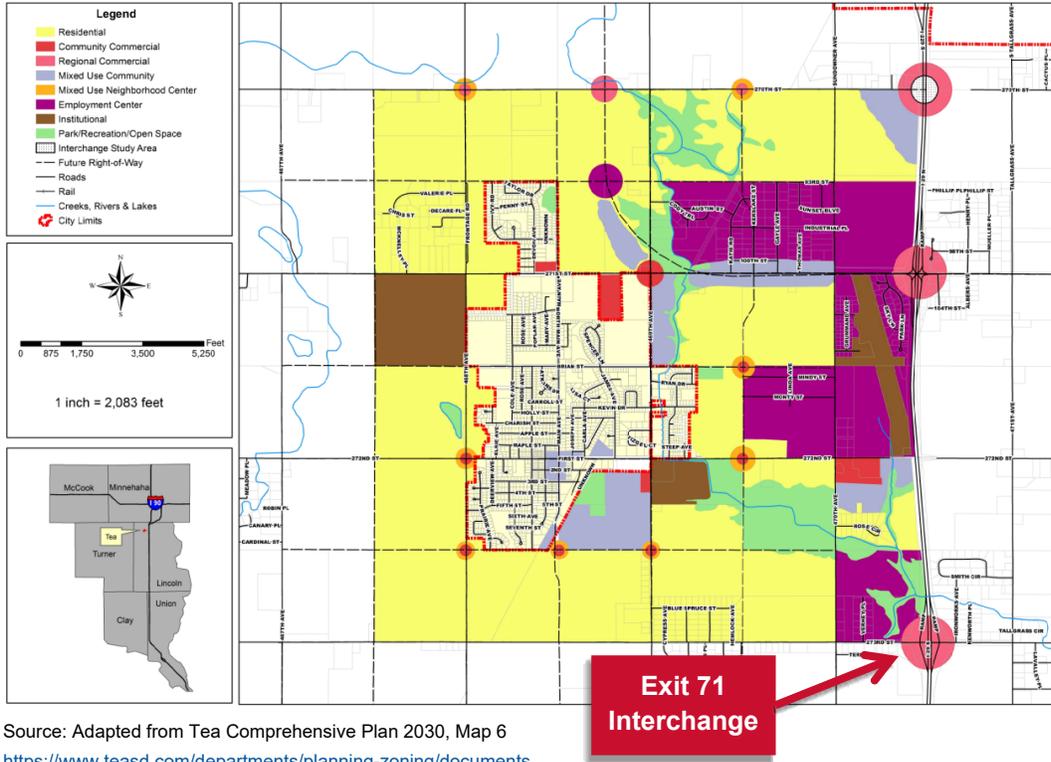


Figure 7: City of Tea Future Land Use

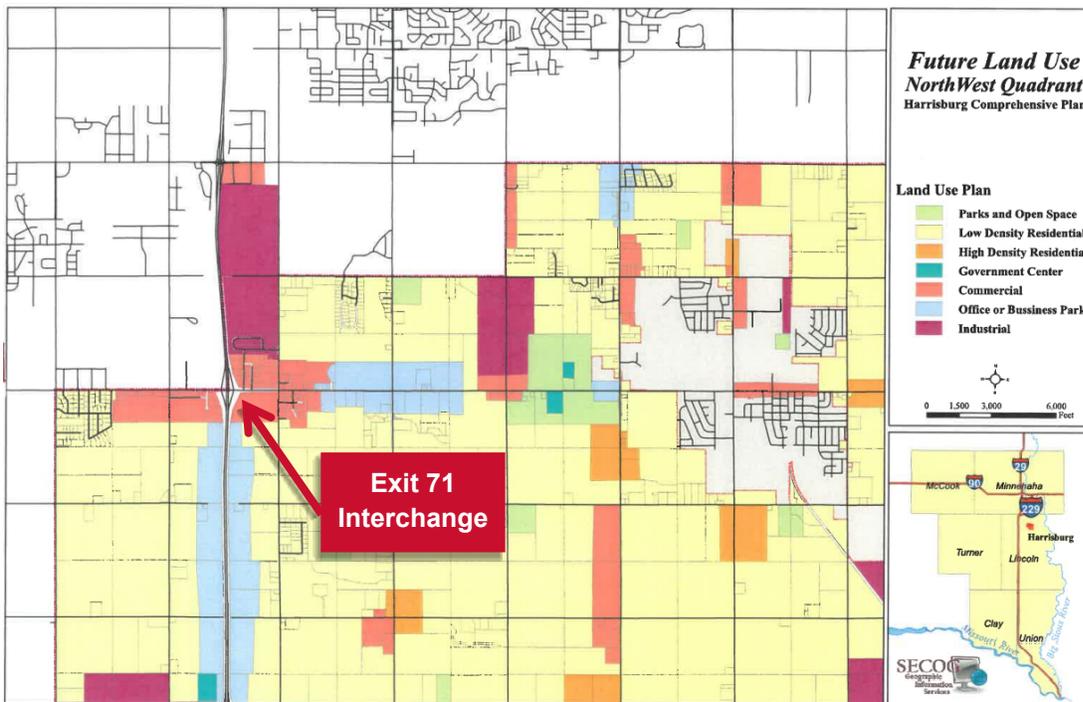


Figure 8: City of Harrisburg Future Land Use

4.3 Existing Roadway Network

Existing major roadways within the study area include:

- **I-29 Mainline**
 - Cross-section: 4-lane divided interstate highway with depressed turf median
 - Functional classification: urban interstate from Exit 71 north; rural interstate south of Exit 71
 - Study limits: from south of I-29 Exit 68 interchange to north of the I-29 Exit 73 interchange, approximately 5.75 miles
- **273rd Street (CH110)**
 - Cross-section: 2-lane rural highway
 - Functional classification: urban major collector
 - Study limits: from the intersection with 470th Avenue to the intersection with 471st Avenue, approximately 0.96 miles
- **271st Street/Lincoln County 106 (CH106)**
 - Cross-section: transitioning to 4-lane urban divided highway
 - Functional classification: urban minor arterial
 - Study limits: from the intersection with 470th Avenue / Sundowner Avenue to the intersection with 471st Avenue / Tallgrass Avenue, approximately 0.97 miles
- **276th Street/Lincoln County 116 (CH116)**
 - Cross-section: 2-lane rural highway
 - Functional classification: rural major collector
 - Study limits: from the intersection with 470th Avenue to the intersection with 471st Avenue, approximately 0.98 miles
- **I-29 Exit 68, Exit 71, and Exit 73 interchange ramps**

4.4 Alternative Travel Modes

Travel within the study area is primarily by automobile. Pedestrian and bicycle modes are used mainly for recreation within the study area; however, facilities are limited. Bicyclists need to use limited shoulders or ride in the travel lane. Pedestrians need to do the same or walk in the roadside ditch as there is no sidewalk. No shoulder is available across the I-29 bridge.

The study area is currently served by Jefferson Lines for regional bus travel. The Sioux Falls airport (commercial service) is located 10.5 miles north of Exit 71 along I-29. The Marv Skie/Lincoln County Airport (large general aviation) is located within the study area, approximately 1.5 miles north of Exit 71 on the west side of I-29.

4.5 Existing Interchanges

Existing interchanges within the study area include:

- **I-29 Exit 73: 271st Street/CH106/Gateway Boulevard**
 - Single point interchange (signalized)
 - I-29 over crossroad
 - 2 miles north of Exit 71

- **I-29 Exit 71: 273rd Street (CH110)**
 - Diamond type interchange (stop-control from off-ramp approaches)
 - I-29 under crossroad
 - Crossroad bridge: continuous concrete bridge ('umbrella' bridge) that cannot be widened
- **I-29 Exit 68: 276th Street (CH116)**
 - Diamond type interchange (stop-control from off-ramp approaches)
 - I-29 under crossroad
 - 3 miles south of Exit 71

Current and planned improvements to existing interchanges and crossroads within the study area limits include:

- **Gateway Boulevard corridor, Exit 71 to Heritage Parkway**
 - Reconstruct to 4- or 6-lane divided section
 - Timeline: construction 2021/2022
- **Exit 73 interchange**
 - Southbound free right turn (westbound lane add)
 - Westbound right turn lane
 - Timeline: construction 2021
- **Veterans Parkway, Exit 73 to Western Avenue**
 - Reconstruct/construct to a 6-lane divided section
 - Exit 73 interchange improvements
 - Southbound dual left turn lanes
 - Northbound free right turn (eastbound lane add)
 - Timeline: construction 2024/2025

The SDDOT currently has a future interchange project identified for I-29/85th Street as part of the 2023-2026 STIP (PCN 06JQ). The IJR-recommended interchange type is a DDI. 85th Street is approximately three miles north of Exit 71.

There are other projects planned beyond the study area, such as 273rd Street/Willow Street capacity improvement projects in Harrisburg, that will contribute to the future-year traffic volumes and patterns within the analyzed interchanges.

4.6 Existing Data

Existing data was provided by participating agencies or collected as part of this study, as summarized below. The data is recent and of high quality.

- Peak hour (morning and afternoon/evening) intersection turning movement counts
 - Collected by consultant on Tuesday, March 2 and Wednesday, March 3, 2021
 - Continuous 12-hour counts, from 6 a.m. to 6 p.m.
 - Peak hour intersection turning movement volumes, peak hour factors, bicycle and pedestrian volumes, and heavy vehicle percentages

- 24-hour crossroad and interchange ramp segment counts
 - Collected by SDDOT on Wednesday March 3, 2021
 - Continuous counts with individual vehicle records
 - Daily segment volumes, heavy vehicle percentages, and speeds
- 24-hour I-29 mainline segment counts
 - Collected by SDDOT from Tuesday June 15 through Thursday June 17, 2021
 - Continuous counts with individual vehicle records
 - Daily segment volumes, heavy vehicle percentages, and speeds
- Seasonal traffic volume factors: SDDOT
- Historical traffic reliability data: National Performance Management Research Data Set (NPMRDS)
- Countywide traffic volume growth factors: SDDOT
- Travel demand model: Sioux Falls MPO travel demand model (TDM)
 - Base year: 2018
 - Planning horizon year: 2045
 - Updated as part of Sioux Falls MPO 2045 Long-Range Plan
- Crash data: SDDOT, State of South Dakota crash database
 - Complete years 2016 through 2020
- Geometric data: SDDOT construction plans and previous studies

4.7 Operational Performance

Methodology

Operational performance of highways is evaluated in terms of quality of service, which describes how well a transportation facility operates from a traveler's perspective. Quality of service is typically measured with 'Level of Service' (LOS), which is presented by a letter grade ranging from LOS A (free-flowing conditions) to LOS F (stopped or heavily delayed traffic). A summary of LOS measures for different roadway facilities pertinent to this study are provided in **Figure 9**.

Peak hour LOS is calculated for study area intersections and roadway segments using Highway Capacity Software, Version 7 (HCS7) and methodology described in the 6th Edition of the Highway Capacity Manual (HCM6). Guidelines for use of HCS7 in this study is documented in the *Methods & Assumptions* document. Level of service and supporting traffic analysis measures used in this study are summarized in **Table 3**. Minimum allowable LOS by facility and urban/rural area designations is provided in **Table 4**. The M&A document identified the urban area / rural area designations for this analysis as:

- **Urban area LOS measures** applicable to segments and intersections within the FHWA Urbanized Boundary
 - The Exit 71 interchange (ramp junctions, ramps, and ramp terminals) will be analyzed entirely in the Urban area
- **Rural area LOS measures** applicable to segments and intersections outside of the FHWA Urbanized Boundary

☰ Multilane Highway/Freeway		
A	Free-flow operation Density: ≤11 passenger cars/mile/lane	
B	Reasonably free-flow operation; minimal restriction on lane changes and maneuvers Density: >11–18 passenger cars/mile/lane	
C	Near free-flow operation; noticeable restriction on lane changes and other maneuvers Density: >18–26 passenger cars/mile/lane	
D	Speed decline with increasing flows; significant restriction on lane changes and other maneuvers Density: >26–35 passenger cars/mile/lane	
E	Facility operates at capacity; very few gaps for lane changes and other maneuvers; frequent disruptions and queues Density: >35–45 passenger cars/mile/lane	
F	Unstable flow; operational breakdown Density: >45 passenger cars/mile/lane or Demand exceeds capacity	

Levels Designation Scale:

LOS is presented through a familiar A to F scale, where "A" means the best operating condition and "F" the worst.

LOS Measures: 6th Edition of the Highway Capacity Manual (HCM6)

LOS Definitions: SDDOT Road Design Manual and HCM6

⊕ Unsignalized Intersection		⊞ Signalized Intersection		
A	Queuing is rare Intersection Control Delay: ≤10 seconds/vehicle	Very minimal queuing; excellent corridor progression and/or short cycle lengths Intersection Control Delay: ≤10 seconds/vehicle		
B	Occasional queuing Intersection Control Delay: >10–15 seconds/vehicle	Some queuing; good corridor progression and/or short cycle lengths Intersection Control Delay: >10–20 seconds/vehicle		
C	Regular queuing Intersection Control Delay: >15–25 seconds/vehicle	Regular queuing; not all demand may be serviced on some cycles (cycle failure) Intersection Control Delay: >20–35 seconds/vehicle		
D	Queue lengths increased Intersection Control Delay: >25–35 seconds/vehicle	Queue lengths increased; routine cycle failures Intersection Control Delay: >35–55 seconds/vehicle		
E	Significant queuing Intersection Control Delay: >35–50 seconds/vehicle	Long queues, congested conditions; majority of cycles fail Intersection Control Delay: >55–80 seconds/vehicle		
F	Volume to capacity ratio approaches 1.0; very long queues Intersection Control Delay: >50 seconds/vehicle	Volume to capacity ratio near 1.0; very long queues, almost all cycles fail Intersection Control Delay: >80 seconds/vehicle		

Note: Unsignalized intersection control delay shown in figure for overall (or weighted) intersection delay. Two-way stop-control delay (TWSC) is measured from the worst-case stop-controlled approach with the same average delay (seconds/vehicle) thresholds.

Figure 9: LOS Descriptions

Table 3: Level of Service Measures

Roadway Feature	LOS Measure	Supporting Measures
Intersections	<ul style="list-style-type: none"> Total (overall) intersection delay 	<ul style="list-style-type: none"> 95th percentile queues Individual movement delay TWSC intersections: worst-case stop-control delay
Interchange RTIs	<ul style="list-style-type: none"> Signalized intersections: total (overall) intersection delay TWSC intersections: worst-case stop-control delay 	<ul style="list-style-type: none"> 95th percentile queues
Interchange (overall)	<ul style="list-style-type: none"> Experienced travel time (ETT) 	<ul style="list-style-type: none"> Individual movement O-D ETT
Urban Street Segments	<ul style="list-style-type: none"> Travel speed as a percentage of base free flow speed 	<ul style="list-style-type: none"> Travel time
Multilane Hwy Segments	<ul style="list-style-type: none"> Vehicle density 	<ul style="list-style-type: none"> Travel time
Freeway Segments	<ul style="list-style-type: none"> Vehicle density 	<ul style="list-style-type: none"> Travel time
2-Lane Hwy Segments	<ul style="list-style-type: none"> Follower density 	<ul style="list-style-type: none"> Travel time
Bicycle and pedestrian	<ul style="list-style-type: none"> LOS score 	

Table 4: Minimum Allowable Level of Service by Facility

Roadway Feature	Minimum Allowable LOS		Notes
	Rural	Urban	
Interchange RTIs	LOS B	LOS C	Individual movements allowed to operate at LOS D in urban areas Individual movements will not be allowed to operate with a v/c ratio > 1.0 Queue storage ratio will not be allowed to exceed 1.0 for any movements
Signalized Intersections	LOS B	LOS C	Individual movements allowed to operate at LOS D in urban areas
Unsignalized Intersections	LOS B	LOS C	TWSC, AWSC, and roundabouts LOS based on weighted average intersection delay Worst-cast stop-controlled (WCSC) approach delay and LOS may be lower than the minimum allowable LOS
Freeway Segments	LOS B	LOS C	LOS B or better is desirable in urban areas
Urban Street Segments	n/a	LOS C	Applies to urban signalized corridors
2-Lane Hwy Segments	LOS B	LOS C	LOS B or better is desirable in urban areas
Urban Street Segments	n/a	LOS C	Applies to urban signalized corridors.

Existing Traffic Operations

Existing condition traffic volumes and operational results are provided in **Figure 10**. I-29 freeway facility operations are summarized in **Table 5**. Additional information is provided in the *Traffic Operations Analysis* memo in **Appendix B**.

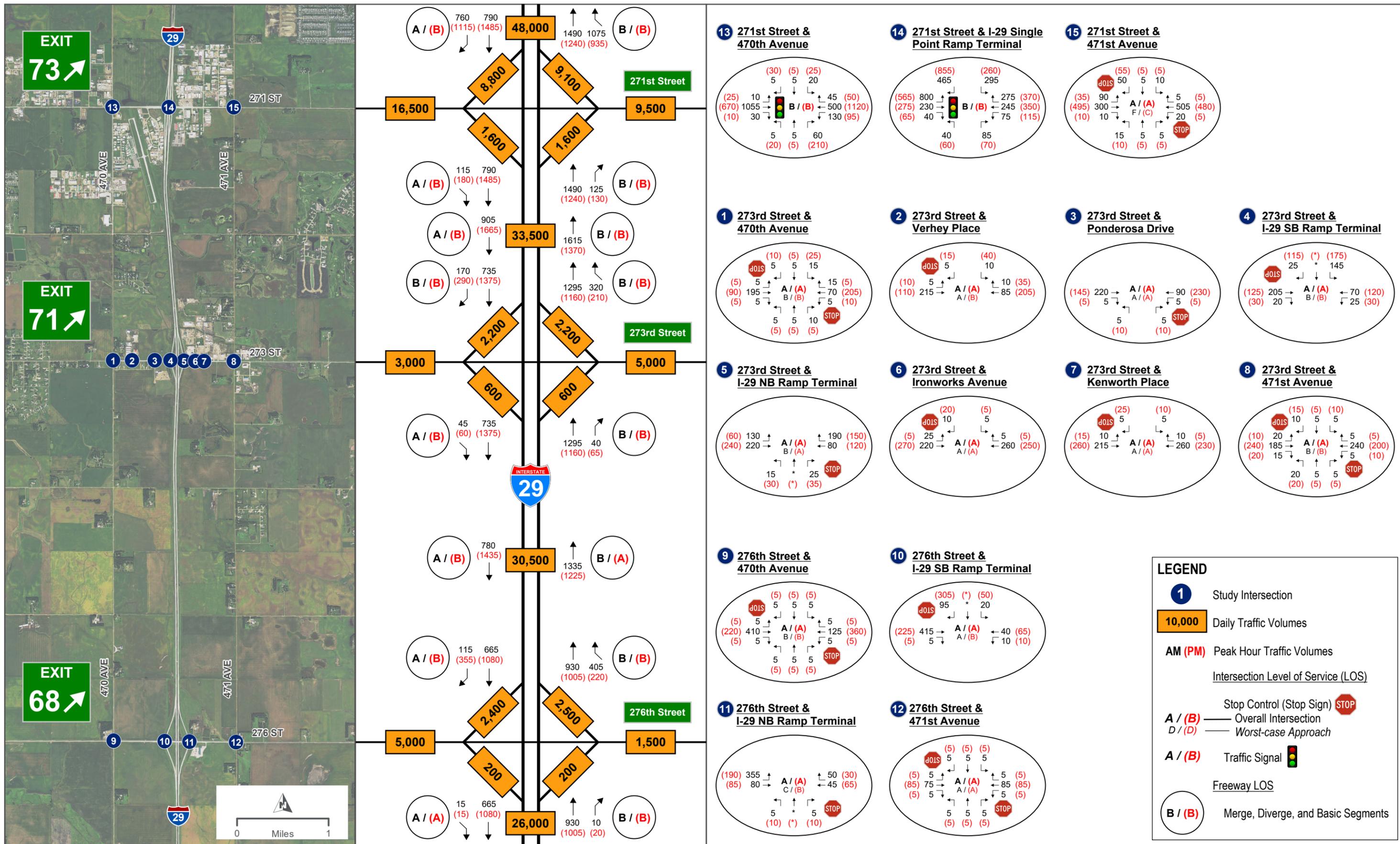
The Existing condition analysis includes improvements constructed as part of the 2021 Gateway Boulevard and I-29 Exit 73 interchange improvement projects.

All study area intersections and highway segments were found to operate at acceptable levels of service.

Table 5: I-29 Freeway Facility Operations – Existing Conditions

Measure	I-29 Southbound		I-29 Northbound	
	AM	PM	AM	PM
Density / LOS	7.6 / A	11.8 / B	13.0 / B	11.3 / B
Travel Time (sec)	6.90	6.90	6.90	6.90

There is currently no pedestrian facility along the 273rd Street corridor and thus was not analyzed in HCS. The bicycle LOS score in HCS was typically LOS D and LOS E, with primary drawbacks being limited shoulder (no shoulder across the I-29 bridge) and high truck volumes.



2021 EXISTING CONDITION TRAFFIC VOLUMES AND LEVEL OF SERVICE



FIGURE 10

4.8 Existing Safety Conditions

Crash records from the State of South Dakota crash database for years 2016 through 2020 were provided by the SDDOT in a GIS database. The following summarizes relevant crash characteristics for the I-29 and 273rd Street corridors. Crash location maps are provided in the *Crash History Review* memo in **Appendix C**.

Crash Review Methodology

Study area crashes were sorted into the following categories:

- 273rd Street intersections and corridor segments
- I-29 Freeway and Ramp Segments

Crash characteristics such as total crashes, crash severity, manner of collision, light condition, and road surface condition were tabulated and presented in the crash tables.

Crash rates and critical crash rates were calculated for both intersections and roadway segments. Intersection crash rates were calculated in terms of crashes per million entering vehicles (crashes/MEV). Roadway segment crash rates were calculated in terms of million vehicle miles traveled (crashes/MVMT).

Critical crash rates were calculated based on the statistical populations for each crash location (intersection or segment), using methods presented in the *Highway Safety Manual* (American Association of State Highway and Transportation Officials (AASHTO), 2010). While the analysis focuses on the Exit 71 interchange and 273rd Street corridors, all intersection and roadway segment crashes reported within the I-29 Exit 71 Interchange Modification Study area were used to build the statistical population. A critical crash rate accounts for a desired level of confidence (95 percent used in this study), vehicle exposure, and similar facility types. Locations where the crash rate exceeds the critical rate were noted for further investigation.

273rd Street Unsignalized Intersections

273rd Street intersection crash characteristics are summarized in **Table 6** and **Table 7**. All intersections exhibit a crash rate less than the critical rate when considering all unsignalized intersections within the study area.

One fatal injury crash was reported at the I-29 southbound ramp terminal intersection (RTI). It was the result of an angle collision that involved a southbound motorcycle and westbound passenger car. Contributing circumstances included speed and a physical obstruction. A non-incapacitating injury angle crash was also reported at this intersection. Disregarding traffic signs and failure to yield were contributing circumstances. In total, there were four crashes at this intersection, three angle and a rear-end crash. All crashes involved a southbound off-ramp vehicle. Intersection sight distance was noted as support for future interchange improvements in the SDDOT *Decennial Interstate Corridor* studies. The current posted speed through the interchange is 25 mph.

273rd Street Corridor Segments

273rd Street segment crashes are summarized in **Table 8** and **Table 9**. No fatal or injury crashes were reported. All segments exhibit a crash rate less than then critical crash rate when considering all study area local network corridor segments.

I-29 Freeway and Ramp Segments

Exit 71 interchange area freeway and ramp segment crash characteristics are summarized in **Table 10** through **Table 13**. No fatal injury crashes were reported on the reviewed freeway or ramp segments.

All I-29 freeway segment crash rates were less than the critical rate. However, two study area trends stood out when compared statewide totals for I-29 (MRM 0 to 252):

- 33% occurred on a pavement condition other than dry (50% for I-29 statewide)
 - The proportion of crashes occurring on pavement conditions other than dry is less through this study area when compared to crashes on I-29 statewide
- 25% were rear-end crashes (12% for I-29 statewide)
 - The proportion of rear-end crashes is higher on this segment when compared to crashes on I-29 statewide
 - Twenty-two of the 34 rear-end crashes were in the northbound direction
 - This crash pattern on freeways is often indicative to segments with high volumes, propensity for lane changes, and high-speed differentials between vehicles

A statewide trend summary of I-29 crashes between 2016 and 2020 is included in **Appendix C**.

The Exit 71 southbound exit ramp exhibited a crash rate greater than the critical rate. Three crashes were reported, two single vehicle crashes and one rear end crash. Contributing circumstances were mixed, but two crashes involved alcohol, two involved wet or icy roadway conditions, and two were at night.

Table 6: 273rd Street Unsignalized Intersection Crash Summary (2016-2020) – Injury Severity and Manner of Collision

Int. No.	273 rd Street Intersection	Total Crashes	Injury Severity					Manner of Collision				
			Fatal	Incap. Injury	Non-Incap. Injury	Possible Injury	No Injury	Single Vehicle	Rear-end	Head-on	Angle	Sideswipe
1	470 th Ave	2	0	0	0	0	2	0	1	0	1	0
2	Verhey Pl	0	0	0	0	0	0	0	0	0	0	0
3	Ponderosa Dr	1	0	0	0	0	1	1	0	0	0	0
4	I-29 SB RTI	4	1	0	1	0	2	0	1	0	3	0
5	I-29 NB RTI	2	0	0	0	1	1	2	0	0	0	0
6	Ironworks Ave	0	0	0	0	0	0	0	0	0	0	0
7	Kenworth Pl	0	0	0	0	0	0	0	0	0	0	0
8	471 st Ave	0	0	0	0	0	0	0	0	0	0	0
	<i>Totals:</i>	9	1	0	1	1	6	3	2	0	4	0

Table 7: 273rd Street Unsignalized Intersection Crash Rates (2016-2020)

Int. No.	273 rd Street Intersection	Total Crashes	Daily Entering Vehicles	Million Entering Vehicles	Crash Rate	Critical Crash Rate	Ratio	
1	470 th Ave	2	6,440	11.74	0.17	0.31	0.55	
2	Verhey Pl	0	5,780	10.54	0.00	0.32	0.00	
3	Ponderosa Dr	1	5,880	10.72	0.09	0.32	0.29	
4	I-29 SB RTI	4	10,940	19.97	0.20	0.25	0.79	
5	I-29 NB RTI	2	10,940	19.96	0.10	0.25	0.39	
6	Ironworks Ave	0	10,560	19.27	0.00	0.26	0.00	
7	Kenworth Pl	0	10,560	19.27	0.00	0.26	0.00	
8	471 st Ave	0	11,480	20.94	0.00	0.25	0.00	
		<i>HSM weighted average crash rate for study area unsignalized intersections = 0.11</i>						

Table 8: 273rd Street Segment Crash Summary (2016-2020) – Injury Severity and Manner of Collision

Seg. No.	273 rd Street Segment	Total Crashes	Injury Severity					Manner of Collision				
			Fatal	Incap. Injury	Non-Incap. Injury	Possible Injury	No Injury*	Single Vehicle	Rear-end	Head-on	Angle	Sideswipe
1	470 th Ave to I-29 NB RTI	1	0	0	0	0	1	1	0	0	0	0
2	I-29 NB RTI to 471 st Ave	1	0	0	0	0	1	1	0	0	0	0

Table 9: 273rd Street Segment Crash Rates (2016-2020)

Seg No.	273 rd Street Segment	Total Crashes	Daily Entering Vehicles	Million Entering Vehicles	Crash Rate	Critical Crash Rate	Ratio
1	470 th Ave to I-29 NB RTI	1	2,840	2.93	0.34	3.70	0.09
2	I-29 NB RTI to 471 st Ave	1	5,150	3.76	0.27	3.50	0.08
		<i>HSM weighted average crash rate for study area local network segments = 2.13</i>					

Table 10: Exit 71 Freeway Crash Summary (2016-2020) – Injury Severity and Manner of Collision

Seg. No.	Segment	Total Crashes	Injury Severity					Manner of Collision				
			Fatal	Incap. Injury	Non-Incap. Injury	Possible Injury	No Injury*	Single Vehicle	Rear-end	Head-on	Angle	Sideswipe
1	I-29 NB – 276 th St to 273 rd St	40	0	0	2	4	34	23	13	0	2	2
2	I-29 NB – 273 rd St Interchange Area	4	0	0	1	0	3	2	1	0	0	1
3	I-29 NB – 273 rd St to 271 st St	28	0	0	2	4	22	18	9	0	0	1
4	I-29 SB – 271 st St to 273 rd St	25	0	0	2	3	20	19	3	0	0	3
5	I-29 SB – 273 rd St Interchange Area	4	0	0	0	2	2	4	0	0	0	0
6	I-29 SB – 273 rd St to 276 th St	33	0	1	3	4	25	17	7	0	2	7

Table 11: Exit 71 Ramp Crash Summary (2016-2020) – Injury Severity and Manner of Collision

Seg. No.	Segment	Total Crashes	Injury Severity					Manner of Collision				
			Fatal	Incap. Injury	Non-Incap. Injury	Possible Injury	No Injury*	Single Vehicle	Rear-end	Head-on	Angle	Sideswipe
1	I-29 NB Exit Ramp @ 273 rd St	0	0	0	0	0	0	0	0	0	0	0
2	I-29 NB Entrance Ramp @ 273 rd St	1	0	1	0	0	0	0	0	0	1	0
3	I-29 SB Exit Ramp @ 273 rd St	3	0	0	0	0	3	2	1	0	0	0
4	I-29 SB Entrance Ramp @ 273 rd St	0	0	0	0	0	0	0	0	0	0	0

Table 12: Exit 71 Freeway Segment Crash Rates (2016-2020)

Seg. No.	Segment	Total Crashes	Daily Vehicles	Million Vehicle Miles Traveled	Crash Rate	Critical Crash Rate	Ratio
1	I-29 NB – 276 th St to 273 rd St	40	12,860	52.81	0.76	2.29	0.33
2	I-29 NB – 273 rd St Interchange Area	4	14,590	17.84	0.22	2.54	0.09
3	I-29 NB – 273 rd St to 271 st St	28	16,320	36.34	0.77	2.36	0.33
4	I-29 SB – 271 st St to 273 rd St	25	16,320	35.15	0.71	2.37	0.30
5	I-29 SB – 273 rd St Interchange Area	4	14,590	18.37	0.22	2.53	0.09
6	I-29 SB – 273 rd St to 276 th St	33	12,860	51.87	0.64	2.29	0.28
		<i>HSM weighted average crash rate for study area I-29 Segments = 1.96</i>					

Table 13: Exit 71 Interchange Ramp Segment Crash Rates (2016-2020)

Seg. No.	Segment	Total Crashes	Daily Vehicles	Million Vehicle Miles Traveled	Crash Rate	Critical Crash Rate	Ratio
3	I-29 NB Exit Ramp @ 273 rd St	0	690	0.24	0.00	5.45	0.00
4	I-29 NB Entrance Ramp @ 273 rd St	1	2,260	1.14	0.88	2.32	0.38
9	I-29 SB Exit Ramp @ 273 rd St	3	2,410	1.20	2.49	2.27	1.10
10	I-29 SB Entrance Ramp @ 273 rd St	0	540	0.20	0.00	6.01	0.00
		<i>HSM weighted average crash rate for study area I-29 Interchange Ramps = 0.65</i>					

Segments with a crash rates exceeding the critical crash rate (ratio > 1.0) noted in **Bold Orange**.

I-29 Freeway Cross-Median Crashes

Cross-median crashes were also reviewed in accordance with methodology proposed in the SDDOT *2020 Decennial Interstate Corridor Study*. Cross-median crashes are defined as head-on, sideswipe opposite, and run-off road left crashes in the SDDOT crash database (in ‘Events’ or ‘Manner of Collision’ fields).

The median barrier warrant guidance set a crash threshold of an average of 0.5 or more Fatal & Injury (F&I) median crashes per mile in a 5-year study period. Three of the four analyzed segments and the overall facility exhibit an average of 0.5 or more fatal/injury median crashes per mile within the 5-year study period.

Table 14: I-29 Cross-Median Crash Summary (2016 – 2020)

I-29 Segment	Approx. Length (miles)	Segment Crashes			
		F&I Crashes	F&I Crashes/ Mile	Total Crashes	Total Crashes/ Mile
Exit 73 Interchange and north	1.15	2	1.7	13	11.3
Exit 73 to Exit 71	1.2	2	1.7	8	6.7
Exit 71 Interchange	0.7	0	0	2	2.9
Exit 71 to Exit 68	2.2	3	1.4	11	5.0
Total	5.25	7	1.3	34	6.5

Segments exceeding crash threshold of an average of 0.5 or more F&I median crashes per mile in a 5-year study period noted in **Bold Orange**

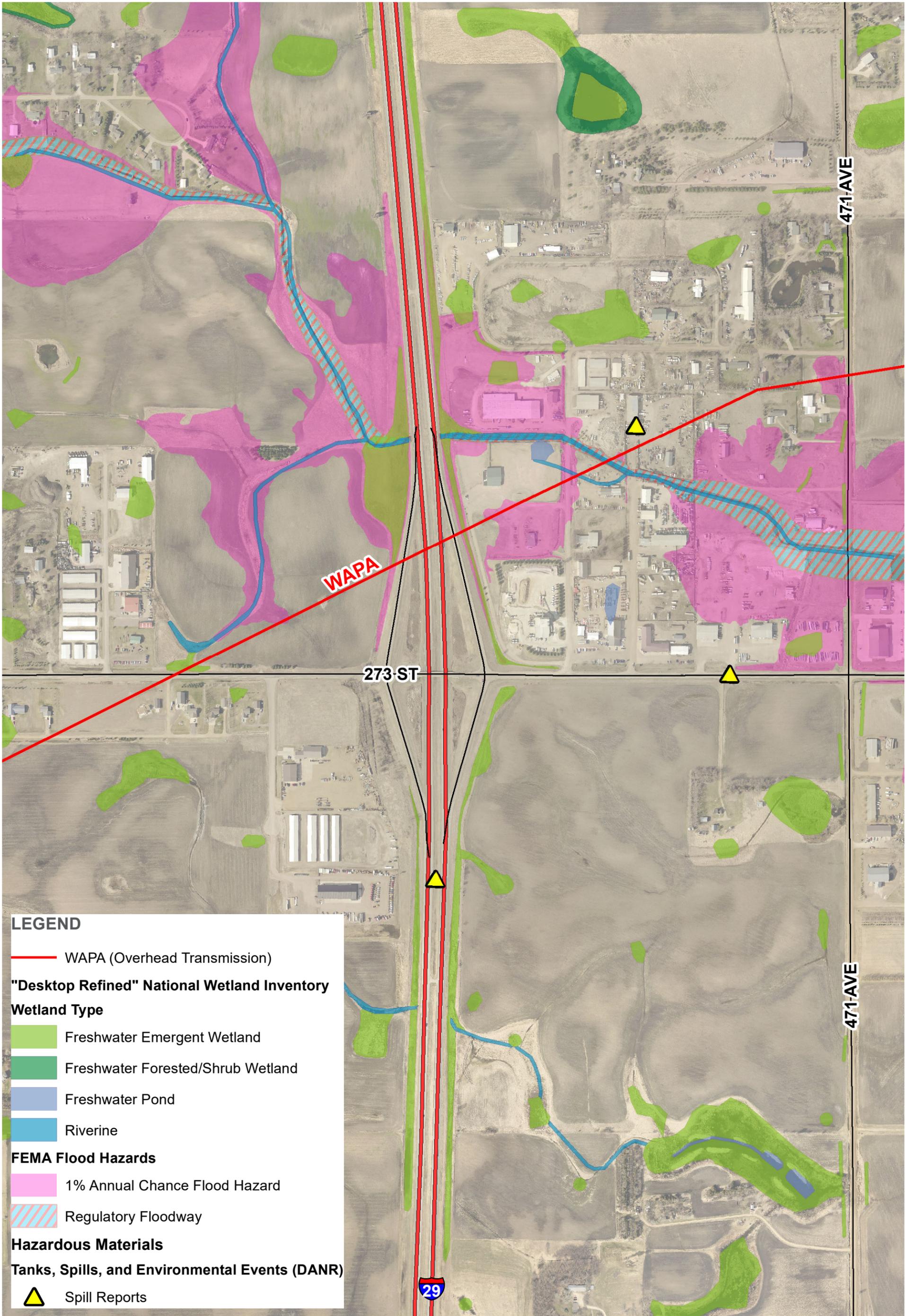
4.9 Existing Environmental Constraints

An environmental scan of the study area was conducted to identify direct, indirect, and cumulative impacts anticipated for the potential improvements. At the onset of this process, a map was created to illustrate environmental resource considerations during the alternative evaluation process ahead of National Environmental Policy Act (NEPA) phase. A map of known resources adjacent to the Exit 71 interchange and I-29 mainline Project area is shown in **Figure 11**, which includes:

- WAPA overhead transmission lines
- Airport property
- Wetlands and streams
- Flood hazards
- Hazardous materials

Other resources being reviewed as part of the Environmental Scan include:

- Historic properties
- Land use (i.e., farmland)
- Threatened and endangered species
- Visual resources
- Noise

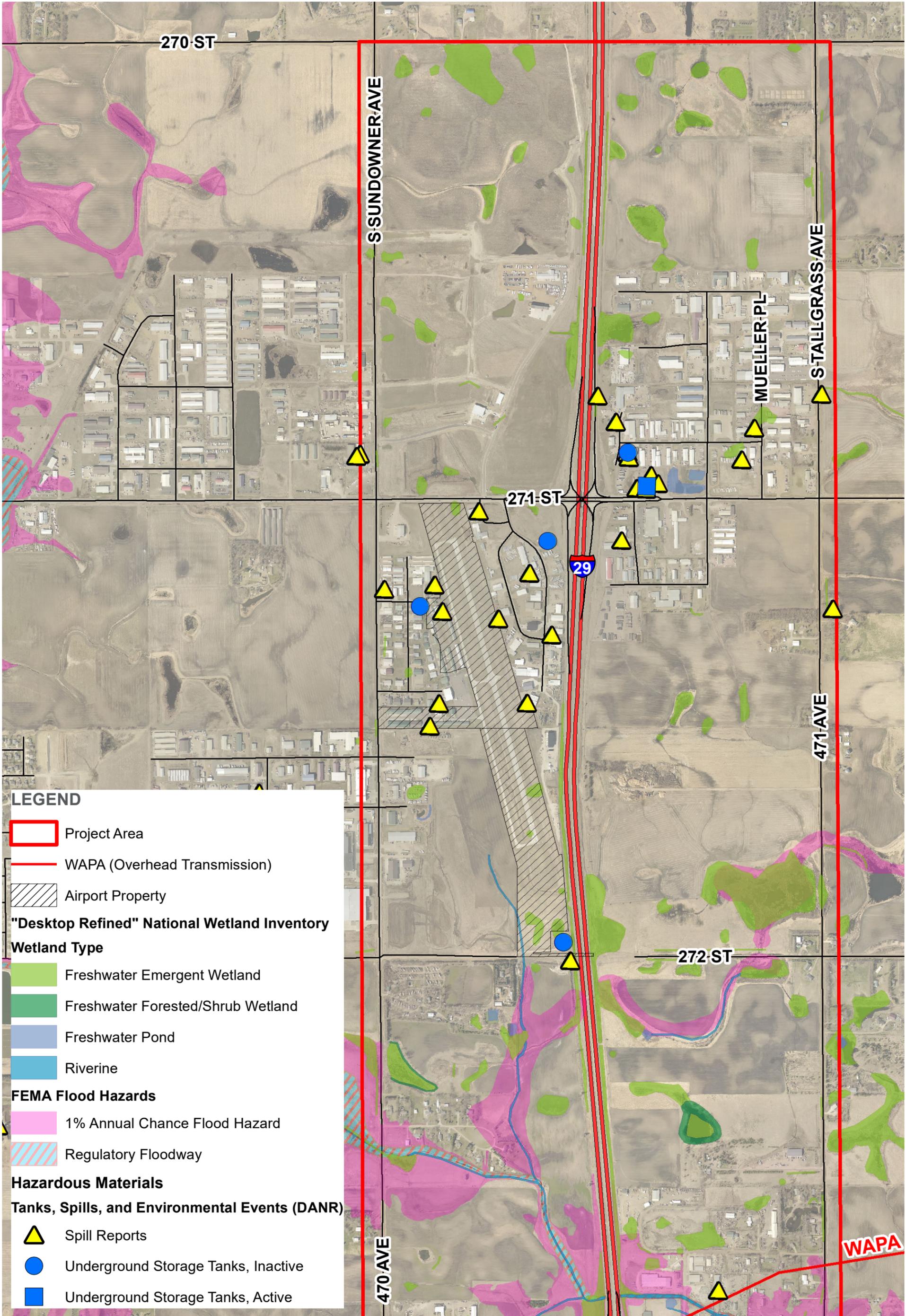


LEGEND

- WAPA (Overhead Transmission)
- "Desktop Refined" National Wetland Inventory**
- Wetland Type**
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Riverine
- FEMA Flood Hazards**
- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Hazardous Materials**
- Tanks, Spills, and Environmental Events (DANR)**
- ▲ Spill Reports

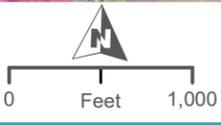
ENVIRONMENTAL CONSTRAINTS

FIGURE 11 (PAGE 1)



LEGEND

- Project Area
- WAPA (Overhead Transmission)
- Airport Property
- "Desktop Refined" National Wetland Inventory**
- Wetland Type**
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Riverine
- FEMA Flood Hazards**
- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Hazardous Materials**
- Tanks, Spills, and Environmental Events (DANR)**
- Spill Reports
- Underground Storage Tanks, Inactive
- Underground Storage Tanks, Active



ENVIRONMENTAL CONSTRAINTS

FIGURE 11 (PAGE 2)

5. Need

Transportation needs to be addressed by the proposed project were categorized as primary needs, secondary needs, and goals as defined by the following:

- **Primary needs** are the primary “drivers” of the project and reflect the fundamental reasons why the project is being pursued
- **Secondary needs** are additional needs that are desirable, but not the core “drivers” of the project
- **Goals** are desired project outcomes beyond the transportation issues identified in the Purpose and Need and balance environmental and transportation values

5.1 Traffic Operations (Primary Need)

Forecasted traffic volumes are expected to exceed available capacity on I-29 mainline and within the Exit 71 interchange within the 2050 Planning Horizon. The following locations were found to not meet the minimum allowable LOS established for this study:

- 273rd Street intersections
 - Exit 71 southbound ramp terminal
- I-29 segments
 - Southbound Exit 71 diverge
 - Southbound basic segment between Exit 71 and Exit 68
 - Southbound Exit 68 diverge
 - Northbound Exit 68 diverge
 - Northbound Exit 68 merge
 - Northbound basic segment between Exit 68 and Exit 71
 - Northbound basic segment between Exit 71 and Exit 73
 - Northbound Exit 73 diverge

5.2 Road Surface Condition (Primary Need)

The SDDOT pavement management system has indicated a need to improve pavement conditions to an acceptable level to accommodate current and projected traffic volumes.

5.3 Safety (Secondary Need)

Crash history trends support a need for safety improvements at:

- Exit 71 southbound ramp terminal
 - Crash rate exceeds the critical crash rate
 - Multiple injury crashes, including one fatality
- I-29 mainline
 - Proportion of rear-end crashes through the study area is approximately two times the percentage of rear-end crashes throughout all of I-29 in South Dakota

5.4 Current Design Standards (Secondary Need)

Existing Exit 71 geometric elements support improvement to meet current *SDDOT Road Design Manual* guidelines:

- Right shoulder width
- Inslope
- Minimum on-ramp taper rate
- Minimum K value for a sag vertical curve (ramp and crossroad)
- Minimum stopping sight distance (crossroad)
- Ramp intersection sight distance
- Minimum control of access from interchange ramps (northeast quadrant)

5.5 Goals

1. Provide for Sioux Falls MPO Multi-Use Trail Study and local municipality bicycle and pedestrian plans
2. Regulatory compliance
3. Avoid and minimize environmental impacts

6. Alternatives

The SDDOT's 2018 *I-29 Exit 62 to Exit 73 Corridor Study* provided a holistic look at needs and potential improvements throughout I-29 study area, including the Exit 71 interchange. Along I-29, the study identified the timeline of need for additional lanes. At the I-29 Exit 71 interchange, the study developed and analyzed several concepts to be considered as part of the Interchange Modification Study. In addition to interchange type, the study developed variations that looked at maintaining I-29 under 273rd Street or whether the roadways should be flipped so I-29 goes over 273rd Street, similar to Exit 73.

6.1 Exit 71 Interchange Alternatives

The following interchange alternatives represent refined Build Options carried forward from the previous corridor study or developed specific to this Interchange Modification Study:

1. No Build
2. Alternative 1a: Compressed Diamond Interchange (I-29 Under)
3. Alternative 1b: Compressed Diamond Interchange (I-29 Over)
4. Alternative 2a: SPI (I-29 Under)
5. Alternative 2b: SPI (I-29 Over)
6. Alternative 3a: DDI (I-29 Under)
7. Alternative 3b: DDI (I-29 Over)

Each alternative reflects intersection lane configuration and traffic control needs established in the traffic operations analysis.

The refined alternatives comply with previous studies and conform with current design standards. The need, and importance, for a westbound right turn lane at the northbound ramp

terminal intersection requires closure of the Ironworks Avenue access to meet FHWA control of access (COA) requirement of 100 feet in all interchange Build alternatives. The Ponderosa Circle access was able to be maintained in its current location with an eastbound right turn lane at the southbound ramp terminal intersection.

A connection between Ironworks Avenue and Kenworth Place is needed to provide Ironworks Avenue access to/from 273rd Street with closure of the existing intersection due to control of access requirements. Each alternative layout shows a frontage road and rearage road option. The frontage road generally follows existing easement purchased by the SDDOT several years ago. The rearage road generally follows platted roadway right-of-way, but a portion of it was shifted south onto private property to avoid Ninemile Creek. While only these two options are shown on the layouts, any feasible rearage location between Ninemile Creek and the potential frontage road is applicable.

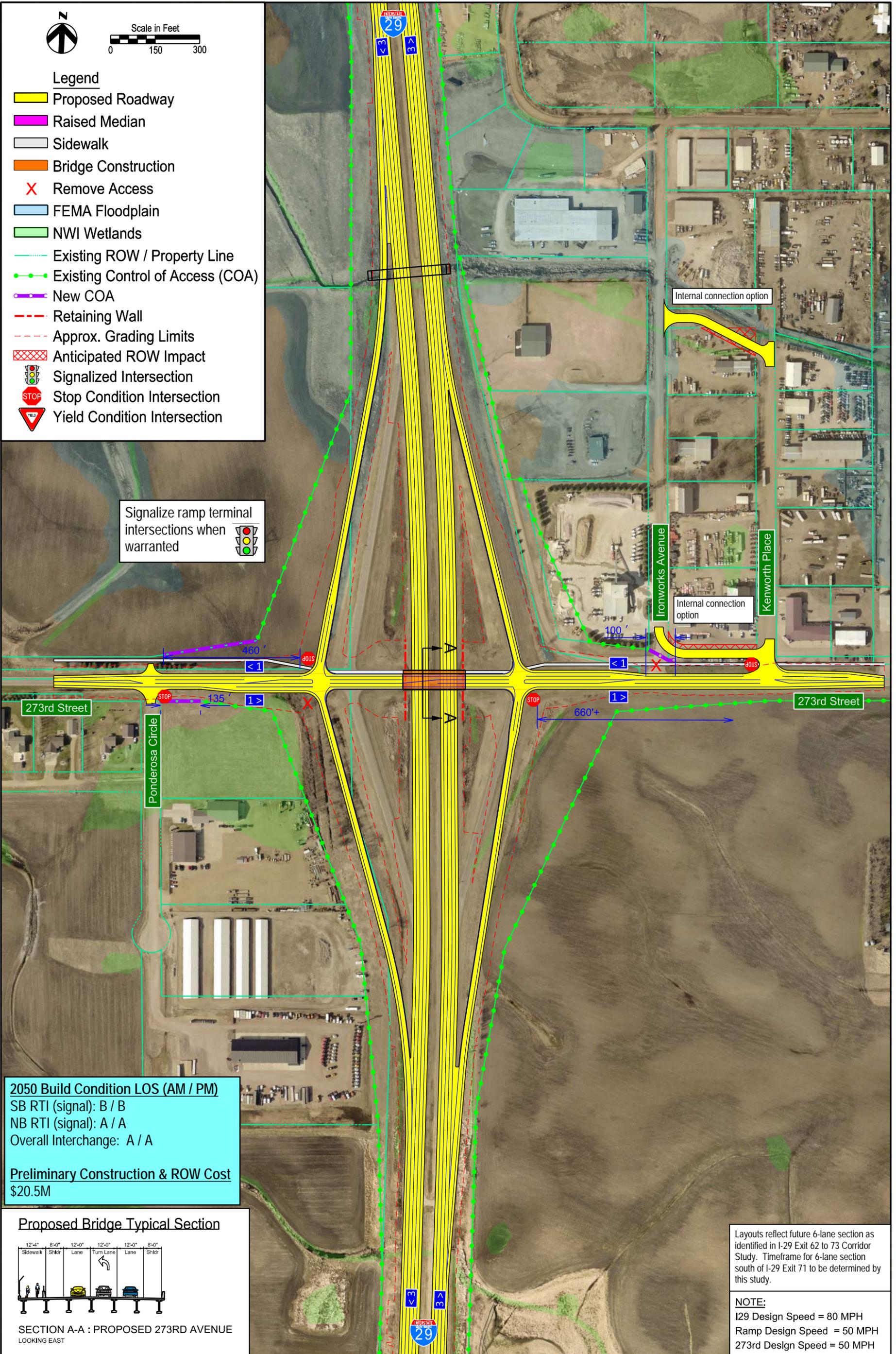
As the study progressed, the 273rd Street corridor was further evaluated with varying degrees of southward alignment shift through the interchange to:

1. Construct new 273rd Street bridge off alignment to maintain traffic on existing bridge during construction
2. Increase separation between 273rd Street and a potential frontage road at Kenworth Place to provide for:
 - a. Rocky Mountain Double truck turning movements between the eastbound frontage road to westbound 273rd Street
 - b. Additional southbound Kenworth Place queue storage to reduce the risk of southbound Kenworth Place queues blocking northbound Kenworth Place (turning from 273rd Street) access to the frontage road

The following options were developed for the Compressed Diamond (I-29 under) alternative but have elements applicable to all interchange types:

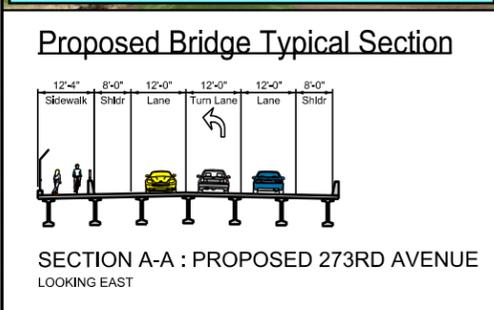
1. Option 1: 6-foot Bridge Offset
2. Option 2: 55-foot Bridge Offset
3. Option 3: 80-foot Bridge Offset

The interchange Build alternatives are shown in **Figure 12** through **Figure 17**. 273rd Street alignment options for the Compressed Diamond (I-29 Under) alternative are shown in **Figure 18** through **Figure 20**.



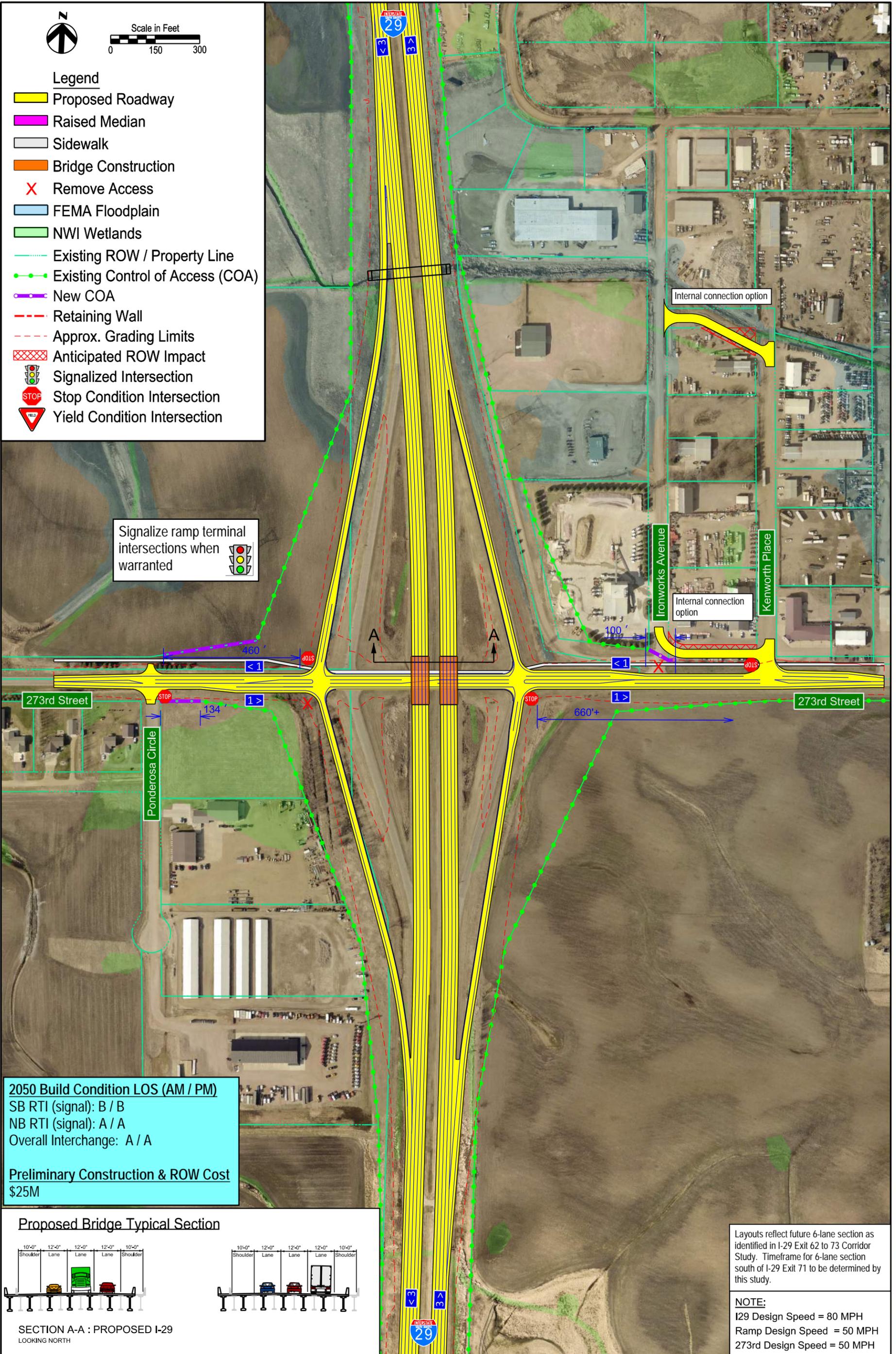
2050 Build Condition LOS (AM / PM)
 SB RTI (signal): B / B
 NB RTI (signal): A / A
 Overall Interchange: A / A

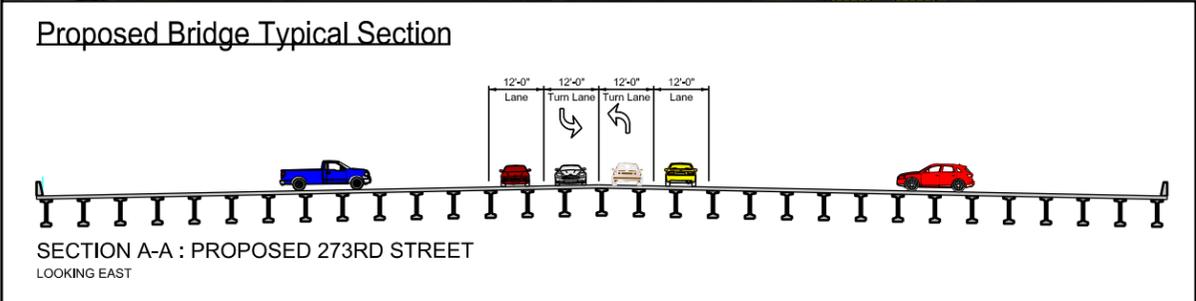
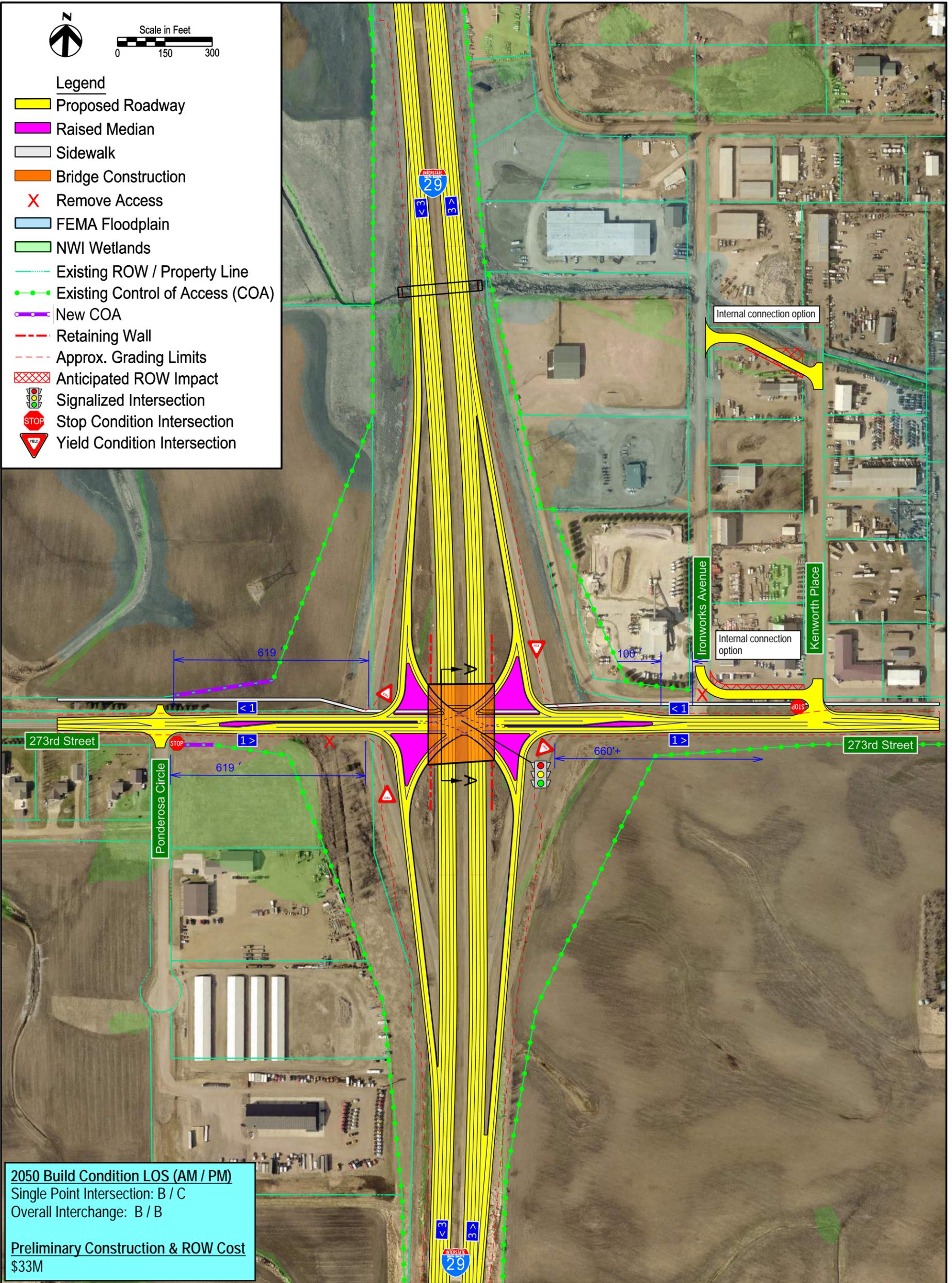
Preliminary Construction & ROW Cost
 \$20.5M



Layouts reflect future 6-lane section as identified in I-29 Exit 62 to 73 Corridor Study. Timeframe for 6-lane section south of I-29 Exit 71 to be determined by this study.

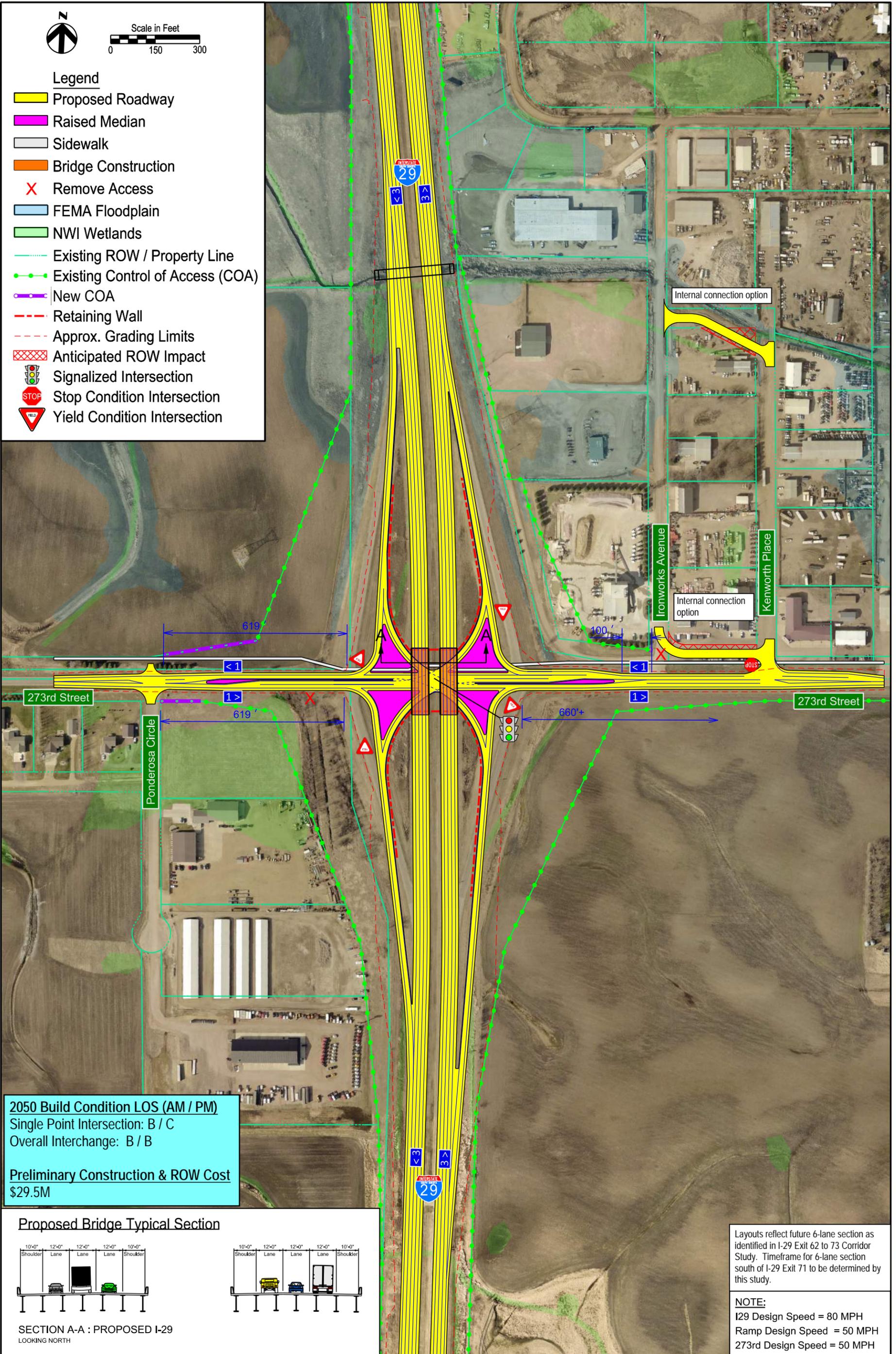
NOTE:
 I29 Design Speed = 80 MPH
 Ramp Design Speed = 50 MPH
 273rd Design Speed = 50 MPH



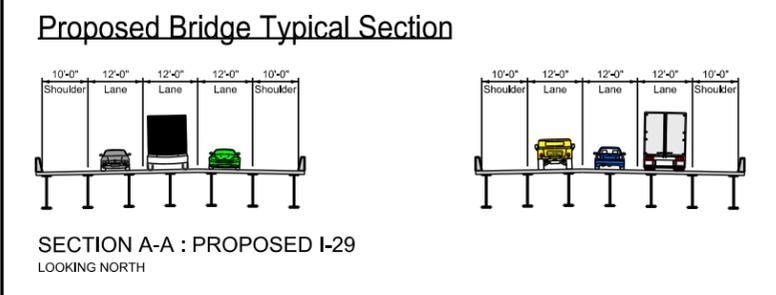


Layouts reflect future 6-lane section as identified in I-29 Exit 62 to 73 Corridor Study. Timeframe for 6-lane section south of I-29 Exit 71 to be determined by this study.

NOTE:
 I29 Design Speed = 80 MPH
 Ramp Design Speed = 50 MPH
 273rd Design Speed = 50 MPH

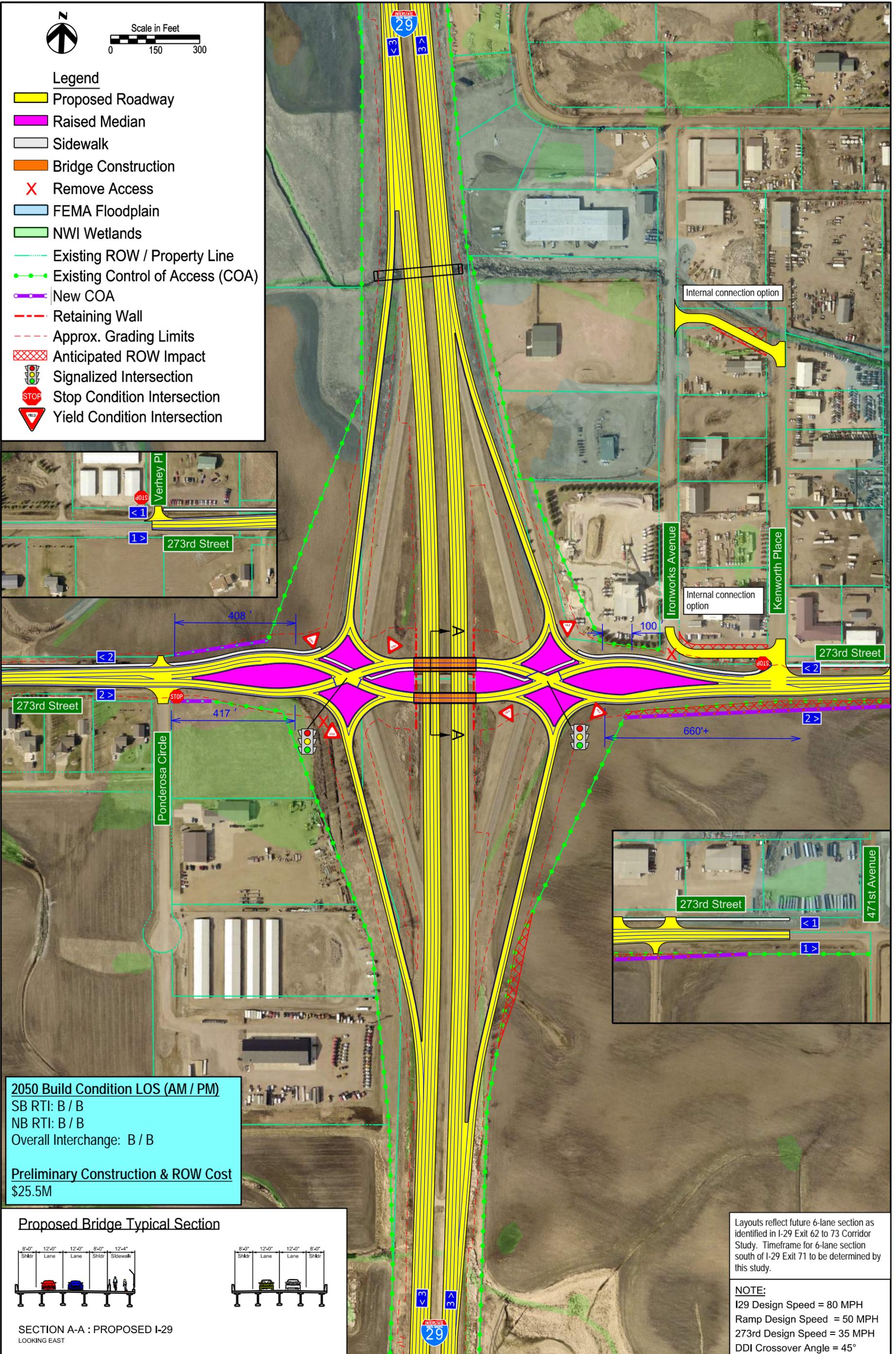


2050 Build Condition LOS (AM / PM)
 Single Point Intersection: B / C
 Overall Interchange: B / B
Preliminary Construction & ROW Cost
\$29.5M



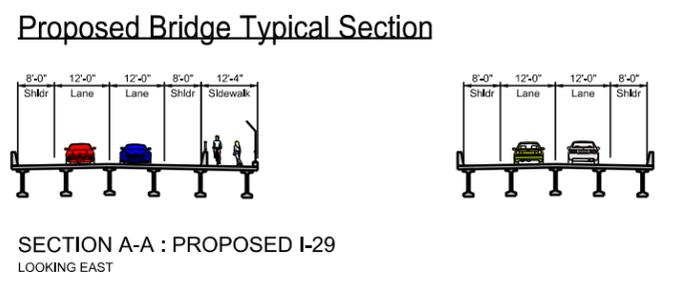
Layouts reflect future 6-lane section as identified in I-29 Exit 62 to 73 Corridor Study. Timeframe for 6-lane section south of I-29 Exit 71 to be determined by this study.

NOTE:
 I29 Design Speed = 80 MPH
 Ramp Design Speed = 50 MPH
 273rd Design Speed = 50 MPH



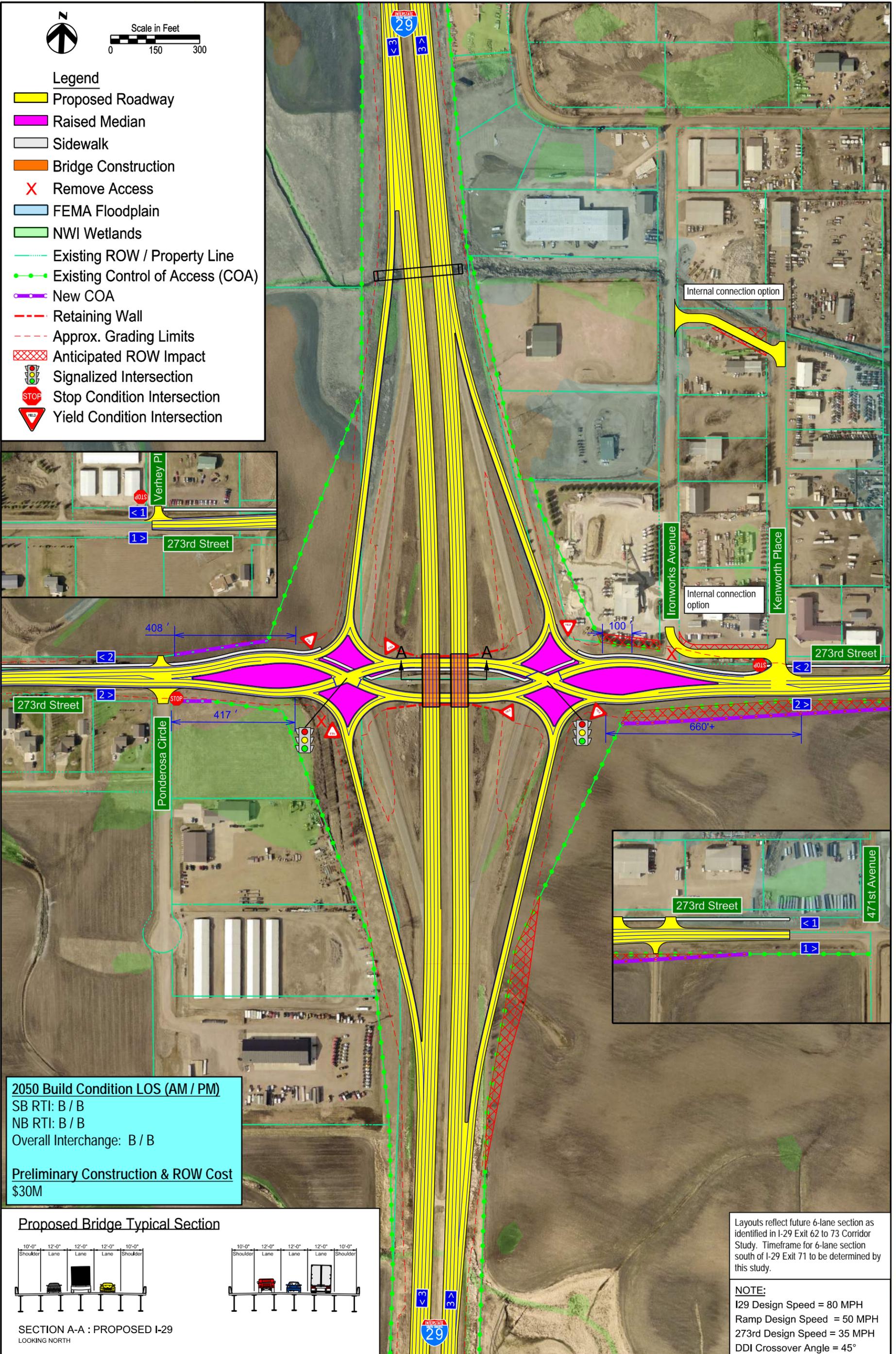
2050 Build Condition LOS (AM / PM)
 SB RTI: B / B
 NB RTI: B / B
 Overall Interchange: B / B

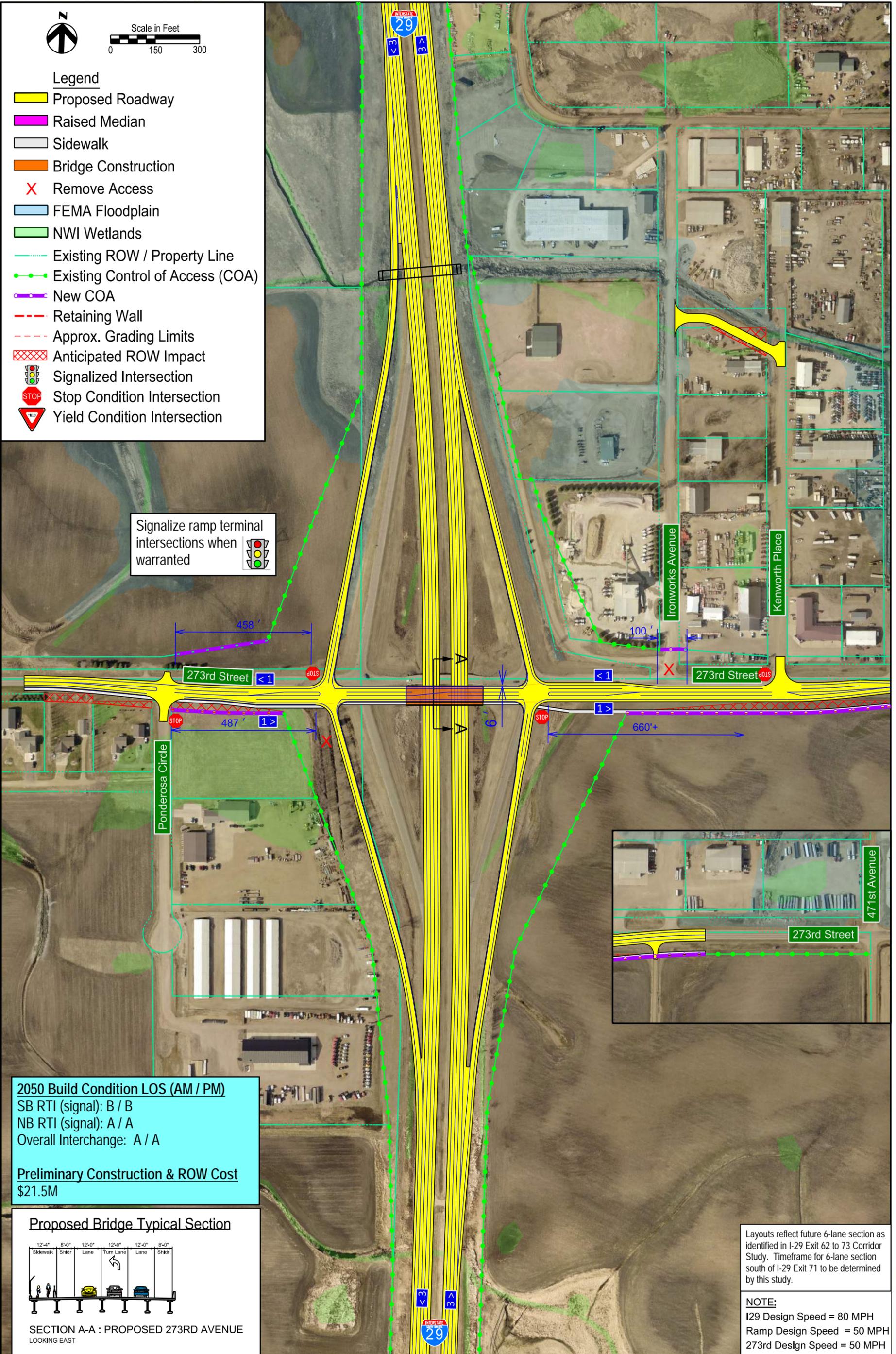
Preliminary Construction & ROW Cost
 \$25.5M



Layouts reflect future 6-lane section as identified in I-29 Exit 62 to 73 Corridor Study. Timeframe for 6-lane section south of I-29 Exit 71 to be determined by this study.

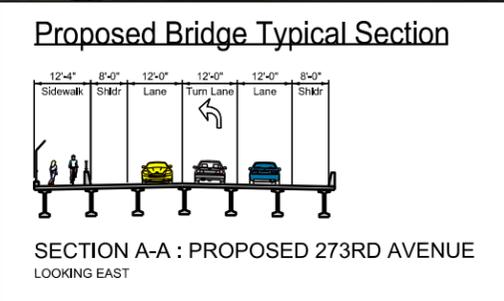
NOTE:
 I29 Design Speed = 80 MPH
 Ramp Design Speed = 50 MPH
 273rd Design Speed = 35 MPH
 DDI Crossover Angle = 45°





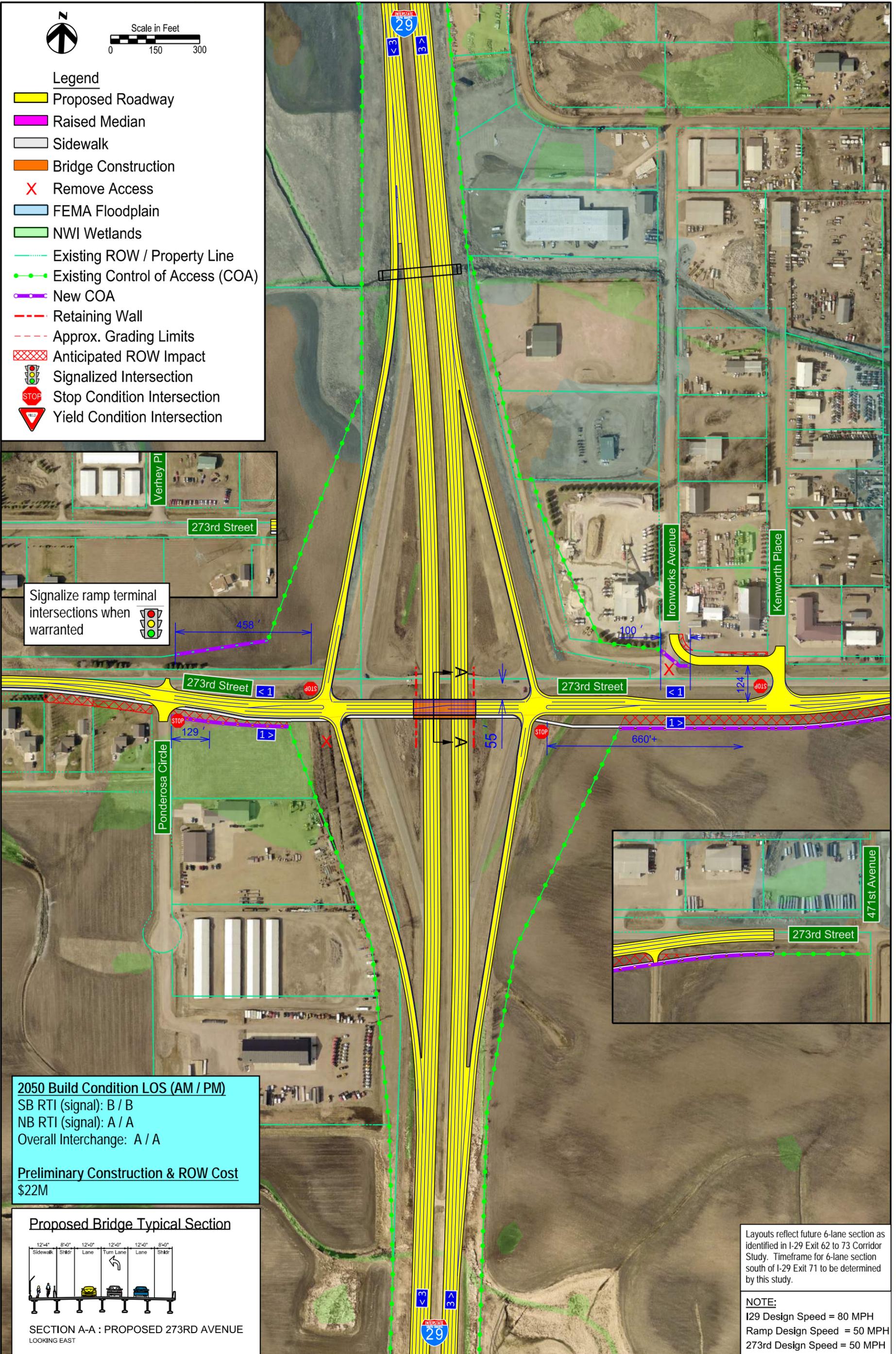
2050 Build Condition LOS (AM / PM)
 SB RTI (signal): B / B
 NB RTI (signal): A / A
 Overall Interchange: A / A

Preliminary Construction & ROW Cost
 \$21.5M



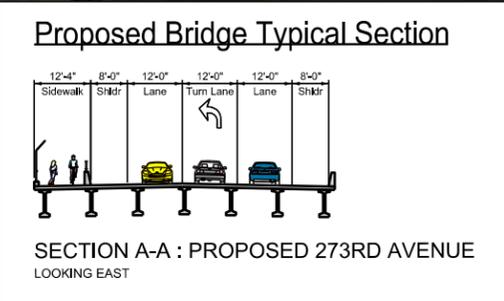
Layouts reflect future 6-lane section as identified in I-29 Exit 62 to 73 Corridor Study. Timeframe for 6-lane section south of I-29 Exit 71 to be determined by this study.

NOTE:
 I29 Design Speed = 80 MPH
 Ramp Design Speed = 50 MPH
 273rd Design Speed = 50 MPH



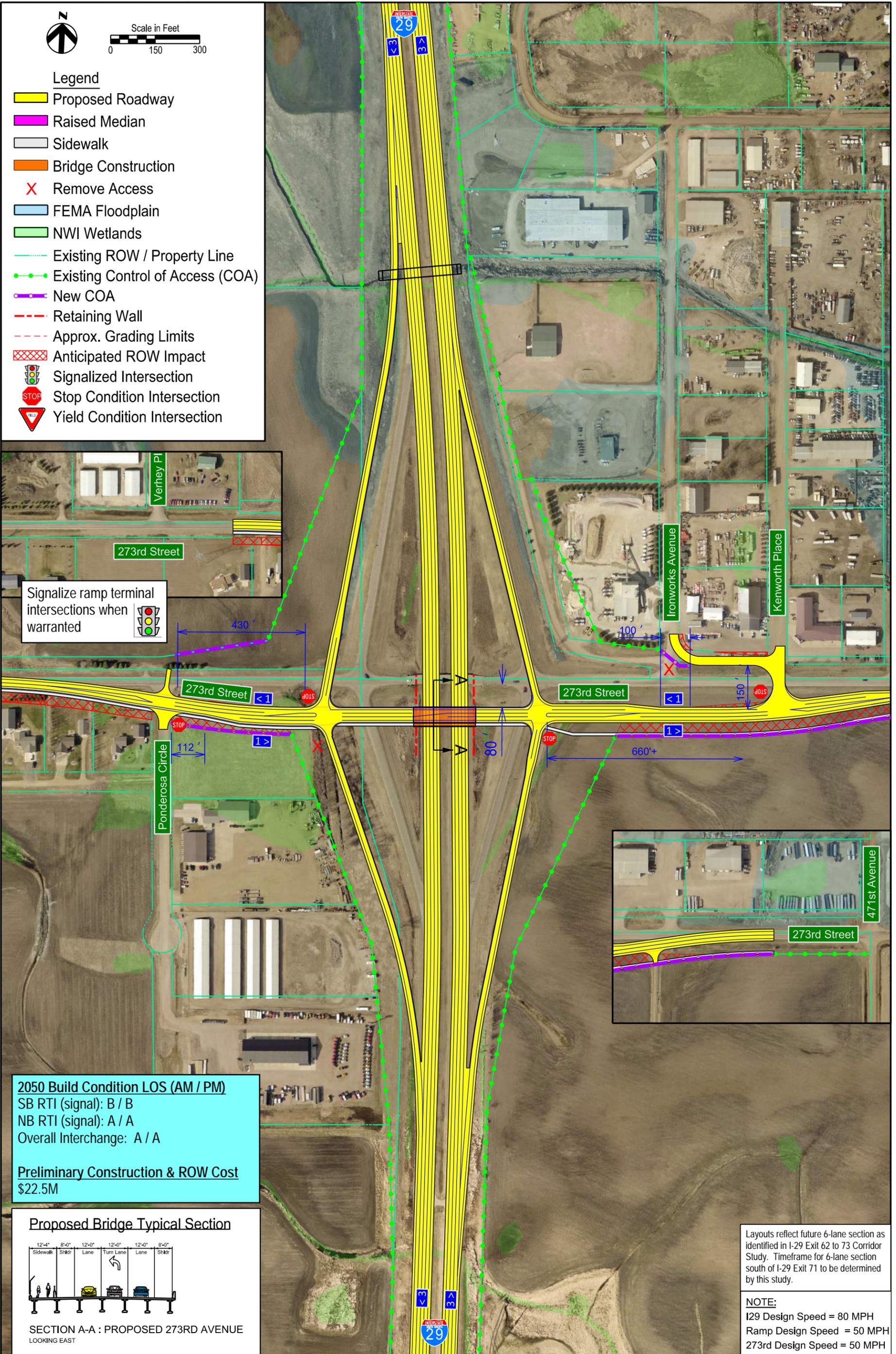
2050 Build Condition LOS (AM / PM)
 SB RTI (signal): B / B
 NB RTI (signal): A / A
 Overall Interchange: A / A

Preliminary Construction & ROW Cost
 \$22M



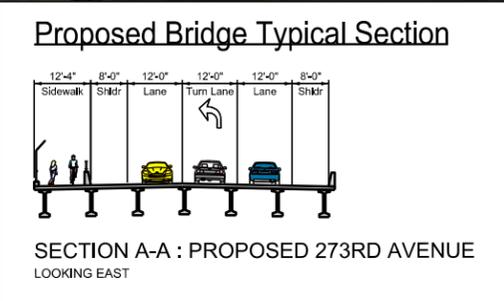
LAYOUTS REFLECT FUTURE 6-LANE SECTION AS IDENTIFIED IN I-29 EXIT 62 TO 73 CORRIDOR STUDY. TIMEFRAME FOR 6-LANE SECTION SOUTH OF I-29 EXIT 71 TO BE DETERMINED BY THIS STUDY.

NOTE:
 I29 Design Speed = 80 MPH
 Ramp Design Speed = 50 MPH
 273rd Design Speed = 50 MPH



2050 Build Condition LOS (AM / PM)
 SB RTI (signal): B / B
 NB RTI (signal): A / A
 Overall Interchange: A / A

Preliminary Construction & ROW Cost
 \$22.5M



Layouts reflect future 6-lane section as identified in I-29 Exit 62 to 73 Corridor Study. Timeframe for 6-lane section south of I-29 Exit 71 to be determined by this study.

NOTE:
 I29 Design Speed = 80 MPH
 Ramp Design Speed = 50 MPH
 273rd Design Speed = 50 MPH

6.2 I-29 Mainline Alternatives

I-29 mainline alternatives were developed with the following considerations:

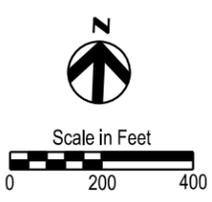
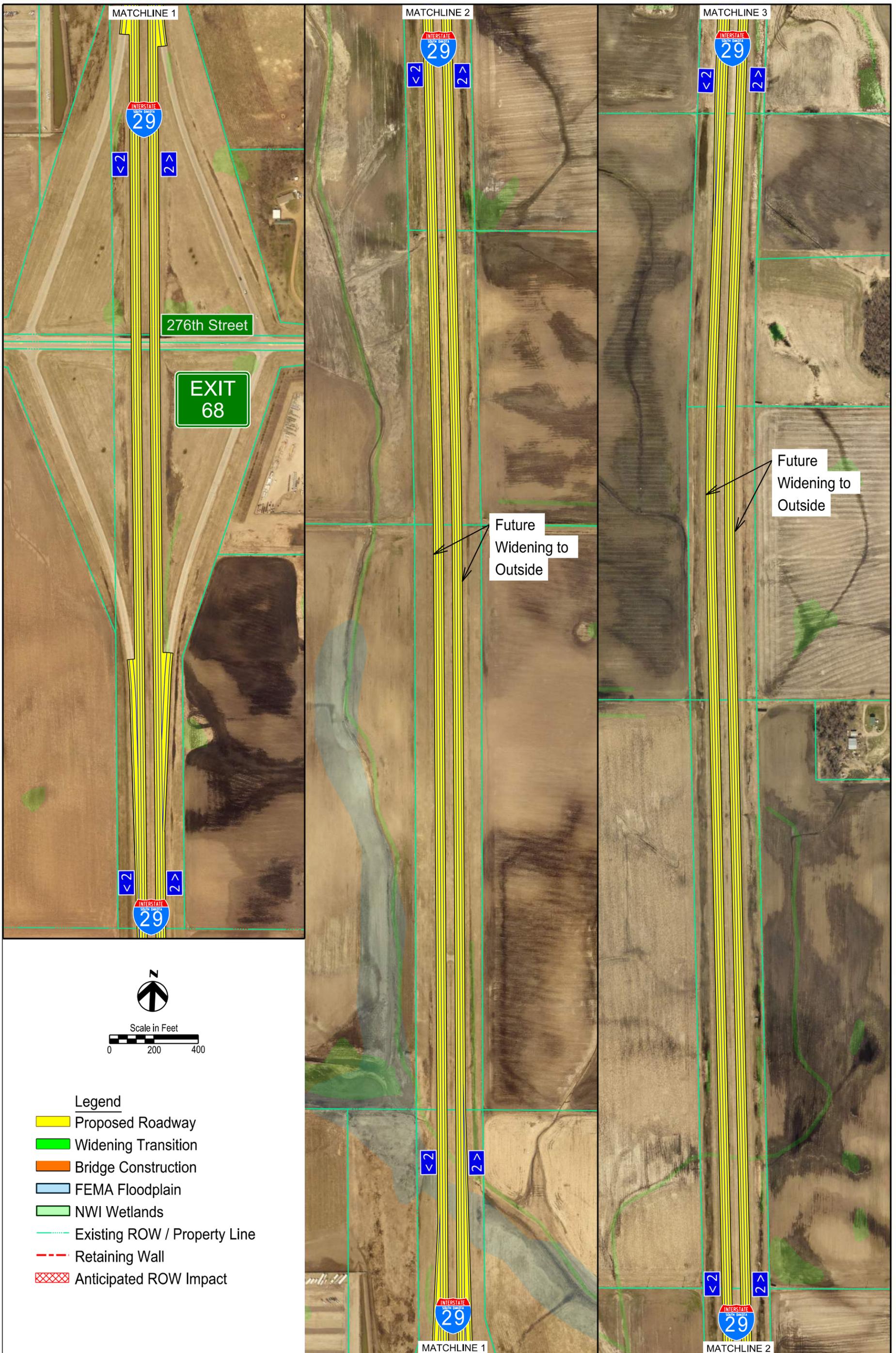
- The future-year No Build condition analysis confirmed the need for additional lanes on I-29 north of Exit 71, but was less definitive from the Exit 71 interchange southward
 - A phased construction option from Exit 71 southward to Exit 68 includes grading for a 6-lane section but only constructing 4 lanes, 2 in each direction
- Northern limits tie into existing I-29 mainline 6-lane section and the southern ramps of a future 85th Street interchange
- I-29 is widened to the inside from the Marv Skie/Lincoln County Airport RPZ northward to the northern limits
 - Exit 73 interchange was designed to widen I-29 to the inside
 - Widening to the inside does not encroach any further into the airport RPZ
- The transition between widening to the inside and widening to the outside occurs between the airport RPZ and Exit 71
- Southern limits tie into the Exit 68 northern ramps

Figure 21 shows the base I-29 mainline alternative with the following number of lanes in each direction:

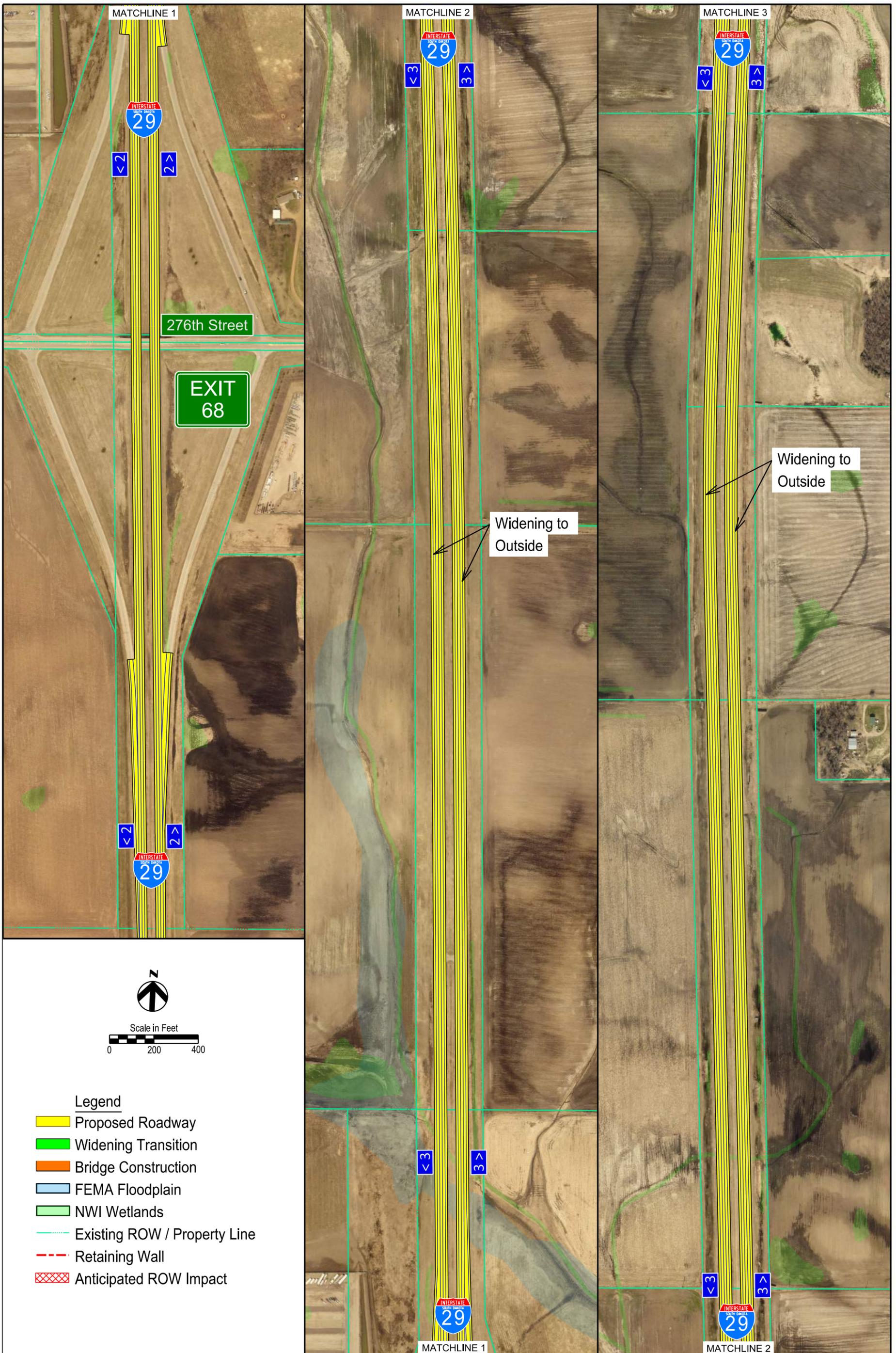
- **North of Exit 73:** 3 through lanes plus auxiliary lane between interchanges
- **Exit 73:** 3 through lanes
- **Exit 73 to Exit 71:** 3 through lanes (with merge/diverge)
- **Exit 71:**
 - 3 through lanes (6-lane Full Build option)
 - 2 through lanes (4-lane Partial Build option)
- **Exit 71 to Exit 68:**
 - 3 through lanes (6-lane Full Build option) (with merge/diverge)
 - 2 through lanes (4-lane Partial Build option) (with merge/diverge)
- **Exit 68:** 2 through lanes (existing)

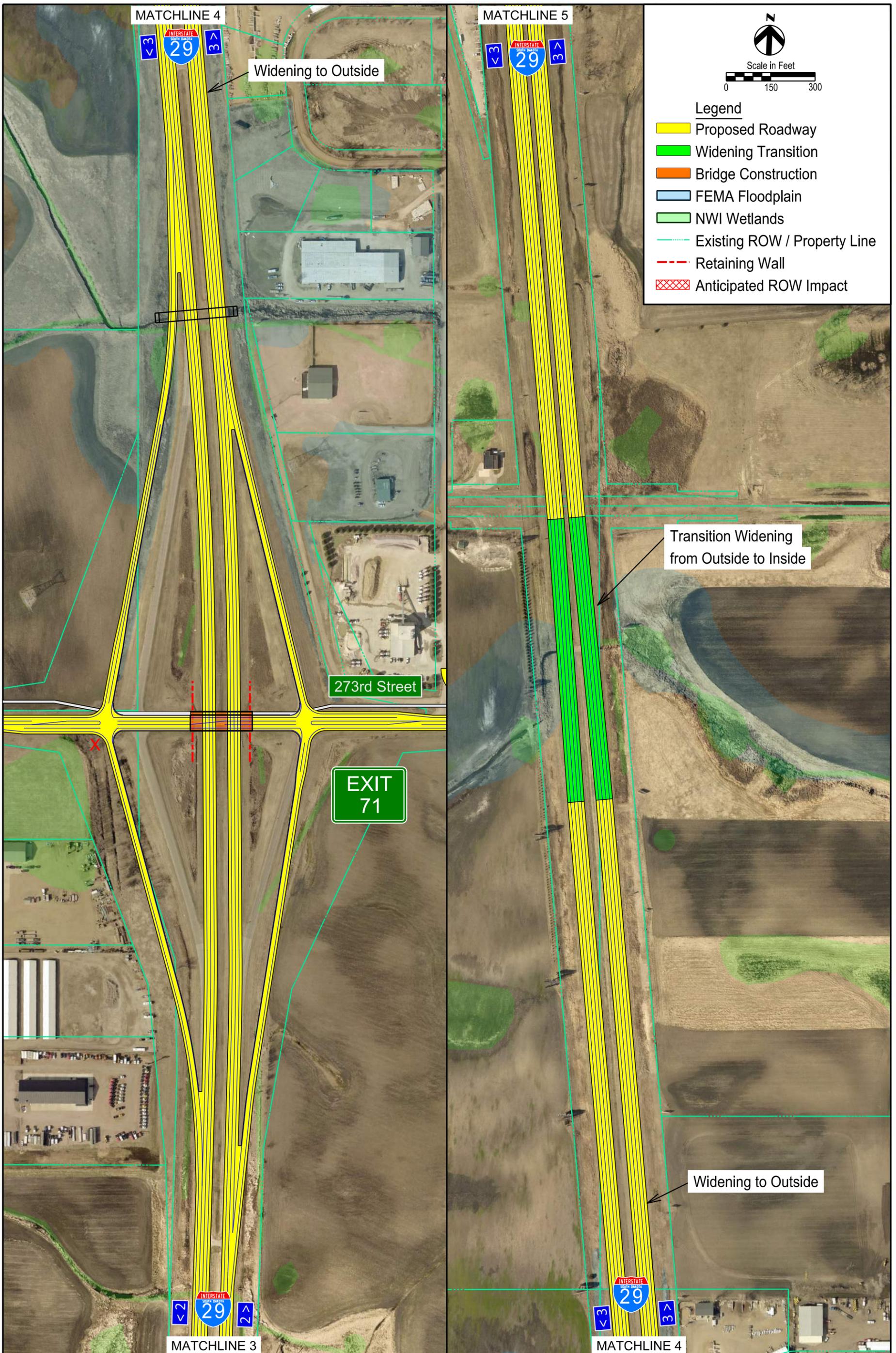
In coordination with FAA and Marv Skie/Lincoln County Airport officials, three airport RPZ 'avoidance' options were developed between Exit 71 and Exit 73 to assess potential impacts with the southern RPZ:

- **Option 1:** reconstructs I-29 on existing alignment with the new third lane in each direction added to the inside (median). New pavement does not encroach further into the RPZ. New Median width is 36 feet (**Figure 22**).
- **Option 2:** realigns I-29 to the east outside of the RPZ. The third lane in each direction is incorporated to the inside (median) for a 36-foot wide median (**Figure 23**).
- **Option 3:** realigns I-29 to the east outside of the RPZ. The third lane in each direction is incorporated to the outside for a 60-foot wide median (**Figure 24**).

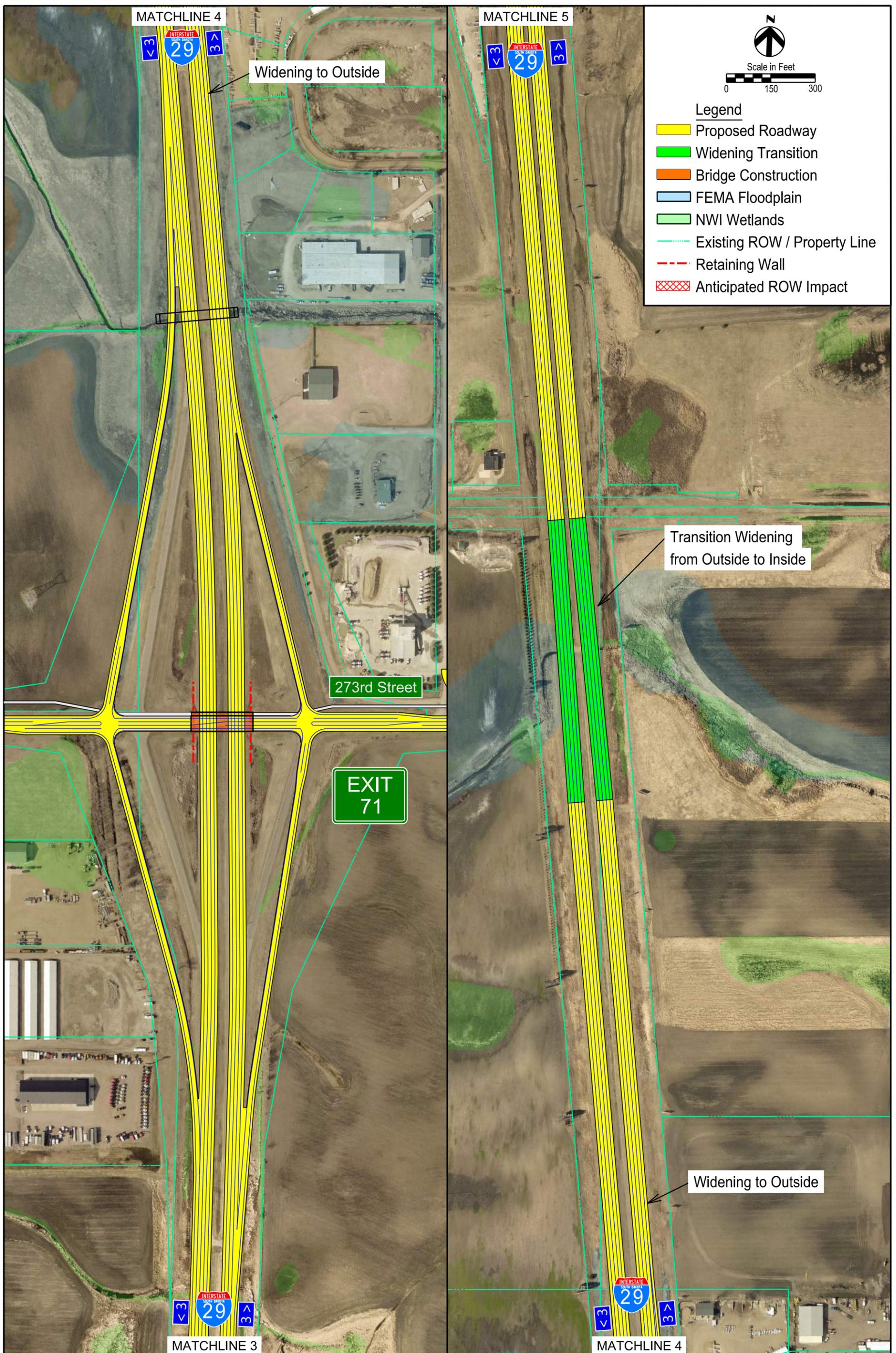


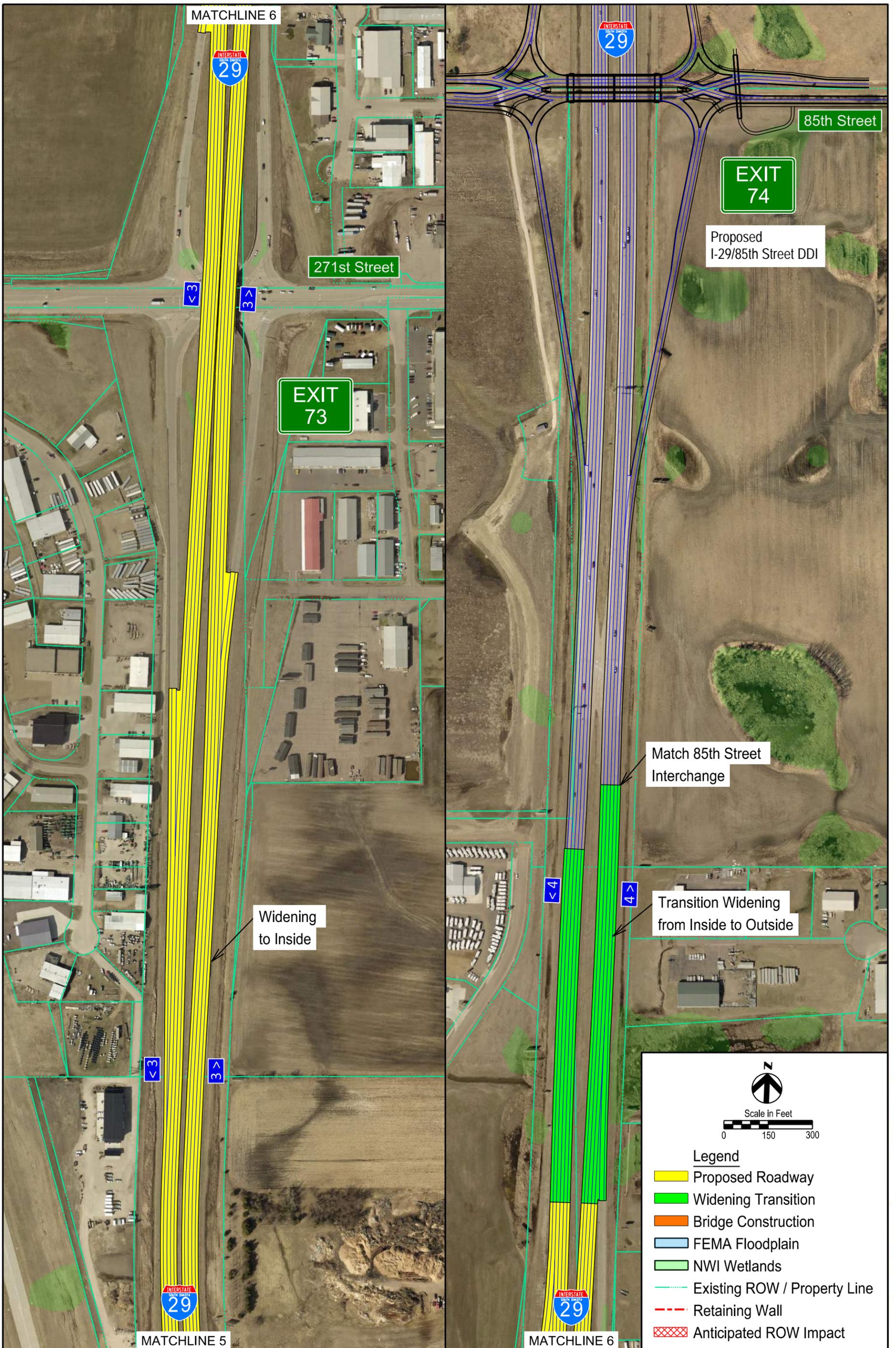
- Legend**
- Proposed Roadway
 - Widening Transition
 - Bridge Construction
 - FEMA Floodplain
 - NWI Wetlands
 - Existing ROW / Property Line
 - Retaining Wall
 - Anticipated ROW Impact

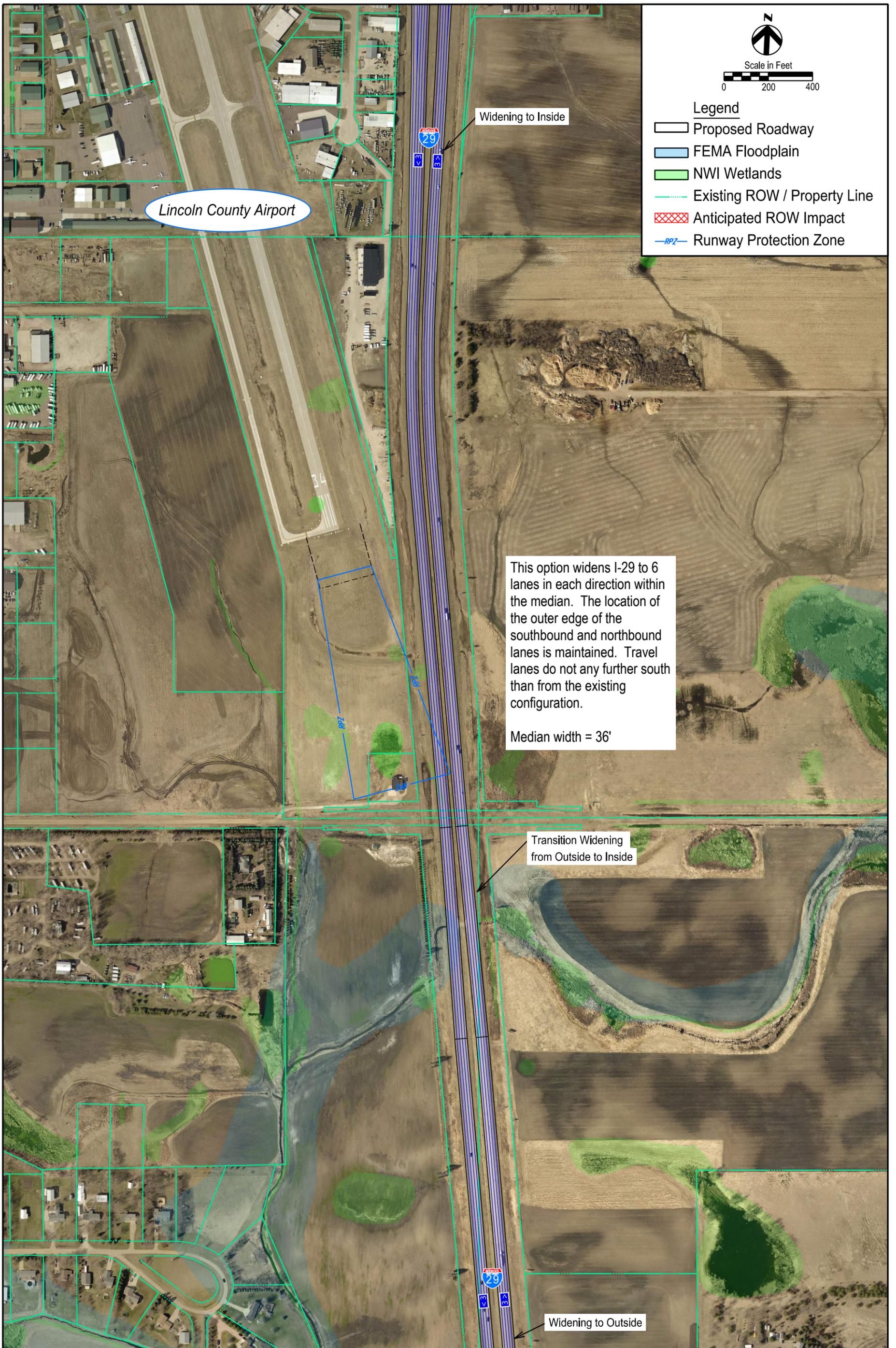


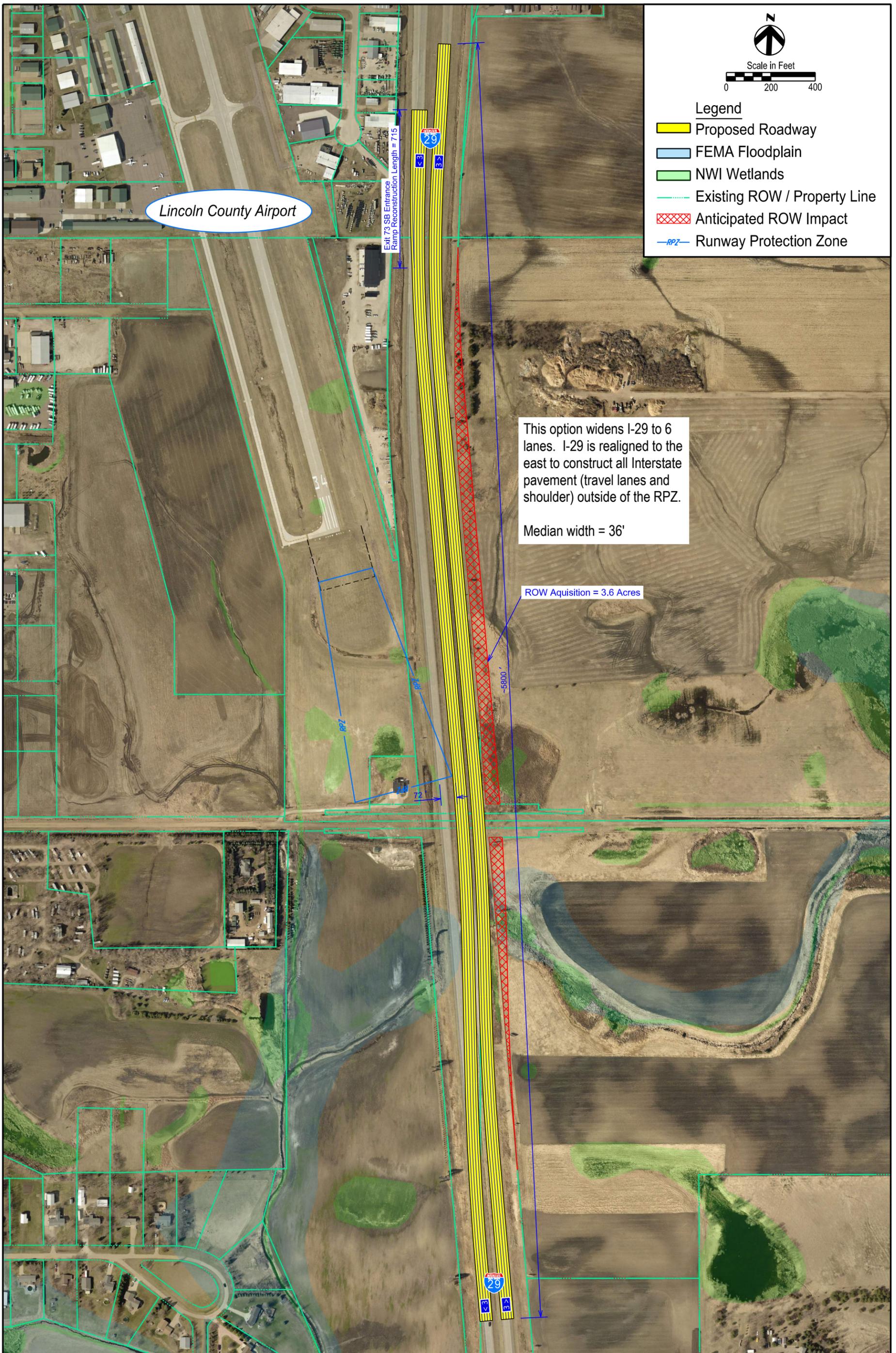


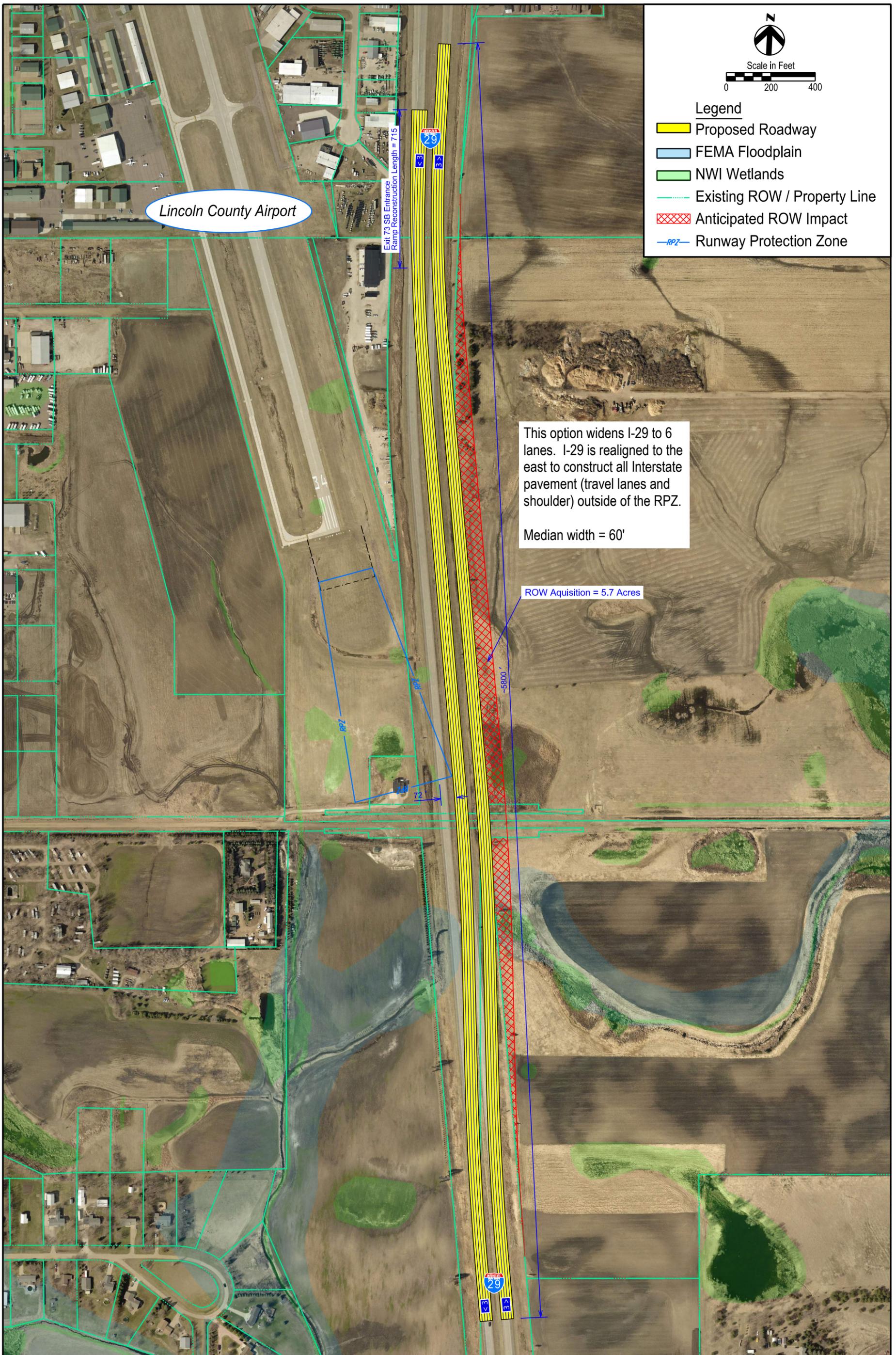
 <p>Revision: 8/11/2021</p>	<p>FIGURE 21 21 (Page 3 of 5)</p>	<p>I-29 Reconstruction - Exit 71 to Exit 73 (6-Lane / 4-Lane Transition at Exit 71) 6-Lanes from Exit 71 Northward; 4 Lanes with Grading for Future 3rd Lanes Southward I-29 Exit 71 IMJR</p>	<p>Tea/Harrisburg, SD</p>
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7. Future Year Traffic

Traffic forecasts help assess future-year capacity and operational needs throughout the study area due to growth in traffic demand and/or changes in traffic patterns. For this study, forecast years include:

- 2028: I-29 Exit 71 Year of Project Completion
- 2040: Interim Year (I-29 mainline only)
- 2050: Planning Horizon

The traffic forecasting process followed methodologies outlined in *NCHRP 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design*. The Sioux Falls MPO TDM was the source of growth rates, based on the following model scenarios:

- 2018: TDM base year
- 2045: TDM planning horizon

Where there were gaps in the model's estimation of future development, additional traffic was assigned to the network based on an estimation of future development occurring within the planning horizon.

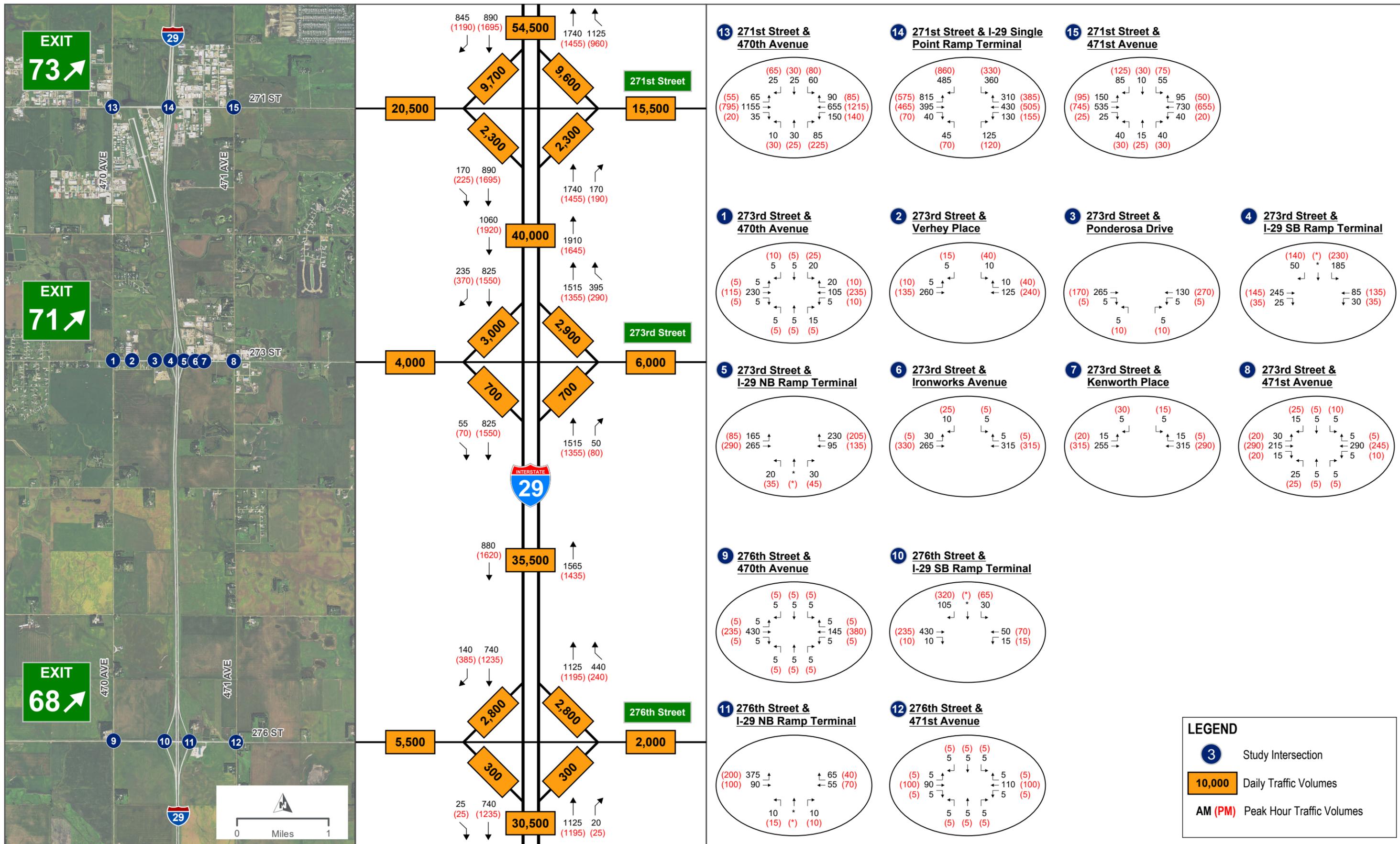
All forecasts assume the completion of the 85th Street interchange, Veterans Parkway, and Gateway Boulevard projects. To account for travel reduction due to the COVID-19 pandemic, forecasted volumes were compared against the following sources and adjusted if they appeared unreasonably low:

- SDDOT GIS Traffic Layer for 25 and 30-year projected traffic
- I-29 Exit 62 to 73 Corridor Study
- SDDOT Needs Book
- Lincoln County Master Transportation Plan
- Historical counts

Year 2028 and 2040 traffic volumes were developed by interpolating straight-line growth between the TDM base year of 2018 and horizon year of 2045. Year 2050 traffic volumes were derived by extrapolating the growth trend line of the TDM's scenario years. Peak hour intersection turning movement volumes were smoothed and balanced throughout the study corridor for all volume sets. Due to high-volume mid-segment access points along 271st Street, volumes do not balance across all intersections in Year 2028. With completion of Veterans Parkway in future years, traffic is expected to become less directional towards Year 2050.

Heavy vehicle percentages in future-year volume sets are based on collected 2021 vehicle classification counts.

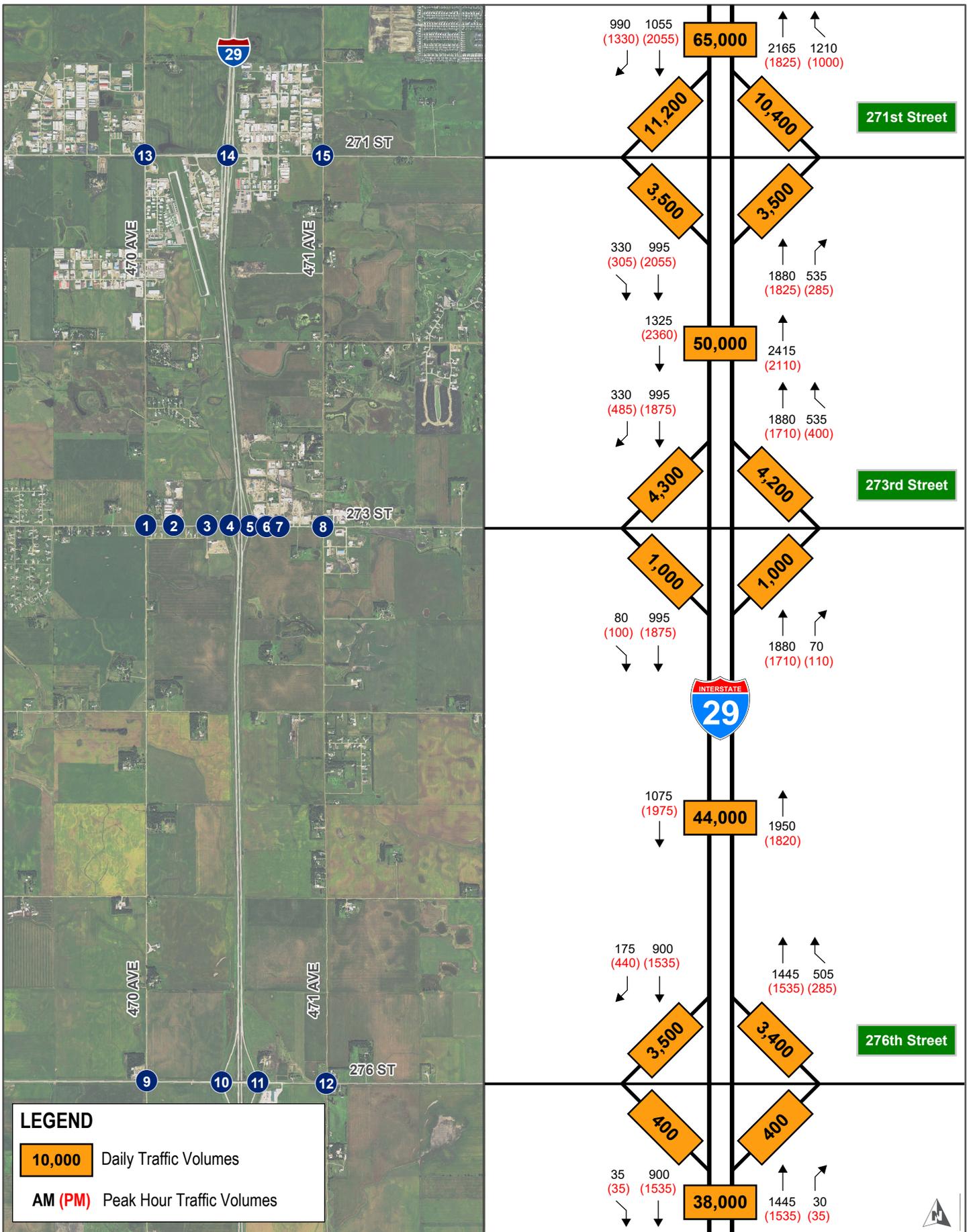
Forecasted traffic volumes are shown in **Figure 25** through **Figure 27**. Additional information is provided in the *Traffic Forecasts* memo in **Appendix D**.

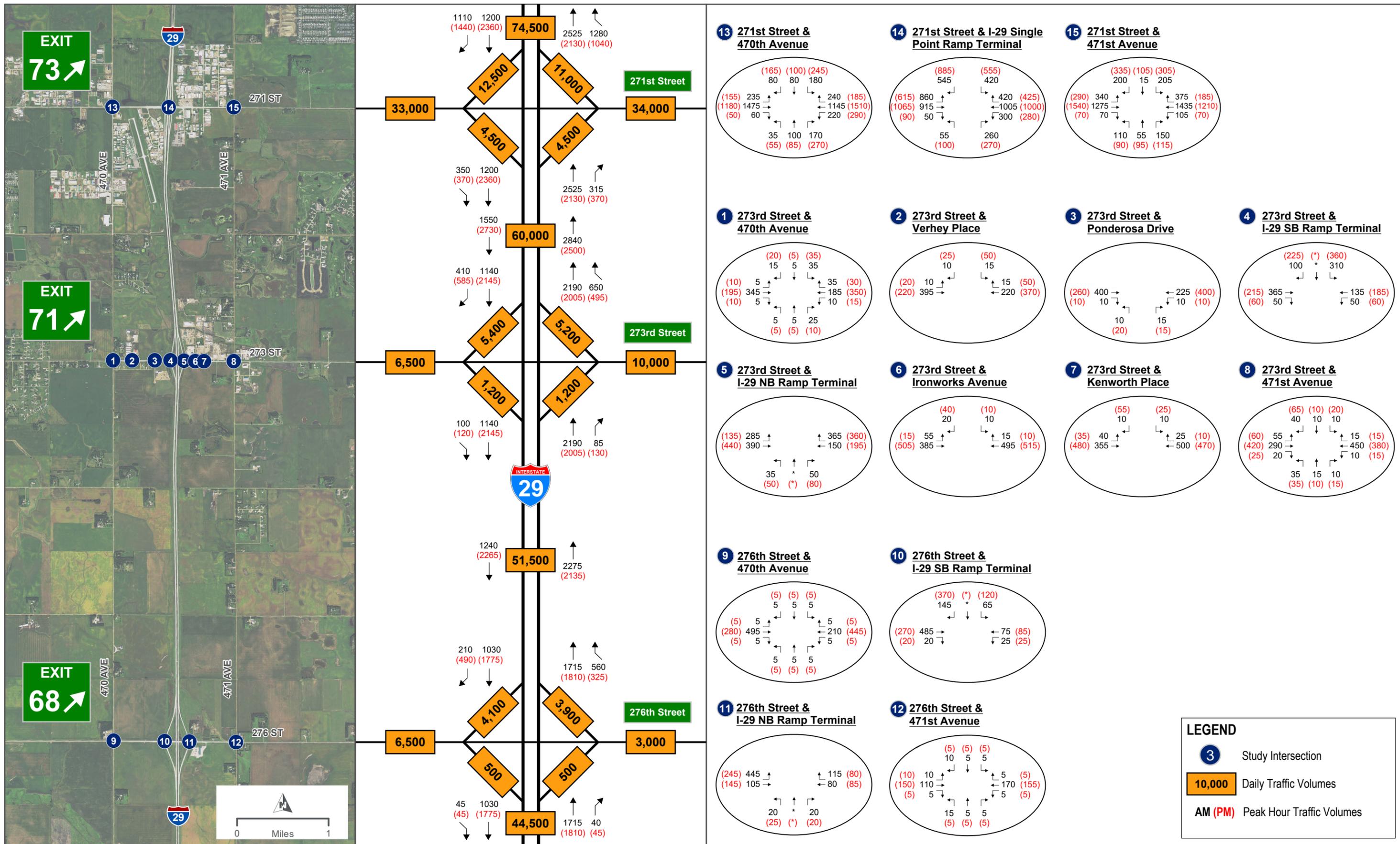


2028 NO BUILD CONDITION TRAFFIC VOLUMES



FIGURE 25





2050 NO BUILD CONDITION TRAFFIC VOLUMES



FIGURE 27

8. Alternatives Analysis

8.1 Conformance with Transportation Plans

The No Build alternative does not address established transportation needs at the Exit 71 interchange and along I-29 mainline, thus does not conform to historical transportation plans that encompass the proposed project area. All interchange and I-29 mainline Build alternatives presented in this IMJR conform to local and state transportation plans.

Transportation needs for improvement have been documented in the SDDOT's *Decennial Interstate Corridor* studies and were the impetus for the *I-29 Exit 62 to Exit 73 Corridor Study*. A future project has also been documented in the *Sioux Falls 2045 Long Range Transportation Plan*.

The SDDOT currently has an Exit 71 interchange and I-29 mainline improvement project programmed in the 2028-2031 developmental STIP (PCN 3167).

The study team has coordinated proposed improvements with agencies represented in the Study Advisory Team and other historical planning studies in the area, including:

- **I-29/85th Street IJR:** the additional I-29 mainline lanes tie into a potential DDI recommended in the IJR
- **Lincoln County Master Transportation Plan:** the 273rd Street corridor improvements presented in the Build alternatives reflect the 3-lane section recommended by the Lincoln County MTP
- **Comprehensive Plans:** from the City of Tea and City of Harrisburg were used to gauge future development type, timing of utility extension to the interchange area, and level of traffic coded into the Sioux Falls MPO TDM

8.2 Compliance with Policies and Engineering Standards

The No Build alternative does not address the current design standards need, with several geometric elements that support improvement as part of a future project:

- Right shoulder width
- Inslope
- Minimum on-ramp taper rate
- Minimum K value for a sag vertical curve (ramp and crossroad)
- Minimum stopping sight distance (crossroad)
- Ramp intersection sight distance
- Minimum control of access from interchange ramps (northeast quadrant)

Build alternatives developed and refined as part of this study were designed in accordance with current *SDDOT Road Design Manual*, AASHTO, and FHWA design guidelines.

8.3 Exit 71 Interchange Operational Performance

Operational performance of the future-year Exit 71 and 273rd Street corridor No Build and Build conditions is summarized in the following sections. Detailed results and discussion are provided in the *Existing and Future No Build Condition Traffic Operations Analysis* memo in **Appendix B** and the *Build Condition Traffic Operations Analysis* memo in **Appendix E**.

I-29 Exit 71 Interchange and 273rd Street Crossroad LOS

2028 and 2050 traffic operations for the No Build and Build alternatives are summarized in the following tables and presented graphically in **Figure 28**. No Build locations that do not meet LOS goals are noted in **Bold Orange** in the tables.

Table 15: Exit 71 Ramp Terminal Intersection Operations – 2028 Conditions

Exit 71 Alternative	Ramp Terminal	RTI Control	Measure	AM Delay / LOS	PM Delay / LOS
Compressed Diamond	Southbound RTI	TWSC	Overall: (WCSC):	6.7 / A (16.5 / C)	7.9 / A (14.6 / B)
	Northbound RTI	TWSC	Overall: (WCSC):	2.8 / A (16.0 / C)	2.3 / A (14.2 / B)
SPI	Single Point Intersection	Signal	Overall:	16.1 / B	14.5 / B
DDI	Southbound RTI	Signal	Overall:	12.2 / B	9.9 / A
	Northbound RTI	Signal	Overall:	9.1 / A	10.5 / B
No Build	Southbound RTI	TWSC	Overall: (WCSC):	6.4 / A (15.7 / C)	7.0 / A (12.8 / B)
	Northbound RTI	TWSC	Overall: (WCSC):	3.2 / A (13.1 / B)	2.3 / A (11.2 / B)

Table 16: I-29 Exit 71 Interchange Operations – 2028 Conditions

Exit 71 Alternative	RTI Control	Measure	AM ETT / LOS	PM ETT / LOS
Compressed Diamond	TWSC	Interchange ETT:	7.2 / A	7.7 / A
SPI	Signal	Interchange ETT:	15.8 / B	14.5 / B
DDI	Signal	Interchange ETT:	13.7 / A	13.5 / A
No Build	TWSC	Interchange ETT:	6.8 / A	6.8 / A

Table 17: 273rd Street Intersection Operations – 2028 Build Condition

Intersection	Intersection Control	Measure	AM Delay / LOS	PM Delay / LOS	Notes
470 th Ave	TWSC	Overall: (WCSC):	1.5 / A (11.5 / B)	1.6 / A (10.6 / B)	<i>No Build: no modifications required as part of Build alternative</i>
Verhey PI	TWSC	Overall: (WCSC):	0.5 / A (9.6 / A)	1.3 / A (10.1 / B)	<i>No Build: no modifications required as part of Build alternative</i>
Ponderosa Dr	TWSC	Overall: (WCSC):	0.3 / A (8.3 / A)	0.4 / A (8.5 / A)	<i>Part of interchange Build alternatives</i>
Ironworks Ave	TWSC	Overall: (WCSC):	Access closed	Access closed	<i>Part of interchange Build alternatives</i>
Kenworth PI	TWSC	Overall: (WCSC):	1.0 / A (10.1 / B)	1.3 / A (9.0 / A)	<i>Part of interchange Build alternatives</i>
471 st Ave	TWSC	Overall: (WCSC):	1.8 / A (15.8 / C)	1.8 / A (15.3 / C)	<i>No Build: no modifications required as part of Build alternative</i>

Local network intersections outside of the proposed interchange footprint incorporate turn lanes warranted by 2028 traffic volumes and may be different than what was analyzed in the 2050 Build condition.

Table 18: 273rd Street Intersection Operations – 2028 No Build Condition

Intersection	Intersection Control	Measure	AM Delay / LOS	PM Delay / LOS
470 th Ave	TWSC	Overall: (WCSC):	1.5 / A (11.5 / B)	1.6 / A (10.6 / B)
Verhey PI	TWSC	Overall: (WCSC):	0.5 / A (9.6 / A)	1.3 / A (10.1 / B)
Ponderosa Dr	TWSC	Overall: (WCSC):	0.3 / A (8.3 / A)	0.5 / A (8.4 / A)
Ironworks Ave	TWSC	Overall: (WCSC):	0.7 / A (9.0 / A)	0.5 / A (9.5 / A)
Kenworth PI	TWSC	Overall: (WCSC):	0.4 / A (9.6 / A)	0.9 / A (8.5 / A)
471 st Ave	TWSC	Overall: (WCSC):	1.8 / A (15.8 / C)	1.8 / A (15.3 / C)

Table 19: Exit 71 Ramp Terminal Intersection Operations – 2050 Conditions

Exit 71 Alternative	Ramp Terminal	RTI Control	Measure	AM Delay / LOS	PM Delay / LOS
Compressed Diamond	Southbound RTI	Signal	Overall:	10.8 / B	10.8 / B
	Northbound RTI	Signal	Overall:	6.7 / A	7.1 / A
SPI	Single Point Intersection	Signal	Overall:	18.3 / B	23.0 / C
DDI	Southbound RTI	Signal	Overall:	16.2 / B	11.7 / B
	Northbound RTI	Signal	Overall:	12.4 / B	13.4 / B
No Build	Southbound RTI	TWSC	Overall: (WCSC):	71.7 / F (175.4 / F) #	85.0 / F (159.6 / F) #
	Northbound RTI	TWSC	Overall: (WCSC):	9.0 / A (76.8 / F) #	4.0 / A (22.1 / C)

TWSC RTI LOS goals compared to WCSC measure/LOS

Table 20: Exit 71 Interchange Operations – 2050 Conditions

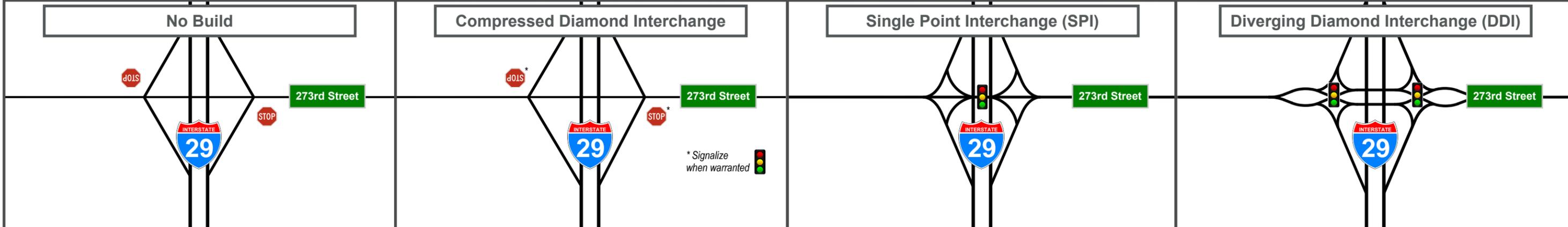
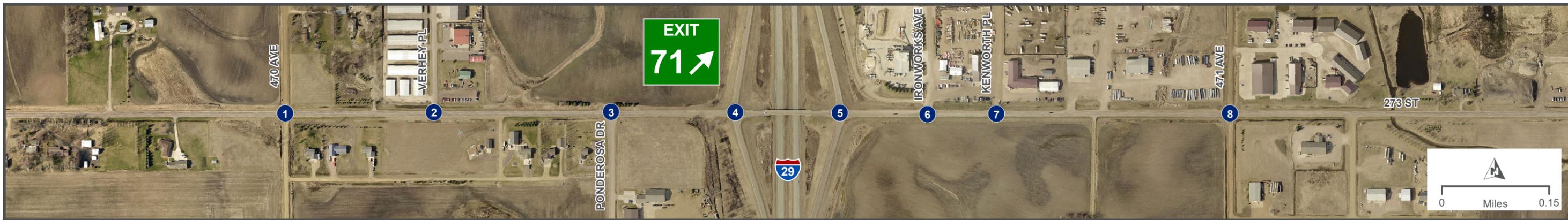
Exit 71 Alternative	RTI Control	Measure	AM ETT / LOS	PM ETT / LOS
Compressed Diamond	Signal	Interchange ETT:	13.7 / A	13.6 / A
SPI	Signal	Interchange ETT:	17.7 / B	22.5 / B
DDI	Signal	Interchange ETT:	17.6 / B	16.0 / B
No Build	TWSC	Interchange ETT:	57.1 / D	63.4 / D

Table 21: 273rd Street Intersection Operations – 2050 Build Condition

Intersection	Intersection Control	Measure	AM Delay / LOS	PM Delay / LOS	Notes
470 th Ave	TWSC	Overall: (WCSC):	1.9 / A (14.5 / B)	1.8 / A (12.9 / B)	No Build: no modifications required as part of Build alternative
Verhey Pl	TWSC	Overall: (WCSC):	0.6 / A (11.3 / B)	1.5 / A (12.3 / B)	No Build: no modifications required as part of Build alternative
Ponderosa Dr	TWSC	Overall: (WCSC):	0.5 / A (9.0 / A)	0.6 / A (10.9 / B)	Part of interchange Build alternatives
Ironworks Ave	TWSC	Overall: (WCSC):	Access closed	Access closed	Part of interchange Build alternatives
Kenworth Pl	TWSC	Overall: (WCSC):	1.7 / A (16.8 / C)	1.7 / A (11.5 / B)	Part of interchange Build alternatives
471 st Ave	TWSC	Overall: (WCSC):	3.7 / A (33.5 / D)	3.9 / A (31.6 / D)	No Build: no modifications required as part of Build alternative

Table 22: 273rd Street Local Network Intersection Operations – 2050 No Build Condition

Intersection	Intersection Control	Measure	AM Delay / LOS	PM Delay / LOS
470 th Ave	TWSC	Overall: (WCSC):	1.9 / A (14.5 / B)	1.8 / A (12.9 / B)
Verhey Pl	TWSC	Overall: (WCSC):	0.6 / A (11.3 / B)	1.5 / A (12.3 / B)
Ponderosa Dr	TWSC	Overall: (WCSC):	0.5 / A (9.0 / A)	0.7 / A (10.9 / B)
Ironworks Ave	TWSC	Overall: (WCSC):	1.2 / A (13.3 / B)	0.8 / A (11.1 / B)
Kenworth Pl	TWSC	Overall: (WCSC):	0.9 / A (13.7 / B)	1.4 / A (11.0 / B)
471 st Ave	TWSC	Overall: (WCSC):	3.7 / A (33.5 / D)	3.9 / A (31.6 / D)



Year	Interchange	273rd Street (CH110) Intersections	
		Control	LOS
2028	A / (A)	1 470th Avenue	STOP A / (A)
		2 Verhey Place	STOP A / (A)
		3 Ponderosa Drive	STOP A / (A)
		4 I-29 SB RTI	STOP A / (A)
		5 I-29 NB RTI	STOP A / (A)
		6 Ironworks Avenue	STOP A / (A)
		7 Kenworth Place	STOP A / (A)
		8 471st Avenue	STOP A / (A)
2028	A / (A)	1 470th Avenue	**
		2 Verhey Place	**
		3 Ponderosa Drive	STOP A / (A)
		4 I-29 SB RTI	STOP A / (A)
		5 I-29 NB RTI	STOP A / (A)
		6 Access closed	
		7 Kenworth Place	STOP A / (A)
		8 471st Avenue	**
2028	B / (B)	1 470th Avenue	**
		2 Verhey Place	**
		3 Ponderosa Drive	STOP A / (A)
		4 5 I-29 SPI	Signal B / (B)
		6 Access closed	
		7 Kenworth Place	STOP A / (A)
		8 471st Avenue	**
		2028	A / (A)
2 Verhey Place	**		
3 Ponderosa Drive	STOP A / (A)		
4 I-29 SB RTI	Signal B / (A)		
5 I-29 NB RTI	Signal A / (B)		
6 Access closed			
7 Kenworth Place	STOP A / (A)		
8 471st Avenue	**		
2050	D / (D)	1 470th Avenue	STOP A / (A)
		2 Verhey Place	STOP A / (A)
		3 Ponderosa Drive	STOP A / (A)
		4 I-29 SB RTI	STOP F / (F)
		5 I-29 NB RTI	STOP A / (A)
		6 Ironworks Avenue	STOP A / (A)
		7 Kenworth Place	STOP A / (A)
		8 471st Avenue	STOP A / (A)
2050	A / (A)	1 470th Avenue	**
		2 Verhey Place	**
		3 Ponderosa Drive	STOP A / (A)
		4 I-29 SB RTI	Signal B / (B)
		5 I-29 NB RTI	Signal A / (A)
		6 Access closed	
		7 Kenworth Place	STOP A / (A)
		8 471st Avenue	**
2050	B / (B)	1 470th Avenue	**
		2 Verhey Place	**
		3 Ponderosa Drive	STOP A / (A)
		4 5 I-29 SPI	Signal B / (C)
		6 Access closed	
		7 Kenworth Place	STOP A / (A)
		8 471st Avenue	**
		2050	B / (B)
2 Verhey Place	**		
3 Ponderosa Drive	STOP A / (A)		
4 I-29 SB RTI	Signal B / (B)		
5 I-29 NB RTI	Signal B / (B)		
6 Access closed			
7 Kenworth Place	STOP A / (A)		
8 471st Avenue	**		



LEGEND

3 Study Intersection

Signal/STOP Intersection Traffic Control

C / (C) AM (PM) Peak Hour LOS Overall Interchange/Intersection

Meet Minimum Allowable LOS?
 YES
 NO
 NO LOS F

** No modifications required as part of Build alternative. No change in LOS from No Build condition.

I-29 EXIT 71 INTERCHANGE AND 273RD STREET TRAFFIC OPERATIONS SUMMARY

FIGURE 28

273rd Street Crossroad Intersections Outside Build Alternative Footprint

The 2028 and 2050 No Build condition analyses show no modifications are required to meet minimum allowable LOS at the 273rd Street intersections with 470th Avenue, Verhey Place, and 471st Avenue. All three intersections operate at overall intersection LOS A in year 2050 with the forecasted traffic volumes. Further, each intersection is outside of the interchange footprint in all Build alternatives and thus do not need to be modified by the proposed interchange project. It is anticipated that improvements to these intersections will be addressed when needed, likely due to increased side-street volumes from future development.

I-29 Exit 71 Interchange and 273rd Street Crossroad Year of Need

The need for volume-warranted turn lanes and signalization at unsignalized intersections were reviewed as part of the study. Because the SPI and DDI ramp terminal intersections would open as signalized, turn lane and traffic signal warrants are only applicable to the compressed diamond interchange alternatives. Turn lane needs at signalized intersections are based on traffic operations and were incorporated in the alternative if needed to achieve LOS requirements in the 2050 traffic operations analysis.

For the Compressed Diamond alternatives, **Table 23** presents a summary planning-level estimate of when a change in traffic control may be needed based on straight-line traffic growth of 2028 and 2050 volume forecasts for the following:

- **Off-ramp approach LOS D:** approximate year when the off-ramp approach or overall ramp terminal intersection LOS will transition from LOS C to LOS D for the TWSC intersection condition
- **Traffic signal warrants:** approximate year when Warrants 1 (8-hour) and 2 (4-hour) from the 2009 *Manual on Uniform Traffic Control Devices* (MUTCD) may be met

Table 23: Exit 71 Compressed Diamond Interchange TWSC Year of Need (LOS D)

Exit 71 RTI	Off-Ramp LOS D	Intersection LOS D	Traffic Signal Warrant Met	Warrant
Southbound RTI	2037	2046	2041	Warrant 2 (70%)
Northbound RTI	2039	<i>Beyond 2050</i>	<i>Beyond 2050</i>	<i>n/a</i>

With both Compressed Diamond alternative ramp terminal intersections not showing a need to be signalized upon opening, unsignalized turn lane warrants are applicable for the 2028 Opening Year Build condition. **Table 24** summarizes volume-warranted turn lanes at both ramp terminal intersections, applicable only to the Compressed Diamond alternative, as well as at other unsignalized intersections being modified by all interchange Build alternatives. Methodology is based on guidance presented in Chapter 15 of the *SDDOT Road Design Manual*.

Table 24: 273rd Street Volume-Based Turn Lane Warrant Review

273 rd Street Intersection	Movement	2021 Existing	2028 No Build	2050 No Build
Ponderosa Dr	EB RT			
	WB LT			
I-29 SB RTI	EB RT			X
	WB LT		X	X
I-29 NB RTI	EB LT	X	X	X
	WB RT	X	X	X
Ironworks Ave	EB LT	X	X	X
	WB RT			
Kenworth PI	EB LT		X	X
	WB RT			X

Crossroad speed based on future design speed of 50 mph (posted speed 45 mph)

I-29 Exit 71 Interchange Year of LOS D

A supplemental analysis was conducted for each interchange Build alternative ramp terminal intersection to determine an approximate timeframe for when an interchange would be expected to reach:

- Ramp terminal intersection LOS D
- Individual ramp terminal intersection movement LOS E or worse

Traffic volumes were based on straight-line extrapolation of 2028 and 2050 peak hour traffic forecasts. Only minor adjustments to the ramp terminal intersections, such as changes in traffic control, were incorporated into the analysis. The 273rd Street corridor was analyzed with both one and two lanes in each direction.

A summary of findings from this analysis is provided in **Table 25**. Associated HCS files and assumptions are provided in the *Interchange Year of Level of Service 'D' Analysis* memo in **Appendix F**.

Table 25: Exit 71 Year of LOS C/D Threshold Analysis

Interchange Build Alternative	Road Section	Year of LOS C/D Threshold (Peak Hour, RTI)
Compressed Diamond	3-Lane	2090-2095 (AM, SB RTI)
	5-Lane	Beyond 2105
SPI	3-Lane	2080-2085 (AM)
	5-Lane	2085-2090 (AM)
DDI	2-Lane	2090-2095 (AM, SB RTI) 2085-2090 (PM, NB RTI)
	4-Lane	Beyond 2105

5-year range in which the LOS transitions from acceptable to unacceptable traffic operations

NB: northbound, SB: southbound, EB, eastbound, WB: westbound, RTI: ramp terminal intersection

The Year of LOS D in chronological order is as follows:

- 2080-2085: SPI (3-lane)
- 2085-2090: DDI (2-lane) and SPI (5-lane)
- 2090-2095: Compressed Diamond (3-lane)
- Beyond 2105: Compressed Diamond (5-lane) and DDI (4-lane)

The SPI is shown to have a slightly lower LOS D ceiling than others due to all through and left turn movements entering/exiting a single signalized intersection. The DDI and Compressed Diamond alternatives show a higher ceiling, with the multilane options maintaining LOS C through the 2105 design horizon. A summary of what ramp terminal intersection feature was first to exceed the LOS threshold is as follows:

- **Compressed Diamond**
 - SB RTI: combination of westbound left turn and southbound left turn delay leads to movement LOS E and overall intersection LOS D
- **SPI**
 - SPI: combination of eastbound left turn, westbound through, and southbound left turn capacity (LOS E)
- **DDI**
 - SB RTI: eastbound through movement LOS F
 - DDI signal timing constraints and random arrival of high commute volume
 - NB RTI: eastbound through movement LOS F (volume/capacity ratio > 1.0)
 - Volume arrives in two platoons, one from southbound off-ramp left turn and one from eastbound corridor through movement

Multimodal Operations

Due to limitations in HCM6 methodology and HCS7 software, multimodal elements were not obtained directly from HCS output for this analysis. However, benefits associated with each can be derived from the conceptual design and other HCS7 measures.

Automobile Facility Operations

Interchange origin-destination ETT (overall interchange LOS previously shown in **Figure 28**) provides the average experienced travel time of all vehicles traversing through the interchange. Ramp terminal intersection delay is the greatest differentiator, thus RTIs with lower intersection delay experience less travel time through the interchange. At unsignalized intersections, operations benefit from implementation of warranted turn lanes to remove turning traffic from the through lane.

Pedestrian and Bicycle Operations

The conceptual layouts include a shared-use path on the north side through the interchange. This is a notable improvement from the No Build condition as the existing interchange does not provide a sidewalk or shared-use path across I-29.

At ramp terminal intersections, the SPI does not provide for north/south crossing of 273rd Street within the interchange, only east/west crossings of the interchange ramps. North/south

crossings need to occur at an adjacent intersection or mid-segment location. The DDI and Compressed Diamond interchanges provide opportunities to cross ramps and 273rd Street within the interchange if connecting facilities are constructed on both sides of the corridor.

Conclusions

Key findings from the Exit 71 interchange traffic operations analysis include:

- Compressed Diamond provides the best overall interchange LOS through Year 2050
- Compressed Diamond likely provides the opportunity to maintain TWSC ramp terminal intersections, which is an operational benefit to overall intersection delay
- Compressed Diamond and DDI provide the best long-term capacity

8.4 I-29 Freeway Interchange Operational Performance

Operational performance of the future-year I-29 mainline No Build and Build conditions is summarized in the following sections. Detailed results and discussion are provided in the *Existing and Future No Build Condition Traffic Operations Analysis* memo in **Appendix B** and the *Build Condition Traffic Operations Analysis* memo in **Appendix E**.

I-29 Freeway Scenarios

The number of I-29 lanes associated with No Build, Partial Build, and Full Build analysis scenarios are summarized in **Table 26**. No Build traffic operations are shown in **Figure 29**. Build condition traffic operations are shown in **Figure 30**.

Table 26: I-29 Freeway Scenario Number of Lanes

I-29 Segment	2028 No Build	2050 No Build	2028 Partial Build	2040 Partial Build	2040 Full Build	2050 Full Build
Exit 73 to 85 th St Interchange*	6	6	8	8	8	8
Exit 73	4	4	6	6	6	6
Exit 71 to Exit 73	4	4	6	6	6	6
Exit 71	4	4	4	4	6	6
Exit 68 to Exit 71	4	4	4	4	6	6
Exit 68 and south	4	4	4	4	4	4

Number of lanes reflects sum of northbound and southbound directions of travel

* Build lane conditions include 85th Street interchange

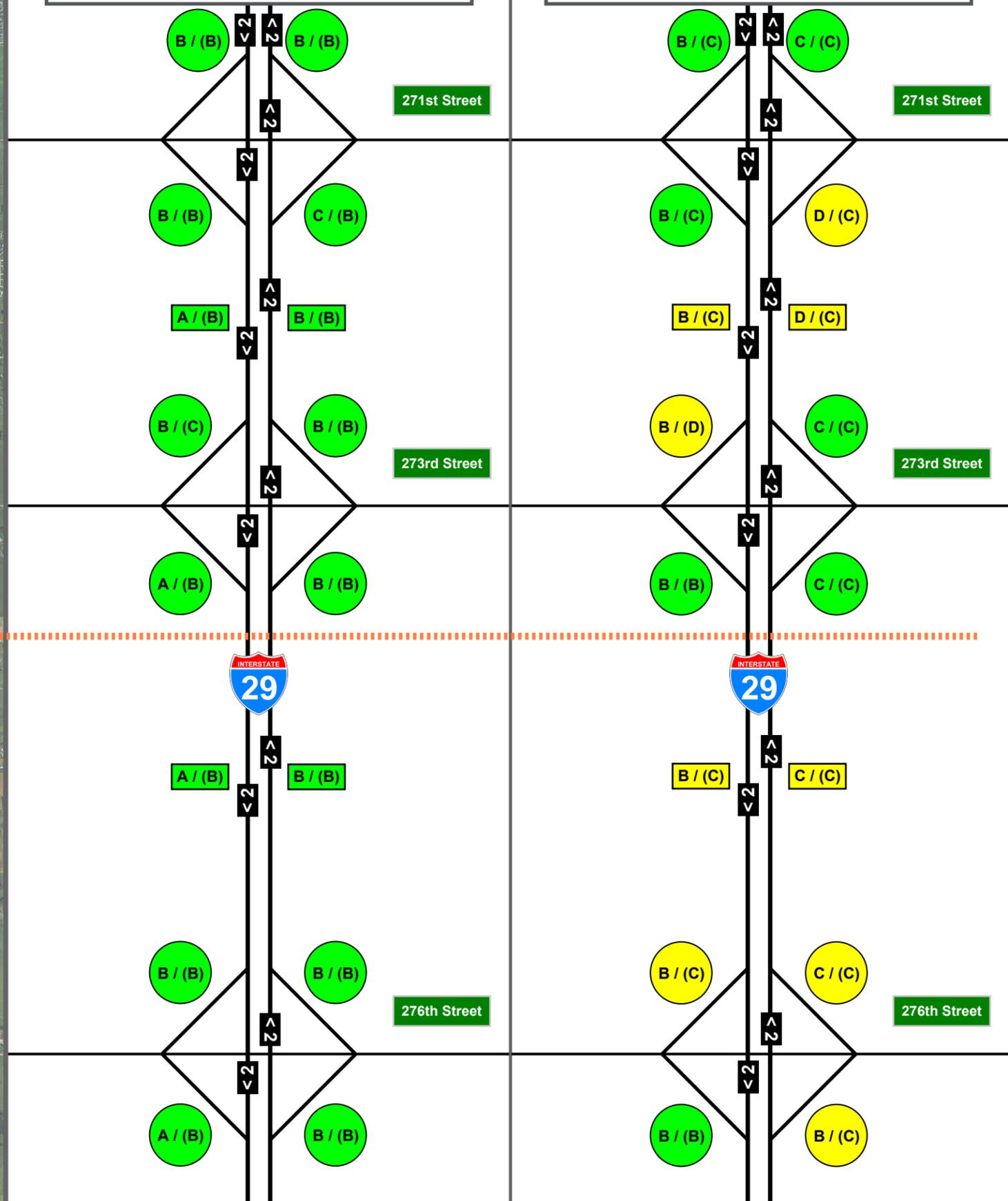
The 2050 No Build condition establishes the operational need for additional lanes throughout the study area within the 2050 Planning Horizon.

The Build condition analyses validates necessary improvements to address these needs northward from the Exit 68 ramps. Further consideration towards timing of improvements was examined by the study to determine whether they are needed as part of the planned 2028 project or can be deferred to a later date.



2028 No Build Conditions

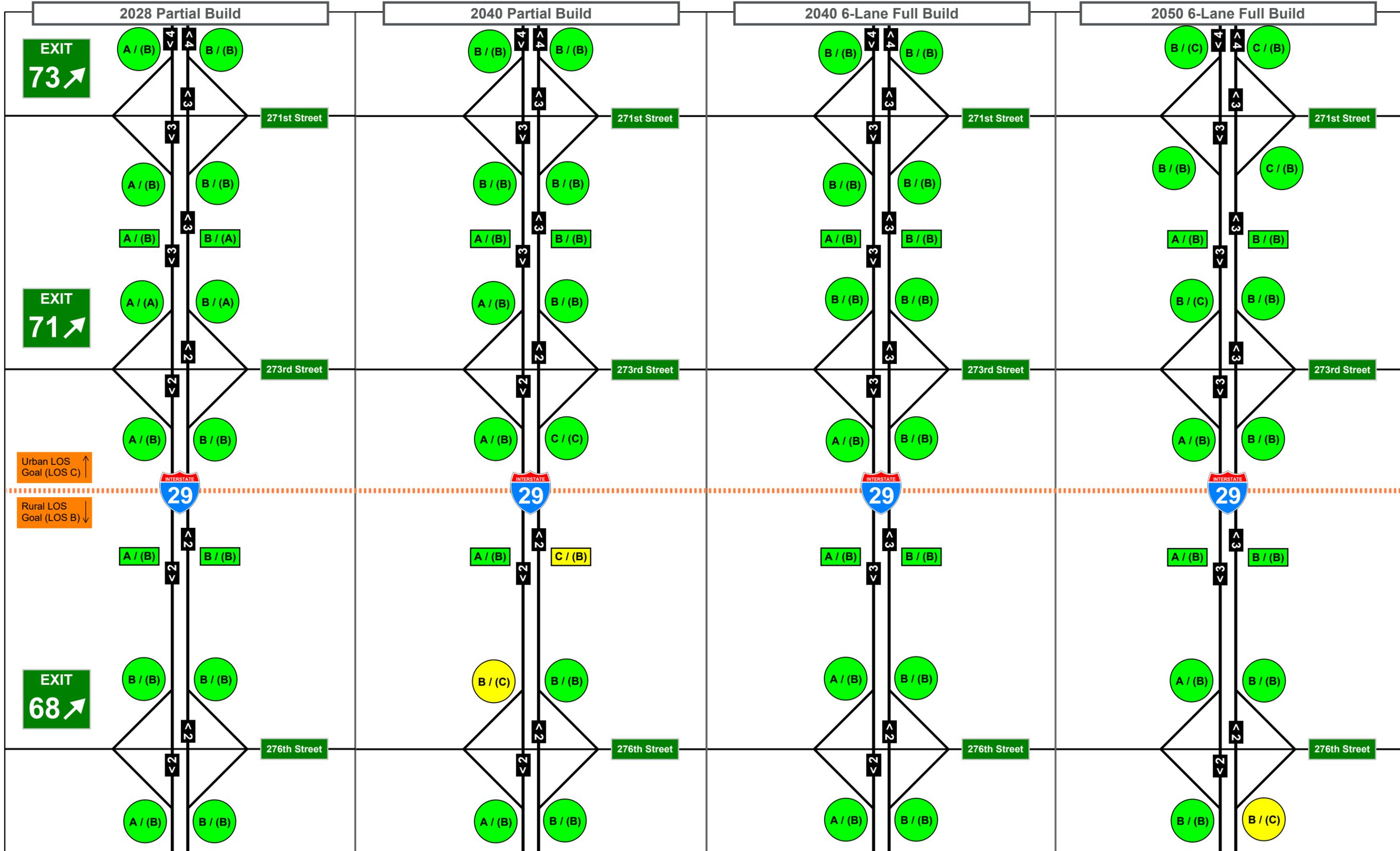
2050 No Build Conditions



LEGEND

- B / (B) AM (PM) Peak Hour LOS I-29 Ramp Junction Freeway Segments
- B / (B) AM (PM) Peak Hour LOS I-29 Basic Freeway Segments
- <2 Traffic Direction and Number of Lanes
- Meet Minimum Allowable LOS?
 - YES
 - NO
 - NO, LOS F

I-29 FUTURE YEAR NO BUILD CONDITION TRAFFIC OPERATIONS SUMMARY



EXIT
73 ↗

EXIT
71 ↗

EXIT
68 ↗

Urban LOS Goal (LOS C) ↑
Rural LOS Goal (LOS B) ↓



LEGEND

AM (PM) Peak Hour LOS
 I-29 Ramp Junction Freeway Segments

AM (PM) Peak Hour LOS
 I-29 Basic Freeway Segments

Traffic Direction and Number of Lanes

Meet Minimum Allowable LOS?
 YES
 NO
 NO, LOS F

I-29 FUTURE YEAR BUILD CONDITION
TRAFFIC OPERATIONS SUMMARY

Exit 73 to 85th Street Segment: Auxiliary Lanes

Proposed spacing between gore areas of the northern Exit 73 ramps and southern 85th Street ramps is approximately 1,630 feet and 2,490 feet in the northbound and southbound directions of travel, respectively. These distances do not provide for the full separation of merge and diverge influence areas, thus there would be overlapping speed change areas within the outside I-29 through lane. The traffic operations analysis found notable operational benefit to I-29 mainline if an auxiliary lane was constructed between ramps to allow for the overlapping speed change area to occur outside of the three I-29 mainline through lanes. Based on this finding, auxiliary lanes are included as part of the 2028 Build conditions.

Exit 71 and South Segments: 4-Lane vs. 6-Lane

The 2040 interim condition estimates the operational feasibility of the 2028 project constructing a 4-lane section from the Exit 71 interchange southward to Exit 68 (Partial Build) or whether the full 6-lanes are needed. The 2040 Partial Build analysis is shown in **Table 27**. Urban and rural analysis segments are designated with **yellow** and **blue** shading, respectively.

Table 27: I-29 Freeway Operations – 2040 Partial Build Condition

Interchange	I-29 Section	I-29 Southbound	Density / LOS		I-29 Northbound	Density / LOS	
			AM	PM		AM	PM
	6-Lane	Basic	11.6 / B	18.3 / C	Basic	19.0 / C	15.1 / B
Exit 85 th Street	8-Lane	Weave	11.1 / B	17.8 / B	Weave	19.7 / B	15.2 / B
Exit 73	6-Lane	Basic	7.1 / A	12.0 / B	Basic	13.6 / B	11.4 / B
	6-Lane	Merge	10.1 / B	15.0 / B	Diverge	18.2 / B	16.0 / B
	6-Lane	Basic	8.9 / A	13.8 / B	Basic	15.1 / B	13.1 / B
Exit 71	6-Lane	Diverge	8.6 / A	13.3 / B	Merge	14.4 / B	12.3 / B
	4-Lane	Basic	10.1 / A	16.5 / B	Basic	17.8 / B	16.0 / B
	4-Lane	Merge	10.2 / A	17.2 / B	Diverge	22.8 / C	21.2 / C
	4-Lane	Basic	10.7 / A	17.2 / B	Basic	18.3 / C	16.9 / B
Exit 68	4-Lane	Diverge	13.7 / B	21.4 / C	Merge	18.5 / B	17.3 / B
	4-Lane	Basic	8.9 / A	13.2 / B	Basic	13.4 / B	14.1 / B
	4-Lane	Merge	9.9 / A	14.6 / B	Diverge	16.9 / B	17.9 / B
	4-Lane	Basic	9.4 / A	13.6 / B	Basic	13.7 / B	14.5 / B

Findings from the 2040 analysis include:

- Two 4-lane segments do not meet study LOS B (rural area) goals:
 - Southbound PM diverge to Exit 68
 - Northbound AM basic segment between Exit 71 and Exit 68
- Two other 4-lane rural segments exhibit measures approaching LOS C:
 - Southbound PM basic segment between Exit 71 and Exit 68
 - Northbound AM merge from Exit 68
- Northbound Exit 71 diverge LOS C is in the urban area, but is of note due to:
 - Location on the periphery of the rural area
 - Reflects the greatest segment density in this scenario

It is anticipated that I-29 southward from Exit 71 will remain rural for the foreseeable future, as the Harrisburg and Tea growth areas are primarily along and to the north of the 273rd Street corridor. The current urbanized boundary within the study area is the 273rd Street corridor. Therefore, it is concluded that the LOS B goal for a rural area south of Exit 71 is applicable through the study’s 2050 Planning Horizon.

I-29 Mainline Reliability

Cumulative travel time distribution curves for future-year Northbound AM/PM and Southbound AM/PM scenarios were developed in HCS to assess the likelihood of reliability impacts from high vehicle demand, incidents, and inclement weather. Summary figures of the high-volume Northbound AM and Southbound PM peak hours are shown in **Figure 31** and **Figure 32**.

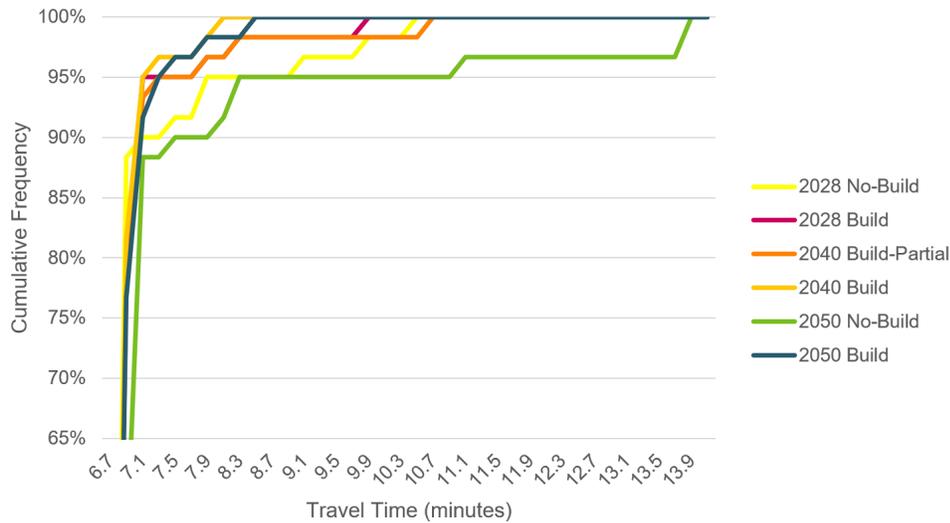


Figure 31: Future Year Northbound AM Reliability Cumulative Frequency

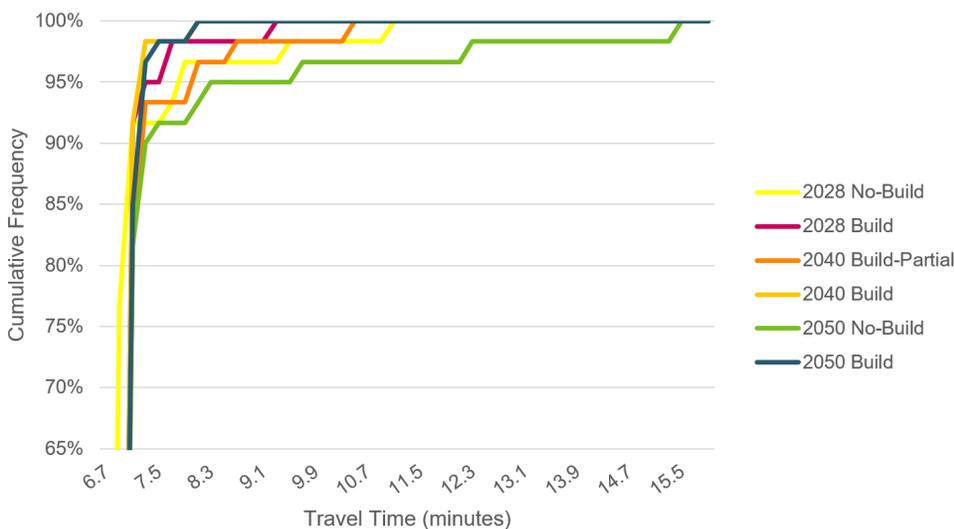


Figure 32: Future Year Southbound PM Reliability Cumulative Frequency

The 2028 and 2050 No Build scenarios show decreased reliability (increases in travel time) around the 90th percentile of travel times. The 2050 No Build shows a significant increase in travel times for the 95th percentile, peaking at 13.5 and 15.5 minutes for the Northbound AM and Southbound PM time periods respectively. This reflects a travel time increase between 5 and 7 minutes when an event occurs and reinforces the long-range need for additional lanes. The 2050 Build scenario shows much tighter curves signifying considerably less deviation in travel times over the course of a year and higher levels of reliability.

The 2040 Partial and Full Build scenarios were also compared. The Northbound AM and Southbound PM scenarios showed very similar travel times through the 95th percentile. However, within the upper five percent of travel times, the impacts of fewer lanes from Exit 71 southward leads to an increase in travel time of around three minutes.

Additional information on the HCS-based future-year reliability analysis is provided in the *Future Condition Reliability Analysis* memo in **Appendix G**.

Conclusions

Key I-29 mainline alternative findings include:

- Auxiliary lane needed between planned 85th Street interchange and Exit 73
 - 4 lanes, 3 through and 1 auxiliary in each direction, satisfies LOS C goal
- Exit 73 south to Exit 71
 - 3 lanes in each direction satisfies LOS C goal
- Exit 71 and southward:
 - 2 lanes in each direction satisfies LOS B goal in Year 2028
 - 3 lanes in each direction needed to meet LOS B goal in Year 2040 and beyond
- 3rd lane in each direction provides reliability benefits when an event occurs on I-29

8.5 Safety

A predictive safety analysis was completed for the No Build and Build conditions using the American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual (HSM) method to evaluate the expected safety of proposed intersection and roadway modifications. As stated in the HSM, 2010, “*The predictive method provides a quantitative measure of expected crash frequency under both existing conditions and conditions which have not yet occurred. This allows proposed roadway conditions to be quantitatively assessed...*”

FHWA’s Interactive Highway Safety Design Model (IHSDM) was used to evaluate safety in the No Build and Build conditions. Output from this tool includes the predicted average annual crash frequency and total crashes over the analyzed timeframe (2028-2050) in terms of fatal and injury (F&I) and property damage only (PDO) crashes.

Supporting information for the analysis is provided in the *Predictive Safety Analysis* memo in **Appendix H**.

I-29 Exit 71 Interchange Alternatives Analysis

A summary of the predicted average annual crash frequencies between years 2028 and 2050 is shown in **Figure 33**. Total analysis period predicted crashes are summarized in **Table 28**.

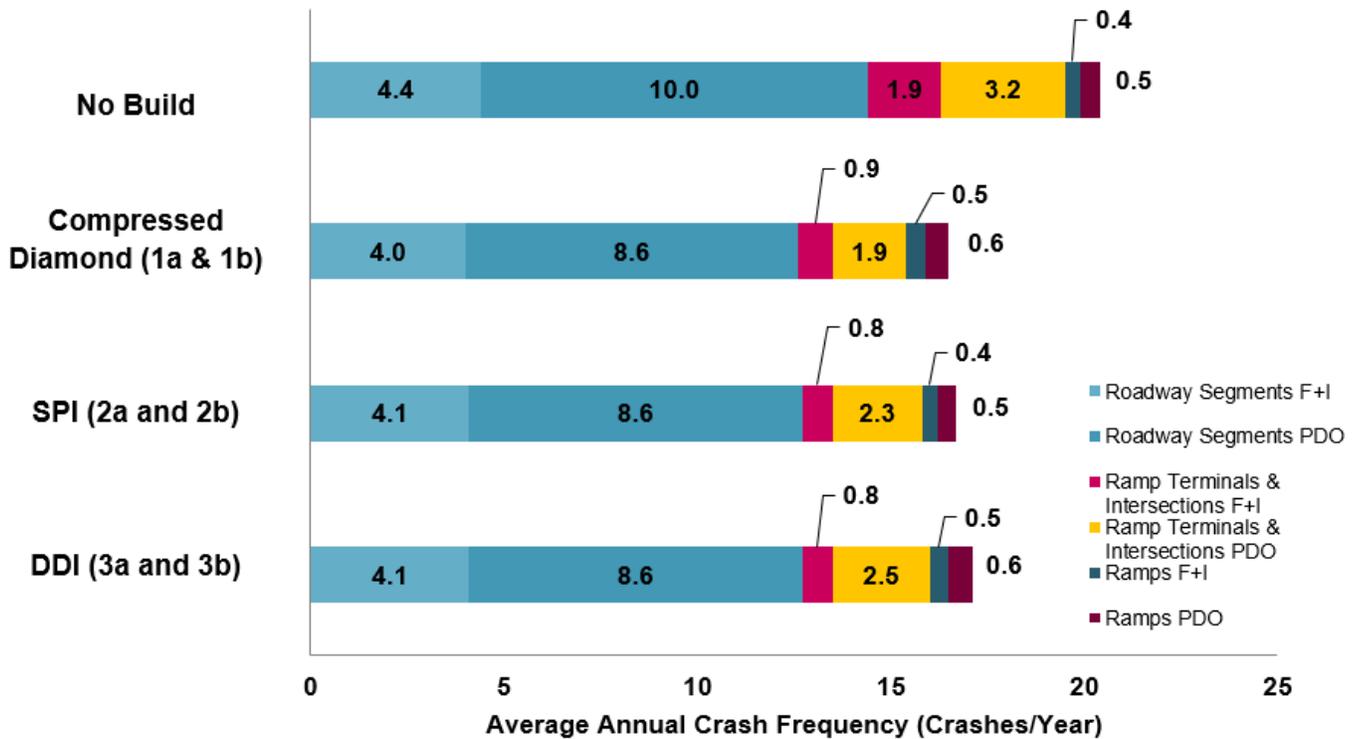


Figure 33: Predicted I-29 Exit 71 Interchange Average Annual Crash Frequency (2028-2050)

Table 28: Predicted I-29 Exit 71 Interchange Total Crashes (2028-2050)

Interchange Alternative	Fatal & Injury Crashes <i>Increase (+) or Decrease (-) from No Build</i>	Total Crashes <i>Increase (+) or Decrease (-) from No Build</i>
Compressed Diamond	-30 (-19%)	-89 (-19%)
SPI	-32 (-21%)	-83 (-18%)
DDI	-30 (-19%)	-76 (-16%)
No Build	154 (baseline, total crashes)	469 (baseline, total crashes)

It was found that all three interchange type Build alternatives demonstrate safety improvements at the Exit 71 interchange when compared to the No Build condition. Amongst the Build alternatives, the results were very similar for all three interchange types. The SPI exhibits the greatest decrease in F&I crashes while the Compressed Diamond exhibits the greatest reduction in Total (F&I plus PDO) crashes.

Geometric improvements contributing to the decrease in crashes include turn lanes (Compressed Diamond and SPI), channelized lanes (SPI and DDI), ramp terminal intersection traffic control (TWSC transitioning to signalization at the compressed diamond and signalization at SPI and DDI), and consolidation of Ironworks Avenue and Kenworth Place intersections to a single access point at Kenworth Place. The anticipated delay in signalizing compressed diamond ramp terminal intersections, compared to the DDI and SPI, until the latter half of the study planning horizon was a benefit to the alternative's safety performance. This is consistent with the HSM's safety performance functions of unsignalized and signalized intersections.

I-29 Mainline Analysis

A supplemental analysis was conducted for I-29 mainline between the northern Exit 71 ramps and the southern Exit 68 ramps between years 2028 and 2040. This analysis evaluates potential safety benefits of reconstructing I-29 to a 6-lane facility in lieu of a 4-lane facility with the planned 2028 project. The 4-lane scenario would postpone the third lane in each direction until a later date (assumed 2040 in this analysis).

Table 29 shows differentiation between the 4-lane and 6-lane segment scenarios in terms of total and PDO crashes, equating to approximately 1 to 1.5 fewer crashes per year. The difference in F&I crashes was minimal.

Table 29: Predicted I-29 Mainline Total Crashes, Exit 68 to Exit 71 (2028-2040)

Interchange Alternative	4-Lane Segment		6-Lane Segment	
	Fatal & Injury Crashes <i>Increase (+) or Decrease (-) from No Build</i>	Total Crashes <i>Increase (+) or Decrease (-) from No Build</i>	Fatal & Injury Crashes <i>Increase (+) or Decrease (-) from No Build</i>	Total Crashes <i>Increase (+) or Decrease (-) from No Build</i>
Compressed Diamond	-3 (-3%)	-13 (-4%)	-4 (-4%)	-31 (-9%)
SPI	+4 (+4%)	-6 (-2%)	+3 (+3%)	-21 (-6%)
DDI	-3 (-3%)	-13 (-4%)	-3 (-3%)	-29 (-9%)
No Build	100 (4-lane baseline, total crashes)	331 (4-lane baseline, total crashes)	100 (4-lane baseline, total crashes)	331 (4-lane baseline, total crashes)

I-29 Median Barrier Analysis

I-29 median barrier warrants were reviewed using proposed methodology developed in the *SDDOT 2020 Decennial Interstate Corridor Study*. The methodology uses three data sources:

- Median width
- Average daily traffic
- 5-Year crash history of cross-median crashes

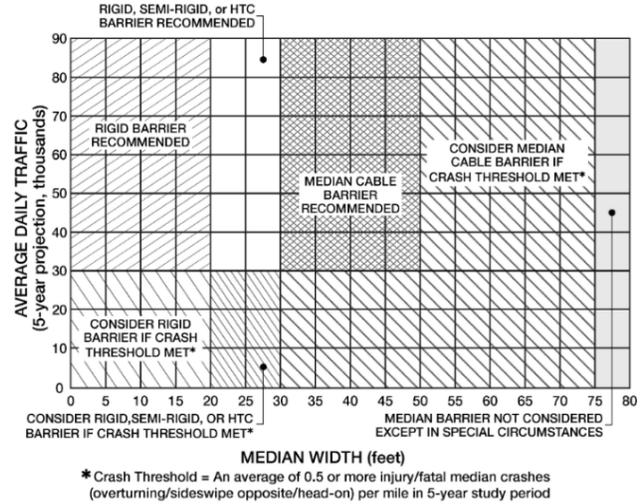
It was found that all I-29 study area segments from Exit 68 northward meet Year 2028 warrants for median barrier based on projected volumes and/or crash history. The *Median Barrier Warrant Review* memo (**Appendix I**) recommends that median cable barrier be installed as part of the future I-29 reconstruction project from Exit 68 northward to the proposed 85th Street

interchange. Within the Exit 71 interchange, rigid, semi-rigid, or HTC barrier is recommended. Installation of median barriers as part of the project would benefit corridor safety and reliability.

Conclusions

Key safety analysis findings include:

- **Exit 71 interchange alternatives**
 - All Build alternatives provide similar safety benefits when compared to the No Build
 - SPI exhibits greatest decrease in F&I crashes
 - Compressed diamond exhibits greatest decrease in total and PDO crashes
- **I-29 mainline: Exit 71 to Exit 68 between Years 2028 and 2040**
 - Approximately 1 to 1.5 fewer total crashes per year with constructing 6 lanes as part of the 2028 project compared to 4 lanes
 - Minimal difference in F&I crashes
- **I-29 mainline:** median barrier warranted throughout study area



Source: SDDOT 2020 Interstate Corridor Study
Figure 34: Median Barrier Warrant Matrix

8.6 Environmental Impacts

Environmental impacts were assessed for each of the study alternatives through the Environmental Scan process. Key environmental differentiators for the interchange alternatives are summarized in **Table 30**.

Table 30: Exit 71 Interchange Alternatives Environmental Impacts

Alt.	Description	Meets Purpose and Need	ROW Acquisition Needs (ac)	WAPA Transmission Line Impacts	Wetlands (ac)	FEMA Floodway (ac)
1a	Compressed Diamond 'I-29 Under'	Need is met	0.7	No	4.6	0.08
1b	Compressed Diamond 'I-29 Over'	Need is met	0.4	Yes	5.7	0.12
2a	SPI 'I-29 Under'	Need is met	0.4	No	2.9	0.06
2b	SPI 'I-29 Over'	Need is met	0.4	Yes	4.4	0.09
3a	DDI 'I-29 Under'	Need is met	1.5	No	5.8	0.10
3b	DDI 'I-29 Over'	Need is met	1.5	Yes	7.0	0.14
NB	No Build	Need is not met	0	No	0	0

8.7 Constructability and Maintenance of Traffic During Construction

Exit 71 Interchange Maintenance of Traffic

Construction duration and maintenance of traffic for each Exit 71 interchange Build alternative was assessed in the *Conceptual Construction Phasing and Sequencing for Maintenance of Traffic* memo (**Appendix J**) to better understand overall impacts to traffic.

Construction duration was estimated in terms of the expected number of construction seasons to substantially complete the project. Traffic impacts, such as detours, lane closures, or notable construction-related delays, would be anticipated during this time.

High-level construction phasing was developed for each interchange alternative to assess the alternative's ability to maintain traffic across I-29 (via 273rd Street) and to/from the interchange ramps during construction. Ramp and I-29 crossing closure duration was estimated within each phase. During these closures, impacted traffic would need to detour to Exit 68, Exit 73, or other routes outside of the study area.

Required closures for the following 'priority movements' identified in the first round of study stakeholder meetings is summarized in **Table 31** for each interchange type:

- 273rd Street across I-29 (east/west traffic across I-29)
- SB I-29 off-ramp to EB 273rd Street (PM commute; travel from Sioux Falls)
- WB 273rd Street to NB I-29 on-ramp (AM commute; travel to Sioux Falls; concrete truck route)

Table 31: Summary of I-29 Exit 71 Interchange Closures During Construction

Interchange Build Alternative	Construction Element	Compressed Diamond	Compressed Diamond - Offset Bridge	SPI	DDI
I-29 Under (1a, 2a, 3a)	Ramps	NB Ramp Closed (portion)		All Ramps Closed (portion)	No Ramp Closures
	Cross Street	273rd St Closed (during bridge construction)	273 rd Street Open		
	I-29 Mainline	I-29 Traffic Maintained on Mainline			
I-29 Over (1b, 2b, 3b)	Ramps	NB Ramp Closed (portion)		All Ramps Closed (portion)	No Ramp Closures
	Cross Street	273rd St Closed (during bridge construction)			
	I-29 Mainline	I-29 Traffic Routed onto Ramps (during I-29 mainline reconstruction and bridges)			

'Portion': see *Conceptual Construction Phasing and Sequencing for Maintenance of Traffic* memo for estimated closure durations

Table 32 provides the estimated overall construction duration as well as a ‘Maintenance of Traffic (MOT) Score’ for each interchange alternative. The MOT score is a comparative measure assigned to each alternative based on its overall construction duration and major traffic movement closures during construction.

Table 32: Summary of I-29 Exit 71 Interchange Construction Duration and MOT Score

Interchange Build Alternative		Construction Duration <i>Seasons</i>	MOT Score <i>10 – Most access 1 – Least access</i>
Compressed Diamond	‘I-29 Under’ (1a)	1.5	8
	‘I-29 Under’ (1a) – Offset Bridge	1.5	10
	‘I-29 Over’ (1b)	2.5	3
SPI	‘I-29 Under’ (2a)	2	8
	‘I-29 Over’ (2b)	2.5	0
DDI	‘I-29 Under’ (3a)	2	10
	‘I-29 Over’ (3b)	2.5	3

Conclusions

Key constructability and MOT benefits and drawbacks include:

- **Compressed Diamond (I-29 Under) with offset bridge**
 - Least construction duration (1.5 seasons)
 - Best MOT score for priority movements due to ability to maintain traffic across I-29 via the offset bridge and ramp construction off existing alignments
- **SPI (I-29 Under)**
 - Moderate construction duration (2 seasons) due to size of structure
 - High MOT score for priority movements
- **DDI (I-29 Under)**
 - Moderate construction duration (2 seasons) due to number of structures
 - High MOT score for priority movements due to ability to maintain traffic across I-29 via offset bridges and ramp construction off existing alignments
- **I-29 Over alternatives**
 - Greatest construction duration (2.5 seasons)
 - Lowest MOT scores due to the full closure of all interchange access to/from and across I-29 throughout construction

Exit 71 Interchange Constructability and Design Considerations

The following three constructability and design considerations stood out as key differentiators between interchange Build alternatives:

- Western Area Power Administration (WAPA) transmission line impacts
- Ninemile Creek grade raise needs
- Bridge number and size

WAPA Transmission Lines

At the onset of the study, the study team met with WAPA to understand potential impacts to the transmission line that runs across the northern half of the existing interchange. The primary concern was whether the 'I-29 Over' interchange alternatives would necessitate alteration to the transmission lines and/or towers due to decreased clearance between the roadway and line. WAPA recommended no less than 32-foot ground clearance, preferably more, between the roadway surface and their transmission line design profile. Their high-level review concluded that towers on the east and west side of I-29 would likely need to be replaced to raise the transmission lines if I-29 were to go over 273rd Street. Depending on the magnitude of this raise, the next adjacent towers may also need to be replaced. These costs would be applied to the interchange project. Additional information is provided in the *WAPA Coordination Summary* memo in **Appendix K**.

Ninemile Creek

One of the drivers towards evaluating interchange alternatives where I-29 goes over 273rd Street (in lieu of going under) is the history of flooding along Ninemile Creek that crosses under I-29 in the northern half of the Exit 71 interchange. While the creek has never overtopped the interstate in this area, it has reached levels that warranted a review as part of this study.

Based on the effective FEMA FIRM panel and the preliminary FEMA FIRM panel, Ninemile Creek does not overtop I-29 during a 1-percent-annual-chance flood event. The water surface elevations upstream of the Ninemile Creek box culvert at I-29 have between approximately 2-3 feet of freeboard before overtopping I-29. The Tributary to Ninemile Creek north of Exit 71 has approximately 4 feet of freeboard before overtopping I-29 according to the preliminary FEMA FIRM panel. It was found the current stream crossing has enough capacity to not require a grade raise, unless the SDDOT is trying to achieve a freeboard greater than 1-2 feet for a 1-percent-annual-chance flood event or protect I-29 from a flood event greater than a 1-percent-annual-chance flood event. The interchange preliminary and final design project will review this crossing using the FEMA 2D model currently in development.

Additional information regarding this review can be found in the *I-29 Exit 71/Ninemile Creek Preliminary Hydrologic and Hydraulic Review* memo in **Appendix L**.

Exit 71 Bridge(s)

The number and size of bridge(s) required for each alternative impact constructability, overall construction duration, and cost. As the number and/or size of the bridge(s) increase, the impacts increase.

The Compressed Diamond (I-29 under) interchange alternative requires only a single structure across I-29 mainline and thus brings benefits not exhibited by the other interchange alternatives. Notable drawbacks for the other interchanges include:

- SPI (I-29 Under): large structure
- DDI (I-29 Under): dual structures
- Compressed Diamond, SPI, and DDI (I-29 Over): dual I-29 structures

Conclusions

Overarching differentiators across the three key constructability and design considerations identified as part of this study include:

- **I-29 Over interchange alternatives** are likely to impact the WAPA transmission lines due to decreased clearance between the elevated roadways and transmission lines. This would likely require replacement of the towers east and west of the interchange and may require replacement of the next adjacent towers, all at a cost to the project.
- **I-29 mainline** grade raise is not required over Ninemile Creek to an extent that necessitates I-29 to be elevated over 273rd Street
- **Compressed Diamond (I-29 Under)**: single structure over I-29 provides notable benefit to constructability, construction duration, and cost compared to the other interchange alternatives

I-29 Mainline Reconstruction

Phasing and Maintenance of Traffic

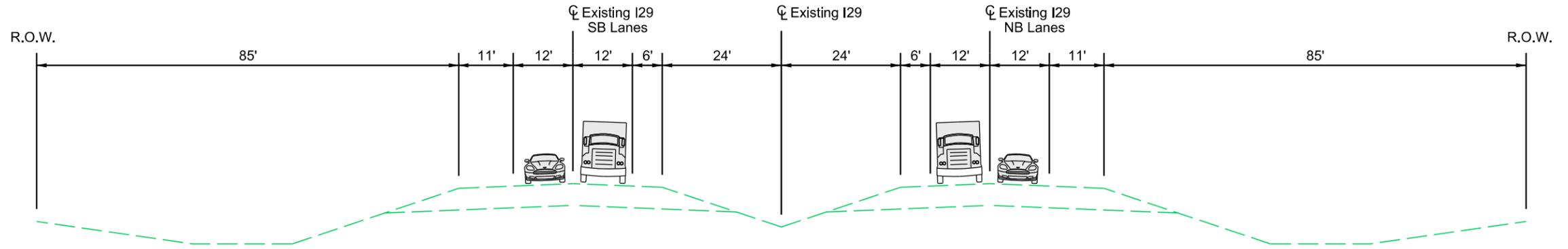
The *Work Zone Maintenance of Traffic Analysis* memo (**Appendix M**) and *Future Condition Reliability Analysis* memo (**Appendix G**) demonstrate a need to maintain two lanes of traffic in each direction during construction north of Exit 71. South of Exit 71, the forecasted 2028 Opening Day peak hour traffic volumes are at the cusp of exceeding available capacity and run the risk of even small fluctuations that exceed analyzed volume leading to operational breakdown.

In coordination with the SDDOT Sioux Falls Area office, I-29 phasing cross-sections were developed to reflect a two-phase approach to maintaining two lanes in each direction while reconstructing long segments of I-29 mainline. This phasing, shown in **Figure 35**, is similar to the approach used to reconstruct I-29 north of Exit 73 as part of PCN 0511.

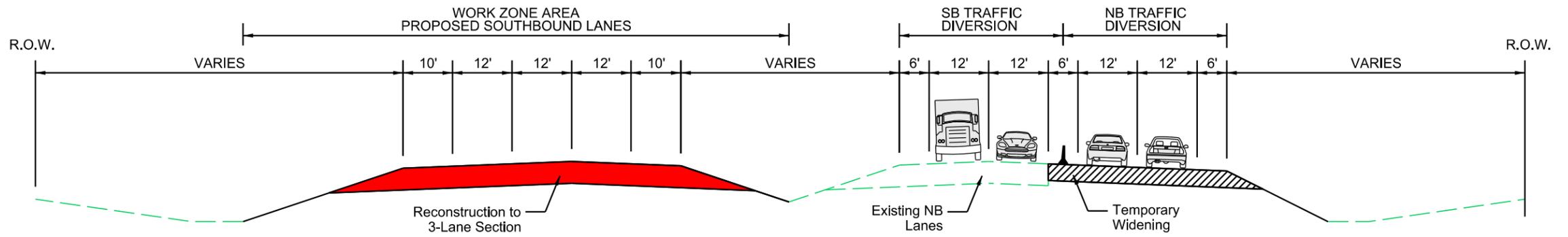
1. Reconstruct southbound lanes
 - a. Maintain 2 lanes northbound and southbound on existing northbound lanes plus temporary widening
 - b. Temporary widening to the east
2. Reconstruct northbound lanes
 - a. Maintain 2 lanes northbound and southbound traffic on reconstructed southbound lanes plus temporary widening
 - b. Temporary widening into median

Crossovers will be needed to maintain interchange access and provide shifts in traffic. I-29 mainline reconstruction is expected to require two construction seasons.

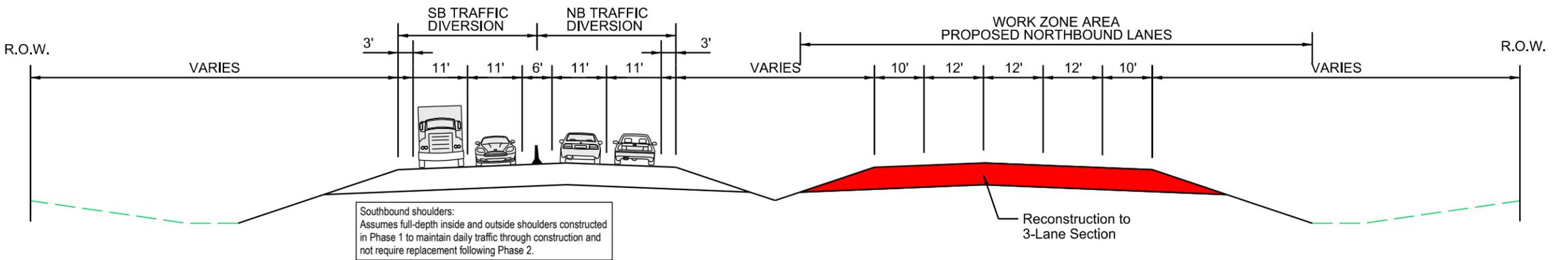
Existing Typical Section
LOOKING NORTH



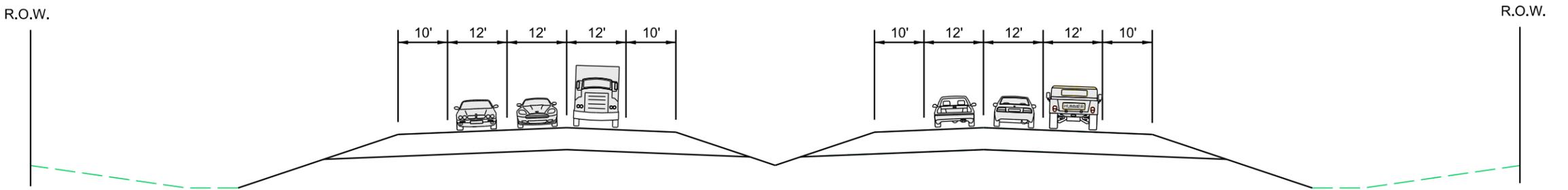
Phase 1: Maintain 2 Lanes NB/SB Traffic on Northbound Lanes; Temporary Widening to East



Phase 2: Maintain 2 Lanes NB/SB Traffic on Southbound Lanes



Final Typical Section



Exit 71 and Southward: 4-Lanes vs. 6 Lanes

As previously discussed in the operational performance section, future-year traffic volumes show a capacity need for 3 lanes in each direction north of Exit 71. Within and south of Exit 71, the need is not as clear. However, there are important constructability and MOT considerations that factor into what is constructed through this segment as part of a future project.

The primary benefit to deferring the construction of all three lanes is short-term costs, in that the pavement cost associated with the third lane would be expended in a future year.

Benefits to constructing the full 6-lane section as part of a future project south of Exit 71 focus on maintenance of traffic during construction, constructability, and worker safety.

Maintenance of Traffic during Construction

- 6-lane phasing maintains two lanes of traffic in both directions and the full southbound 3-lane section is constructed in Phase 1 (see **Figure 35**)
 - To maintain two lanes in each direction during construction, 4-lane phasing requires either:
 - New roadway constructed entirely off alignment so two lanes of traffic in each direction can be maintained on existing pavement, or
 - Two lanes of temporary pavement constructed in both Phase 1 and Phase 2
- 4-lane phasing exhibits greater traffic operations and safety risks associated with only providing a single lane in each direction
 - June/July/August traffic volumes typically greater than September volumes, thus greater propensity of demand exceeding capacity throughout the summer construction months
 - Slight volume fluctuations or random peak arrival platoons exceeding the analyzed volumes could lead to operational breakdown
 - May require alternate routes for wide loads, while two lanes would provide adequate width for a wide load to traverse through the work zone
 - Requires the future third lane to be constructed adjacent to even higher traffic volumes than shown in Year 2028 forecasts

Constructability

- 4-lane phasing (two projects) requires thickened outside shoulders in both directions to maintain two lanes of traffic in each direction during construction of the third lane
 - 6-lane phasing (single project) only requires thickened shoulder in southbound direction
- 4-lane phasing (two projects) requires additional traffic control measures
 - The second project to construct the third lane requires 6 miles of jersey barrier (3 miles in each direction) to provide separation between work area and traffic
 - 6-lane phasing (single project) only requires 3 miles of jersey barrier

- Drawbacks of two projects (4-lane phasing), potentially separated by several years, include:
 - Year-over-year increase in material labor costs for deferred construction
 - Loss of economy of scale efficiencies, such as needing a second iteration of:
 - Design plans
 - Contractor mobilization
 - Construction engineering
 - Traffic control
 - Duplicate work, such as removal of inside shoulder pavement, subgrade preparation, and construction of new lane and outside shoulder

Estimated additional costs associated with a deferred, second project to construct the third lane in each direction range between \$5 million and \$6 million.

Worker Safety

- With the 4-lane section, constructing a third lane in each direction would occur adjacent to traffic in both directions
- With a 6-lane section, one side is reconstructed while traffic is maintained on the other side with separation of traffic and work area

Conclusions

Key considerations associated I-29 mainline reconstruction include:

- Importance of maintaining two lanes of travel through the work zone
- Constructing a 6-lane section, in lieu of a 4-lane section, from Exit 71 southward to Exit 68 as part of the 2028 project provides benefits to:
 - Maintenance of traffic during construction
 - Constructability and cost
 - Worker safety

8.8 Other Traffic Considerations

The following is a summary of other key benefit/drawback differentiators for the interchange alternatives regarding additional traffic considerations identified by the Study Advisory Team, public, and/or stakeholders.

I-29 Overheight Trucks

- Compressed Diamond (I-29 Under): use ramps to bypass 273rd Street bridge conflict
- DDI and SPI (I-29 Under): alternate route required
- 'I-29 Over' alternatives: no conflict

Expandability

- All interchange Build alternatives are expandable for additional lanes
- Current 273rd Street bridge is not expandable

Driver Familiarity and Ability to Sign

- All interchange types will be familiar by 2028
- SPI alternatives: greatest distance between ramp terminal and adjacent intersections
- DDI alternatives: least distance between ramp terminals and adjacent intersections
- Conceptual signing plans provided in **Appendix N**

Winter Driving Conditions

- 'I-29 Under' alternatives: risk blowing snow deposits on I-29 within interchange
- 'I-29 Over' alternatives: introduce vertical grade and change in roadway conditions (at bridges)
- SPI alternatives: intersection is on the bridge

Public Input

- Compressed Diamond alternatives: supported for low cost, signals not needed upon opening, and similar configuration to existing
- SPI alternatives: high cost not supported for traffic need
- DDI alternatives: moderate support based on costs and long-term capacity
- 'I-29 Over' alternatives: I-29 over 273rd Street not supported

8.9 Evaluation of Interchange Alternatives

Each interchange alternative was evaluated on how it compares to the No Build and other Build alternatives and whether it meets study goals. Evaluation categories include:

Conformance with Plans

- Consistent with long-range plans for Exit 71 interchange improvements
- Fits with long-range plans for 273rd Street corridor

Compliance with Policies and Engineering Standards

- Meets SDDOT, AASHTO and FHWA design guidelines
- Meets SDDOT/FHWA control of access requirements (100' minimum)

Environmental Impacts

- Meets project Purpose and Need
- Potential environmental impacts, such as Section 4(f), Section 6(f), Wetlands, Noise, Cultural, Env. Justice, Floodplain, and/or ROW Acquisitions

Operational Performance

- 2028 – 2050 traffic operations
- Long-range traffic operations (Year of LOS D)

Safety

- 2028 – 2050 predicted safety

Constructability

- Construction duration (seasons)
- Construction maintenance of traffic (MOT)
- Constructability benefits/drawbacks

Other Traffic Considerations

- Over height trucks (conflicts and alternate routes)
- Expandability
- Driver familiarity and ability to sign
- Winter driving conditions
- Traffic and safety-related public input on interchange type

The evaluation, shown in **Table 33**, is summarized through the following number/color coding in the evaluation matrix:

- **'5' and '4' Bold Green** text indicates an alternative measure was favorable compared to the other alternatives in a category. An underlined 5 indicates the best alternative within a given category.
- **'3'** Black text indicates that the alternative meets baseline study goals, but the measure reflects a middle rating compared to other alternatives in the respective category. The alternative may have additional considerations, or flaws, that would require careful consideration for it to move forward in the study process.
- **'1' and '2' Bold Orange** text indicates an alternative measure was unfavorable compared to other alternatives in a category, does not meet study goals, and/or has critical flaws.

Table 33: Exit 71 Interchange Alternative Evaluation Matrix

Alt.	Description	Conformance with Plans	Compliance with Design Guidelines	Operational Performance	Safety	Environmental Impacts	Constructability & MOT	Other Traffic Considerations
1a	Compressed Diamond 'I-29 Under'	<u>5</u>	<u>5</u>	<u>5</u>	4	4	<u>5</u>	4
1b	Compressed Diamond 'I-29 Over'	<u>5</u>	<u>5</u>	<u>5</u>	4	3	3	4
2a	SPI 'I-29 Under'	<u>5</u>	<u>5</u>	3	<u>5</u>	<u>5</u>	4	3
2b	SPI 'I-29 Over'	<u>5</u>	<u>5</u>	3	<u>5</u>	3	2	3
3a	DDI 'I-29 Under'	<u>5</u>	<u>5</u>	4	3	4	4	3
3b	DDI 'I-29 Over'	<u>5</u>	<u>5</u>	4	3	3	2	2
NB	No Build	1	1	2	2	<u>5</u>	<u>5</u>	1

A summary of benefits and drawbacks for each alternative associated with the evaluation matrix is provided in the *I-29 Exit 71 Interchange Build Option Evaluation Report* in **Appendix O**.

The interchange alternative screening followed a 3-step process to compare and eliminate alternatives from further consideration:

1. **'I-29 Under' or 'I-29 Over'**: determine whether I-29 goes under or over 273rd Street
2. **Interchange type**: determine interchange type
3. **273rd Street alignment**: whether 273rd Street is constructed on- or off-alignment and to what degree of offset

Step 1: 'I-29 Under' or 'I-29 Over' 273rd Street

The two primary considerations for whether I-29 goes over or under 273rd Street are:

1. Is a grade raise required at Ninemile Creek?
2. What are the benefits and drawbacks of each?

First, it was found that a grade raise is not required at Ninemile Creek based on the current FEMA model. Even if I-29 is raised a few feet during design, that does not necessitate I-29 going over 273rd Street.

Second, drawbacks for I-29 going over 273rd Street outweigh the benefits. Primary drawbacks of I-29 going over 273rd Street include:

- Potential WAPA transmission line conflicts, requiring reconstruction of up to four towers
- Higher construction costs (for Compressed Diamond and DDI alternatives)
- May require full reconstruction of Ninemile Creek structure due to increased fill
- Longer construction duration (2.5 seasons)
- No interchange access during construction
- Multiple I-29 mainline structures required
- Initiates change in grade and surfacing (at bridge) on I-29 mainline
- Greater environmental impacts (wetlands and floodway)

Based on these findings, it is recommended that the 'I-29 Under' interchange alternatives (1a, 2a, and 3a) be carried forward to Step 2 and all 'I-29 Over' interchange alternatives (1b, 2b, 3b) be removed from further consideration.

Step 2: Interchange Type

The second step evaluates interchange types for the 'I-29 Under' alternatives carried forward from Step 1.

Conformance with Plans

Interchange Build alternatives presented in this IMJR are consistent with long-range plans for Exit 71 interchange improvements, having been developed from and/or incorporated into the following historical studies:

- *SDDOT Decennial Interstate Corridor studies*
- *SDDOT I-29 Exit 62 to 73 Corridor Study*
- *Sioux Falls MPO 2045 Long Range Transportation Plan*

273rd Street corridor improvements were developed to integrate with Lincoln County's long-range vision for the corridor as identified in the *Lincoln County Master Transportation Plan*.

Conclusions:

- *All interchange Build alternatives developed, refined, and evaluated as part of this Interchange Modification Study conform with historical planning to date*
- *The No Build alternative does not satisfy this criterion*

Compliance with Design Guidelines

Interchange Build alternatives presented in this IMJR were designed in accordance with current design guidelines, including SDDOT, AASHTO, and FHWA design guidelines. No design exceptions are anticipated with the presented interchange configurations.

All interchange Build alternatives meet current control of access requirements of a minimum of 100 feet spacing between ramp terminal intersections and the first adjacent access. West of the interchange, the Parklane Drive access is proposed to be removed. The Ponderosa Circle access is outside of the 100-foot control of access minimum and is maintained. To the east, the need for a westbound right turn lane to manage long-range traffic operations and improve safety extends the control of access beyond Ironworks Avenue when the movement is signalized. This requires the Ironworks Avenue access to be closed and rerouted to Kenworth Place.

The No Build alternative does not meet current design guidelines with several geometric features contributing to long-range safety and operational deficiencies. The existing configuration meets minimum control of access requirements of 100 feet on the east side, however, a full westbound right turn lane at the northbound ramp terminal would encroach into the minimum 100 feet control of access with Ironworks Avenue and would require either an exception or a design variance for a truncated right turn lane.

Conclusions:

- *All interchange Build alternatives developed, refined, and evaluated as part of this Interchange Modification Study comply with current design guidelines*
- *The No Build alternative does not satisfy this criterion*

Operational Performance

All three interchange types meet minimum allowable LOS goals established for this study. The No Build alternative fails before the 2050 Planning Horizon.

The Compressed Diamond interchange provides the best traffic operations at interchange ramp terminal intersections due to:

- Compressed Diamond ramp terminal intersections can open as stop-controlled from the off-ramp approach
 - Traffic signals are not anticipated to be warranted until the middle to latter stages of the 2050 Planning Horizon
- SPI and DDI ramp terminals need to be signalized upon opening and thus introduce delay to eastbound/westbound through movement traffic that would be ‘zero’ delay with a Compressed Diamond
- SPI results in greatest delay as cycle lengths are longer than the Compressed Diamond and DDI cycle lengths due to accommodating all interchange movements at a single intersection
- DDI signal coordination requirements introduce delay for certain movements and is not as responsive to low-volume traffic periods as a Compressed Diamond

From a long-range LOS C/D threshold perspective, the SPI alternative exhibits capacity considerations similar to those identified at the Exit 73 interchange. The initial capacity breakdowns were southbound left turn and westbound right turn movements. The Compressed Diamond and DDI alternatives exhibited the best long-range capacity without notable modifications.

Conclusions:

- *Best ramp terminal intersection operations (LOS): Compressed Diamond*
- *Best overall interchange operations (LOS): Compressed Diamond*
- *Best long-range LOS C/D: Compressed Diamond and DDI*

Safety

The predicted safety measures were very similar across the three interchange Build alternatives. All three Build alternatives are expected to improve safety compared to the No Build alternative. The SPI alternative exhibited the greatest reduction in Fatal & Injury crashes. The Compressed Diamond exhibited the greatest reduction in Total crashes.

Conclusions:

- *All three interchange Build alternatives improve safety compared to No Build*
- *Greatest Fatal & Injury crash reduction: SPI*
- *Greatest Total crash reduction: Compressed Diamond*

Potential Environmental Impacts

None of the alternatives exhibit significant environmental impacts. The SPI requires the least right-of-way, wetland, and floodway impact due to the compact footprint of bringing the ramps into a single ramp terminal. The DDI exhibits the greatest wetland, floodway, and right-of-way impact. The Compressed Diamond received the greatest support due to costs in line with what the public considers reasonable with respect to long-range traffic and safety needs.

Conclusions:

- *No significant environmental impacts for any of the interchange alternatives*
- *Least ROW, wetland, and floodway impacts: SPI*
- *Greatest public support: Compressed Diamond*

Constructability and Maintenance of Traffic

The key element to maintaining traffic throughout the interchange during construction is constructing the new bridge and ramps off existing alignment. The more work that can be done off-alignment, the less temporary pavement or closure duration is required. Size and number of structures was one of the bigger contributors to schedule, with the large SPI structure or two DDI structures requiring longer overall construction timeframe than the smaller, single structure in the Compressed Diamond.

From a constructability standpoint, the interchange alternatives exhibit similar characteristics such as requiring a 273rd Street grade raise, temporary surfacing at transitions, and reinforced earth slope or sheet piling during construction.

Conclusions:

- *Shortest construction duration: Compressed Diamond (1.5 seasons)*
- *Best MOT score: Compressed Diamond (with offset bridge) and DDI*

Other Traffic Considerations

Several other traffic elements were considered throughout the study that provide key differentiating benefits and drawbacks to the evaluation process.

Conclusions:

- *I-29 over height truck traffic*
 - *Compressed Diamond: use ramps to bypass 273rd Street bridge conflict*
 - *DDI and SPI: alternate route required*
- *Driver familiarity and ability to sign*
 - *All interchange types will be familiar by 2028*
 - *SPI: greatest distance between ramp terminal and adjacent intersections*
 - *DDI: least distance between ramp terminals and adjacent intersections*
- *Public input*
 - *Greatest public support: Compressed Diamond for low cost that reflects long-term capacity needs, signals not needed upon opening, and similar configuration to existing*

Step 2 Conclusions

A summary of key differentiating benefits for the remaining Exit 71 interchange 'type' alternatives with 'I-29 Under' is provided in **Table 34**. A green check signifies a differentiating benefit, a green asterisk (*) signifies a moderate benefit, while an orange 'X' reflects a differentiating drawback or elements not meeting the project purpose and need.

Table 34: Interchange Type (I-29 Under) Screening Summary

Category	No Build	1a Compressed Diamond	2a SPI	3a DDI
Conformance with Plans	✘	✓	✓	✓
Compliance with Design Guidelines	✘	✓	✓	✓
Operational Performance	✘	✓	*	*
Safety	✘	✓	✓	✓
Potential Environmental Impacts	✓	*	✓	*
Constructability and MOT	✓	✓	*	*
Other Traffic Considerations	✘	✓	*	*

Based on these findings, it is recommended that the Compressed Diamond (I-29 Under) interchange alternative (1a) be carried forward and the SPI (I-29 Under) (2a), DDI I-29 Under) (3a), and No Build alternatives be removed from further consideration.

Step 3: 273rd Street Alignment

Alignment of 273rd Street focuses on two key considerations:

1. Maintaining Ironworks Avenue access with 273rd Street
 - a. Direct or via frontage/rearage connection to Kenworth Place
 - b. Provide for turning movements of 'Rocky Mountain Double' trucks
2. Bridge constructability and maintenance of traffic across I-29 during construction

Four Compressed Diamond interchange bridge alignment options were developed for further evaluation:

- **No offset:** 273rd Street constructed on alignment
 - Sub-options:
 - Maintain Ironworks Avenue intersection, or
 - Close Ironworks Avenue intersection and construct rearage road
- **6-foot bridge offset:** new 273rd Street bridge constructed with approximately six feet of separation from the existing bridge
 - Sub-options:
 - Maintain Ironworks Avenue intersection, or
 - Close Ironworks Avenue intersection and construct rearage road (**Figure 18**)
- **55-foot bridge offset:** new 273rd Street bridge constructed with approximately 55 feet of separation from the existing bridge (**Figure 19**)
 - Close Ironworks Avenue intersection and construct frontage road
- **80-foot bridge offset:** new 273rd Street bridge constructed with approximately 80 feet of separation from the existing bridge (**Figure 20**)
 - Close Ironworks Avenue intersection and construct frontage road

The sub-options that maintain the existing Ironworks Avenue intersection are contingent upon being able to provide a minimum 100-foot control of access between the northbound ramp terminal intersection and Ironworks Avenue right-of-way.

A summary of key differentiating measures is shown in **Table 35**.

Table 35: 273rd Street Alignment Screening Summary

	Category	No Offset	6' Bridge Offset	No Offset	6' Bridge Offset	55' Bridge Offset	80' Bridge Offset
Sub-Options	Maintain Ironworks Avenue Intersection	X	X				
	Ironworks Avenue Intersection Closed; Rearage Road			X	X		
	Ironworks Avenue Intersection Closed; Frontage Road					X	X
	Accommodates Rocky Mountain Truck Turning Movement	✓	✓	✓	✓	✓	✓
	Separation between 273 rd Street and First Intersection to the North	✓ > 300'	✓ > 300'	✓ > 300'	✓ > 300'	✗ > 124'	✓ >150'
	Option to Maintain Traffic Across I-29 During Construction	✗	✓	✓	✓	✓	✓
	273 rd Street Alignment Skew East/West of Interchange Bridge	✓	✓	✓	✓	✗	✗
	Potential Need to Improve Kenworth Avenue (due to new traffic impacts)	n/a	n/a	✗	✗	n/a	n/a
	Right-of-Way Impacts	✓ Baseline	✓ Baseline	✗ +0.2 ac;	✗ +0.2 ac;	✗ +1.5 ac	✗ +3.3 ac

Based on evaluation findings and Study Advisory Team discussions, the following options were eliminated from further consideration:

- The Frontage Road 55-foot and 80-foot Bridge Offset options were not carried forward due to:
 - 273rd Street alignment skew on both sides of the interchange
 - Right-of-way impacts to parcels south of 273rd Street
 - 55-foot offset option exhibits the least separation between frontage road and 273rd Street, and does not meet SDDOT design guidelines for 150-foot minimum frontage road separation
- The Rearage Road No Offset and 6-foot Bridge Offset options were not carried forward due to:
 - Potential project-related need to improve Kenworth Avenue between rearage road and 273rd Street due to additional traffic from Ironworks Avenue
 - Right-of-way impacts to construct the rearage road

Based on these findings, it is recommended that the Compressed Diamond (I-29 Under) interchange alternative (1a) with No Offset or 6-foot Bridge Offset options be carried forward contingent upon a Compressed Diamond interchange configuration that maintains the 273rd Street & Ironworks Avenue intersection and provides the minimum 100-foot control of access.

Recommendation Refinement

Refinement of the recommended alternative, Compressed Diamond (I-29 Under) interchange alternative (1a) with no offset or 6-foot bridge offset, focuses on four key components:

- Number of lanes across the interchange bridge and 273rd Street corridor cross-section
- Northbound ramp terminal intersection options to maintain 100-foot control of access with Ironworks Avenue intersection
- 273rd Street offset options
- Bicycle and pedestrian routes

Number of Lanes

The SDDOT plans for a 75-year design life for new bridges and thus often considers factors beyond a study's planning horizon. In this instance, two considerations are important at this location:

1. Timeline of servicing the interchange area with utilities
2. Timeline of development/redevelopment (with or without utilities in place)

The lack of some utilities, such as sanitary sewer, in the area surrounding the interchange is one of the main limiting factors of development and redevelopment. At the beginning of the study, the Study Advisory Team noted that servicing the area with utilities was a long-term outlook and most likely closer to the study's planning horizon. In 2022, new development plans were announced in the southeast quadrant of the interchange and potential redevelopment in the northeast quadrant. These developments may be a catalyst to bring utilities to the interchange area and spur additional development. Therefore, the SDDOT wanted to incorporate the crossroad's operational needs through the bridge's 75-year planning horizon and construct a 5-lane section through the interchange area. The 5-lane section ties back into the existing 273rd Street corridor west of Ponderosa Circle and east of Kenworth Place.

Northbound Ramp Terminal Intersection

The analysis demonstrated that a westbound right turn lane is warranted at the northbound ramp terminal intersection during unsignalized conditions due to the highly directional interchange traffic to and from the north.

While the intersection is not anticipated to meet signal warrants until towards the end of the study's planning horizon (or beyond), the interchange design was based on 2050 Planning Horizon traffic operations with both ramp terminal intersections signalized. Stopping this westbound right turn movement within a signalized intersection generates a queue that extends the westbound right turn lane back into the required 100-foot control of access extending west of Ironworks Avenue. This condition requires that Ironworks Avenue be closed.

To address this conflict, the recommended alternative was refined to introduce a free westbound to northbound right turn movement at the northbound ramp terminal intersection. This removes the high-volume westbound right turn traffic from a future signalized intersection and provides a free movement. The westbound right turn lane in this condition incorporates deceleration distance but does not require queue storage. This addresses the 100-foot control of access conflict with Ironworks Avenue and allows the intersection to be maintained.

The free right turn will also provide long-range operational benefits to the intersection as future signalized conditions will not need to account for this high-volume movement and can focus on the traffic movements entering the signalized intersection.

273rd Street Offset

The recommended alternative was refined to incorporate the options of maintaining traffic or full closure. All corridor widening is to the south, which allows the first half of the bridge to be constructed with the required 6-foot separation from the existing bridge (see **Figure 36**). Maintenance of traffic across I-29, maintained or closed, can be determined through final design as both options are feasible with the refined layout.

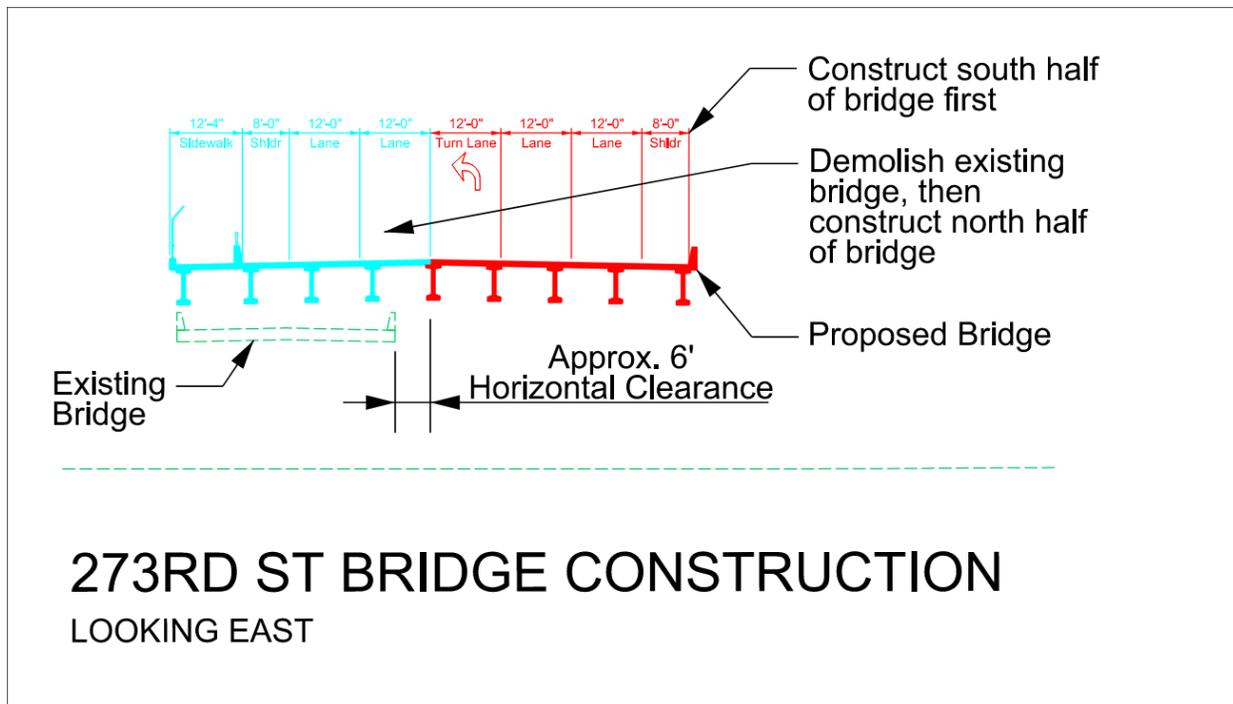


Figure 36: 5-Lane Bridge Phasing Option to Maintain Traffic during Construction

Bicycle and Pedestrian Routes

The recommended alternative includes a shared-use path on the south side and grading and bridge width for a sidewalk on the north side. The design process will determine whether the sidewalk will be constructed on the north side based on development and opportunities for the sidewalk to connect to other facilities. The shared-use path on the south side is anticipated to be constructed with the interchange project.

Recommended Alternative

The recommended alternative for I-29 Exit 71, shown in **Figure 37**, includes:

Alternative 1a (5L): Compressed Diamond (I-29 Under) with 273rd Street 5-Lane Section

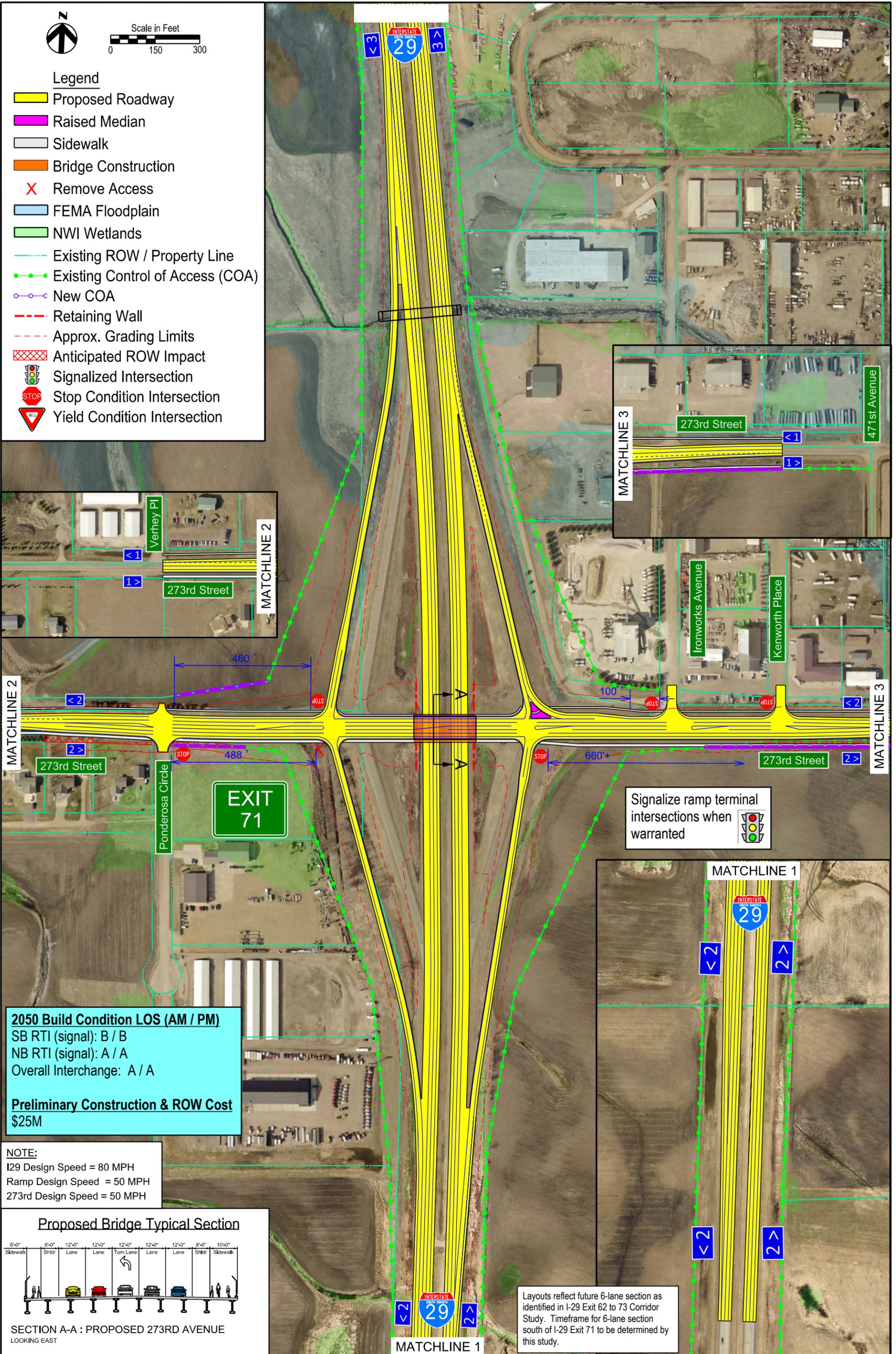
- ‘Compressed Diamond (I-29 Under) interchange alternative 1a’
- Refinement elements:
 - 5-lane section through the interchange ‘(5L)’
 - Westbound free right turn at northbound ramp terminal intersection
 - Maintain 273rd Street & Ironworks Avenue intersection
 - 100-foot control of access provided between westbound right turn lane and Ironworks Avenue right-of-way
 - Shared-use path on south side of 273rd Street and, at minimum, plan for a sidewalk on north side by providing sufficient bridge width and grading for future construction

A comparison of the recommended alternative 1a (5L) vs. the 3-lane 273rd Street alternative 1a (3L) provided in **Table 36**. Additional information is provided in a *Compressed Diamond – 3-Lane vs. 5-Lane 273rd Street Crossroad Summary* memo in **Appendix P**.

Table 36: Compressed Diamond – 1a (3L) vs. 1a (5L) Comparison

Alt.	Description	2050 Planning Horizon Traffic Operations			Interchange Year of LOS D		Predicted Safety (2028-2050)	
		Interchange LOS	SB RTI LOS	NB RTI LOS	2/3-Lane Section	4/5-Lane Section	Fatal & Injury Crashes	Total Crashes
		AM / PM	AM / PM	AM / PM	5-Year Range	5-Year Range	% Increase (+) or Decrease (-) from No Build	% Increase (+) or Decrease (-) from No Build
1a (3L)	Compressed Diamond I-29 Under; 3-Lane	A / A	B / B	A / A	2090-2095	-	-19%	-19%
1a (5L)	Compressed Diamond I-29 Under; 5-Lane	A / A	B / B	A / A	-	Beyond 2105	-16%	-16%

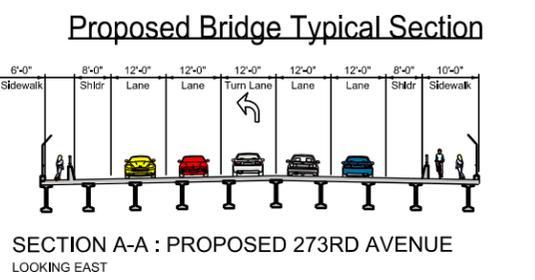
Alt.	Construction		Potential Environmental Impacts	ROW & Costs	
	Duration	Interchange Maintenance of Traffic Rating	WAPA, Wetlands and Floodway	ROW Acquisition	Construction + ROW + Contingency Costs
	Seasons	10 – Most access 1 – Least access	Potential Impacts and Acres	Acres	\$ M
1a (3L)	1.5	8 (on alignment) 10 (offset)	Wetlands: 4.6 ac Floodway: 0.08 ac	0.7	\$20.5
1a (5L)	1.5 (on alignment) 2 (offset)	8 (on alignment) 10 (offset)	Wetlands: 4.7 ac Floodway: 0.08 ac	0.7	\$25



2050 Build Condition LOS (AM / PM)
 SB RTI (signal): B / B
 NB RTI (signal): A / A
 Overall Interchange: A / A

Preliminary Construction & ROW Cost
 \$25M

NOTE:
 I29 Design Speed = 80 MPH
 Ramp Design Speed = 50 MPH
 273rd Design Speed = 50 MPH



Layouts reflect future 6-lane section as identified in I-29 Exit 62 to 73 Corridor Study. Timeframe for 6-lane section south of I-29 Exit 71 to be determined by this study.

8.10 Evaluation of I-29 Mainline Alternatives

The I-29 freeway alternatives evaluation focuses on number of lanes between and within interchanges and I-29 alignment between Exit 71 and Exit 73.

I-29 Number of Lanes (Exit 71 North through Exit 73)

The future-year No Build condition analysis established the following number of lanes are required to meet LOS C or better from Exit 71 northward:

- **Exit 73 to 85th Street:** 8-lane section
 - 3 through lanes plus 1 auxiliary lane in each direction
 - Auxiliary lane required due to spacing between northern Exit 73 ramps and southern 85th Street interchange ramps
- **Exit 71 through Exit 73:** 6-lane section
 - 3 through lanes in each direction

I-29 Number of Lanes (Exit 71 and South)

I-29 mainline capacity needs are less definitive within the Exit 71 interchange and southward to Exit 68. Key differentiators when comparing the 6-lane (Full Build) vs. 4-lane (Partial Build) alternatives within this area are traffic operations, maintenance of traffic during construction, and constructability.

Traffic Operations

The interim Year 2040 analysis is key through this area to show that I-29 operational needs begin to appear prior to the 2050 Planning Horizon but are not as near-term as segments north of Exit 71. This is due to traffic volumes being considerably less south of the Exit 71 interchange. The long-range operations-based conclusions are as follows:

- **Exit 68 through Exit 71:** 6-lane section
 - 3 through lanes in each direction (Full Build)
 - 6-lane (Full Build) alternative: addresses LOS needs in Year 2040
 - 4-lane (Partial Build) alternative: does not address LOS needs in Year 2040 due to two LOS C segments between Exit 68 and Exit 71 (rural LOS B goal)

When considering I-29 mainline capacity needs, it can be concluded that additional lanes through this segment can be deferred to a project closer to 2040.

Maintenance of Traffic during Construction

I-29 work zone capacity and reliability analyses demonstrated a need or benefit to maintaining a minimum number of lanes in both directions during construction:

- **Exit 71 northward:** 2 lanes required (in each direction)
- **Exit 71 southward:** 2 lanes beneficial (in each direction), as a single lane in each direction poses risk of congestion during peak traffic periods

Proposed I-29 phasing reflects a similar approach to I-29 reconstruction between Exit 73 and I-229 interchange, where one side is reconstructed and the other maintains two lanes of traffic in each direction. This phasing, coupled with the strong benefits of maintaining two lanes of traffic in each direction south of Exit 71, are also important considerations for constructability.

Construction/Constructability

Benefits to constructing the full 6-lane section from Exit 71 southward, in lieu of 2 lanes in each direction with the 3rd lane deferred until a later date, include:

- Economies of scale and less duplicate work with a single project
- Less temporary pavement and traffic control
- Worker safety with traffic and work areas separate
 - Future addition of a third lane would be adjacent to work zone traffic

Further, by maintaining two lanes of traffic in each direction, constructing a 4-lane section one half at a time would nearly build-out the full 3 southbound lanes in the first phase.

It is estimated that the total cost for two projects, to initially construct a 4-lane Partial Build and the third lanes at a later date, will increase total costs by \$5 million to \$6 million (not considering inflation to the future year of construction/expenditure).

Exit 71 to Exit 73 Alignment

Through coordination with the FAA, it was determined that FAA will accept the alternative to widen I-29 to the inside within the footprint of the Marv Skie/Lincoln County Airport RPZ. If driving lanes were to move further into the RPZ (to the west), it would warrant a new RPZ analysis. Therefore, the 'Reconstruct on Alignment, Widen to the Inside', option is recommended through the airport RPZ area. Additional information regarding this coordination and guidance is provided in **Appendix Q**.

I-29 Freeway Conclusions

The recommended I-29 freeway sections and associated construction timelines are as follows:

PCN 3167 Recommendation

- **Exit 73 to 85th Street:** 8-lane section
 - 3 through lanes plus 1 auxiliary lane in each direction
 - Tie into planned 85th Street interchange (PCN 06JQ)
- **Exit 73:** 6-lane section
 - 3 through lanes in each direction
- **Exit 71 through Exit 73:** 6-lane section
 - 3 through lanes in each direction
 - Airport RPZ alignment option: 'Reconstruct on Alignment, Widen to the Inside'
- **Exit 71:** 6-lane section
 - Pavement width for 3 through lanes in each direction
 - Open with 2 through lanes in each direction
 - Northern ramp junctions: northbound lane-add and southbound lane-drop

Defer to Future Project

- **Exit 68 to Exit 71:** 6-lane section
 - Grade and construct 3 through lanes in each direction
- **Exit 68:** 2 through lanes (existing)
 - Northern ramp junctions: northbound lane-add and southbound lane-drop

Supporting Recommendations

Supplemental I-29 recommendations associated with the number of lanes and project timing include:

- Heading south from the 85th Street interchange, transition from I-29 widening to the inside (36-foot median) to widening to the outside (60-foot median) south of the Marv Skie/Lincoln County Airport RPZ
- Coordinate I-29 mainline design with planned 85th Street interchange project (PCN 06JQ)
- Consider a median barrier from Exit 68 northward through the study limits based on warrants presented in the *2020 Decennial Interstate Corridor Study*
- When a project is identified for I-29 mainline reconstruction south of Exit 71, it is recommended the full 6-lane section be constructed (in lieu of deferring construction of the third lane in each direction) due to constructability, maintenance of traffic, and cost benefits

9. Coordination

Two sets of public and stakeholder meetings were held as part of the Interchange Modification Study, prior to submittal of the IMJR, with the following objectives:

- **Public & Stakeholder Meeting No. 1: August 23, 2021, and virtual**
 - Provide study overview
 - Present the project Draft Purpose and Need
 - Introduce I-29 Exit 71 interchange and I-29 freeway alternatives
 - Gather feedback and answer questions
- **Public & Stakeholder Meeting No. 2: November 30, 2021, and virtual**
 - Present refined Exit 71 alternatives and preliminary recommendations
 - Present refined I-29 freeway alternatives and preliminary recommendations
 - Gather feedback and answer questions

Both public meetings also requested feedback on potential impacts during construction, such as vehicle width and access requirements, potential alternative routes, timelines, etc.

Each public meeting followed a hybrid format with in-person and virtual components. Both provided opportunities for the public to submit comments. The in-person public meetings included an open house with display boards and a presentation. The virtual component included all the same information but presented in a self-paced format on a specific public

meeting website. The in-person public meeting presentation was livestreamed on the website. A recording was posted following the meeting.

Two stakeholder meetings were held prior to each public meeting, one focused on the west side of I-29 and the other focused on the east side of I-29. These meetings provided an opportunity for area land and business owners, government representatives, organizations, and others who may be impacted during construction of the interchange to participate in informal, small-group discussions related to the evening's public meeting topics.

Comments at the first public meeting primarily centered on interchange type and access at Ironworks Avenue and Kenworth Place. Regarding interchange type, the Compressed Diamond (I-29 Under) was generally favored due to the likely deferral of signaling ramp terminal intersections beyond opening and costs that were in line with the long-range traffic needs. The DDI also received support. The SPI and all 'I-29 Over' interchange alternatives were least supported due to the high cost and construction impacts. At Kenworth Place, comments primary focused on traffic patterns, intersection operations, spacing, and truck turning movements. These comments contributed to the development of 273rd Street alignment options.

Comments from the second public meeting focused on Ironworks Avenue and Kenworth Place access, maintenance of traffic across I-29 during construction, and interchange type. Stakeholders in the northeast interchange quadrant stated concern about closing the Ironworks Avenue intersection when considering frontage, rearage, or alternative access options presented at the meeting. Concerns included traffic volumes consolidated to a single access point, rerouting internal traffic to the north to access 471st Avenue, and right-of-way impacts. There was general support to maintain access across I-29 during construction and the compressed diamond interchange type (a similar configuration to what is out there today).

Meeting summary reports for the first and second public meetings are provided in **Appendix R**.

A project website (www.i29exit71.com) was created to disseminate information and gather feedback from the public and study stakeholders. A screenshot of the main page is shown in **Figure 38**.

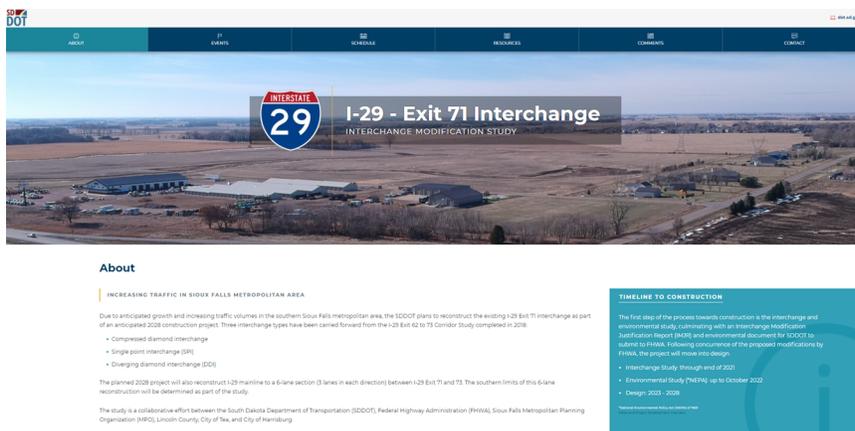


Figure 38: Study Website (www.i29exit71.com)

10. Funding Plan

Anticipated funding allocation for the recommended improvements presented in this IMJR is shown in **Table 37**.

Table 37: Anticipated Funding Allocation

Project Number	State Funding Category	Federal Funding Category	Federal Funds (\$M)	State Funds (\$M)	Total Funds (\$M)
IM 0292(61)71 PCN 3167	Interstate	National Highway Performance Program	\$39.558	\$3.927	\$43.485
Total:			\$39.558	\$3.927	\$43.485

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

As the project is anticipated to be let to contract in Federal fiscal year 2029, the inflated estimated cost for the overall project is \$49.950 Million.

11. Recommendation

The technical analysis contained in this IMJR has found that the best technical solution for transportation needs in the study area are as follows:

I-29 Exit 71 Interchange

PCN 3167 Recommendation

- **Alternative 1a (5L) Compressed Diamond (I-29 Under) with 273rd Street 5-Lane Section**
 - 1a Compressed Diamond (I-29 Under)
 - 273rd Street 5-lane section through interchange
 - Free westbound right turn at northbound ramp terminal intersection

I-29 Mainline

PCN 3167 Recommendation

- **Exit 73 to 85th Street:** 8-lane section
 - 3 through lanes plus 1 auxiliary lane in each direction
 - Tie into planned 85th Street interchange (PCN 06JQ)
- **Exit 73:** 6-lane section
 - 3 through lanes in each direction
- **Exit 71 through Exit 73:** 6-lane section
 - 3 through lanes in each direction
 - Airport RPZ alignment option: 'Reconstruct on Alignment, Widen to the Inside'
- **Exit 71:** 6-lane section
 - Pavement width for 3 through lanes in each direction
 - Open with 2 through lanes in each direction
 - Northern ramp junctions: northbound lane-add and southbound lane-drop

Defer to Future Project

- **Exit 68 to Exit 71:** 6-lane section
 - Grade and construct 3 through lanes in each direction
- **Exit 68:** 2 through lanes (existing)
 - Northern ramp junctions: northbound lane-add and southbound lane-drop

Supporting Recommendations

- I-29 widening (median width)
 - Widen to inside (36-foot median width)
 - Within and north of Marv Skie/Lincoln County Airport RPZ
 - Widen to outside (60-foot median width)
 - South of Marv Skie/Lincoln County Airport RPZ
 - Transition to begin south of RPZ (no widening within RPZ)
- Coordinate design with planned 85th Street interchange project (PCN 06JQ)
- When I-29 mainline is to be reconstructed from Exit 71 southward, construct the full 6-lane section based on constructability, maintenance of traffic, and cost benefits
- Consider median barrier from Exit 68 northward

Recommendation Layouts

The recommended modifications as part of PCN 3167 for Exit 71 and I-29 mainline are shown in **Figure 39**. A conceptual interchange signing plan is provided in **Figure 40**.

FHWA Policy Points

The response to the two requirements presented in FHWA's Policy on Access to the Interstate System, dated May 22, 2017, is as follows:

1. **An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).**

The operational and safety analysis contained in this study shows that the recommended 1a (5L) Compressed Diamond (I-29 Under) interchange alternative is not expected to adversely affect the safety or efficiency of the Interstate system.

The study area extends from south of I-29 Exit 68 interchange to north of the I-29 Exit 73 interchange, approximately 5.75 miles. The local street network corridors of 271st Street, 273rd Street, and 276th Street between 470th Avenue and 471st Avenue are also included in the study.

The No Build alternative, six interchange Build alternatives (plus sub-options), and two I-29 mainline alternatives (plus sub-options) were reviewed for operational capacity using Highway Capacity Manual 6th Edition methodology and Highway Capacity Software, version 7. All interchange Build alternatives achieve LOS C in the 2050 Planning Horizon at all intersections, along all arterial corridor segments, and along all Interstate segments with the study area. The No Build condition does not meet LOS C at the Exit 71 southbound ramp terminal intersection (which also results in overall interchange LOS degrading beyond LOS C) or along eight I-29 segments within the study area within the 2050 Planning Horizon.

I-29 Exit 71 Interchange Recommendation

The interchange alternative screening followed a 3-step process to compare and eliminate alternatives from further consideration:

4. **'I-29 Under' or 'I-29 Over'**: determine whether I-29 goes under or over 273rd Street
5. **Interchange type**: determine interchange type
6. **273rd Street alignment**: determine whether 273rd Street is constructed on- or off-alignment and to what degree of offset

In Step 1, all interchange alternatives with I-29 traversing under 273rd Street were carried forward. Interchange alternatives where I-29 went over 273rd Street were eliminated from further consideration due to potential WAPA transmission line conflicts that may require reconstruction of up to four towers, high construction costs, constructability impacts, and environmental impacts.

In Step 2, the Compressed Diamond interchange type was carried forward based on a comparison of benefits and drawbacks. All other interchange types, the SPI and DDI, were eliminated from further consideration. The Compressed Diamond was found to provide differentiating benefits, when compared to other interchange types, for the following criteria:

- Operational performance (traffic operations)
 - Best ramp terminal intersection operations
 - Best overall interchange operations
 - Best long-range operations when considering bridge design life
- Constructability and maintenance of traffic
 - Shortest construction duration
 - Best maintenance of traffic score (comparison)

- *Other traffic considerations*
 - *Allows over height trucks to use interchange ramps to bypass the 273rd Street bridge conflict, while other interchange types require a detour*
 - *Public support*

In Step 3, the No Offset or 6-foot Bridge Offset options for 273rd Street alignment were carried forward contingent upon refining the Compressed Diamond alternative to provide the minimum 100-foot control of access and maintain the Ironworks Avenue & 273rd Street intersection. All rearage road and frontage road (55-foot and 80-foot offset alignment) options were eliminated from further consideration. Key drawbacks to the rearage road options included right-of-way impacts, property acquisition, and potential additional costs to upgrade Kenworth Place. Key drawbacks to the frontage road options included a notable skew to 273rd Street alignment on both sides of the interchange and right-of-way impacts. The No Offset and 6-foot Bridge Offset options best managed right-of-way impacts and 273rd Street alignment skew on either side of the interchange.

The interchange alternative coming out of the 3-step process was the Alternative 1a: Compressed Diamond (I-29 Under) to be constructed on-alignment or with a 6-foot bridge offset to maintain traffic during construction. From there, the Study Advisory Team identified the following items to include as part of further refinement:

- *5-lane section for 273rd Street interchange to align with 75-year bridge design life and provide flexibility to address potential future development surrounding the interchange*
- *Free westbound right turn lane at the northbound ramp terminal intersection to:*
 - *Maintain Ironworks Avenue & 273rd Street intersection while providing the full 100-feet control of access and*
 - *Benefit intersection operations by removing a high-volume movement from the potential signalized intersection through a free, or uncontrolled, movement expected to experience zero or minimal delay*

The recommended interchange alternative is Alternative 1a (5L): Compressed Diamond (I-29 Under) with 273rd Street 5-Lane Section.

Minimum required control of access (100 feet) is provided in all four interchange quadrants.

Local network improvements consist of constructing a 5-lane section on 273rd Street through the Ponderosa Circle, interchange ramp terminals, Ironworks Avenue, and Kenworth Place intersections. The 5-lane section will transition back to the existing 2-lane section prior to the 470th Avenue and 471st Avenue intersections west and east of the interchange, respectively.

Conceptual signing plans for the recommended interchange alternative, and the other two interchange types, are provided in this report.

I-29 Mainline Recommendation

The I-29 mainline evaluation focused on number of lanes through the study area and alignment between Exit 71 and Exit 73.

The traffic operations analysis of future-year volumes established the long-range 2050 Planning Horizon number of lanes to meet LOS requirements:

- Exit 73 to 85th Street (planned interchange): 8-lane section
- Exit 71 through Exit 73: 6-lane section
- Exit 68 through Exit 71: 6-lane section

Higher volumes from Exit 71 northward illustrate a short-range need for capacity improvements and reconstruction to the recommended long-range number of lanes as part of the Exit 71 interchange project.

Within and south of Exit 71, volumes are lower and capacity improvement needs to the long-range lane configuration (6-lane section) are less urgent. However, it is recommended that when I-29 mainline within Exit 71 and south is reconstructed (which may be deferred to a future project due to pavement needs), it is constructed as a 6-lane section based on constructability, maintenance of traffic, and cost considerations presented in this IMJR.

Through coordination with FAA, it was determined that I-29 be reconstructed on existing alignment and widened to the inside through the Marv Skie/Lincoln County Airport runway protection zone (RPZ). I-29 driving lanes will not be allowed to encroach any further west towards the airport without a new RPZ analysis.

I-29 mainline recommendations for this IMJR are as follows:

PCN 3167 Recommendation

- **Exit 73 to 85th Street:** 8-lane section
 - 3 through lanes plus 1 auxiliary lane in each direction
 - Tie into planned 85th Street interchange (PCN 06JQ)
- **Exit 73:** 6-lane section
 - 3 through lanes in each direction
- **Exit 71 through Exit 73:** 6-lane section
 - 3 through lanes in each direction
 - Airport RPZ alignment option: 'Reconstruct on Alignment, Widen to the Inside'
- **Exit 71:** 6-lane section
 - Pavement width for 3 through lanes in each direction
 - Open with 2 through lanes in each direction
 - Northern ramp junctions: northbound lane-add and southbound lane-drop

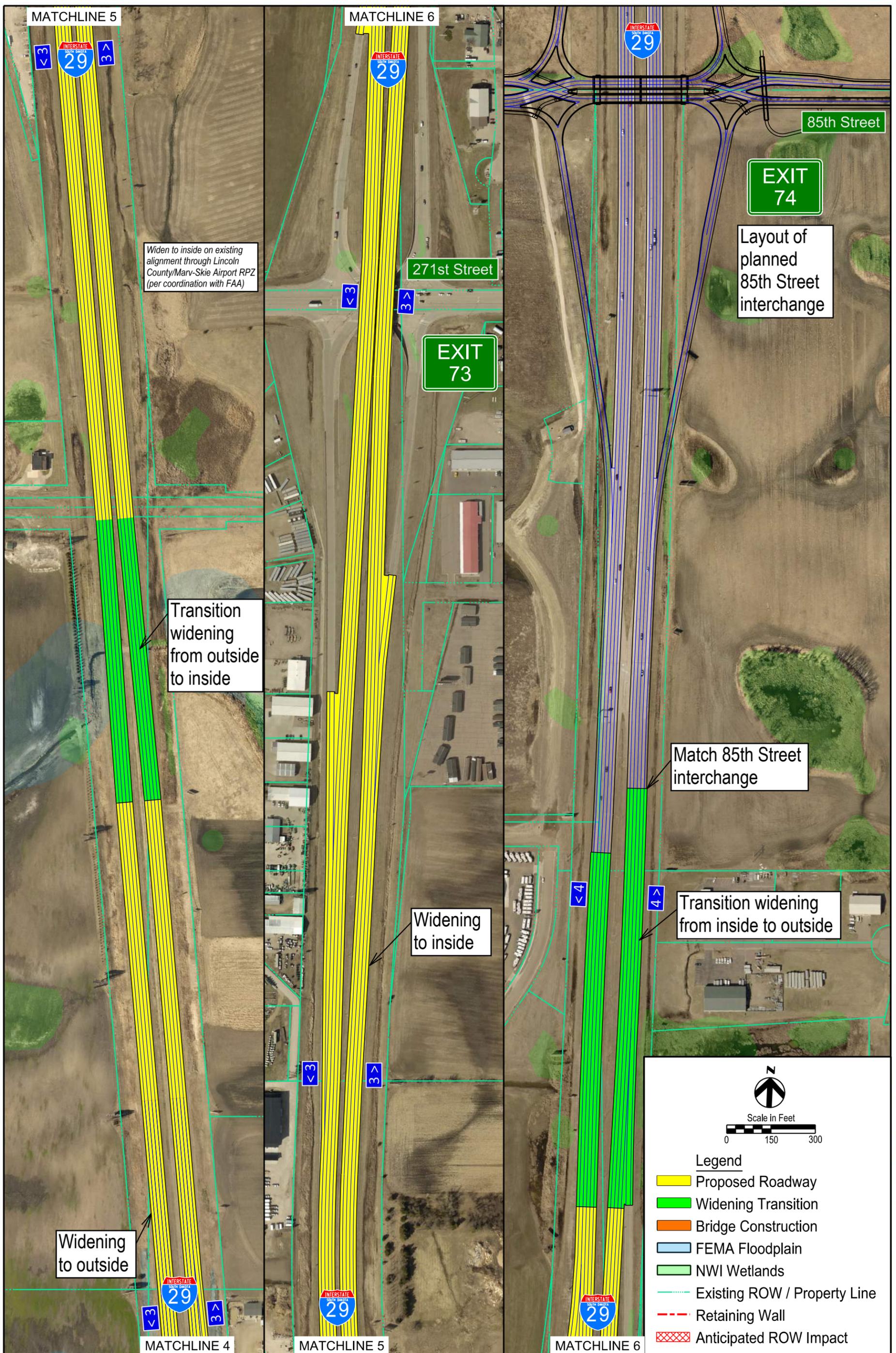
Defer to Future Project

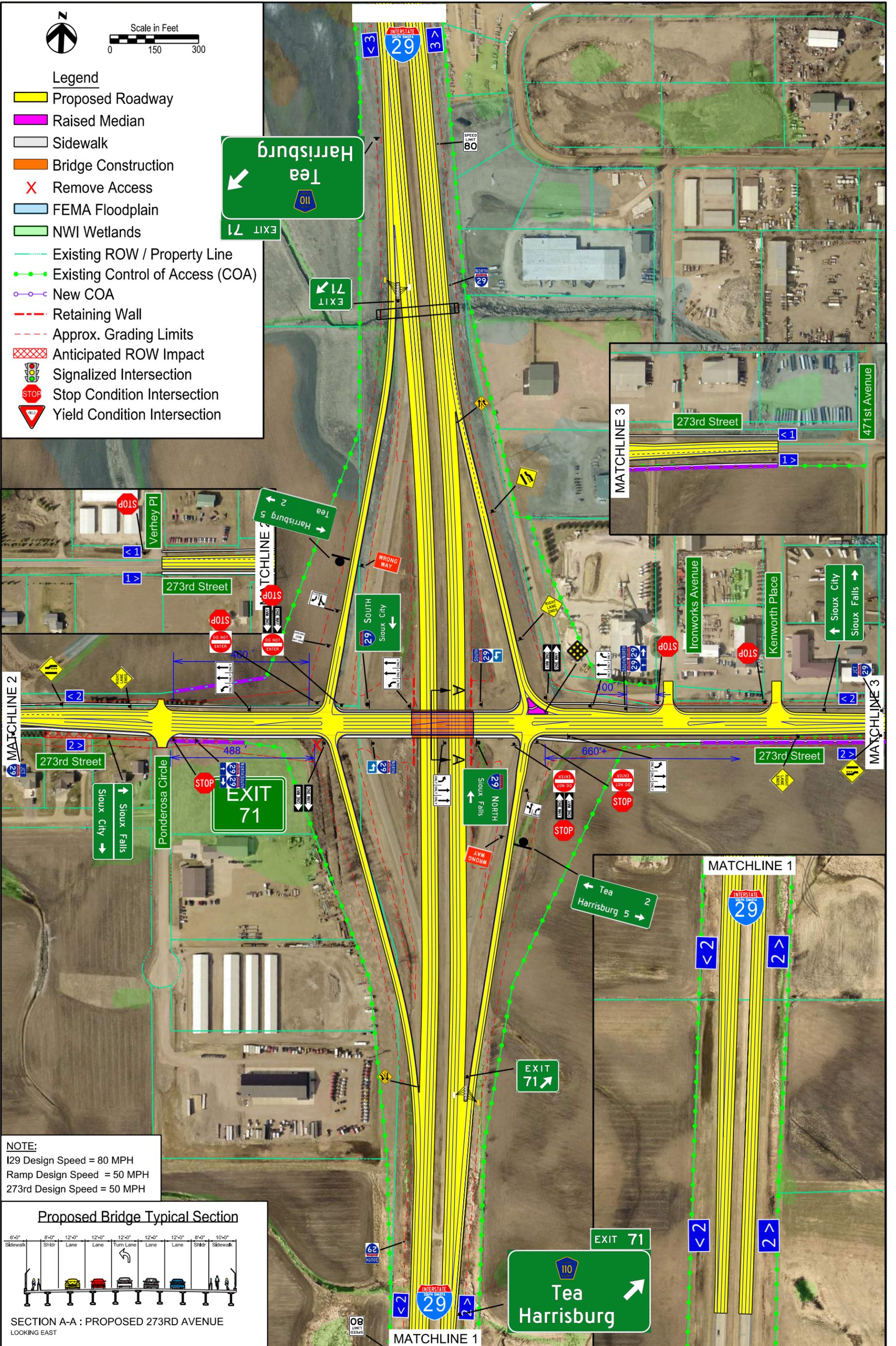
- **Exit 68 to Exit 71:** 6-lane section
 - Grade and construct 3 through lanes in each direction
- **Exit 68:** 2 through lanes (existing)
 - Northern ramp junctions: northbound lane-add and southbound lane-drop

Supporting Recommendations

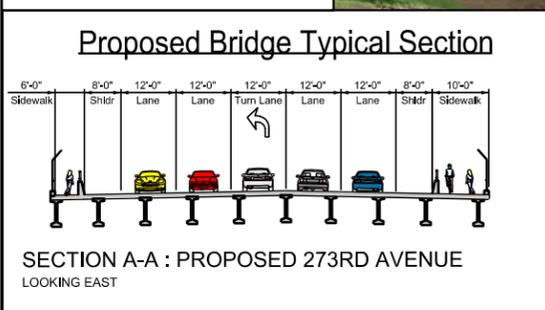
- *I-29 widening (median width)*
 - *Widen to inside (36-foot median width)*
 - *Within and north of Marv Skie/Lincoln County Airport RPZ*
 - *Widen to outside (60-foot median width)*
 - *South of Marv Skie/Lincoln County Airport RPZ; transition to begin south of RPZ*
 - *Coordinate design with planned 85th Street interchange project (PCN 06JQ)*
 - *When I-29 mainline is to be reconstructed from Exit 71 southward, construct the full 6-lane section based on constructability, maintenance of traffic, and cost benefits*
 - *Consider median barrier from Exit 68 northward*
2. **The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.**

The proposed access action is a modification to an existing interchange with full access to a public street. All movements will continue to be served by the modified interchange. The conceptual drawings have been prepared using current standards. Further design using current standards is anticipated.





NOTE:
 I29 Design Speed = 80 MPH
 Ramp Design Speed = 50 MPH
 273rd Design Speed = 50 MPH



12. Appendix

A. Methods and Assumptions

B. Existing and Future No Build Condition Traffic Operations Analysis Memo

C. Crash History Review Memo

D. Traffic Forecast Memo

E. Build Condition Traffic Operations Analysis Memo

F. Interchange Year of Level of Service 'D' Memo

G. Future Condition Reliability Analysis Memo

H. Predictive Safety Analysis Memo

I. Median Barrier Warrant Review Memo

J. Conceptual Construction Phasing and Sequencing for Maintenance of Traffic Memo

K. WAPA Coordination Summary Memo

L. I-29 Exit 71/Ninemile Creek Preliminary Hydrologic and Hydraulic Review Memo

M. Work Zone Maintenance of Traffic Analysis Memo

N. Conceptual Interchange Signing Plans

O. I-29 Exit 71 Interchange Build Option Evaluation Report

P. Compressed Diamond – 3-Lane vs. 5-Lane 273rd Street Crossroad Summary Memo

Q. FAA Coordination Summary Memo

R. Public Meeting Summary Reports