

Options Evaluation

I-229 Benson Road Interchange Modification Study

Sioux Falls, South Dakota

July 27, 2018



1.0 Background

As identified in the previously completed I-229 Major Investment Study, the I-229 Exit 9 (Benson Road) Interchange requires capacity improvements due to planned development of this area of Sioux Falls. It is the purpose of this memo to discuss the options that have been carried forward from the I-229 Major Investment Study as well as the refinements that have been made which caused additional options to be evaluated. Interchange Concept Build Options 1a to 1e and 4a and 4b are discussed in this memo, previous options 2 and 3 from the I-229 Major Investment Study were previously determined to not be carried forward. Due to the significant amount of work completed in that previous study it was determined that the option numbering would be used and updated as needed for consistency. Within this memo, 7 separate interchange options are evaluated.

The Interchange Build Options are provided in reduced size versions within the memo for visual purposes, full scale layouts are included in the appendix.

The purpose of this memo is to provide an evaluation of each of all the Options including the no-build and provide recommendations on which options to carry forward in the Interchange Modification Justification Report and within the environmental documents. A brief summary of the information in this memo is incorporated into the environmental document.

The main criteria used to evaluate the Build Options included (not necessarily in order of importance):

- Traffic operations
- Right of way acquisition
- Environmental impacts
- Comparative construction costs

The complete Interchange Options Comparison Matrix is provided on pages 17 and 18 of this memo. To allow the reviewers of this document to understand where the environmental impacts discussed in the matrix are located a figure of environmental resources is including in Appendix A.

2.0 Evaluation

2.1 No-Build Option

The No-Build Option will be carried forward as a base-line comparison for the build options. As noted in the Options Comparison Matrix, the No-Build Option does not:

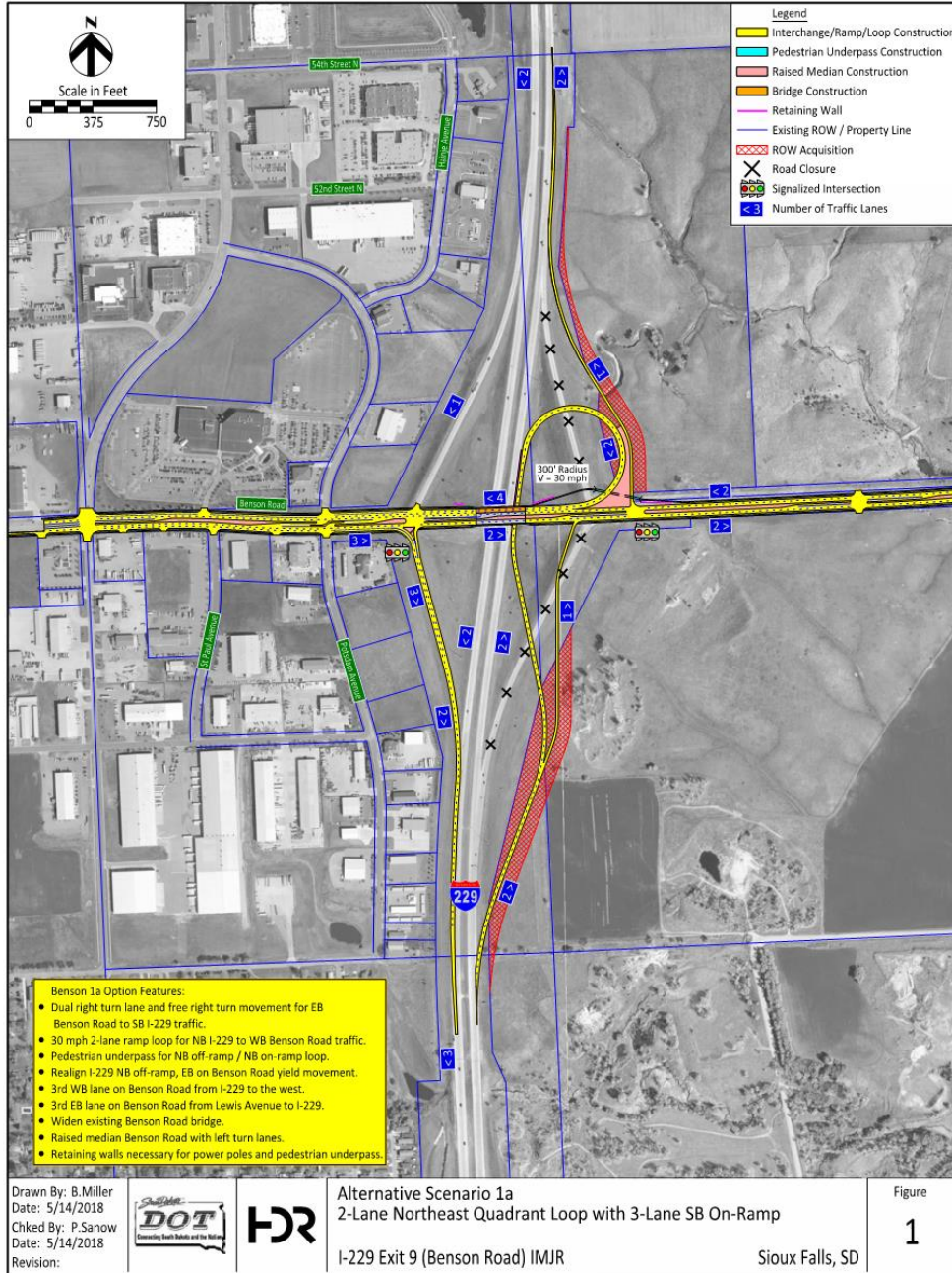
- Meet design criteria or policy for interchange configuration.
- Resolve the existing and future traffic congestion at the interchange.

2.2 Build Options

The following pages describe each build options including the benefits and drawbacks. Appendix B includes a larger scale version of each option.

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

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



Benefits of Option 1a:

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

Drawbacks of Option 1a:

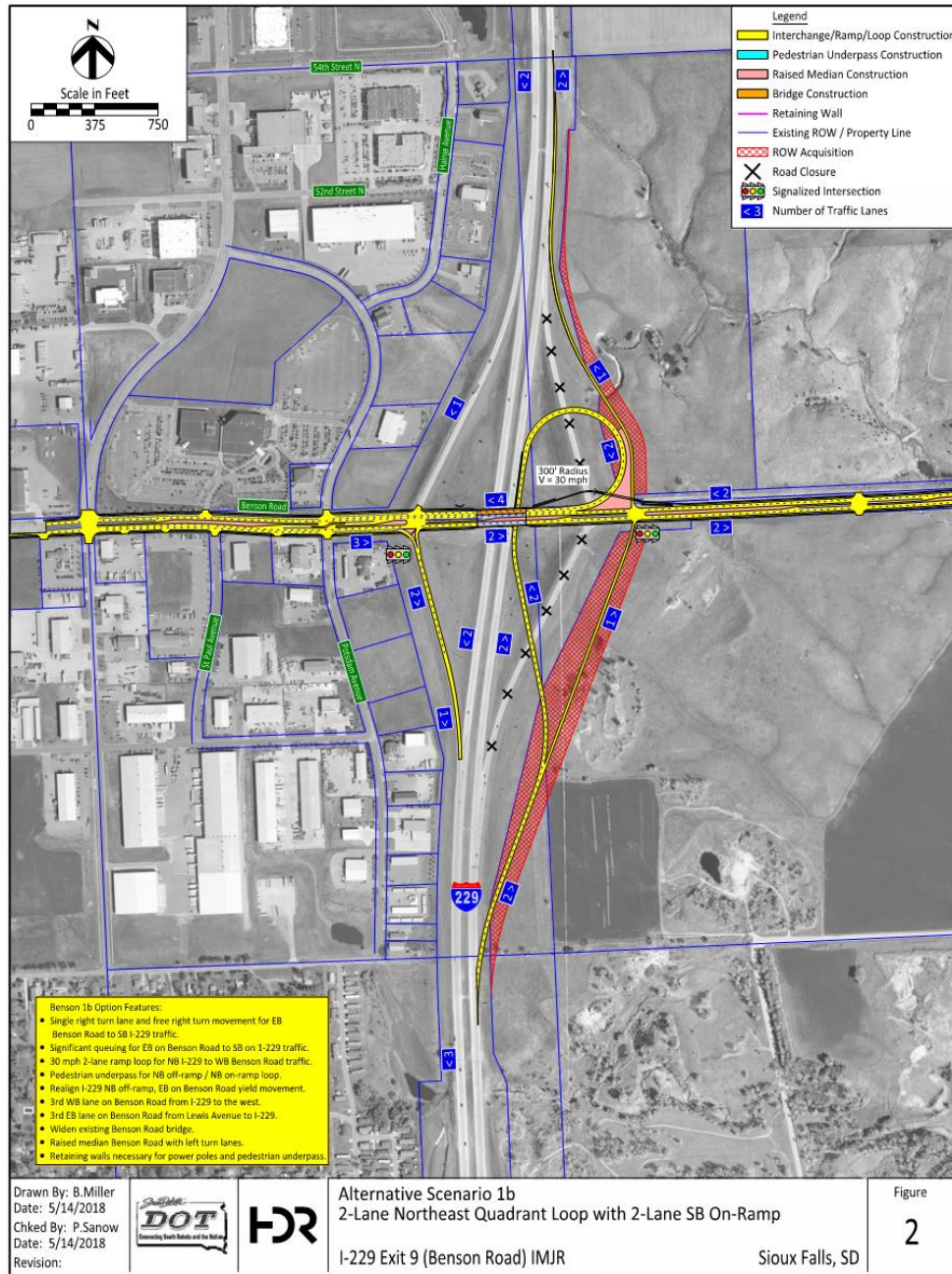
- The construction of the ramps requires substantial right of way acquisition and grading costs associated with constructing a new loop ramp and removal of the existing ramps.
- Option 1a could result in additional crashes compared to the no-build due to added lanes and additional length on some of the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

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

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

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

Option 1b (Figure 2) is very similar to Option 1a. Proposes a northbound off-ramp with separation of eastbound and westbound traffic on Benson Road. This separation reduces the amount of vehicles queued at the existing signal and the east-bound off ramp skew supports one-way eastbound turning movement. The proposed Benson Road eastbound lanes and two southbound on-ramp lanes from Lewis Avenue to the east to the southbound on-ramp also reduces queuing, however, not as efficient as Option 1a.



Benefits of Option 1b:

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

Drawbacks of Option 1b:

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

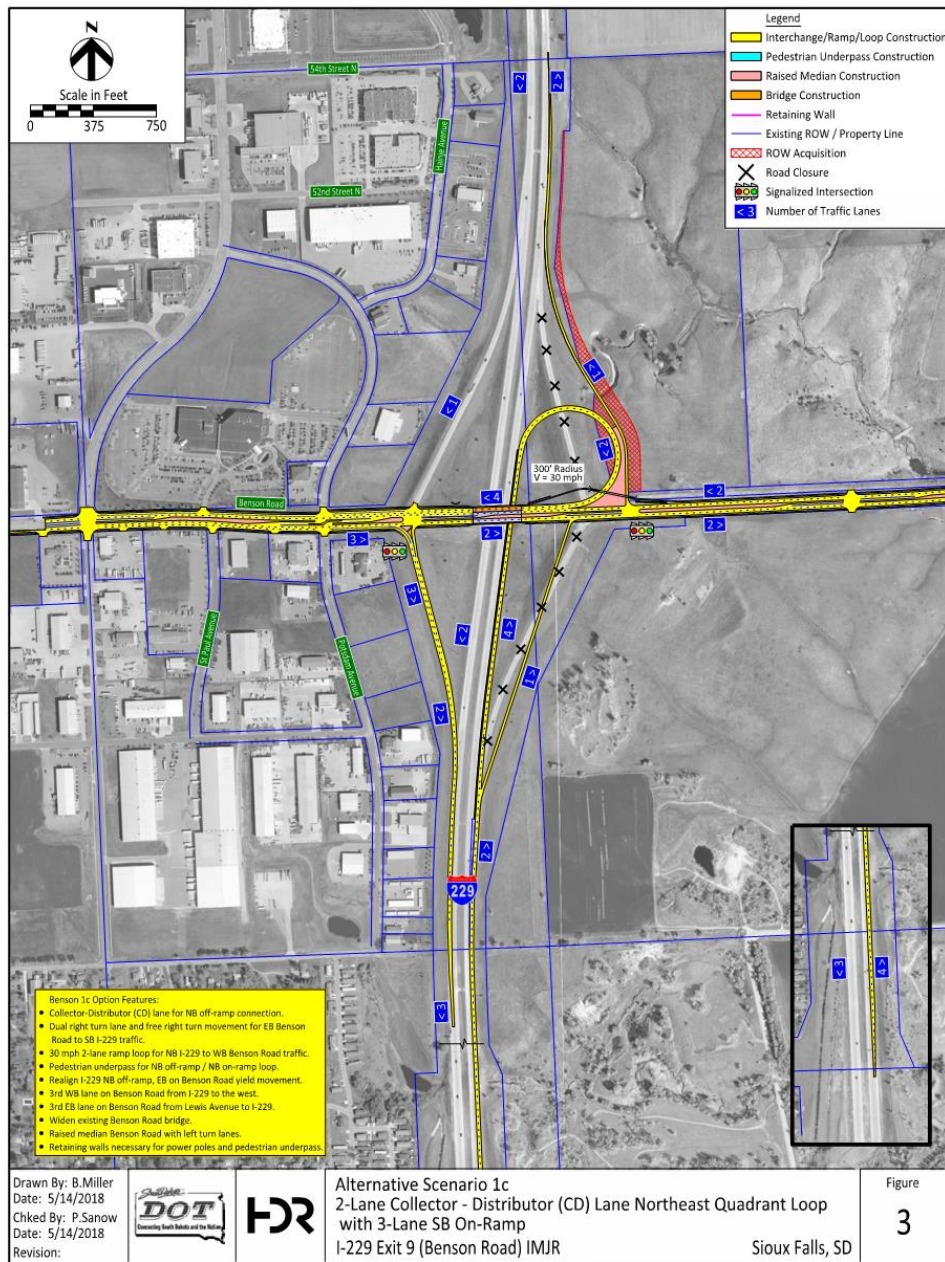
- Option 1b is anticipated to create more crashes compared to the no-build due to added lanes and additional length on some of the ramps.
- Although the pedestrian underpass in this option reduces conflict, the additional cost per pedestrian and bicycle user is high.

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

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

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

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



Benefits of Option 1c:

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

Drawbacks of Option 1c:

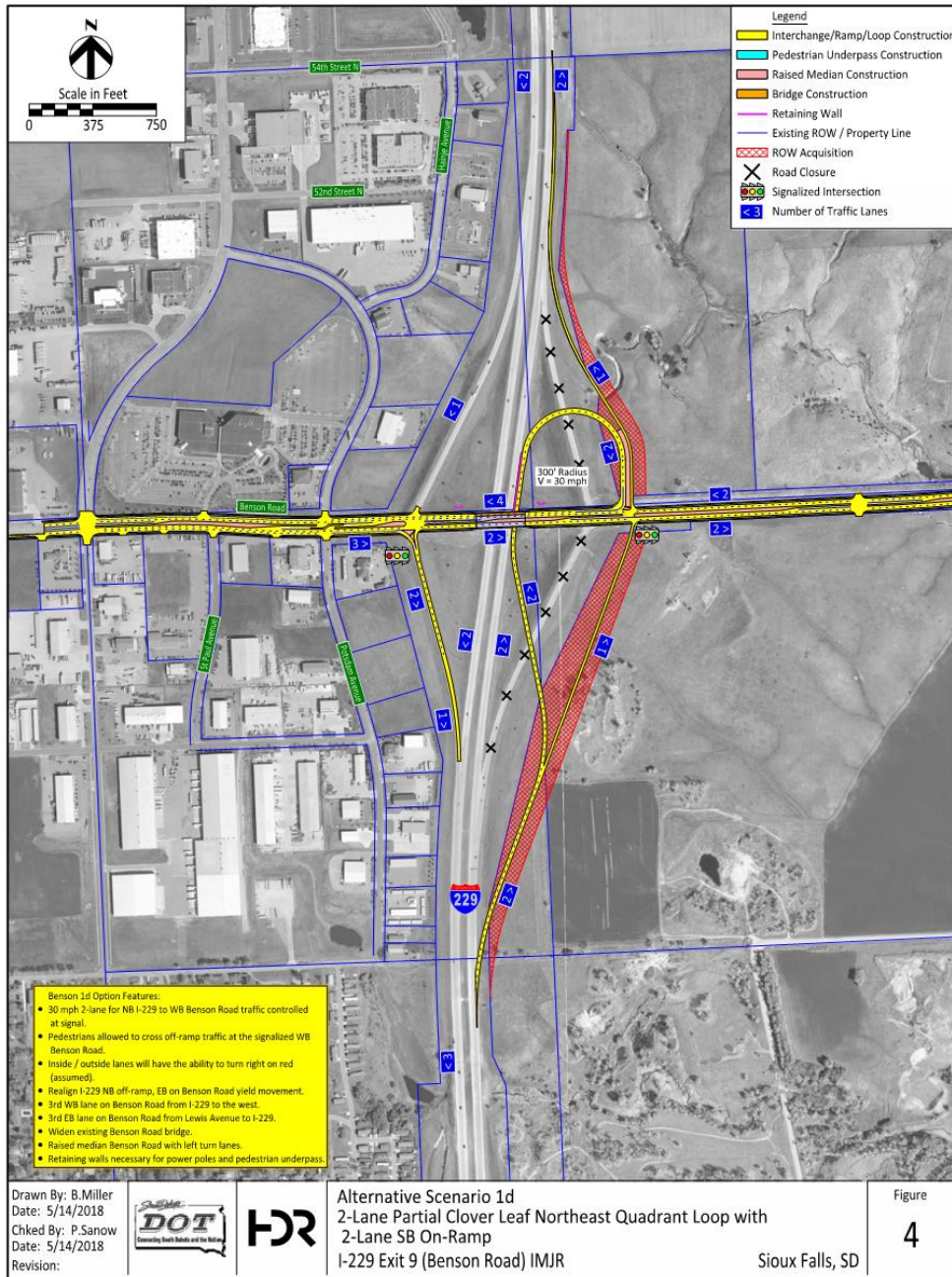
- Option 1c is anticipated to create more crashes compared to the no-build due to added lanes and additional length on some of the ramps.
- Although the pedestrian underpass in this option reduces conflict, the additional cost per pedestrian and bicycle user is high.

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

- *High construction cost.*

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

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



Benefits of Option 1d

- Access Management treatments considered with installation of raised median

Drawbacks of Option 1d:

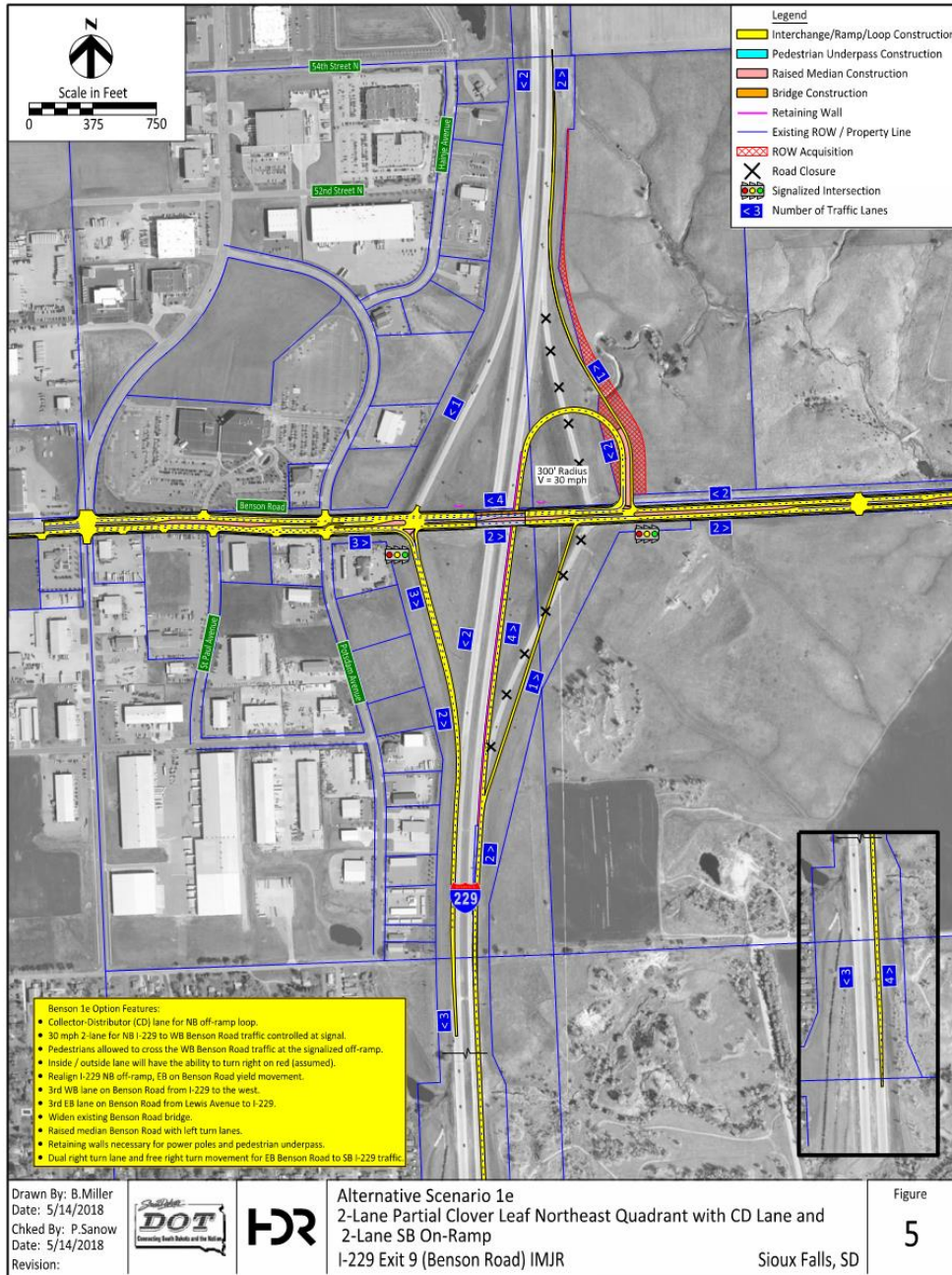
- Does not meet Purpose and Need. The Level of Service falls below the acceptable level C because the right turn on red movements would not be allowed to operate as a free-flow movement.
- The construction of the ramps requires substantial right of way acquisition and grading costs associated with constructing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

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

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

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

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



Benefits of Option 1e:

- Access management treatments considered with installation of raised median.

Drawbacks of Option 1e:

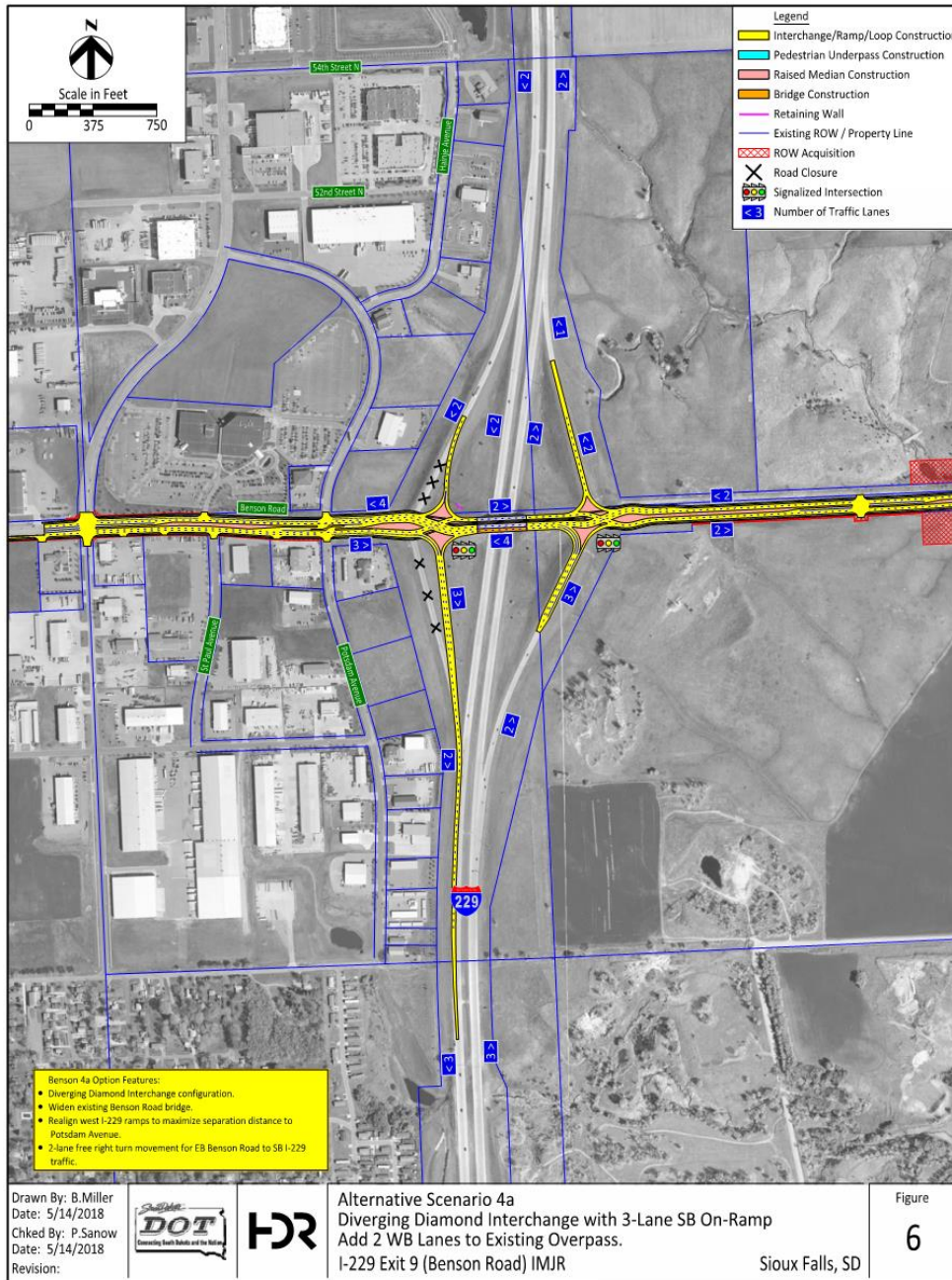
- Does not meet Purpose and Need. The Level of Service falls below the acceptable level C because the right turn on red movements would not be allowed to operate as a free-flow movement.
- The construction of the ramps requires substantial right of way acquisition.

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

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

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

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



Benefits of Option 4a:

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

Drawbacks of Option 4a:

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

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

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

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

Option 4b (Figure 6) proposes a diverging diamond interchange with a three lane southbound on-ramp for eastbound traffic on Benson Road. This option proposes constructing a new and separate structure for the future two eastbound lanes of the DDI and converting the existing structure into the four lanes for the westbound traffic.



Benefits of Option 4b:

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

Drawbacks of Option 4b:

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

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

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

3.0 Conclusion

Table 3-1. Build Options Evaluation Summary

Options recommended to be carried forward for further refinement and evaluation

Option	Interchange Description	Main reason(s) for carrying forward
4a	Diverging Diamond Interchange (DDI) with 3-Lane SB On-Ramp. Add 2 WB Lanes to Existing Overpass	<ul style="list-style-type: none"> Minimal cost and impacts compared to other options Increase in safety compared to other options Decrease in traffic accidents compared to no-build by 25% Less impact to environmental resources
4b	Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB Lanes	<ul style="list-style-type: none"> This option is the least expensive of all the options discussed Increase in safety in compared to other options Decrease in traffic accidents compared to no-build by 25% Less impact to environmental resources

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

Options recommended to be eliminated from further evaluation

Option	Interchange Description	Main reason(s) for not carrying forward
1a	2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp	<ul style="list-style-type: none"> Additional right of way acquisition High construction cost
1b	2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp	<ul style="list-style-type: none"> Additional right of way acquisition High construction cost
1c	2-Lane Collector – Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp	<ul style="list-style-type: none"> High construction cost Greater impact to environmental resources
1d	2-Lane Partial Clover Leaf Northeast Quadrant Loop with 2-Lane SB On-Ramp	<ul style="list-style-type: none"> This option does not meet the acceptable Level of Service Additional right of way acquisition High construction cost Greater impact to environmental resources
4b	2-Lane Partial Clover Leaf Northeast Quadrant Loop with CD Lane 2-Lane and 2-SB On-Ramp	<ul style="list-style-type: none"> This option does not meet the acceptable Level of Service. High construction cost Greater impact to environmental resources

Options	Alternative	Meets Purpose and Need		Provide Adequate Separations to Nearest Access (1)	Year 2045 Traffic Operations								Safety		Driver/ Public Perception	Construction Impacts		Comparative Costs								Potential Environmental Impacts		
		Improve Traffic Operations	Improves Multimodal Mobility		Northbound Ramp Intersection		Southbound Ramp Intersections		Southbound Off Ramp	Northbound Off Ramp	Southbound Weaving	Northbound Weaving	Predicted Annual Total Crashes Year of Opening to 2045	Predicted Annual Facility and Injury Crashes Year of Opening to 2045		Maintenance of Traffic During Construction	Allows for Phased Construction	Bridge(6)	Retaining Wall	Pedestrian Underpass	Benson Road	I-229 Ramps	20% Contingencies (not included on bridge)	ROW Acquisition	Total	Wetlands (4)	Potential Traditional Cultural Properties	Habitat
		Yes	Yes		Worst LOS AM/ PM	Worst Delay AM/ PM	Worst LOS AM/ PM	Worst Delay AM/ PM	Worst LOS AM/ PM	Worst LOS AM/ PM	Worst LOS AM/ PM	Worst LOS AM/ PM	#	#		M \$	M \$	M \$	M \$	M \$	M \$	M \$	M \$	M \$	M \$	acre	Yes	Moderate
1A	2-Lane NE Quadrant Loop with 3-Lane SB On-Ramp. Widen Existing Structure	Yes	Yes	Yes	A/A	1.3/1.2	B/B	10.4/12.2	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	2.4	1.1	0.6	19.7	8.0	5.9	3.4	41.1	< 1.0	Yes	Moderate
1B	2-Lane NE Quadrant Loop with 2-Lane SB On-Ramp. Widen Existing Structure	Yes	Yes	Yes	B/A	10.5/7.6	B/B	10.5/12.9	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	2.4	1.1	0.6	19.7	6.5	5.6	4.4	40.3	<1.0	Yes	Moderate
1C	2-Lane Collector-Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp. Widen Existing Structure	Yes	Yes	Yes	A/A	1.3/1.2	B/B	10.4/12.2	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	2.4	2.4	0.5	0.6	19.7	8.9	5.9	2.0	<1.0	Yes	Moderate
1D	2-Lane Partial Clover Leaf Northeast Quadrant with 2-Lane SB On-Ramp. Widen Existing Structure	No	Yes	Yes	D/B	52.8/19.9	F/B	313.1/16.8	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	1.5	0.8	0.0	19.4	6.1	5.3	4.4	37.5	<1.0	Yes	Moderate

		Meets Purpose and Need			Year 2045 Traffic Operations								Safety		Driver/ Public Perception	Construction Impacts		Comparative Costs								Potential Environmental Impacts			
		No	Yes	Yes	E/B	64.9/ 15	F/B	244.3/ 12.1	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	1.5	0.2	0.0	19.4	6.7	5.3	2.0	35.1	<1.0	Yes	Moderate	
1E	2-Lane Partial Clover Leaf Northeast Quadrant with CD Lane and 2-Lane SB On-Ramp. Widen Existing Structure	No	Yes	Yes	E/B	64.9/ 15	F/B	244.3/ 12.1	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	1.5	0.2	0.0	19.4	6.7	5.3	2.0	35.1	<1.0	Yes	Moderate	
4A	Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add 2 WB Lanes to Existing Overpass. Widen Existing Structure	Yes	Yes	Yes	C/B	26.1/ 14.6	B/A	10.9/ 6.4	B/B	A/B	B/C	B/A	17.2	6.1	Fair	Good	Yes	1.7	0.2	0.0	20.1	3.9	4.8	1.1	31.8	<1.0	No	Low	
4B	Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB lanes	Yes	Yes	Yes	C/B	26.1/ 14.6	B/A	10.9/ 6.4	B/B	A/B	B/C	B/A	17.2	6.1	Fair	Good	Yes	1.8	0.2	0.0	16.9	3.9	4.2	1.1	28.1	<1.0	No	Low	
No	No Build	No	No	No	F/B	255. 5/ 18.2	F/F	555.4/ 124.8	B/B	A/B	B/C	B/A	22.9	8.7	Good	N/A	N/A	0	0	0	0	0	0	0	0	0	0	No	None

N/A: Not Applicable

Does not meet purpose and need criteria or requirements in the Methods & Assumptions document

- (1) SDDOT policy requires a minimum 100' separation from an interstate ramp junction/turn lane to the nearest access point.
- (2) LOS and Delay applies to the single intersection associated with the SPI.
- (3) While the DDI would be a new configuration for this area, drivers have become well-adapted to DDI interchanges where they have been implemented in other locations.
- (4) Wetland impacts are similar due to a large percentage of the impacts being on Benson Road east of I-229. Each alternative involves more than 0.5 but less than 1.0 based on the conceptual level of design; there is a less than 0.05 acre difference between the alternatives
- (5) Benson Road construction cost limits are based on estimated final Control of Access limits (per direction from SDDOT).
- (6) Determination of bridge treatment with DDI alternative will be made during the final design process.

Options	Alternative	Meets Purpose and Need			Year 2045 Traffic Operations								Safety		Driver/ Public Perception	Construction Impacts			Comparative Costs								Potential Environmental Impacts		
		Improve Traffic Operations	Improves Multimodal Mobility	Provide Adequate Separations to Nearest Access (1)	Northbound Ramp Intersection		Southbound Ramp Intersections		Southbound Off Ramp	Northbound Off Ramp	Southbound Weaving	Northbound Weaving	Predicted Annual Total Crashes Year of Opening to 2045	Predicted Annual Facility and Injury Crashes Year of Opening to 2045		Driver Familiarity	Maintenance of Traffic During Construction	Allows for Phased Construction	Bridge(s)	Retaining Wall	Pedestrian Underpass	Benson Road	I-229 Ramps	20% Contingencies (not included on bridge)	ROW Acquisition	Total	Wetlands (4)	Potential Traditional Cultural Properties	Habitat
					Worst LOS AM/ PM	Worst Delay AM/ PM	Worst LOS AM/ PM	Worst Delay AM/ PM	Worst LOS AM/ PM	Worst Delay AM/ PM	Worst LOS AM/ PM	Worst Delay AM/ PM																	
1A	2-Lane NE Quadrant Loop with 3-Lane SB On-Ramp. Widen Existing Structure	Yes	Yes	Yes	A/A	1.3/ 1.2	B/B	10.4/ 12.2	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	2.4	1.1	0.6	19.7	8.0	5.9	3.4	41.1	<1.0	Yes	Moderate	
1B	2-Lane NE Quadrant Loop with 2-Lane SB On-Ramp. Widen Existing Structure	Yes	Yes	Yes	B/A	10.5/ 7.6	B/B	10.5/ 12.9	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	2.4	1.1	0.6	19.7	6.5	5.6	4.4	40.3	<1.0	Yes	Moderate	
1C	2-Lane Collector-Distributor (CD) Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp. Widen Existing Structure	Yes	Yes	Yes	A/A	1.3/ 1.2	B/B	10.4/ 12.2	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	2.4	2.4	0.5	0.6	19.7	8.9	5.9	2.0	<1.0	Yes	Moderate	
1D	2-Lane Partial Clover Leaf Northeast Quadrant with 2-Lane SB On-Ramp. Widen Existing Structure	No	Yes	Yes	D/B	52.8/ 19.9	F/B	313.1/ 16.8	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	1.5	0.8	0.0	19.4	6.1	5.3	4.4	37.5	<1.0	Yes	Moderate	
1E	2-Lane Partial Clover Leaf Northeast Quadrant with CD Lane and 2-Lane SB On-Ramp. Widen Existing Structure	No	Yes	Yes	E/B	64.9/ 15	F/B	244.3/ 12.1	B/B	A/B	B/C	B/A	26.0	10.2	Fair	Good	Yes	1.5	0.2	0.0	19.4	6.7	5.3	2.0	35.1	<1.0	Yes	Moderate	
4A	Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add 2 WB Lanes to Existing Overpass. Widen Existing Structure	Yes	Yes	Yes	C/B	26.1/ 14.6	B/A	10.9/ 6.4	B/B	A/B	B/C	B/A	17.2	6.1	Fair	Good	Yes	1.7	0.2	0.0	20.1	3.9	4.8	1.1	31.8	<1.0	No	Low	
4B	Diverging Diamond Interchange with 3-Lane SB On-Ramp. Add a Separate Structure for 2 EB lanes	Yes	Yes	Yes	C/B	26.1/ 14.6	B/A	10.9/ 6.4	B/B	A/B	B/C	B/A	17.2	6.1	Fair	Good	Yes	1.8	0.2	0.0	16.9	3.9	4.2	1.1	28.1	<1.0	No	Low	
No	No Build	No	No	No	F/B	255.5/ 18.2	F/F	555.4/ 124.8	B/B	A/B	B/C	B/A	22.9	8.7	Good	N/A	N/A	0	0	0	0	0	0	0	0	0	0	No	None

N/A: Not Applicable

Does not meet purpose and need criteria or requirements in the Methods & Assumptions document

(1) SDDOT policy requires a minimum 100' separation from an interstate ramp junction/turn lane to the nearest access point.

(2) LOS and Delay applies to the single intersection associated with the SPI.

(3) While the DDI would be a new configuration for this area, drivers have become well-adapted to DDI interchanges where they have been implemented in other locations.

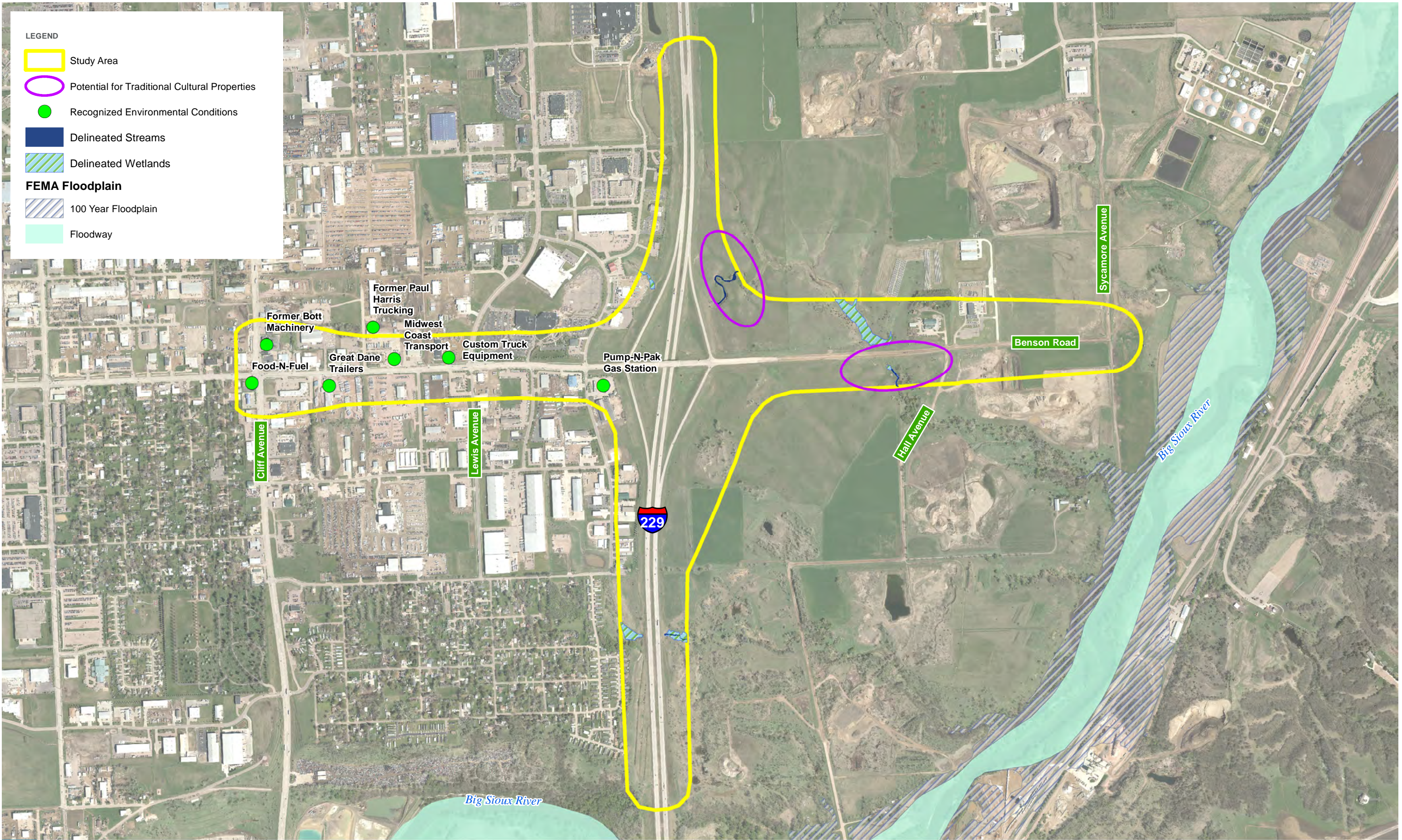
(4) Wetland impacts are similar due to a large percentage of the impacts being on Benson Road east of I-229. Each alternative involves more than 0.5 but less than 1.0 based on the conceptual level of design; there is a less than 0.05 acre difference between the alternatives

(5) Benson Road construction cost limits are based on estimated final Control of Access limits (per direction from SDDOT).

(6) Determination of bridge treatment with DDI alternative will be made during the final design process.

Options Evaluation Appendices

Appendix A Environmental Constraints

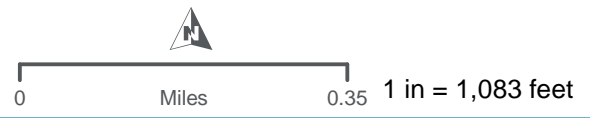


LEGEND

- Study Area
- Potential for Traditional Cultural Properties
- Recognized Environmental Conditions
- Delineated Streams
- Delineated Wetlands

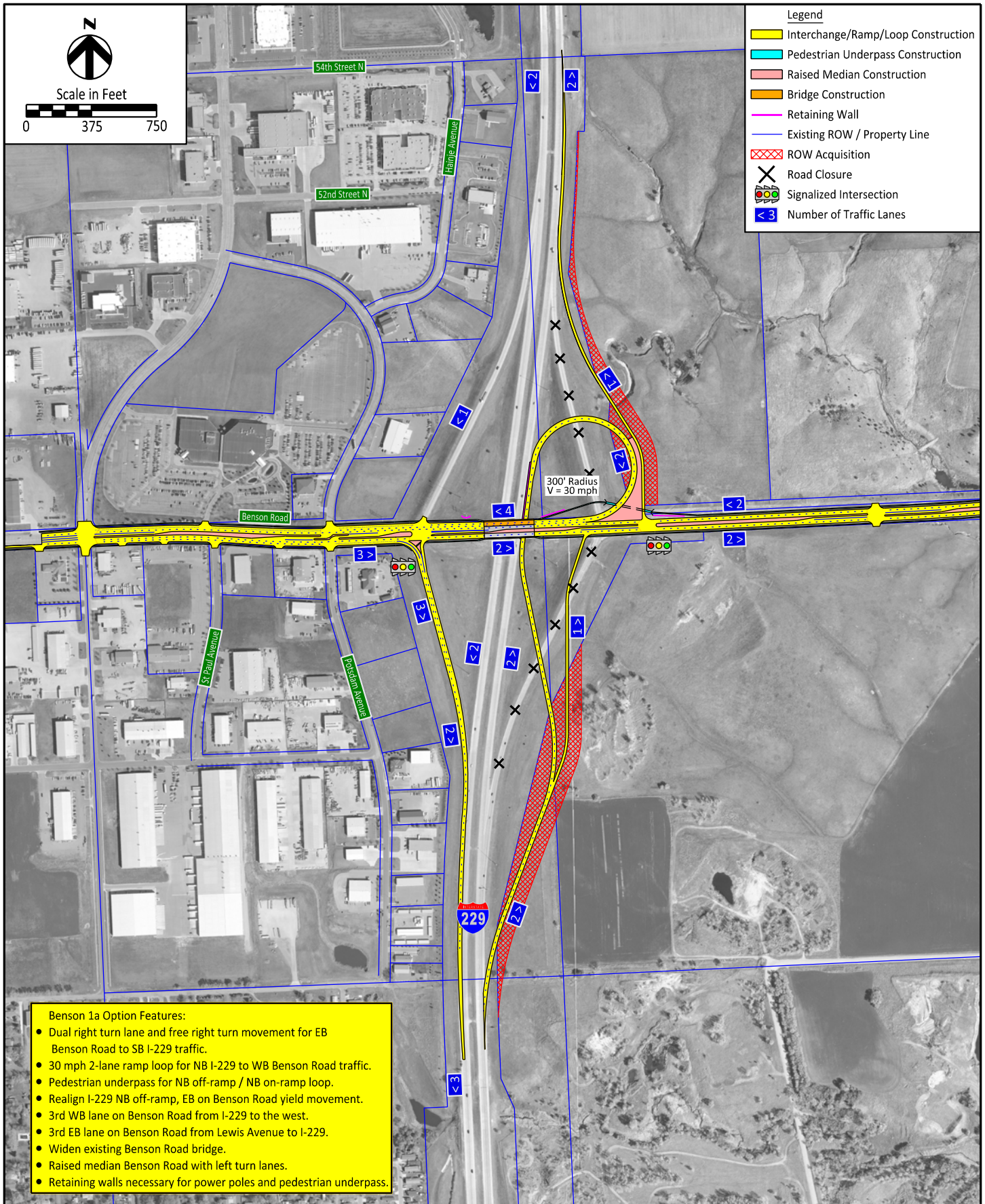
FEMA Floodplain

- 100 Year Floodplain
- Floodway



ENVIRONMENTAL CONSTRAINTS
I-229 BENSON ROAD INTERCHANGE MODIFICATION STUDY

Appendix B Build Options

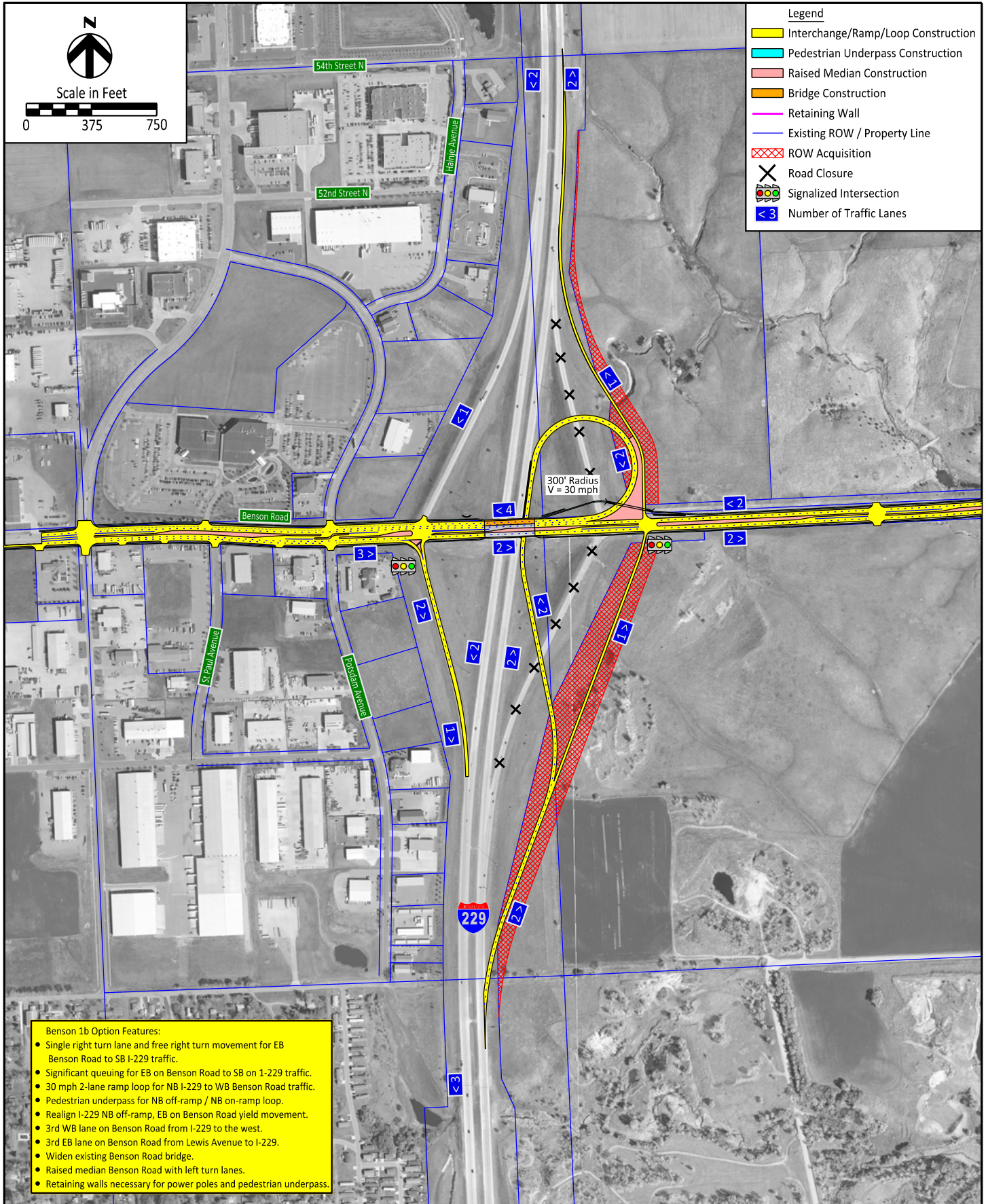


Drawn By: B.Miller
 Date: 5/14/2018
 Chkd By: P.Sanow
 Date: 5/14/2018
 Revision:



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

Figure
1

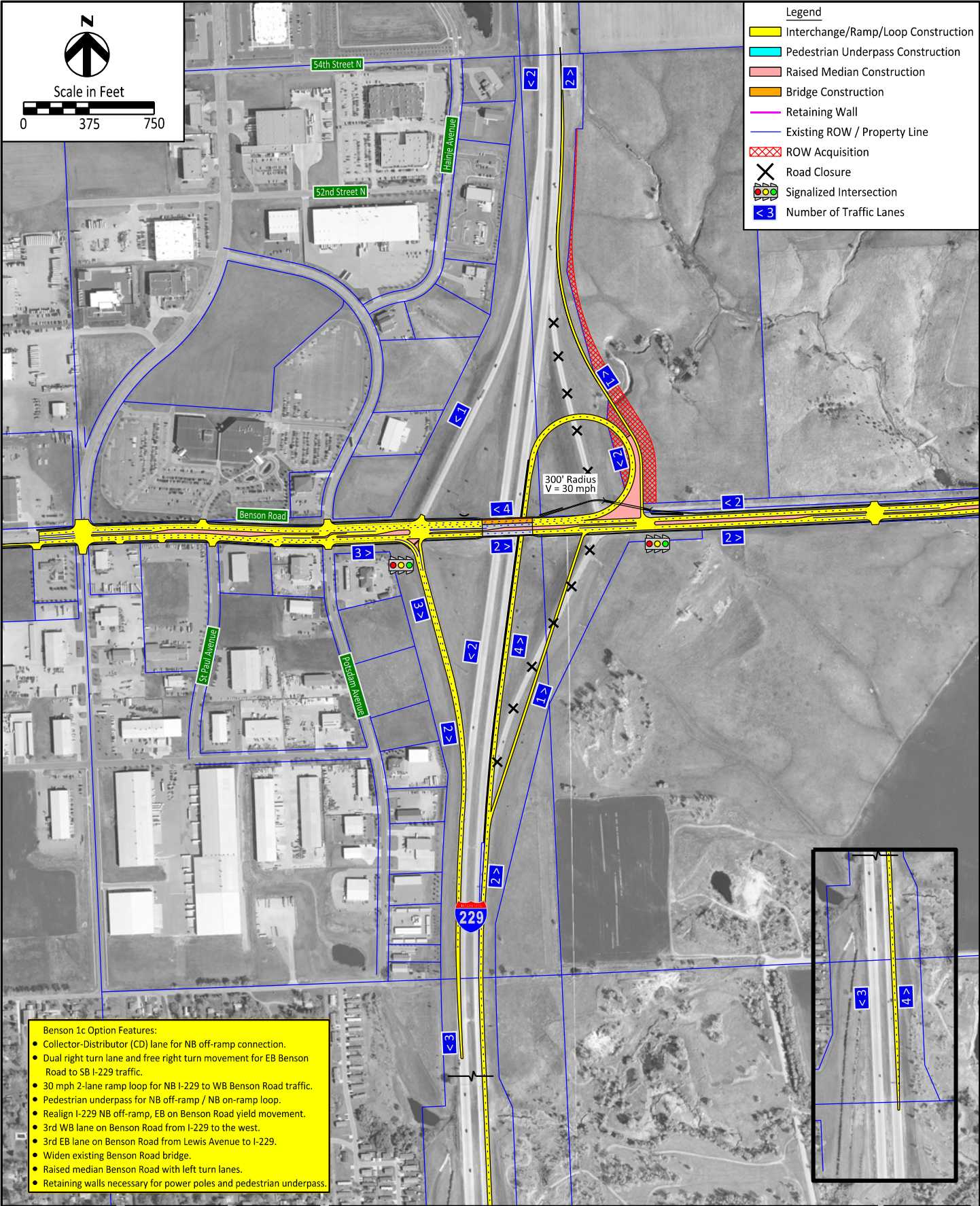


Drawn By: B.Miller
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 Revision:



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

Figure
 2



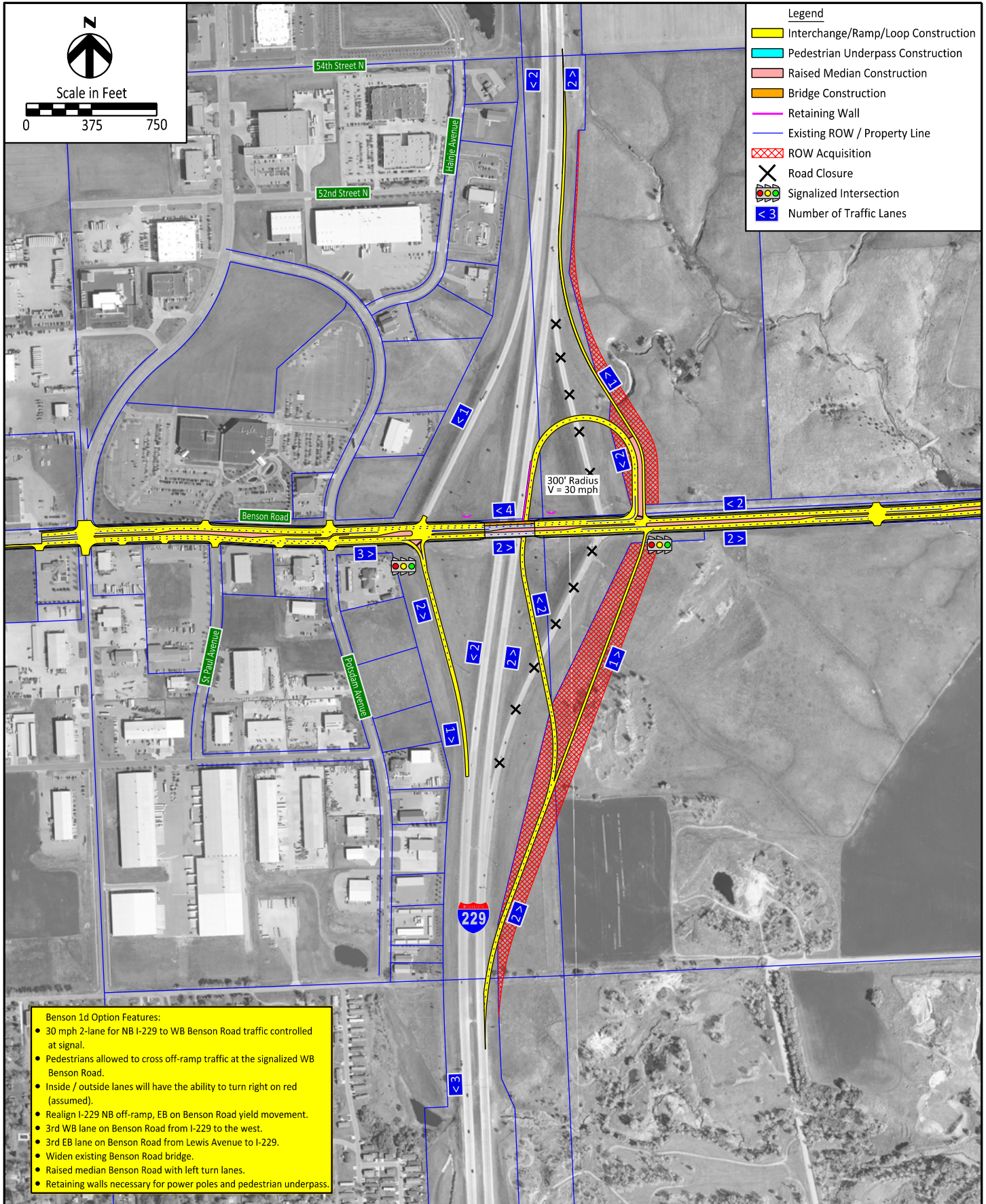
- Benson 1c Option Features:**
- Collector-Distributor (CD) lane for NB off-ramp connection.
 - Dual right turn lane and free right turn movement for EB Benson Road to SB I-229 traffic.
 - 30 mph 2-lane ramp loop for NB I-229 to WB Benson Road traffic.
 - Pedestrian underpass for NB off-ramp / NB on-ramp loop.
 - Realign I-229 NB off-ramp, EB on Benson Road yield movement.
 - 3rd WB lane on Benson Road from I-229 to the west.
 - 3rd EB lane on Benson Road from Lewis Avenue to I-229.
 - Widen existing Benson Road bridge.
 - Raised median Benson Road with left turn lanes.
 - Retaining walls necessary for power poles and pedestrian underpass.

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



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

Figure
3
 Sioux Falls, SD

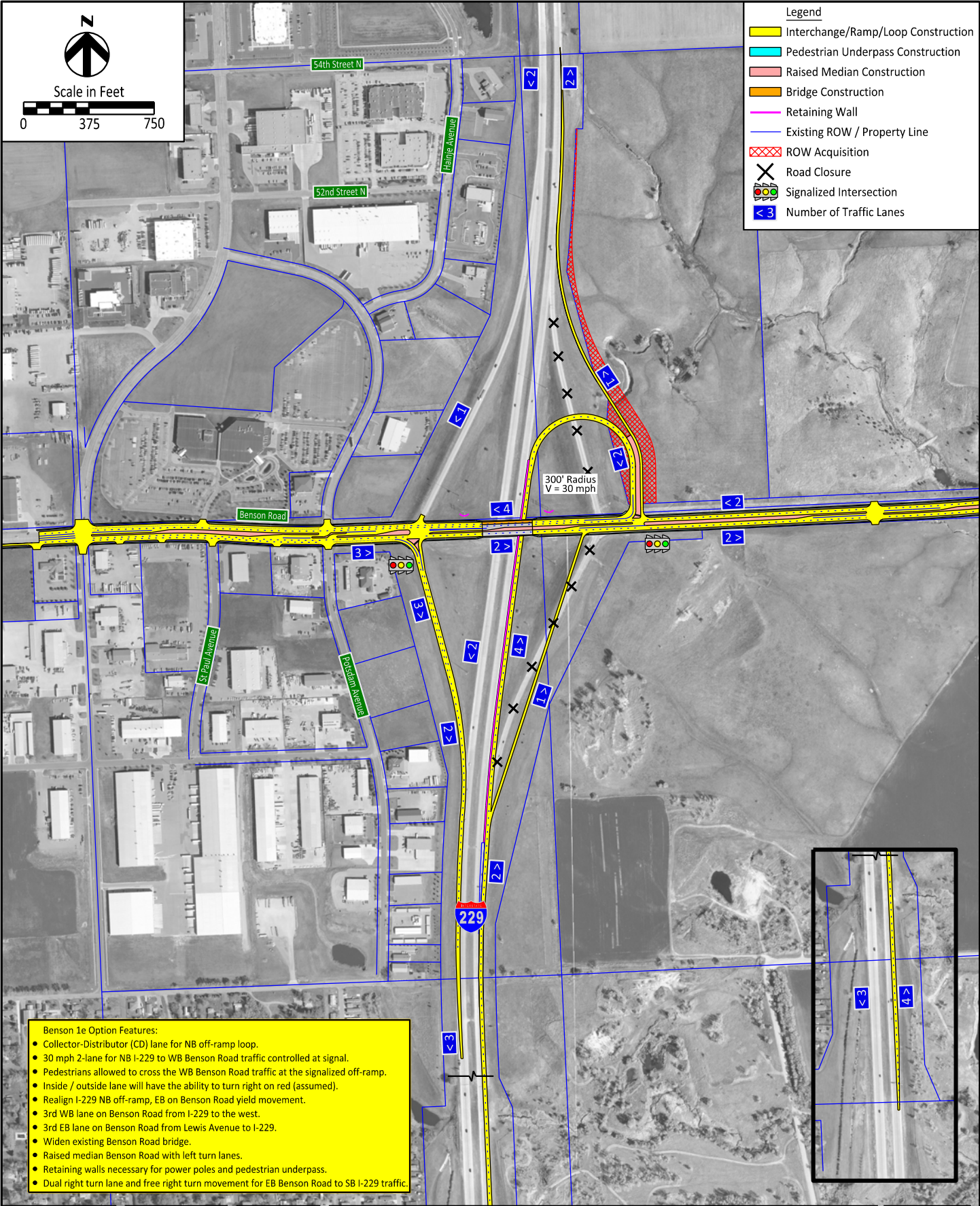


Drawn By: B.Miller
 Date: 5/14/2018
 Chkd By: P.Sanow
 Date: 5/14/2018
 Revision:



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

Figure
 4



- Legend**
- Interchange/Ramp/Loop Construction
 - Pedestrian Underpass Construction
 - Raised Median Construction
 - Bridge Construction
 - Retaining Wall
 - Existing ROW / Property Line
 - ROW Acquisition
 - X Road Closure
 - Signalized Intersection
 - <3> Number of Traffic Lanes

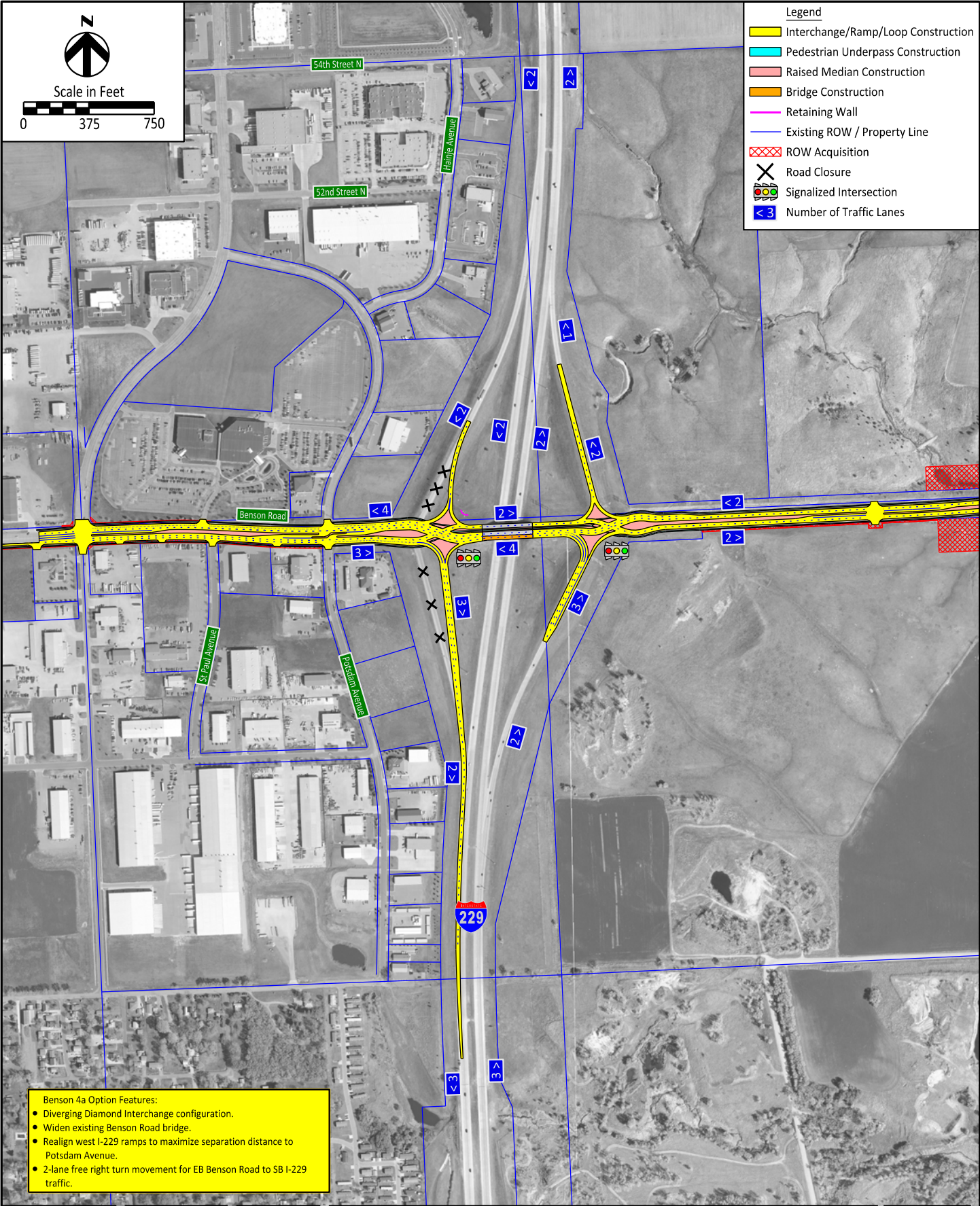
- Benson 1e Option Features:**
- Collector-Distributor (CD) lane for NB off-ramp loop.
 - 30 mph 2-lane for NB I-229 to WB Benson Road traffic controlled at signal.
 - Pedestrians allowed to cross the WB Benson Road traffic at the signalized off-ramp.
 - Inside / outside lane will have the ability to turn right on red (assumed).
 - Realign I-229 NB off-ramp, EB on Benson Road yield movement.
 - 3rd WB lane on Benson Road from I-229 to the west.
 - 3rd EB lane on Benson Road from Lewis Avenue to I-229.
 - Widen existing Benson Road bridge.
 - Raised median Benson Road with left turn lanes.
 - Retaining walls necessary for power poles and pedestrian underpass.
 - Dual right turn lane and free right turn movement for EB Benson Road to SB I-229 traffic.

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



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

Figure
 5



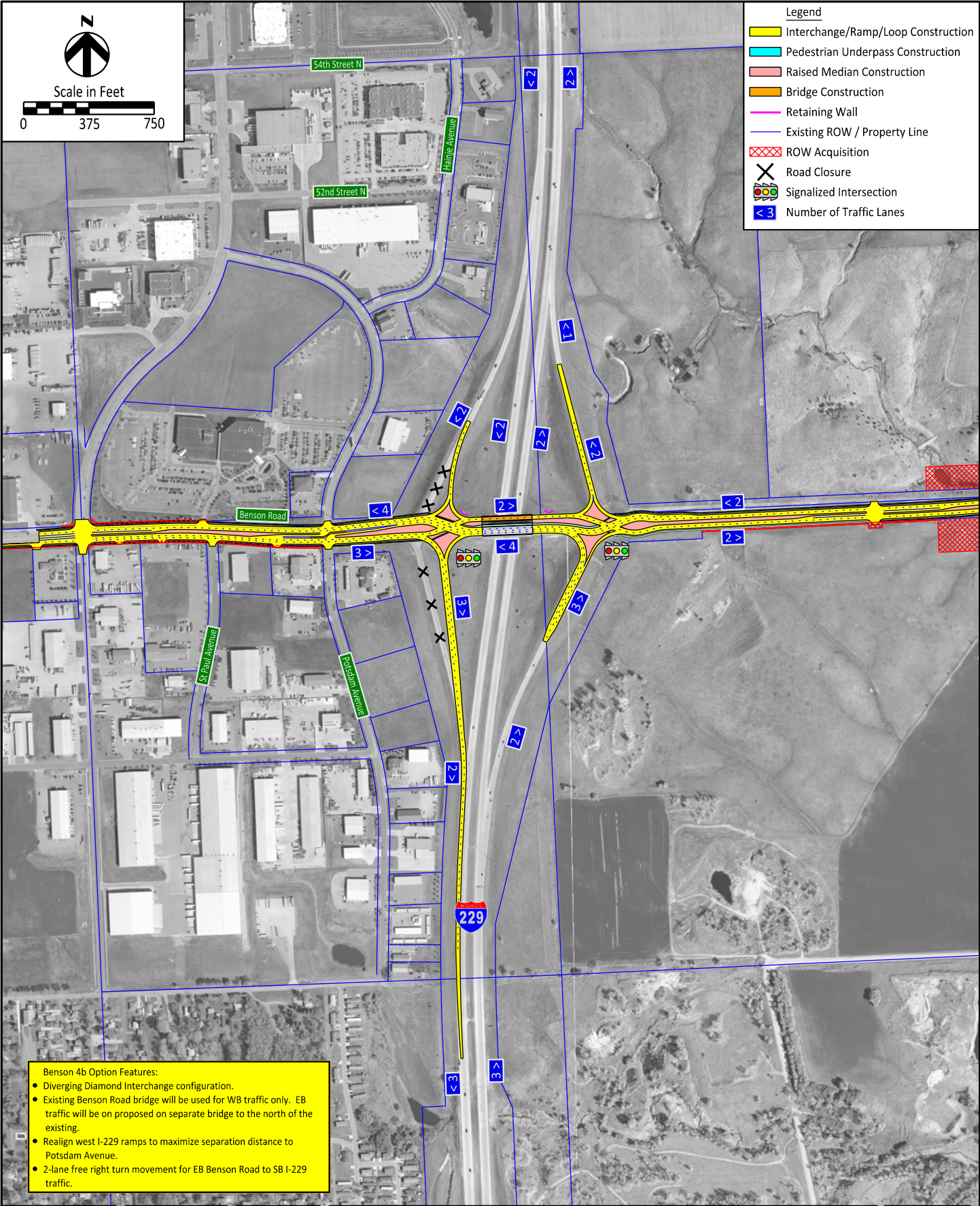
Drawn By: B. Miller
 Date: 5/14/2018
 Chkd By: P. Sanow
 Date: 5/14/2018
 Revision:



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

Sioux Falls, SD

Figure
 6



- Benson 4b Option Features:**
- Diverging Diamond Interchange configuration.
 - Existing Benson Road bridge will be used for WB traffic only. EB traffic will be on proposed on separate bridge to the north of the existing.
 - Realign west I-229 ramps to maximize separation distance to Potsdam Avenue.
 - 2-lane free right turn movement for EB Benson Road to SB I-229 traffic.

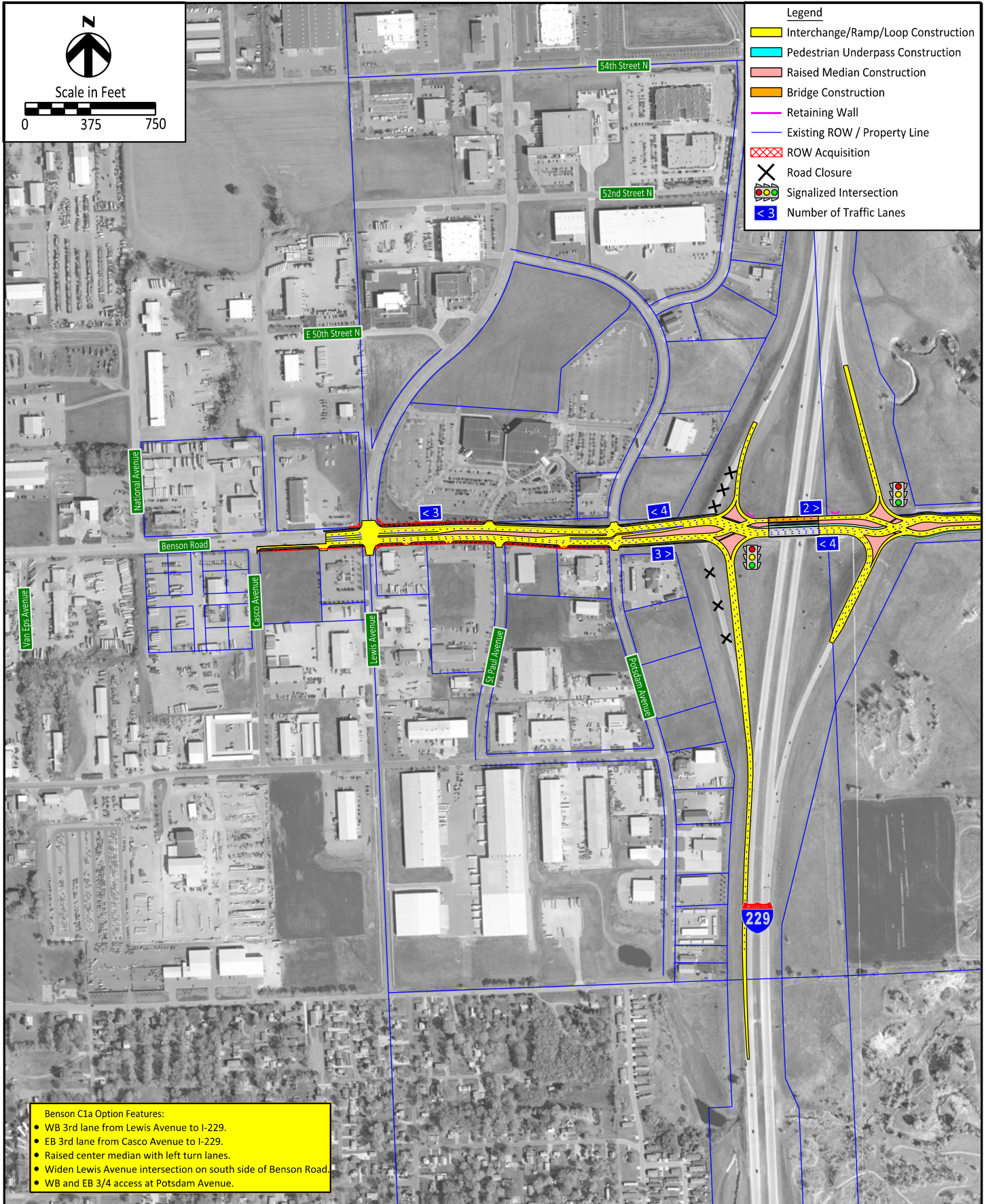
Drawn By: B.Miller
 Date: 5/14/2018
 Chkd By: P.Sanow
 Date: 5/14/2018
 Revision:



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

Sioux Falls, SD

Figure
 7



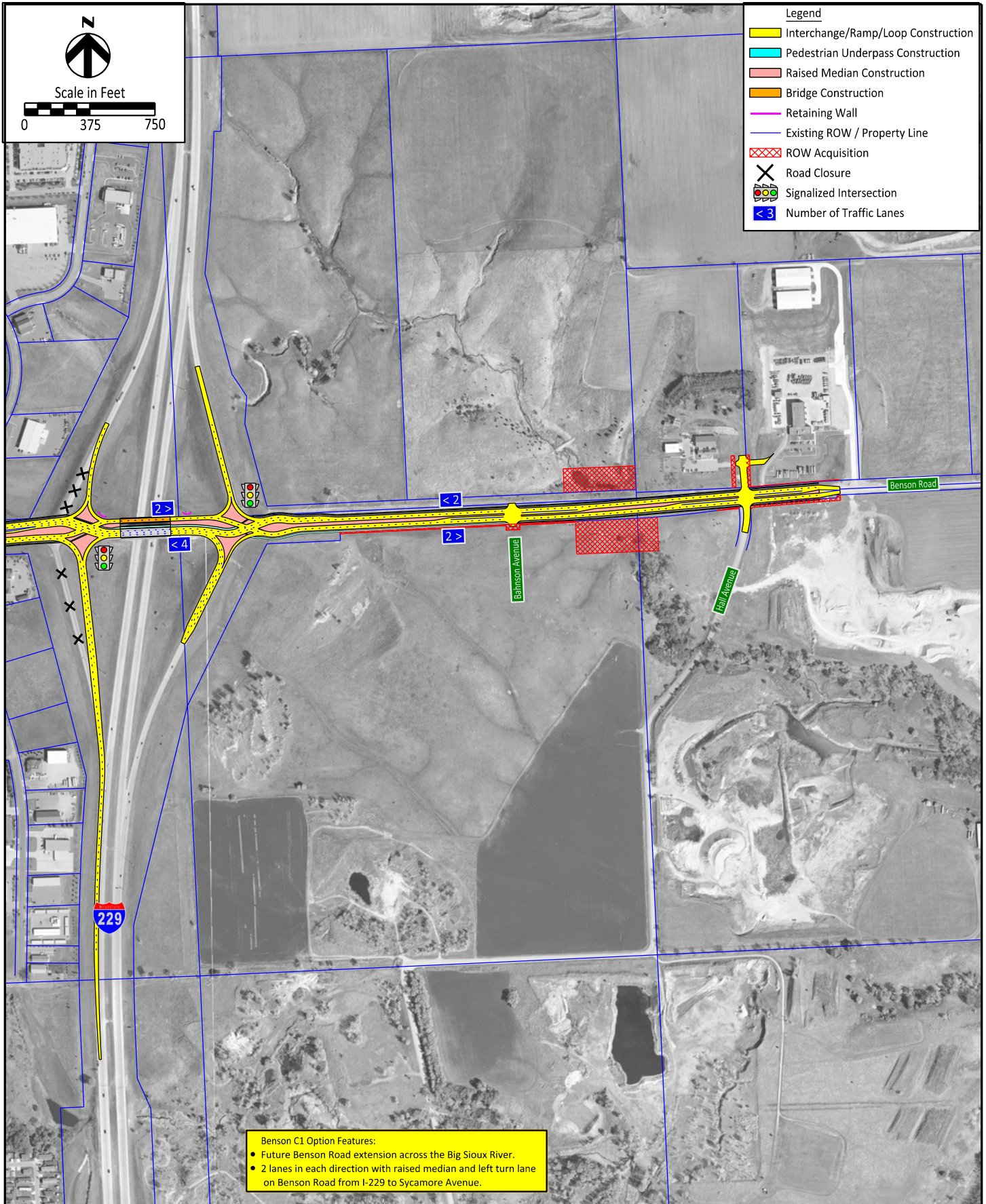
Drawn By: B. Miller
 Date: 5/14/2018
 Chkd By: P. Sanow
 Date: 5/14/2018
 Revision:



Alternative Scenario Benson Road
 Westbound 3rd Lane from Lewis Avenue to I-229
 I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure
 8



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



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

I-229 Exit 9 (Benson Road) IMJR

Sioux Falls, SD

Figure

9