



**US Army Corps
of Engineers®**
St. Paul District

Project Alignment Appendix A

Fargo Moorhead Metropolitan Area
Flood Risk Management Project

EA Document

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Project Alignment Appendix A

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Project Alignment Appendix A

1 BACKGROUND

Following completion of the Final Feasibility Report and Environmental Impact Statement (FEIS) for the Fargo-Moorhead Metropolitan (FMM) Area Flood Risk Management Project (Project), the Corps and the non-Federal Sponsors optimized the project alignment from what was included in the FEIS. The project alignment was divided into four areas for optimization efforts:

- Northern Alignment – Maple River to Red River Outlet
- Sheyenne River Aqueduct Structure
- Western Alignment – Sheyenne River to Maple River
- Southern Alignment – Red River Inlet and Tieback Embankments to Sheyenne River

It is important to note that minor adjustments to the project alignment may still occur due to issues identified during the design of the project features.

1.1 Description of Alternatives Considered

1.1.1 Northern Alignment – Maple River to Red River Outlet

The process of optimizing the Northern Alignment began in October 2011. The process did not include the identification of different alignment alternatives but instead focused on reducing the number and severity of the channel bends and shortening the alignment if possible to reduce construction and operation and maintenance costs. The location of the structures and major highway crossings was optimized and then the number of channel bends between the structures was reduced. The FEIS Locally Preferred Plan (LPP) locations of the Outlet and the Maple River structure were confirmed as optimal. In order to straighten and shorten the diversion channel, the modified alignment has shifted to the southeast about 5,000 feet where the channel intersects Interstate 29 and the Rush River Hydraulic Structure has moved about 5,000 feet to the west of the FEIS alignment for the LPP (hereafter referred to as the FEIS alignment). The proposed modified alignment is shown in Figure 1.

Several channel bends have been eliminated and replaced with straighter, more broadly sweeping curves, reducing the diversion channel length by 1 mile and project cost by nearly \$19 million. Reduction in the number and severity of channel bends is advantageous for passing ice and debris down the channel and also reduces the chance for erosion and sedimentation within the channel. Additionally, fewer parcels of land and residences are affected by the modified alignment.

Approximately 287 acres of additional wetlands would be affected by this modified alignment when compared to the information provided for the FEIS alignment, of which 286 acres are considered low

functioning. The increase in affected acres of wetlands can be attributed to updated calculations which used more up-to-date data and the addition of 250 ft. of temporary and permanent easement areas on each side of project features. It is estimated that there is a net gain of approximately 700 acres of floodplain with the modified alignment when compared with the FEIS alignment. Potential impacts to cultural resources are decreased by reducing the affected lands needed for the Project.

The negative impacts associated with the proposed modified alignment are that it impacts new landowners that were not impacted by the FEIS alignment. The proposed modified alignment has been coordinated with affected landowners via mailings and a public open house and individual affected landowner meetings in December 2011.

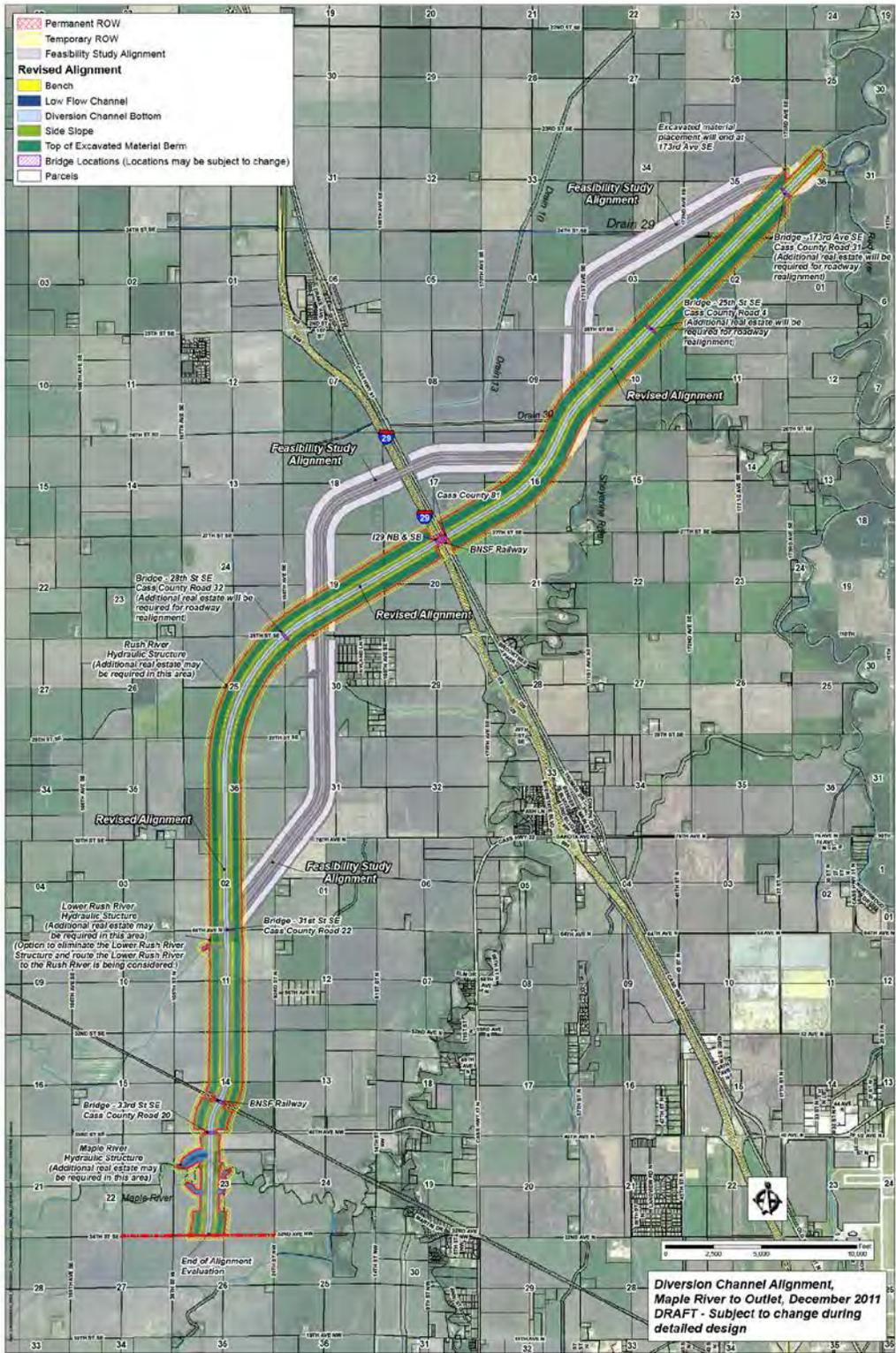


Figure 1 Proposed Northern Alignment Shift

1.1.2 Sheyenne River Aqueduct Structure

It was determined that the FEIS location of the Sheyenne River Aqueduct appeared optimal and movement of the structure north or south was not feasible. Any adjustments would have to be made within the general footprint identified in the FEIS. It was recommended that the planned physical model of the Sheyenne River Aqueduct include the structure location, approach channel, and diversion channel bend configuration into and out of the structure as shown in the FEIS. If this future modeling indicates problems with the FEIS location, inlet and/or exit channels, the structure and/or inlet or exit channels could be rotated. Further optimization of the channel upstream and downstream of the Sheyenne River Aqueduct used the FEIS location of the aqueduct.

1.1.3 Western Alignment – Sheyenne River to Maple River

The process of optimizing the Western Alignment began in February 2012. Concerns identified with the FEIS alignment included:

- North of I-94: The FEIS alignment closely follows the existing Drain 14 oxbows, increasing the risk of encountering sand lenses and cultural areas of concern during construction. It would also impact higher quality wetlands located in this area. It also requires a temporary bridge for the bypass of the railroad due to its proximity to the existing West Fargo Diversion.
- At I-94: The FEIS alignment is between the I-94 Raymond Interchange to the west and the existing West Fargo Diversion channel to the east. The temporary bypass of traffic during construction would require extended head to head traffic, including during the winter, which would pose a safety hazard to the travelling public. It would also require extensive shoring during construction; both increase risk to the public. See Figure 2.
- South of I-94: The FEIS alignment follows the existing West Fargo and Horace to West Fargo diversion channels, increasing the number and severity of channel bends, which is less conducive for passing ice and debris and increases the chances for erosion and sedimentation. The FEIS alignment would incorporate the existing Horace to West Fargo diversion channel, which presents difficulties such as handling of water during construction.

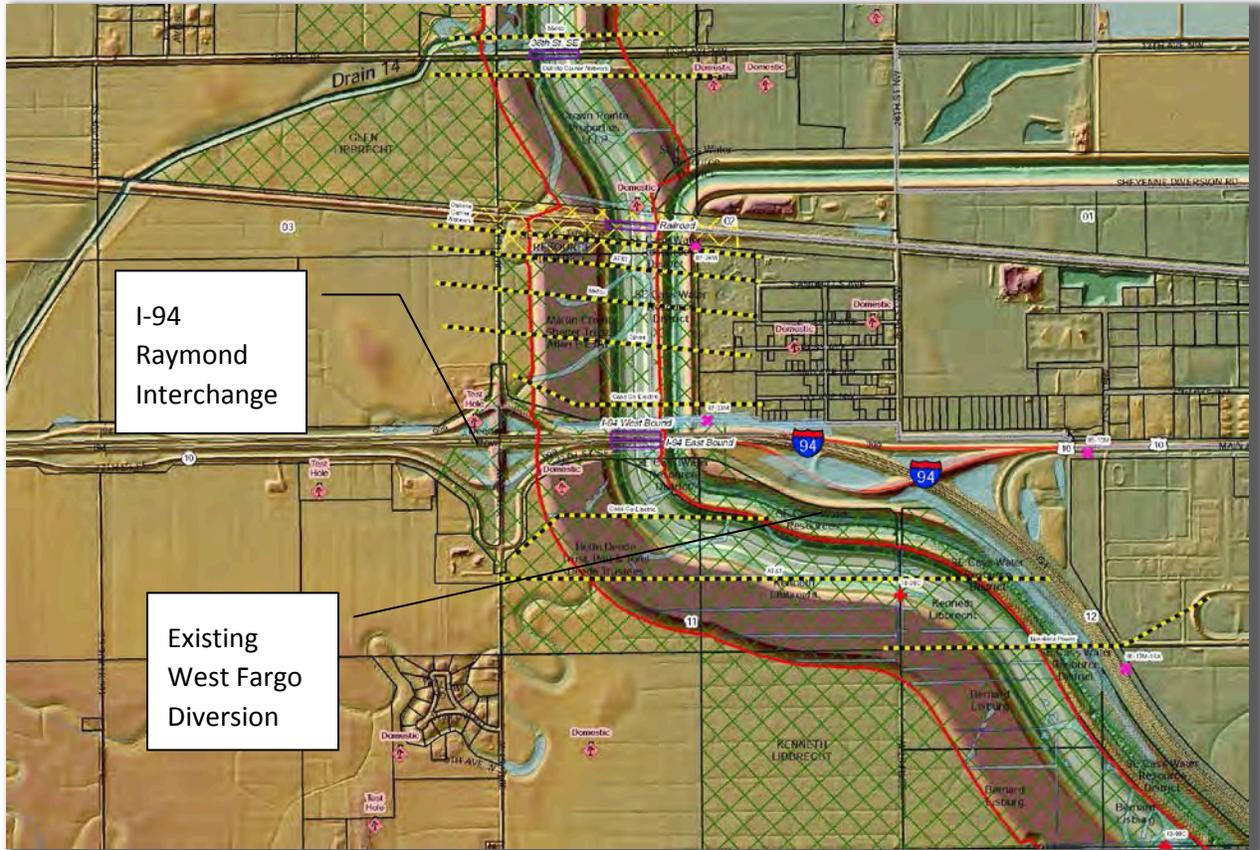


Figure 2 FEIS alignment near I-94 Raymond Interchange

Eight alignment alternatives were identified as shown on Figures 3, 4 and 5. Alignments west of Option A, which were intended to protect the WAPA substation, were dismissed in the FEIS (pages 78-80) because the WAPA substation was adequately protected without moving the alignment west, and therefore Options D1, D2, E, and E' were not considered further since no new technical information was provided that would justify such a modification. Moving the alignment west of WAPA would have taken additional acres out of the floodplain, and that tradeoff was not warranted because WAPA is significantly above the 0.2-percent chance (500-year) event level already. Those alignments west of WAPA did not produce enough benefits to justify the associated loss of floodplain, per EO 11988. Figure 6 includes how each alignment alternative addresses or does not address the concerns identified with the FEIS alignment.

The Option A' alignment is the proposed alignment alternative for the following reasons:

- Solves the technical issues identified with FEIS alignment while preserving the most floodplain:
 - Avoids construction in sand lenses, higher quality wetlands, and cultural areas at the Drain 14 oxbows.
 - Allows for a simpler, at grade BNSF railroad bypass which is more cost effective and safer for continued use during construction.

- Is west of the I-94 Raymond Interchange, allowing for less complicated construction and reducing the risk to the public during construction. Allows for a less complicated at-grade, separated lane bypass, which is more cost effective and safer for continued public use during construction.
- Reduces the number and severity of channel bends, which is better for passing ice and debris and reduces the chances for erosion and sedimentation.
- Removes all construction from the existing Horace to West Fargo diversion, allowing for Excavated Material Berms (EMBs) on both sides of the diversion channel, reducing flood risk during construction, and allowing the existing diversion to remain active as a local drain.
- Removes the least amount of additional land from the floodplain while still addressing the technical issues.
- Affects fewer residences when compared with the FEIS alignment.

The negative impacts associated with the proposed alignment alternative:

- It is west of the FEIS alignment, reducing the available floodplain and impacting new landowners that were not impacted by the FEIS alignment. These changes were necessary to solve the technical and constructability issues with the FEIS alignment and to reduce risk to the public during construction.
- Approximately 324 acres of additional wetlands would be affected by this modified alignment when compared to the information provided for the FEIS alignment. Although there is an increase in affected wetlands, there is a decrease in affected higher functioning wetlands. The majority of the additional wetlands affected are farmed wetlands. The increase in affected acres of wetlands can be attributed to updated calculations which used more up-to-date data and the addition of 250 ft. of temporary and permanent easement areas on each side of project features.

The proposed alignment will be coordinated with affected landowners via mailings, a public meeting and one-on-one affected landowner meetings.

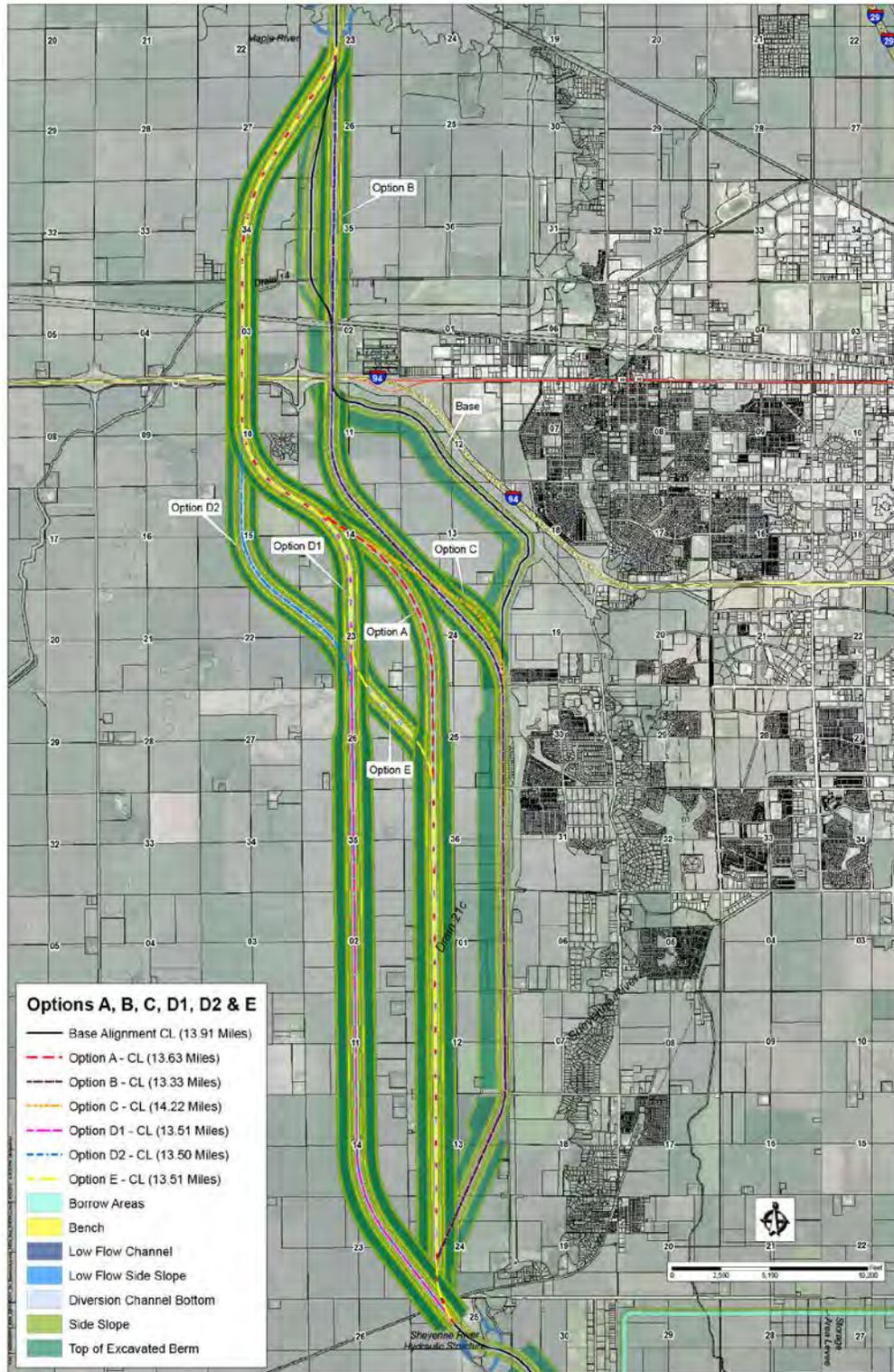


Figure 3 Western Alignment Options A, B, C, D1, D2 & E



Figure 4 Western Alignment Option E'

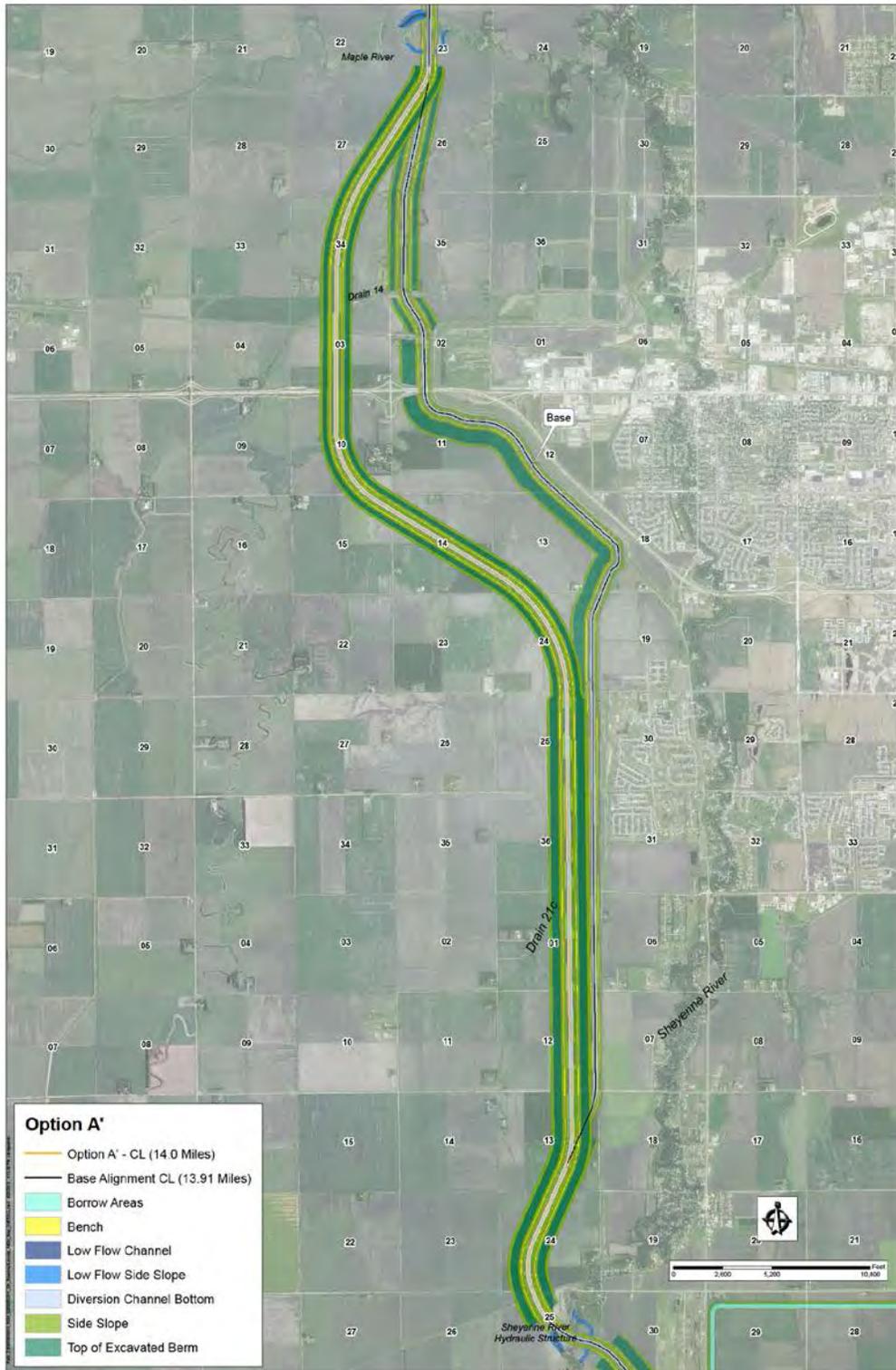


Figure 5 Western Alignment Proposed Alternative (Option A')

Criteria	FEIS	A	A'	B	C	E	E'	Comments
Engineering								
Oxbows in Drain 14 north of I-94	Requires construction in sand lenses	Avoids construction in sand lenses	Avoids construction in sand lenses	Requires construction in sand lenses	Avoids construction in sand lenses	Avoids construction in sand lenses	Avoids construction in sand lenses	Preliminary geotech investigation identified sand lenses in the area of the Drain 14 oxbows
Crossing of railroad	Requires temporary bridge for the bypass of railroad	Allows a simpler, at grade bypass	Allows a simpler, at grade bypass	Requires temporary bridge for the bypass of railroad	Allows a simpler, at grade bypass	Allows a simpler, at grade bypass	Allows a simpler, at grade bypass	Due to proximity to the West Fargo Diversion, the diversion alignment east of the Raymond interchange requires a bridge for the bypass
Crossing of I-94	East of Raymond interchange requiring head to head traffic in winter months	West of Raymond interchange allowing simpler at grade, separated lane bypass	West of Raymond interchange allowing simpler at grade, separated lane bypass	East of Raymond interchange requiring head to head traffic in winter months	West of Raymond interchange allowing simpler at grade, separated lane bypass	West of Raymond interchange allowing simpler at grade, separated lane bypass	West of Raymond interchange allowing simpler at grade, separated lane bypass	Head to head traffic, especially in the winter, poses a safety hazard to the travelling public and will not be allowed by NDDOT
Construction in Horace to West Fargo diversion channel	Construction in the existing diversion channel complicates construction by requiring the EMB on a single side and increase risk during construction if the diversion has to operate	Construction adequately removed from the existing channel allows for EMBs on both sides, reduces flood risk during construction and allows the existing diversion to remain a local drain	Construction adequately removed from the existing channel allows for EMBs on both sides, reduces flood risk during construction and allows the existing diversion to remain a local drain	Construction adequately removed from the existing channel allows for EMBs on both sides, reduces flood risk during construction and allows the existing diversion to remain a local drain	Construction in the existing diversion channel complicates construction by requiring the EMB on a single side and increase risk during construction if the diversion has to operate	Construction adequately removed from the existing channel allows for EMBs on both sides, reduces flood risk during construction and allows the existing diversion to remain a local drain	Construction adequately removed from the existing channel allows for EMBs on both sides, reduces flood risk during construction and allows the existing diversion to remain a local drain	
Channel length (mi)	13.9	13.6	14.0	13.2	14.2	13.5	13.5	
Number of bends	13	4	6	4	6	6	4	
Excavation volume (cy)	27,796,000	29,567,000	29,994,000	27,532,000	30,033,000	29,451,000	29,707,000	
Environmental								
Cultural	Impacts known cultural sites in area of Drain 14 oxbows	No known cultural impacts	No known cultural impacts	Impacts known cultural sites in area of Drain 14 oxbows	No known cultural impacts	No known cultural impacts	No known cultural impacts	
Wetlands affected (ac)		~60 less than FEIS	~30 less than FEIS			TBD – assumed more than A'	TBD – assumed more than A'	
Area removed from floodplain (ac) – Red River peak event (Ph 4)	-	1320	980	270	770	1360	1370	
Area removed from floodplain (ac) – Tributary peak event (Ph 4)	-	4260	3190	1480	2690	4870	5180	
Parcels with structures impacted	9	4	6	7	6	4	4	
Parcels with structures protected	0	41	37	3	36	42	44	
Cost								
Reduction from FEIS alignment								
Other								
WAPA substation	Outside protected area	Outside protected area	Outside protected area	Outside protected area	Outside protected area	Inside protected area	Inside protected area	

Figure 6 Comparison of Western Alignment Alternatives

1.1.4 Southern Alignment – Red River Inlet and Tieback Embankments to Sheyenne River

Following completion of the FEIS, a Value Engineering Study was performed on the FMM Flood Risk Management Project; the report from the study is dated December 2, 2011. Proposal No. 13 titled “North of Wolverton Creek and Red River Confluence” (or “VE-13”) suggested an alignment north of the FEIS alignment that eliminated the Wolverton Creek structure and Storage Area 1 and reduced the length of the embankment with an estimated cost savings of \$109 million. Subsequently, several alternative alignments were evaluated that had the potential to increase project value by further optimizing the project functionality. This analysis was referred to as the Post-Feasibility Southern Alignment Analysis (PFSAA).

Two alternative alignments—Options A and C, as shown in Figure 7—were developed for analysis. Calculations performed indicated that both of the alternatives would meet the goals of replacing the storage provided by Storage Area 1 and would eliminate the Wolverton Creek structure. Options A and C were considered further for the following reasons:

- Option A was the smallest shift north that accomplished the goals of deleting Storage Area 1 and the Wolverton Creek structure. It likely would not significantly affect the upstream staging elevation.

- Option C would quantify the potential to change the upstream staging elevation and impacts.

The PFSAA evaluated and compared the alternative alignments to the FEIS alignment. In addition to the two alignment alternatives recommended for analysis, Options A and C, the non-Federal sponsors elected to analyze two additional alignments that had been screened out in the FEIS:

North of Wild Rice River (NWRR)

NWRR would relocate the connecting channel and associated tieback embankments north of the confluence of the Red River and Wild Rice Rivers. NWRR would eliminate Storage Area 1, eliminate the Wolverton Creek structure, eliminate the Wild Rice River Control Structure and associated fish passage, and reduce staging elevation at communities of Oxbow, Bakke, Hickson, Christine, and Comstock and at the Richland and Wilkin County lines.

The rationale for screening out the NWRR alignment is stated in the FEIS. At the time it was originally considered, during Phase 4 of the feasibility study, the NWRR alignment was not sufficient to eliminate the need for the upstream staging area to adequately reduce downstream impacts. (Appendix O section 8.4.2.1.6 of the FEIS) In addition, a large number of existing structures south of the NWRR alignment would have been left out of the benefitted area. After the Corps' value engineering study, the non-Federal sponsors considered the NWRR alignment again as the northern limit of the upstream staging area. It was determined that locating the staging area that far north would impact a much higher number of existing structures than the location that was selected.

South of Oxbow (OXBOW)

OXBOW would relocate the connecting channel and associated tieback embankments south of the communities of Oxbow, Hickson, and the Bakke subdivision. OXBOW would include the communities of Oxbow, Hickson, Bakke, and Comstock in the flood risk management area. This alternative was screened out because it would take more land out of the floodplain which would require additional staging or storage, would impact more communities further upstream, and would raise additional technical challenges associated with the higher structures and levees that would be required (section 3.7.4 of the FEIS.)

Assessment criteria were developed for the investigation of the alignment alternatives relative to the FEIS alignment and included:

1. Risk Reduction Considerations
2. Implementability
3. Property Impacts (Number of Residential Structures)
4. Environmental Considerations
5. Property Impacts (Number of Acres)
6. Floodplain Considerations

7. Transportation Safety Considerations

These different assessment factor categories were weighted based on their perceived importance. In addition, it was decided to bundle the estimated cost of PFSAA alignment alternatives with the estimated cost of features developed as part of separate concurrent studies - in-town levees and diversion inlet gates.

A low assessment score was preferable, and Option A had the lowest assessment factor score with Option C being very close. When taking cost into consideration, Option A had the lowest cost and assessment factor score of all of the options, in part because Option A affected the fewest residential structures when compared with the FEIS, Option C and NWRR alignments. Therefore Option A (with in-town levees and with diversion inlet gates) is the proposed alignment alternative. See Figure 8 and Figure 9. The evaluation of the alternatives is documented in the *Final Technical Memorandum FM Diversion Post-Feasibility Southern Alignment Analysis: VE-13, North of Wild Rice River, South of Oxbow*, dated October 10, 2012.

With Option A, the proposed modified diversion channel alignment from the diversion inlet structure to the Minnesota tieback embankment has moved approximately 1 mile north and follows a line parallel to and just south of Country Road 16 (CR 16). This alignment improves on the FEIS alignment by eliminating the Wolverton Creek structure, eliminating Storage Area 1, decreasing embankment lengths, and reducing cost.

The modified diversion channel and southern embankment alignment from the Sheyenne River Aqueduct Structure to the Red River, including tieback embankments, solves technical issues identified with the FEIS alignment:

- Eliminates the need for a Wolverton Creek structure, significantly reducing cost and environmental impacts.
- Eliminates the need for Storage Area 1, thereby decreasing lands and damages associated with the Project.
- Eliminates the need for Storage Area 1 embankments and drainage control structures, thereby significantly reducing cost and the length of Class I dam features.
- Decreases channel length between the Red River and the diversion inlet structure and decreases length of tieback embankments, thereby reducing cost.

In addition, the Option A alignment affects 309 residential and 373 non-residential structures, which is 10 fewer residential and 42 fewer non-residential structures when compared with the FEIS alignment. However, the modified alignment would impact new landowners that were not impacted by the FEIS alignment. Option A affects 37,901 acres, which is 2,374 fewer acres than the FEIS alignment. The modified alignment also reduces the acreage of land in Richland and Wilkin counties that is impacted by the upstream staging area.

Approximately 95 acres of additional wetlands, of which 66 acres are considered lower functioning, would be affected by this modified alignment when compared to information provided for the FEIS alignment. The increase in affected acres of wetlands can be attributed to updated calculations which

used more up-to-date data and the addition of 250 ft. of temporary and permanent easement areas on each side of project features. An additional 760 acres of land is removed from the floodplain when compared to the FEIS alignment; although the alignment would be moved approximately 1 mile north, Storage Area 1 would no longer be included, resulting in a net loss of floodplain. Potential impacts to cultural resources are decreased by reducing the affected lands needed for the Project.

The modified alignment was presented to the public at a public meeting and open house held on Thursday, September 13, 2012. When detailed design efforts begin for this area, an open house and one-on-one meetings with impacted landowners will be conducted to discuss concerns, impacts to property access, farming operations, and drainage.

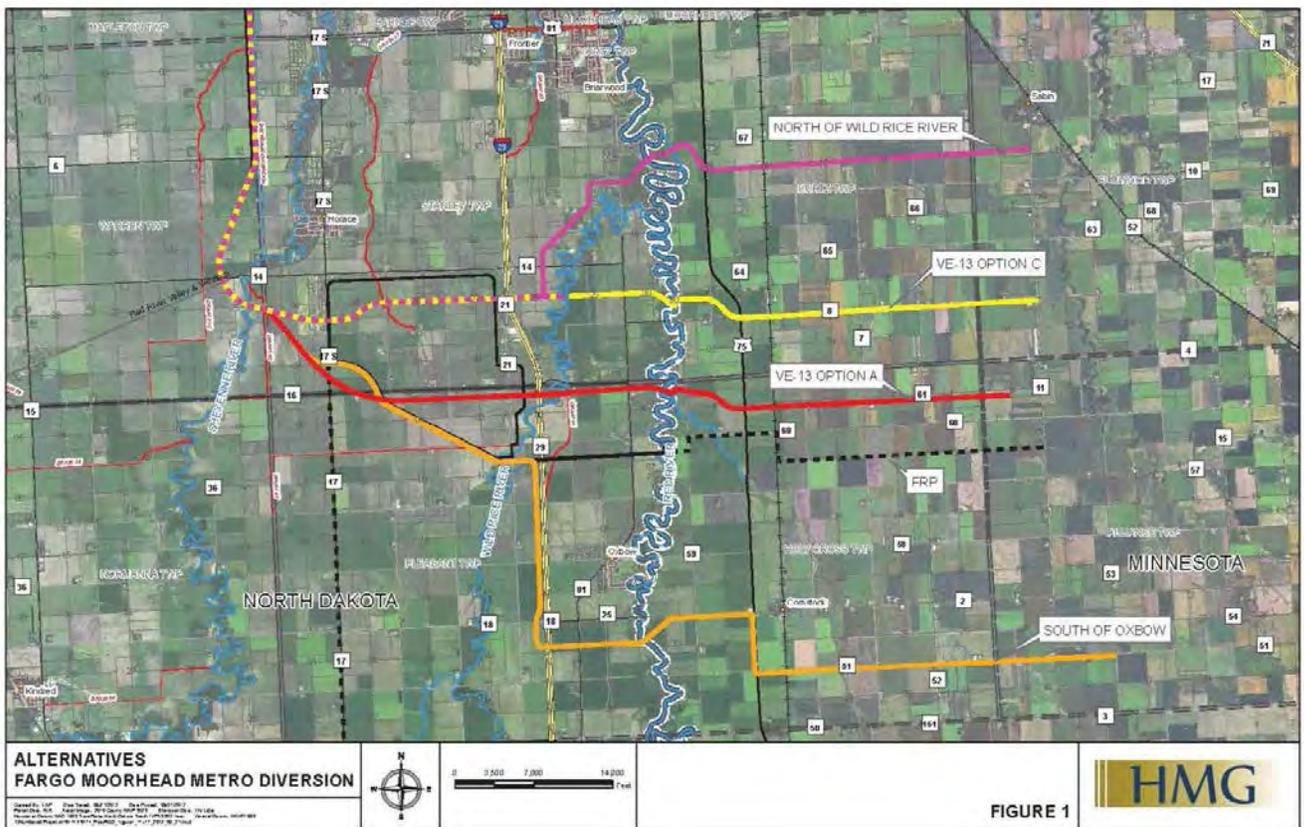


Figure 7 Southern Alignment Alternatives

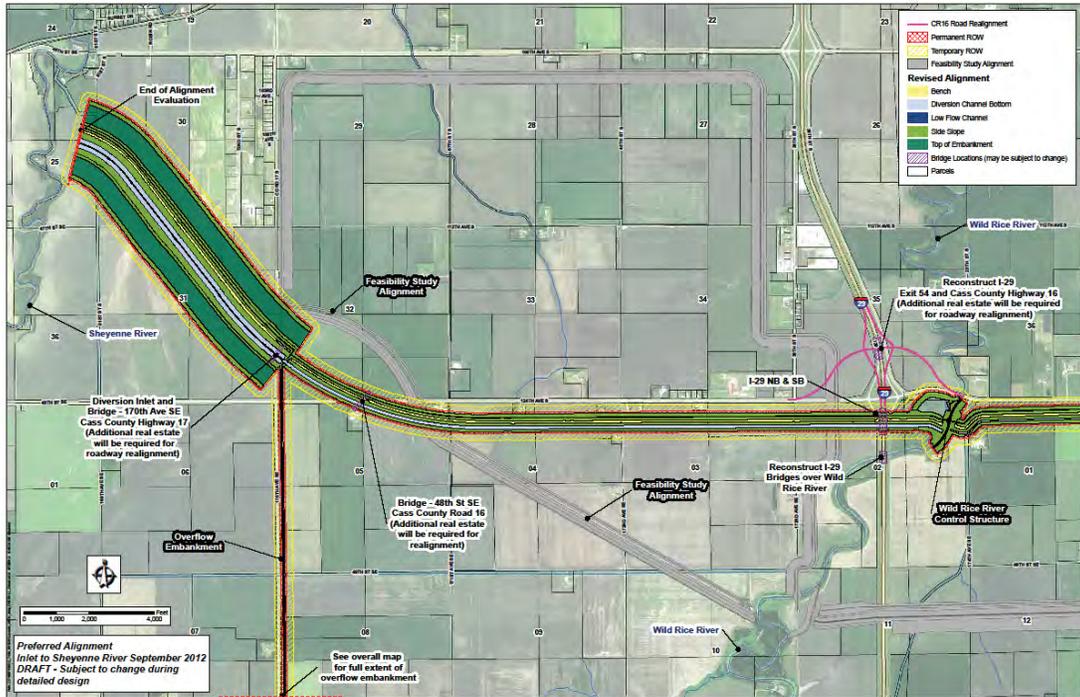


Figure 8 Proposed Southern Alignment – Sheyenne River to Wild Rice Control Structure

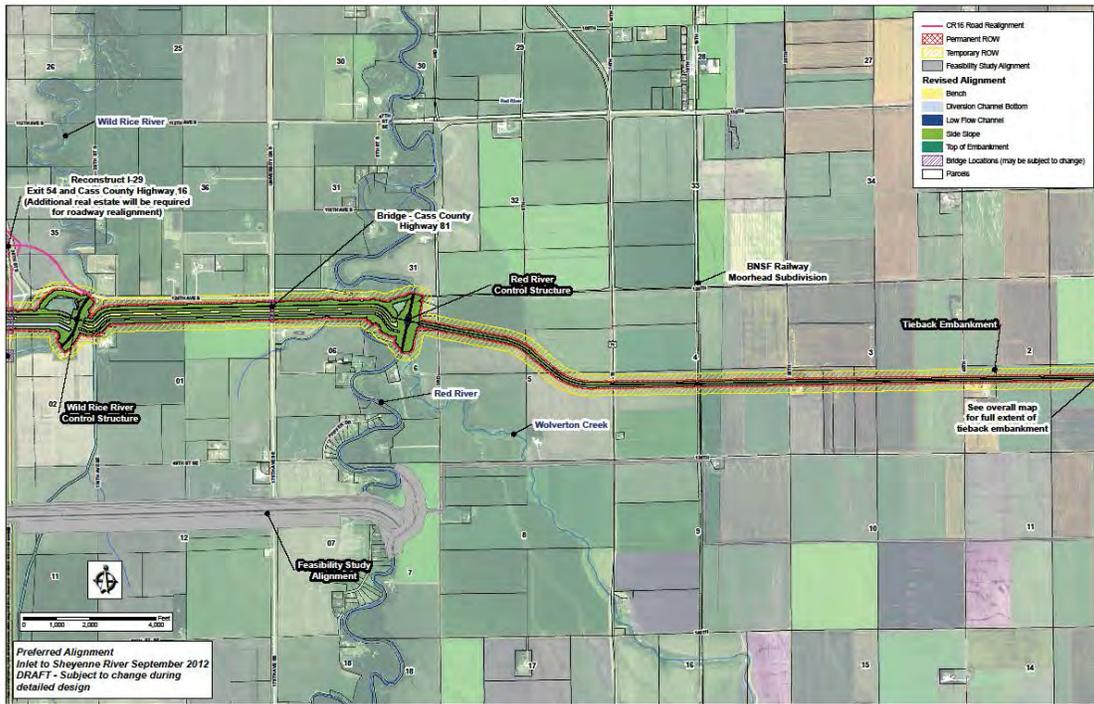


Figure 9 Proposed Southern Alignment – Red River Control Structure to Minnesota Tieback Embankment

2 PROPOSED ALIGNMENTS

2.1 Northern Alignment – Maple River to Red River Outlet

The proposed alignment at the northern portion of the Project is as shown in Figure 10. When compared with the FEIS alignment, the modified alignment is shorter and straighter. Several bends were removed. As a result of these changes, the modified alignment has shifted to the southeast about 5,000 feet where the channel intersects Interstate 29 and the Rush River Hydraulic Structure has moved about 5,000 feet to the west of the FEIS alignment.

2.2 Western Alignment – Sheyenne River to Maple River

The proposed alignment at the western portion of the Project is as shown in Figure 10. The proposed diversion channel alignment from the Sheyenne River to the Maple River when compared with the FEIS alignment has moved west of existing oxbows north of I-94, west of the Raymond Interchange of I-94, slightly west of the Horace to West Fargo diversion, and replaced several bends with a straighter alignment.

2.3 Southern Alignment – Red River Inlet and Tieback Embankments to Sheyenne River

The proposed alignment at the southern portion of the Project is as shown in Figure 10. The proposed modified diversion channel alignment from the diversion inlet structure to the Minnesota tieback embankment when compared with the FEIS alignment has moved approximately 1 mile north and follows a line parallel to and just south of Country Road 16 (CR 16). This alignment eliminates the need for Storage Area 1 and the Wolverton Creek structure.

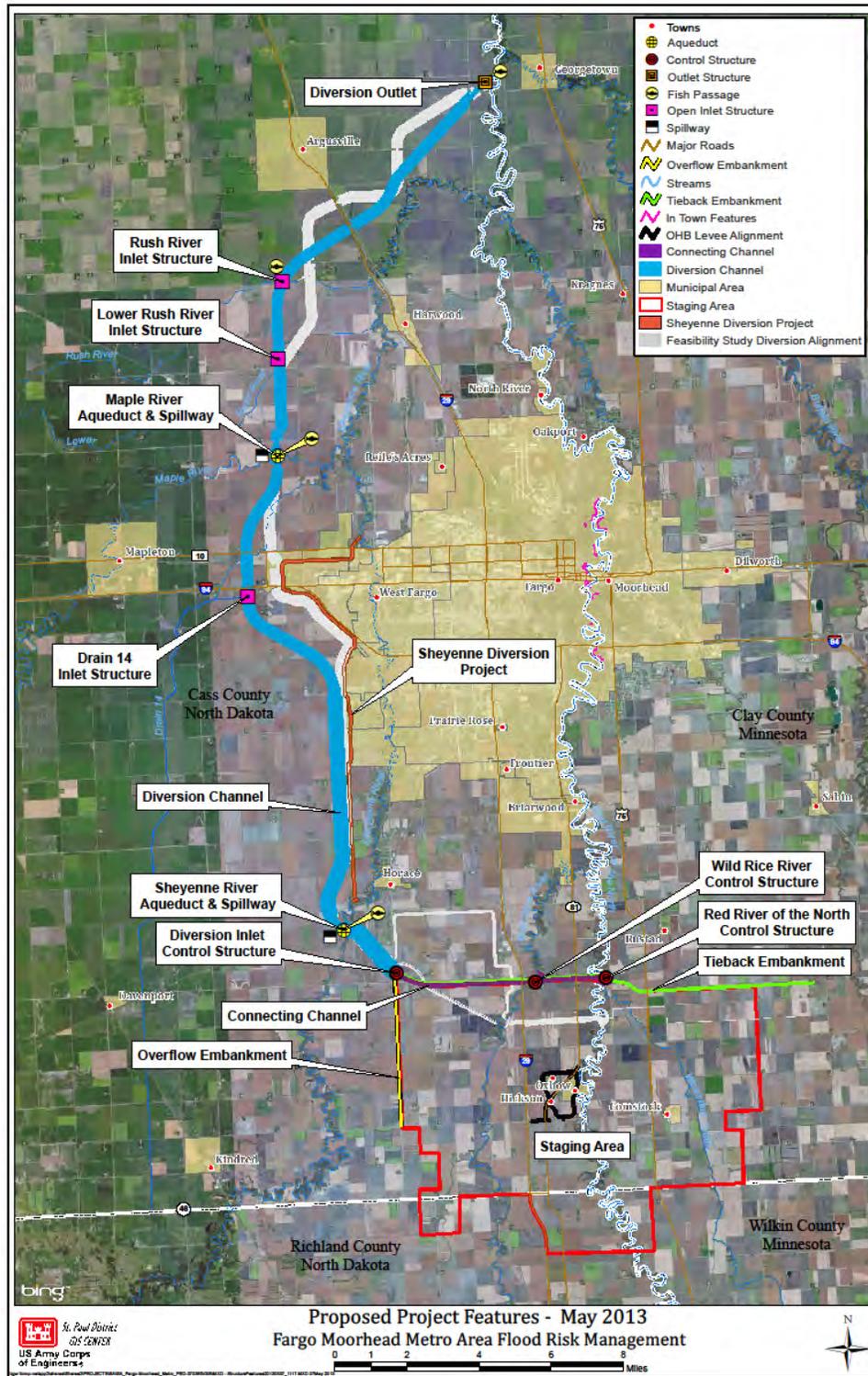


Figure 10 Proposed Alignment

