



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

Appendix E: Civil-Site

Fargo Moorhead Metropolitan Area Flood Risk Management Project

Reach 2

Engineering and Design Phase

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Appendix E: Civil-Site

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Appendix E: Civil-Site

E.1 GENERAL

Civil design for this project will include demolition, levee and excavated material berm layout, access road layout, utility relocations, general grading, and storm water pollution prevention. This section summarizes the proposed layout, method of analyses, and support for preparation of the plans, specifications, and cost estimate.

E.2 DEMOLITION

Demolition will include clearing. See Section E.7 for demolition of utilities. Existing roads located within the proposed diversion, levees, and Excavated Material Berm (EMB) areas will require demolition. Based on the Reach 3 relocation/re-alignment of 27th Street SE, the Reach 2 contractor shall remove 170th Ave. SE.

E.3 DIVERSION CHANNEL LAYOUT

The control for the centerline of the diversion channel was set to flow in alignment with the existing centerline of the Red River of the North. The control alignment for the Reach 2 project is 7,300 feet which begins at Station 227+00 and ends at Station 300+00.

E.3.1 Low Flow Channel and Sinuosity

The low flow channel within the main diversion channel for Reach 2 has a 52' wide bottom with a 2% cross slope and 1V:4H side slopes. The low flow channel side slopes extend and tie into the main diversion channel bottom which has a cross slope of 2%. The top of the low flow channel is approximately 100' wide. The low flow channel continues from the previous reach at Station 227+00 and extends continuously through the reach to Station 300+00. The low flow channel meanders within a 200' wide meander belt width. Based on the width of the meander belt and this constraint, the sinuosity within the low flow channel is somewhat restricted. The average sinuosity for Reach 2 from Station 227+00 to the end of the reach at Station 300+00 is 1.127.

E.4 LEVEES/EXCAVATED MATERIAL BERMS (EMB)

The EMBs on the sides of the diversion begin at Station 227+00 when looking downstream of the diversion. The EMB can be constructed to a maximum initial height as determined by geotechnical analysis. The initial max height is the top edge of the EMB closest to the diversion channel. The initial maximum height next to the channel based on geotechnical analysis is 15' for Reach 2. The EMB will rise at a 2% slope from that point to a crest point, then down at a 2% slope to the backside edge of the EMB. The EMBs will continue along the length of the diversion up to the end of the Reach 2 project to Station

300+00. The alignment and configuration of the channel and EMBs are based on Hydraulic and Geotechnical considerations.

With the continuation of design, coordination with, and support of the local sponsor, final layout of the EMB's will take into account the desired end use as determined by the local sponsor. The final layout will involve balancing excavation/fill while generally placing 50% of the volume on each side of the channel. Other factors affecting EMB layout include drainage structures, bridge relocations, and real estate acquisition.

Additional information on the design and layout of the levees and EMBs is available in MFR-001 Margo-Moorhead Metro Flood Risk Management (FMMFRM) Project - Levees and Excavated Material Berms along the Diversion Channel.

E.4.1 Shrink/Swell/Overexcavation/Rebound

Guidance Memo (GM)-002 Excavated Material Berm Design with Swell Factor Variations, provides guidance for design considerations of the EMBs for shrink and swell variations of the excavated material. The EMB has been designed to accommodate a 15% swell factor in the excavation material. The right bank EMB must be constructed to the neatlines shown in the drawings, and within allowable tolerances. The left bank EMB may be constructed between the neatline shown and the minimum berm limits shown on the plans.

E.4.2 Excavated Material Piles

Excavated material piles are being designed for the placement of excess material if the swell factor exceeds 15%. Two (2) excavated material piles have been designed and are directly adjacent to the local drainage ditch on both the right bank and left bank. The piles were designed with a 1V:6H side slope and a maximum height not to exceed the maximum height of the EMB directly adjacent to the pile. The top slope of the pile will slope at a minimum of 1% to provide positive drainage.

E.4.3 Viewshed

GM-001 Construction Heights of EMBs, provides guidance for design considerations related to the construction height of EMBs. Cultural considerations included a viewshed analysis to determine visual impacts to the project. The analysis determined EMBs over 20 feet in maximum height will be visually intrusive, therefore the maximum construction height of the EMB is 21 ft. and accounts for an expected settlement of 12" for a final height of 20 ft.

E.4.4 Recreation/Undulations

The minimum EMB width recommended by the Local Sponsor to accommodate the undulations for the right bank EMB is 250'. Below this minimum, it would be difficult to balance earthwork with the undulation grading and could impact the user experience with the future recreational features. The right bank EMB considered this minimum width and where practical, this 250' guidance was followed. In order to follow this guidance, the right EMB height was reduced to 14 feet, which is more conservative than that required elsewhere in the design.

E.4.5 Levees

The levee for Reach 2 is completely encapsulated within the right bank EMB, which will result in reduced operation and maintenance requirements. The levee shall extend from Station 227+00 for the full length of the reach to Station 300+00. The levee within Reach 2 shall have a 10-foot crown with 1V:3H side slopes and will have a minimum of 6-foot of cover. These encapsulated levees shall be seamlessly connected to those of Reaches 1 and 3.

E.5 LOCAL DRAINAGE STRUCTURES

Local drainage is being designed by the local sponsor for incorporation into the Reach 2 construction documents. The local drainage design includes drainage ditches that run parallel along the right and left bank EMB's within the project right-of-way. A minimum 20' wide buffer will be provided between the toe of the EMB and the local drainage ditch. The local ditches convey local runoff from adjacent properties, as well as the EMB's, to larger County Drains or rivers. For Reach 2, the discharge from these ditches will be routed north to tie into the Reach 1 ditches which will ultimately discharge into the inlets at Cass County Drain 30 at approximately Diversion Channel Station 222+20.

Additional information on the Non-Federal Sponsor Local Drainage Plan can be found in Appendix C, Attachment 02.

E.5.1 Field Drainage and Drainage Ditch Inlets

Reach 2 includes drainage ditches along the outside of the EMB's that convey runoff from the EMB's and adjacent properties to Drain 30. These ditches were designed by the local sponsor design team and incorporated into the Reach 2 plans by the PDT. These ditches intersect small drains (Road Ditches), and open swales on adjacent agricultural fields. These intersection points, referred to as drainage ditch inlets, were designed to provide adequate drainage and minimize erosion.

The Local Sponsor's drainage ditch design includes side berms as necessary to contain the 10 year event and not allow it to back into the adjacent field. Side berms are not necessary in Reach 1 to contain the 10 year event. However, side berms can be added on a case by case basis, if it provides a better drainage solution than open swales/ditches.

Design of inlets is in accordance with GM-003, Local Drainage Features Outside of the Diversion Channel. Based on research by the local sponsor design team, there are no farm fields within Reach 2 that have field tile drainage that will be intersected by excavation. Therefore, all the side ditch inlets would be "open swale".

The design team analyzed base topography and aerial photography to identify each location where the drainage ditch intersected an adjacent drainage feature. The intersections of interest in Reach 2 were farm field swales at approximately stations 245+00 and 256+00 on the right bank and 290+00 on the left bank. Based on GM-003 the structural measure applying to the smallest drainage intersection was that for open swales entering the drainage ditch. This measure includes a riprap armored swale inlet to include site-specific grading. This measure is required if the height difference between the swale and the drainage ditch invert is greater than 2'. The intersections' aforementioned analysis resulted in recommendations that none of these intersections justify a structural measure. The invert differences at

these locations are very near 2', but after construction of the project the remaining drainage areas for these surface swales will not generate enough flow volume to justify a structural measure.

E.6 ACCESS ROADS AND PARKING AREAS

The proposed roadway re-alignment of County Road 27th St. SE shall be designed and constructed by others; this coordination is ongoing. County Road 170th Avenue SE is to be abandoned, with the location of abandonment being coordinated.

The contractor shall construct temporary access roads as necessary utilizing the 27th St. SE alignment when it is rerouted. Additional access roads shall be constructed connecting to the remaining abandoned northern portion of 170th Avenue SE and 171st Avenue SE alignments.

There shall be no permanent access road access constructed within Reach 2, as it was determined during discussions between the PDT and MVP, to be a short distance with adjacent reaches constructing access adjacent to the reach transitions.

E.7 UTILITY INFORMATION

Utility information, including surveyed locations was obtained from Moore Engineering under contract with the local sponsor.

E.7.1 Existing Utilities

Utilities identified within the limits of Reach 2 include overhead electrical power lines; buried telephone lines; and a Natural gas line. A total of three encroachments were identified through review of utility mapping and field locates. Field locates were conducted in December of 2011 and January of 2012.

The following table lists utilities known to cross the diversion channel within Reach 2:

Table E-1: Utility Encroachments Reach 2

UTILITY	CROSSING STATION	DESCRIPTION
ELECTRIC		
Cass County Electric	Overhead line runs parallel to project alignment from Station 225+00 to 246+00 on the west side of 171 st Ave SE	Line runs North/South west of 171 st Ave SE likely along the edge of the EMB
COMMUNICATION		

UTILITY	CROSSING STATION	DESCRIPTION
Century Link	Underground telephone cable crosses at Station 285+40	Line runs North/South along the East side of 170 th Ave SE then runs East/West along the North side of 27 th St. SE
Natural Gas		
Magellan	6" dia. Natural gas line crosses at Station 296+05	Line runs nearly perpendicular to alignment (NW-SE)

E.7.2 Utility Relocations

Utility relocations will comply with the MVP MFR for Utility Relocation Requirements and local/state requirements. The non-federal sponsor made the determination that the local utilities and the FMM Diversion Authority will be handling the relocations within Reach 2, prior to construction. The electrical lines shall be relocated with proposed new location identified on plans. All relocation and demo for the communications lines will be complete with proposed new location identified on the plans. The natural gas line will be relocated to a depth beyond the project boundaries along the same alignment.

E.8 VEGETATION FREE ZONE (VFZ)/VEGETATION MANAGEMENT ZONE (VMZ)

The Vegetation Free Zone (VFZ)/Vegetation Management Zone (VMZ) will comply with the requirements in ETL 1110-2-571, as well as the criteria set forth in project specific guidance documents such as the Memo For Record (MFR) Levees and Excavated Material Berms along the Diversion Channel (provided in Appendix E Civil-Site, Attachment 1). The VFZ will be a minimum of 15' from the toe of stand-alone levees and partially embedded levees. The VMZ will extend 15' from the landside crown of the levees embedded within EMB's.

E.9 REAL ESTATE/WORK LIMITS/CONSTRUCTION

E.9.1 Easements

Fee title real estate is set at 50' from the toe of the outermost project feature which includes excavated material piles, access and maintenance roads, and the local drainage ditch. Temporary easements are being set at 200' from the 50' fee title real estate line. Temporary easements will be used for a variety of construction purposes, including temporary storage of stripped topsoil. The access and maintenance roads are included in the fee title real estate. Fee title, permanent easement, and temporary easements are shown on the real estate plans. The construction plans identify only the outermost work limit that typically represents the temporary easement.

E.9.2 Construction Staging Areas

Staging Areas are not explicitly identified for Reach 2 construction activities. Staging will be at the discretion of the contractor, but it is recommended due to potential flood plain issues related to using the right bank.

E.9.3 Stormwater During Construction

A temporary plug just upstream of the Reach 1/2 transition is required for Reach 2 during construction activities to minimize sediment discharge and water flow into Reach 1. This plug will be made up of existing material left in place directly upstream of the Reach 1/2 transition. Excavation of the channel would begin upstream of this plug. The plug would not be removed until Reach 2 is stabilized upstream and meets final stabilization requirements for the applicable NPDES permit.

The primary purpose of the temporary outlet plug is to minimize sediment discharge into Reach 1 and eventually Red River to be in compliance with the applicable NPDES permit. A secondary benefit would minimize overtopping of backwater from the Red River, via the Reach 1 connection, into the construction area. The contractor will be responsible to protect and armor the plug as necessary.

E.10 TECHNICAL GUIDELINES AND REFERENCES

<p><i>A Policy on Geometric Design of Highways and Streets</i>, Fifth Edition; American Association of State Highway and Transportation Officials (AASHTO); 2004.</p>
<p><i>Guidelines for Geometric Design of Very Low-Volume Local Roads</i>, American Association of State Highway and Transportation Officials (AASHTO); 2001</p>
<p>USACE EM 1110-2-1913, Design and Construction of Levees</p>
<p>USACE ETL 1110-2-571, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures</p>
<p>USACE MVP MFR-001-Fargo-Moorhead Metro Flood Risk Management (FMMFRM) Project- Levees and Excavated material Berms along the Diversion Channel</p>
<p>USACE MVP MFR-010-Utility Relocation Requirements; Fargo-Moorhead Metropolitan Area Flood Risk Management Project</p>
<p>USACE MVP GM-001, Guidance Memo, Construction Heights of EMBs</p>
<p>USACE MVP GM-002, Guidance Memo, Excavated Material Berm Design with Swell Factor Variations</p>
<p>USACE MVP GM-003, Guidance Memo, Local Drainage Features Outside of the Diversion Channel</p>