



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

Appendix E1: Civil-Site

Fargo Moorhead Metropolitan Area
Flood Risk Management Project
Reach 5, Volume 2:
Stations 576+00 to 596+00
Lower Rush River Inlet/Drop Structure
Engineering and Design Phase

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Appendix E1: Civil-Site

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Appendix E1: Civil-Site

E.1 GENERAL

Civil design for this project will include demolition, levee and excavated material berm (EMB) layout, grading and rock placement at the Lower Rush River drop structure, 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 by the diversion contractor will include clearing and grubbing of mature trees. The non-federal local sponsor is responsible for providing all lands and removing/capping existing utility structures prior to construction of the diversion channel. All holes resulting from the removals in the non-federal sponsor's demolition contracts will be temporarily filled to prevent any safety hazard.

As part of the CR 22 bridge construction contract, a temporary bypass channel will be excavated by the local sponsor in order to reroute all Lower Rush River flows around the project site to the east. After the Lower Rush River drop structure is completed and the Lower Rush River is realigned into the main diversion channel, the temporary bypass channel will be backfilled in its entirety and the box culverts under CR 22 will be abandoned in place and the bypass ditch blocks with intercept culverts will be removed.

E.3 DIVERSION CHANNEL LAYOUT

The control for the Reach 5 centerline of the diversion channel was set to flow parallel to existing property lines between Stations 521+00 and 656+00. Reach 5 Plans include three volumes. Volume 1 control alignment extends between Stations 521+00 and 566+00, Volume 2 extends between Stations 576+00 and 596+00 and includes the Lower Rush River Structure, and Volume 3 extends between Stations 596+00 and 656+00. Within Reach 5 is the County Road 22 bridge (Stations 566+00 to 576+00) which will be designed by the local sponsor. The proposed 590 foot bridge located at approximately Station 571+50 will be designed to allow traffic to pass over the channel via CR 22. In addition to the bridge and associated road realignments, this Bridge Reach also includes 1000' of diversion channel and EMB's to be designed by the local sponsor.

The overall length of Reach 5, excluding the bridge reach limits, is approximately 12,500 ft with 4500' in Volume 1, 2000' in Volume 2, and 6000' in Volume 3. Station 521+00 ties into reach 4 approximately 250 ft. north of 76th Ave. Station 656+00 ties into Reach 6 approximately 500 ft. downstream from the BNSF rail line.

The Lower Rush River reach (Volume 2) is bounded on the downstream end by the CR 22 bridge reach and on the upstream end by the Volume 3 reach. The Lower Rush River drop structure intercepts the main diversion channel at Station 578+34.31.

E.3.1 Low Flow Channel and Sinuosity

The low flow channel within the main diversion channel for Reach 5 including the Lower Rush River has a 46' 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 90' wide. The low flow channel meanders within a 200' wide meander belt width. Based on the width of the meander belt width and this constraint, the sinuosity within the low flow channel is somewhat restricted. The sinuosity of the downstream portion (Station 521+00 to Station 566+00) of the Reach 5 Diversion Channel is approximately 1.12. The upstream sinuosity for the Reach 5 Diversion Channel is also approximately 1.12. In the Lower Rush River reach, there will be a straight portion of low flow channel between Stations 576+00 to 583+37.66 where the drop structure discharges into the main diversion channel. The overall average sinuosity for the Lower Rush River reach is 1.07. Excluding the straight portion of low flow channel necessary at the drop structure confluence, the average sinuosity for the Lower Rush River is 1.11.

E.4 LEVEES/EXCAVATED MATERIAL BERMS (EMB)

EMB descriptions for Volume 1 and 3 can be found in *Appendix E: Civil-Site*.

The EMBs in Volume 2 are located on both sides of the diversion channel along the entire reach length except in the area where the drop structure enters the main diversion channel. The left bank EMB can be constructed to a maximum height of 20 feet and the right bank EMB can be constructed to maximum height of 16.3 feet. The maximum height is given at the EMB crown. The EMBs will slope away on each side of the crown with a 2% slope. The alignment and configuration of the channel and excavated material berms are based on Hydraulic and Geotechnical considerations.

With the continuation of design, coordination with, and support of the local sponsor, final layout of the EMBs 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 except in the area of the drop structure. Other factors effecting EMB layout include coordination of the design section with adjacent reaches, the new CR 22 bridge, the Lower Rush River drop structure, and real estate acquisition.

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%. An excavated material pile has been designed and is located directly adjacent to the left bank drainage ditch and northern side berm of the Lower Rush River realignment. The pile is 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

Guidance Memo (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 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.

E.5 LOCAL DRAINAGE STRUCTURES

Local drainage was designed by the local sponsor for incorporation into the Reach 5 construction documents. The local drainage design includes drainage ditches that run parallel along the right and left bank EMB's. The local ditches convey local runoff from adjacent properties, as well as the EMB's, to larger County Drains or rivers. A minimum 20' wide buffer will be provided between the toe of the EMB and the local drainage ditch. The Lower Rush River flows east towards the Sheyenne River and would intercept the project footprint at approximately Station 560+00. The right local drainage ditch shall intersect and drain into the Lower Rush River at approximate Station 546+00. For the downstream portion of Reach 5, the left local drainage ditch will transition into the left drainage ditch of the CR 22 bridge reach. For the upstream portion of Reach 5, the left local drainage ditch will transition into the left drainage ditch of Lower Rush Drop Structure.

For the Lower Rush Drop Structure, the local ditch behind the right bank EMB will drain to the portion of the Lower Rush River remaining east of the diversion channel that discharges into the Sheyenne River. The local ditch behind the left bank EMB will drain to the realigned Lower Rush River and drop structure where it will be discharged into the main diversion channel. Culverts will be installed through the side berms upstream of the drop structure to pass the ditch flows into the realigned Lower Rush River.

Additional information on the Non-Federal Sponsor Local Drainage Plan can be found in Appendix M, Attachment M-7.

Draft technical memorandum prepared by Houston Moore dated 12/18/2012, AWD-0005, Local Drainage Plan, provided sizing of the culverts in Table 2 for the local drainage ditches. Culverts for the local drainage ditches at the Lower Rush River will utilize round corrugated steel pipes. The double and triple culvert pipes to be installed on the south and north side of the Lower Rush River realignment will have cast-iron flap gates installed to prevent water from backing out of the river.

As part of the CR 22 bridge construction contract, a temporary bypass channel will be excavated by the local sponsor in order to reroute all Lower Rush River flows around the project site to the east. After the Lower Rush River drop structure is completed and the Lower Rush River is realigned into the main diversion channel, the temporary bypass channel will be backfilled in its entirety and the box culverts under CR 22 will be abandoned in place.

Additional information on local drainage structures for Volumes 1 and 3 can be found in *Appendix E: Civil-Site*.

E.5.1 Field Drainage and Drainage Ditch Inlets

The Local Sponsor's drainage ditch design does not include drainage ditch inlets or associated side berms within Volume 2. Field Drainage and Drainage Ditch Inlets for Volumes 1 and 3 can be found in *Appendix E: Civil-Site*.

An existing 24 inch CMP field drain located in the eastern side berm of the existing Lower Rush River will be removed as part of the demolition for Volume 2. The southern drainage area for this culvert will be picked up by a new 24 inch CMP culvert that will be installed through the southern side berm of the relocated Lower Rush River channel. The new culvert will have a cast-iron flap gate installed to prevent water from backing out of the river and into the field.

E.6 ACCESS ROADS AND PARKING AREAS

The design of permanent access roads for operation and maintenance of the diversion channel, drop structure and EMB's will be developed through coordination with the local sponsor and in accordance with USACE MVP MFR-001-Fargo-Moorhead Metro Flood Risk Management (FMMFRM) Project-Levees and Excavated Material Berms along the Diversion Channel. Primary Access to the Reach 5 Diversion Channel will be from both cut off/abandoned 30th ST SE (Downstream Portion of Reach 5), and the CR 22 bridge. 30th ST SE shall be cut off and abandoned during Diversion Channel construction efforts. Permanent access roads shall be designed and constructed on the land side of the EMBs where the existing roadway dead ends.

The CR 22 bridge reach is located between diversion channel Station 566+00 and Station 576+00. A new bridge at approximate diversion channel Station 571+00 will be constructed to allow CR 22 traffic to cross the new diversion channel. The proposed CR 22 bridge will be designed and constructed by others. Primary access to the Lower Rush Drop Structure site will be by CR 22.

Permanent access ramps for operation and maintenance of the EMBs are proposed at 76th Avenue North and 32nd St SE for the left bank EMB and at 30th St SE for the right bank EMB.

The design of permanent access roads for operation and maintenance of the diversion and EMBs include culverts where the roads cross over local drainage ditches.

E.6.1 Geometric Design Criteria – Access Road

The geometric design criteria and guidance used for the design of the access and maintenance roads is summarized below:

- 20' wide access roads and 15' wide maintenance roads with 8" thick ND Class 13 gravel surface
- Grade of ramp should be no steeper than 1:10.
- Design Speed of vertical curves 15 mph minimum
- Design Length of vertical curves 100 ft minimum
- Side slopes should not be steeper than 1:3 to allow grass cutting equipment to operate.
- Turnouts should be provided at intervals of approximately 2,500 feet, provided there are no ramps within that reach.
- Turnarounds shall be provided at dead ends. Cul-de-sacs are designed with 50' radius for turnaround and emergency vehicles near the outlet.

EM 1110-2-1913 defines some design considerations for permanent project access ramps as well as maintenance roads.

6" gravel over geotextile fabric is a typical section for Cass County roads in this area. The maintenance and access roads are designed with 8" gravel over geotextile fabric due to the uncertainty in the compaction that will be achieved in the excavated material berms (EMBs).

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

Field locates were conducted in December of 2011 and January of 2012. Utilities identified within the limits of Reach 5 include overhead electrical power lines; buried telephone lines (to include fiber optic); and buried water mains. However, no utilities encroachments were identified within the Volume 2, Lower Rush River reach. A table of existing utilities located within Reach 5 and utility encroachments for Volumes 1 and 3 can be found in *Appendix E: Civil-Site*.

E.7.2 Utility Relocations

Any utility relocation that become necessary during the course of design or construction will comply with the MVP MFR-001 Utility Relocation Requirements for Utility Relocation Requirements and local/state requirements.

E.8 VEGETATION MANAGEMENT ZONE (VMZ)

The Vegetation Free Zone (VFZ) and Vegetation Management Zone (VMZ) will comply with the requirements of the Memorandum for Record (MVP MFR-Fargo-Moorhead Metro Flood Risk Management (FMMFRM) Project-Levees and Excavated material Berms along the Diversion Channel). The requirements for VFZ are outlined in the USACE Technical Letter ETL 1110-2-571 which the MFR has been developed in accordance with. 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. The VFZ/VMZ lines will not be shown in the Reach 5 contract documents, but will be defined in the O&M documents provided to the local sponsor at project completion.

E.9 REAL ESTATE/WORK LIMITS

E.9.1.1 Easements

Permanent easement is being set at 50' from the toe of the outermost project feature. Temporary easement is being set at 200' from the 50' permanent easement line. Temporary easement will be used for a variety of construction purposes, including temporary storage of stripped topsoil. Additional easements will likely be required for access roads when that design is complete. Additional temporary easement will be shown once contractor storage and staging areas are defined by the local sponsor and incorporated into the Reach 5 design.

E.9.1.2 Construction Staging Areas

For Volume 2, staging areas totaling 4.53 acres are proposed on the east side of the reach along CR 22. These staging areas are located in the same areas identified for use during the CR 22 bridge construction project. In addition, another 5.44 acres will be designated as a dual purpose area for staging and placement of excavated material in excess of the 15% swell factor that the EMBs are sized for. This area is located on the west side of the reach, just north of the Lower Rush River realignment. The western staging area will provide convenient operations while constructing the Lower Rush River drop structure. During later phases of construction, if this dual purpose area is needed for placement of excess excavated material, backfill operations for the temporary Lower Rush bypass channel will likely be complete and the previously identified staging areas adjacent to CR 22 could be expanded further south and east if more staging room is needed. The existing Lower Rush channel remnant between the CR 22 bridge reach and the Lower Rush realignment will be backfilled utilizing the existing side berm material present on each side of the channel.

Construction Staging Areas for Volumes 1 and 3 can be found in *Appendix E: Civil-Site*.

E.10 TECHNICAL GUIDELINES AND REFERENCES

<p><i>A Policy on Geometric Design of Highways and Streets</i>, Sixth Edition; American Association of State Highway and Transportation Officials (AASHTO); 2011.</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 EM 1110-2-2902, Conduits, Culverts and Pipes</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>