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St. Paul District



**US Army Corps
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Vicksburg District

Appendix E: Civil-Site

Fargo Moorhead Metropolitan Area
Flood Risk Management Project

Reach 4 Diversion Channel and Rush River Inlet/Drop Structure

Engineering and Design Phase

P2# 370365

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Appendix E: Civil-Site

Table of Contents

List of Tables	1
E.1 General.....	1
E.2 Demolition	1
E.3 Diversion Channel Layout	1
E.3.1 Low Flow Channel and Sinuosity.....	2
E.3.2 Rush River Drop Structure	2
E.4 Levees/Excavated Material Berms (EMB).....	2
E.4.1 Shrink/Swell/Overexcavation/Rebound	3
E.4.2 Viewshed.....	3
E.4.3 Recreation/Undulations.....	3
E.5 local Drainage Structures	3
E.6 Access Roads and Parking Areas	4
E.6.1 Geometric Design Criteria – Access Road	4
E.7 Utility Information	5
E.7.1 Existing Utilities.....	5
E.7.2 Utility Relocations	5
E.7.2.1 Overhead Electric.....	5
E.8 Vegetation Free Zone (VFZ)/Work Limits.....	6
E.9 Real Estate/work limits	6
E.9.1 Easements.....	6
E.9.2 Construction Staging Areas	6
E.10 Technical Guidelines and References	6

LIST OF TABLES

<u>Table No.</u>	<u>Table Title</u>	<u>Page</u>
E-1	Utility Encroachments Reach 4	E-3

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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.

For funding and constructability purposes, Reach 4 has been broken up into three separate volumes which are arranged in such a way that they can be advertised as separate construction items if necessary. Volume 1 covers stations 350+00 through 403+47; Volume 2 covers channel stations 413+47 through 456+00 and the Rush River Drop Structure; and Volume 3 covers stations 456+00 through 521+00. Volumes 1 and 3 are being designed by the Vicksburg District, and Volume 2 is being designed by the St. Louis District.

E.2 DEMOLITION

Demolition by the diversion contractor will include clearing and grubbing mature trees. Existing roads located within the proposed diversion, levees, and EMB areas will also require demolition. The Local Sponsor will be responsible for structure demolition prior to construction of the diversion. This demolition will include the removal of structures, foundations, and septic systems. The capping of existing abandoned wells will be directed by the Contracting Officer. All holes will be temporarily filled to not create a safety hazard. The farmstead located at approximately Sta. 383+00 to 387+00 will require demolition to construct the diversion. Demolition will include clearing and grubbing mature trees as well as demolition and removal of a farm equipment shed and storage tanks. See Section E.7 for demolition of utilities. The Phase I Environmental Investigation (Phase I ESA) addresses the removal and disposal of materials. A Phase II ESA will also be required for this property. The non-federal local sponsor is responsible for providing all lands.

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 4 project is 17,100 ft which begins at Station 350+00 and ends at Station 521+00. Construction will start at station 350+00 by tying into the upstream end of the Reach 3 construction reach and continue upstream to station 403+47. At station 403+47, the diversion will tie into the County Road 32 bridge channel segment, which is being designed by the local sponsor. The Rush River reach ties into the upstream end of the County Road 32 (CR 32) bridge reach. The Rush River drop structure intercepts the main diversion channel at Station 428+53.92. The diversion continues upstream until station 521+00 where it slopes into natural ground.

E.3.1 Low Flow Channel and Sinuosity

The low flow channel within the main diversion channel has 2% cross slopes and 1V:4H side slopes. The low flow channel has a 52 ft wide bottom and approximately a 100 ft wide top between station 350+00 - station 428+53.92 and a 46 ft wide bottom and approximately a 90 ft wide top between station 431+02.95 and 521+00. The transition in the low flow channel bottom width from 46 ft to 52 ft occurs at the confluence of the Rush River and the main diversion channel (see civil plans for additional details). The low flow channel side slopes extend and tie into the main diversion channel bottom which has a cross slope of 2%. The low flow channel meanders within a 200 ft wide meander belt width. Based on the 200 ft constraint of the meander belt width, the sinuosity within the low flow channel is somewhat restricted. There will be a straight portion of low flow channel between station 425+64.48 - station 435+87.78 where the Rush River drop structure discharges into the main diversion channel. The average sinuosity for each of the volumes is as follows:

- Volume 1 – 1.094
- Volume 2 – 1.06 (1.08 if the straight portion of the low flow channel at the Rush River confluence is excluded)
- Volume 3 – 1.095

E.3.2 Rush River Drop Structure

The realignment of the Rush River necessary for the Rush River drop structure is 2,414 ft which begins at station 0+00 and ends at station 24+14.43. The Rush River drop structure is 660 ft long and begins at station 7+72 and ends at station 14+32. The drop structure will be constructed as a rock ramp consisting of a series of steps and pools formed by boulder fields configured in a trapezoidal layout. The slope of the drop structure will be 2% with a 30 ft step length and a 0.6 ft drop per step. The realigned channel upstream of the drop structure will utilize spoil piles on each bank consistent in section with the spoil piles along the existing Rush River channel. In addition, a series of stepped stone dikes will be installed upstream of the drop structure to help mitigate impacts to the 0.2-percent chance flood event.

E.4 LEVEES/EXCAVATED MATERIAL BERMS (EMB)

The excavated material berms (EMBs) on the sides of the diversion tie into the existing EMBs at station 350+00 and continue throughout the rest of the reach. In Volume 1, the EMB height was limited by geotechnical considerations to 17 ft measured from the top of the channel. For Volume 2, the left bank EMB can be constructed to a maximum height of 17 ft and the right bank EMB can be constructed to a maximum height of 15.3 ft. For Volume 3, the EMB height is limited by geotechnical considerations to 20 ft measured from the top of the channel. 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.

Other factors effecting EMB layout include drainage structures, bridge relocations, 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.

E.4.2 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 ft 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.4.3 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 is being designed by the local sponsor for incorporation into the Reach 4 construction documents. The local drainage design includes drainage ditches that run parallel along the right and left bank EMBs. The local ditches convey local runoff from adjacent properties, as well as the EMBs, to larger County Drains or rivers. The local ditch behind the right bank EMB will drain to the portion of the 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 Rush River and drop structure where it will be discharged into the main diversion channel. Culverts will be installed through the spoil piles upstream of the drop structure to pass the ditch flows into the realigned Rush River. A minimum 20' wide buffer will be provided between the toe of the EMB and the local drainage ditch.

There is an existing ditch in Reach 4 that flows east towards the Red River that will intersect the diversion at approximately Station 492+20. A drainage structure will be installed to allow this flow into the diversion. There were three alternatives considered regarding the design of the drainage structure: a cast-in-place headwall alternative, a precast flared end section alternative, and a rock weir. The final was made to proceed with the pipe structure design. The width of the EMB at the drainage structure will be narrowed to 50 ft, and the back slope of the EMB will be reduced to 1V:4H to reduce the quantity of the structure required. The local drainage on both sides of the diversion will be designed by the local sponsor and will include a drainage ditch adjacent to and parallel to the diversion and EMBs and be located within the diversion channel work limits.

Additional information on the Non-Federal Sponsor Local Drainage Plan can be found in Appendix C, Attachment 05.

Culverts for the Local Drainage Ditch will be arch corrugated steel pipe (CSPA) to provide greater capacity at shallow depths since the local drainage channels will have relatively shallow normal water depths as indicated in the Local Drainage Report.

Draft memorandum prepared by Houston Moore dated 11/14/2012, AWD-0005, Local Drainage Plan provided sizing of the culverts in Table 2 for the local drainage ditches.

E.6 ACCESS ROADS AND PARKING AREAS

The design of permanent access roads for operation and maintenance of the diversion channel, drop structure, and EMBs was 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.

The proposed roadway re-alignment and bridge for County Road 32 between stations 403+47 and 413+47 within Reach 4 was designed by the local sponsor, and it will be constructed prior to construction of Reach 4. County Roads 169th Avenue SE, 168th Avenue SE, and 29th Street SE are currently being proposed for realignment.

Due to the access that is being designed by the local sponsor at the County Road 32 Bridge as well as the access immediately upstream and downstream of Reach 4 in adjacent reaches, there will be no permanent access construction features located within Reach 4. Site access during construction will be provided by permanent roads already in place: County Road 169th Avenue SE, Co. Rd. 32, 168th Avenue SE, and 29th Street SE.

E.6.1 Geometric Design Criteria – Access Road

As the design progresses and the transportation design is received from the local sponsor, this will be summarized in detail.

EM 1110-2-1913 defines some design considerations for permanent project access ramps as well as maintenance roads. The following guidance will be used in designing the access roads:

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

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 of utilities were conducted in December of 2011 and January of 2012. The only utility identified within the limits of Reach 4 is an overhead electrical power lines.

The following table lists utilities known to cross the diversion channel within Reach 4:

Table E-1: Utilities Reach 4

UTILITY	CROSSING STATION	DESCRIPTION
ELECTRIC		
Western Area Power Administration	Overhead line crosses Reach 4 center line at Station 505+80.	115 kV OHE Line crosses the control line in a NW-SE vector and changes direction to run north-south (parallel along the west edge of the diversion).

E.7.2 Utility Relocations

Utility relocations will comply with the MVP MFR for Utility Relocation Requirements and local/state requirements. Scope-of-work revisions are currently underway for Reach 4, and it is anticipated that the role of utility relocations will be assumed by the local sponsor as a result of those revisions.

E.7.2.1 Overhead Electric

Overhead electrical lines will be relocated by the utility owner prior to project construction. Demolition of existing lines will be the responsibility of the utility owner Cass County Electric.

E.8 VEGETATION MANAGEMENT ZONE (VMZ)/WORK LIMITS

The 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 VMZ are outlined in the USACE Technical Letter ETL 1110-2-571 which the MFR has been developed in accordance with. The VMZ will extend 15' from the landside crown of the levees embedded within EMBs. Refer to Paragraph 7.3.2. The VMZ lines will not be shown in the Reach 4 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 Easements

Fee title 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. Temporary easements are shown for the contractor staging areas. 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

In total, there will be four staging areas proposed for Reach 4 construction activities. One will be located on the east side of the Volume 1 reach. In Volume 2, there will be a 6.3 acre staging area on the east which is accessible from 168th Ave. SE side and a 6.6 acre staging area on the west side accessible from CR 32. The Volume 3 staging area will also be on the east side.

E.10 TECHNICAL GUIDELINES AND REFERENCES

<i>A Policy on Geometric Design of Highways and Streets</i> , Fifth Edition; American Association of State Highway and Transportation Officials (AASHTO); 2011.
<i>Guidelines for Geometric Design of Very Low-Volume Local Roads</i> , American Association of State Highway and Transportation Officials (AASHTO); 2001
EM 1110-2-1913, Design and Construction of Levees
EM 1110-2-2902, Conduits, Culverts and Pipes
ETL 1110-2-571, Guidelines for Landscape Planting and Vegetation Management at Levees,

Floodwalls, Embankment Dams, and Appurtenant Structures
USACE MVP MFR-001-Fargo-Moorhead Metro Flood Risk Management (FMMFRM) Project-Levees and Excavated material Berms along the Diversion Channel
USACE MVP MFR-010-Utility Relocation Requirements; Fargo-Moorhead Metropolitan Area Flood Risk Management Project
USACE MVP GM-001, Guidance Memo, Construction Heights of EMBs
USACE MVP GM-002, Guidance Memo, Excavated Material Berm Design with Swell Factor Variations