



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

Appendix E: Civil-Site

Fargo Moorhead Metropolitan Area
Flood Risk Management Project

Reach 7 – Maple River Aqueduct

Engineering and Design Phase

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Appendix E: Civil-Site

Table of Contents

E.1	GENERAL	1
E.2	DEMOLITION	1
E.3	DIVERSION CHANNEL LAYOUT	1
E.3.1	Low Flow Channel and Sinuosity.....	1
E.4	LEVEES/EXCAVATED MATERIAL BERMS (EMB)	2
E.4.1	Shrink/Swell/Overexcavation/Rebound	2
E.4.2	Viewshed.....	2
E.4.3	Recreation/Undulations.....	2
E.5	ENGINEERED CHANNEL LAYOUT	3
E.6	SPILLWAY LAYOUT	3
E.7	LOCAL DRAINAGE STRUCTURES	3
E.7.1	Field Drainage and Drainage Ditch Inlets.....	3
E.8	ACCESS ROADS AND PARKING AREAS.....	3
E.8.1	Geometric Design Criteria – Access Road	4
E.9	UTILITY INFORMATION	4
E.9.1	Existing Utilities.....	4
E.9.2	Utility Relocations	4
E.10	VEGETATION FREE ZONE (VFZ)/VEGETATION MANAGEMENT ZONE (VMZ)	4
E.11	REAL ESTATE/WORK LIMITS.....	4
E.11.1	Easements.....	4
E.11.2	Construction Staging Areas.....	5
E.12	TECHNICAL GUIDELINES AND REFERENCES	5

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Appendix E: Civil-Site

E.1 GENERAL

Civil design for this project will include demolition, levee and excavated material berm (EMB) layout, access road layout, utility relocations, civil design at Aqueduct and spillway 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.

Existing roads located within the proposed diversion, levees, and EMB areas will also require demolition. See Section E.11 for demolition of utilities. The Phase 1 Environmental Investigation (Phase 1 ESA) will address the removal and disposal of materials. The non-federal local sponsor is responsible for providing all lands.

E.3 DIVERSION CHANNEL LAYOUT

The control alignment for the Reach 7 Aqueduct project is 7,200 feet which begins at Station 683+00 and ends at Station 755+00. The Aqueduct bridge crosses the diversion channel at Station 709+68.62.

E.3.1 Low Flow Channel and Sinuosity

The low flow channel within the main diversion channel for Reach 7 from Station 683+00 – 755+00 will have 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. From Station 683+00 to approximately 698+00, the low flow channel meanders within a 200' wide meander belt width. Adjacent the spillway, the low flow channel will be a straight channel (Station 698+00 - 700+50). The low flow channel will then meander again from Station 700+50 - 708+50. Beginning at Station 708+50, the low flow channel transitions and the main channel starts to drop. Between Stations 709+40 – 709+96, the main channel is at an elevation of 869.33 to come within 0.99' of the low flow channel bottom elevation of 868.34. The low flow channel then begins the transition back to a 46' wide bottom width from Station 709+96 - 711+93. Similar to downstream of the Aqueduct, the low flow will meander within a 200' meander belt between Station 733+93 – 729+00. Between Stations 729+00-739+00, the low flow channel's meander belt will transition from 200' to 120'. This configuration will continue through to Station 755+00. See Appendix C Hydrology and Hydraulics for additional information.

E.4 LEVEES/EXCAVATED MATERIAL BERMS (EMB)

The Excavated Material Berms (EMBs) on the sides of the diversion begin at Station 683+00 when looking downstream of the diversion. The EMB can be constructed to a maximum height as determined by geotechnical analysis. 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 until Station 696+00. There will not be an EMB from Station 696+00 - Station 711+00, where the spillway and engineered channel are located. At Station 711+00 the left bank EMB continues to Station 717+50. There is an overflow area between Station 717+50 – 729+00 where there is no left bank EMB. The left bank EMB then continues at Station 729+00 thru to the end of the Reach 7 project to Station 755+00+00. At Station 711+00 the right bank EMB continues to the end of the Reach 7 project to Station 755+00+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, engineered channel and spillway locations, 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 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.4.3 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, 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. Undulation design will be included in future submittals.

E.5 ENGINEERED CHANNEL LAYOUT

The basic geometric layout of the channel is summarized as follows:

- A Bottom width of 14 ft with lower channel slopes = 1V:3.5H.
- On either side 20 ft wide benches with a 1V:40H slope towards the center of the channel.
- From the outside edge of the benches a slope of 1V:6.5H from outside edge of benches up to existing ground is to be used.

Where the engineered channel converges into the Aqueduct it becomes the "winter channel". It is expected that this location will be using large rock to provide the necessary roughness and calmer areas to promote fish passage. Additionally the eastern end of the winter channel as it transitions back into the engineered channel will have one to two riffle structures to mitigate an approximate 1' drop.

E.6 SPILLWAY LAYOUT

This will be summarized as the design progresses.

E.7 LOCAL DRAINAGE STRUCTURES

Local drainage was designed by the local sponsor for incorporation into the Reach 7 construction documents. The local drainage design includes drainage ditches that run parallel along the right and left bank EMB's and be located within the diversion channel work limits. 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.

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

Culverts for the Local Drainage Ditch will be either corrugated steel pipe (CSP) or arch corrugated steel pipe (CSPA). CSPA provides greater capacity at shallow depths. Some of the local drainage channels will have relatively shallow normal water depths as indicated in the Local Drainage Report and therefore, CSPA is recommended.

Draft technical memorandum prepared by Houston Moore dated 03/31/2014, Local Drainage Plan - South, provided sizing of the culverts in Table 2.a for the local drainage ditches.

E.7.1 Field Drainage and Drainage Ditch Inlets

This will be summarized as the design progresses.

E.8 ACCESS ROADS AND PARKING AREAS

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

Aqueduct itself will be primarily from the north east off of County Rd 20. This was chosen because of it being within the protected side and had the best infrastructure connection coming into the site. In addition, other access routes are provided from the southwest and southeast to further conductivity and maintenance access.

E.8.1 Geometric Design Criteria – Access Road

The primary road geometry is set at a 15' width with 2% cross slopes. Center crowning will be used except where otherwise dictated by EMB road criteria and/or Aqueduct bridge slopes. Large turning radii of 48' have been selected to facilitate the usage of emergency/maintenance equipment.

E.9 UTILITY INFORMATION

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

E.9.1 Existing Utilities

Utilities identified within the limits of Reach 7 will be included in future submittals.

E.9.2 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. Additional Utility relocation information will be included in future submittals.

E.10 VEGETATION FREE ZONE (VFZ)/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 1110-2-583 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 7 contract documents, but will be defined in the O&M documents provided to the local sponsor at project completion.

E.11 REAL ESTATE/WORK LIMITS

E.11.1 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 7 design.

E.11.2 Construction Staging Areas

This will be summarized as the design progresses.

E.12 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); 2004.
<i>Guidelines for Geometric Design of Very Low-Volume Local Roads</i> , American Association of State Highway and Transportation Officials (AASHTO); 2001
USACE EM 1110-2-1913, Design and Construction of Levees
USACE EM 1110-2-2902, Conduits, Culverts and Pipes
USACE ETL 1110-2-583, 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