



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

Appendix E: Civil-Site

Fargo Moorhead Metropolitan Area
Flood Risk Management Project

Diversion Inlet Structure

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, dam embankments, site grading, excavated material berm layout, access road layout, parking lot layout, building site layout, utility removals 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 DIVERSION STRUCTURE LAYOUT

The diversion structure is located at the entrance to the main diversion channel (Sta. C 15+00) and directs flow from the staging area to the main diversion channel. Left and right dam embankments (top El. 932.5) connect to the southwest and northeast limits of the proposed diversion inlet structure. Details of the Diversion Inlet Structure design can be found in the structures appendix.

E.3 DEMOLITION

Demolition will involve removal of an existing road core for CTH 17 and clearing and grubbing the limits of work. A fiber optic line (Midcontinent Communications) running parallel to the east side of CTH 17 will require removal. This line will be abandoned prior to construction, and will be relocated along the eastern work limits (5' within the work limits).

E.4 LEFT AND RIGHT DAM EMBANKMENTS AND EMBEDDED LEVEE

Left and right dam embankments shall connect to the Diversion Inlet's flood walls on the southwest and northeast sides of the inlet structure. The embankments have a design elevation of 931.0 and a construction elevation of 932.5 to allow for settlement. Embankment top width is 15 feet, side slopes are 1V:4H. The top of the diversion embankments shall have a cross slope of 2% for drainage and shall have a 15 foot wide gravel surface (8 inches thick) underlain with geotextile fabric Type 2. The dam embankment design elevation is located on the channel side edge of the embankment; elevations indicated on the design profiles are referenced to the centerline of the dam embankments.

At the connection to the inlet structure, the inlet's flood walls shall extend 10 feet into the embankments, for a secure connection between embankment and flood wall.

An embedded levee (top EL. 923.5, top width 10', 1V:3H fill slopes) will be located within the RT EBM as indicated on the plan sheets. The embedded levee will connect into the RT Dam Embankment near the end of the RT Dam Wall as indicated on the plans.

The embankments and embedded levee shall be constructed of impervious material taken from the Sherack formation which underlays the project site. Calculations suggest that there is sufficient sherack

material to construct the LT and RT dam embankments, the embedded levee and fill below the parking lot/staging area.

E.5 SITE GRADING

Site grading consists of diversion inlet structure excavation, and diversion channel excavation. Other grading is covered in demolition for removal of the CTH 17 road core.

The diversion channel section upstream and downstream of the Diversion Inlet consists of a 300 foot wide channel (bottom width). The channel will have 1V:7H side slopes on the left and right banks. On the left bank (looking downstream) the 1V:7H slope will match into existing grade. On the right bank a bench will be provided to separate the excavated material berm or right dam embankment from the channel edge. Downstream of the Inlet, the bench will vary in width from 50 feet to 125 feet and will have a cross slope that varies between 1% and 2%; upstream of the Inlet the bench will have a varying width (75 -80 feet) and a cross slope of 2%. The bench extends from top of channel elevation 915.5 to the RT dam embankment. The width of the bench varies as the slope of the US channel varies.

Upstream of the Diversion Inlet, the channel bottom will be reduced at a 2:1 taper to meet the Diversion Inlet opening width of 182 feet; downstream of the Diversion Structure the channel will expand at a 3.5:1 taper from 176.5 feet at the downstream edge of the stilling basin to the full channel width of 300 feet. The channel bottom will be flat at the US and DS connections to the inlet structure, and will transition through the taper length to a channel section with a 2% bottom slope (toward the channel center).

Reach 19 will have a low flow channel; the downstream section of channel will transition from a flat bottom at the outlet of the diversion structure to a section with a low flow channel and a 2% bottom slope to match the future Reach 19 low flow channel.

At the limits of upstream and downstream grading, the channel excavation shall end with a 1V:7H slope up to existing grade.

E.6 EXCAVATED MATERIAL BERM

Two Excavated Material Berms (EMB's) are located on the site. A large RT EMB and a smaller LT EMB. The RT EMB will be separated from the downstream diversion channel by a bench that varies in width to account for the structure width and expanding channel. The bench will have a cross slope that is normally 2% but varies in slope to account for the channel expansion (minimum slope 1%). The EMB will have 1V:6H side slopes on the outer edges and shall drain to the north with a 2% cross slope. EMB top elevation will vary by location. Top elevation downstream of the inlet shall be 930.5; upstream of the inlet the top will match the top of the right dam embankment at elevation 932.5.

The RT EMB shall have an embedded levee located 468 feet from the center of the diversion channel. The embedded levee shall have a top width of 10 feet with 1V:3H side slopes. Top elevation shall be 923.5.

The LT EMB is located where the Reach 19 EMB is planned. This EMB is an overflow EMB for excess excavation material from the proposed channel and structure excavation. The LT EMB will not be constructed until the RT EMB has been constructed to the limits provided on the design plans. The LT EMB is considered necessary due to the uncertainty of the expansion properties of the excavated material.

E.7 MAINTENANCE ROAD

Access to the diversion structure and control building will be from the northwest via a maintenance road connection to realigned CTH 17. This access will be a gravel roadway 15' feet in width, paved with 8" of aggregate base course and geotextile fabric Type 2. The access will connect to a maintenance road constructed as part of Reach 19. Access to the diversion structure, right dam embankment and left dam embankment will be provided from this access point as indicated on the project drawings.

A vehicle "turn around" will be provided along the top of the left dam embankment at the connection to the left dam wall. This turn around area will have a depth of 50 feet and a width of 30 feet, and may also be used as a temporary parking area for maintenance vehicles.

E.8 PARKING LOT AND CONTROL BUILDING

A parking lot and control building pad will be provided at the northeast corner of the Diversion Inlet as indicated on the drawings. The building location provides ready access to the diversion inlet. The adjacent parking lot will be paved with 8" of aggregate base course and 2.5" of asphalt (by others) and shall provide for access parking for the control building and for future repair/maintenance staging. The parking lot is sized to provide parking for a minimum of ten vehicles.

The proposed control building will be provided with electrical, water and sewer service. The water connection is anticipated to be from a 2" service line connecting to the building from the north via a relocated water main (by others). Temporary water service to the building via a temporary holding tank may be required to meet water service demands until the main water line is relocated to the north of the diversion inlet structure.

Sewer service shall consist of installation of a waste water holding tank located to the northeast of the building adjacent to the edge of the proposed parking lot. Electrical service is from an underground line connecting to the transformer that will be installed to provide service to the diversion inlet structure.

The parking lot footprint and building pad location will be underlain by impervious fill (Sherack formation) as indicated on the drawings. This material will be used in lieu of random fill to insure a well compacted and stable base for the parking area and building site. Limits of the fill are as indicated on the project drawings.

Concrete sidewalk (reinforced with welded wire mesh) with an ADA accessible ramp will be provided to connect the parking area with the control building. Parking will consist of five concrete (reinforced) parking stalls along the front of the control building (only the handicap stall will be marked); remaining portions of the parking lot will be paved with aggregate base course and with an asphalt surface at a later date by others.

A six foot high (72") galvanized steel, woven wire security fence with vehicle access gates will be installed as indicated on the drawings to enclose the control building and parking lot. Vehicle access gates will also be provided at each flood wall connection to control vehicle access to the diversion structure. The security fence will have a single out facing outrigger along the top of the fencing with 3 strands of barbed wire. A 12" wide by 12" thick concrete grade beam will be provided along the centerline of the fence between all posts to prevent access between the fence low cord and finished grade.

E.9 UTILITY RELOCATIONS

Construction of the Diversion Inlet Structure shall require relocation of one underground fiber optic line located along the eastern right-of-way of CTH 17. The line runs north – south and is owned and operated by Midcontinent Communications. This line will be relocated along the south edge of CTH 16 and then north along the east edge of the project work limits.

A water main of unknown size runs east – west within the roadway embankment of CTH 16. This line is not within the limits of this project; however the water line will require relocation when the left dam embankment is extended by others.

E.10 VEGETATION FREE ZONE (VFZ)/WORK LIMITS

The Vegetation Free Zone (VFZ) will comply with the requirements in ETL 1110-2-583, as well as the criteria set forth in project specific guidance documents such as the Memo for Record (MFR) FMM Vegetation Free Zone, and Dam vs. Levee Criteria. The VFZ shall include the entire embankment and shall extend a minimum of 50' from the toes of the left and right dam embankments. For the right bank embedded levee there will be a vegetation management zone (VMZ) that extends 15' from the landside crown of the levee embedded within the EMB. This VMZ shall also extend along the left edge of the diversion inlet channel and main diversion channel.

E.11 TECHNICAL GUIDELINES AND REFERENCES

1. ***A/E/C CADD Standard***, Release 3.0; U.S. Army Engineer Research and Development Center, Vicksburg, MS; September 2006.
2. ***A/E/C CADD Standard Supplement***, Release 6.2.0; U.S. Army Corps of Engineers, St. Paul District; July 2004.
3. ***A Policy on Geometric Design of Highways and Streets***, Fifth Edition; pp. 131-229, 231-234, and 380-389; American Association of State Highway and Transportation Officials (AASHTO); 2004.

4. **United States National CAD Standard**, Version 4.0; National Institute of Building Sciences; July 2009.
5. **Guidelines for Geometric Design of Very Low-Volume Local Roads**, American Association of State Highway and Transportation Officials (AASHTO); 2001

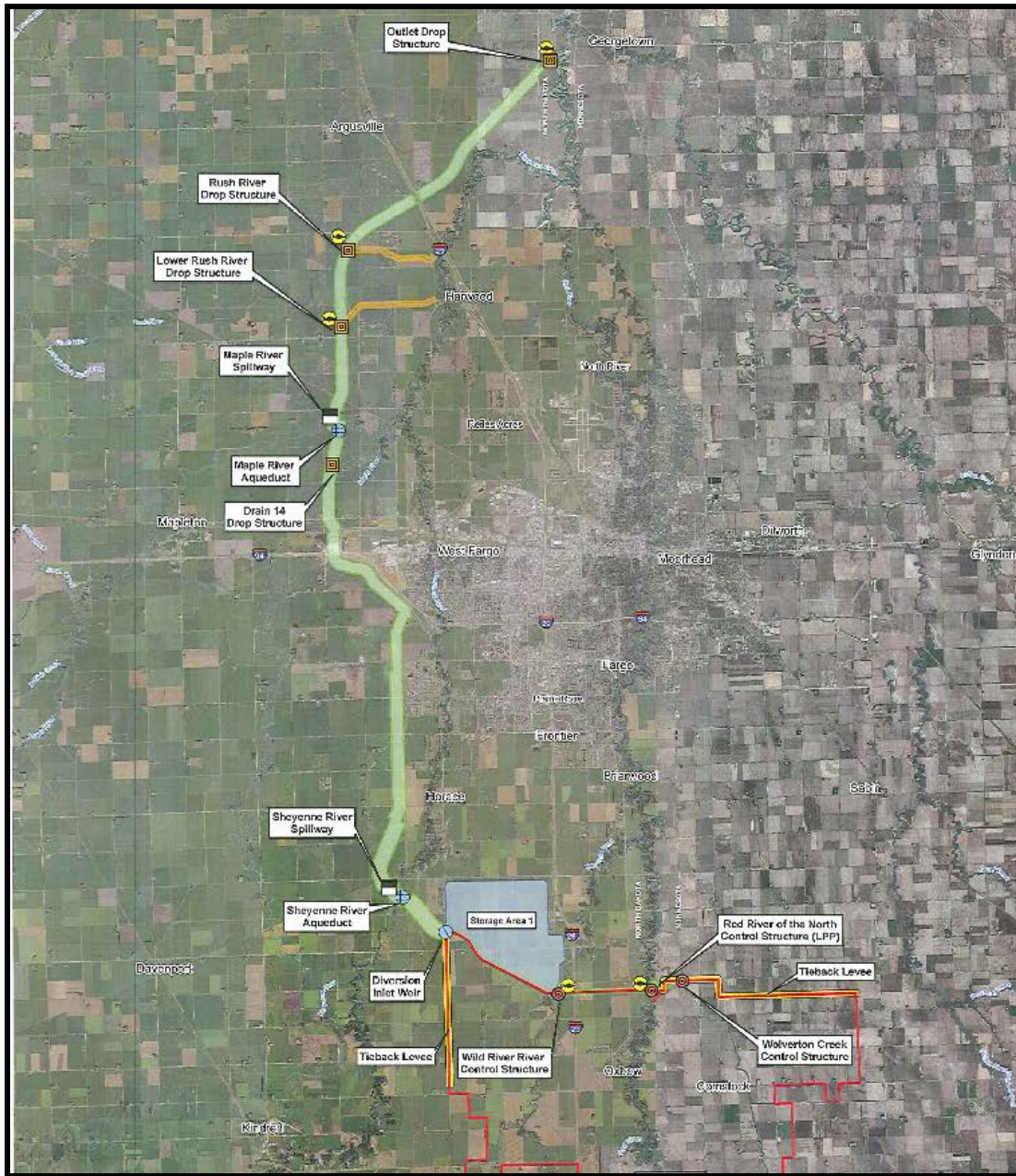
E.12 REFERENCE DOCUMENTS

Links to or copies of the following documents are on the project Extranet site at: https://extranet.dse.usace.army.mil/sites/Divisions/MVD/MVP/FargoMoorhead/ [accessible within USACE] or https://onecorps.usace.army.mil/sites/Divisions/MVD/MVP/FargoMoorhead/ [accessible outside of USACE]
Final Feasibility Study and Environmental Impact Statement , Fargo-Moorhead Metropolitan Area Flood Risk Management, July 2011
Value Based Design Charrette , Fargo-Moorhead Metropolitan Area Flood Risk Management Project, Outlet & Diversion Reach 1, Cass County, ND, November 2011
Value Engineering Study , Fargo-Moorhead Metropolitan Area Flood Risk Management Project, Outlet & Diversion Reach 1, Cass County, ND, October 2011
Reach Management Plan for Reach 1 , Fargo-Moorhead Metropolitan Area Flood Risk Management Project,
Design Guidelines for the overall FMM Project and Reach-Specific Design Guidelines

E.13 PROJECT LOCATION

Figure E-1 shows the location of the proposed Diversion Inlet in relation to the overall project limits.

Figure E-1: Diversion Alignment and Features



E.14 ENGINEERING DRAWINGS FOR CIVIL FEATURES AND SITE WORK

Drawings produced for this document utilized the following information:

- LIDAR Topographic Survey Data
- Corps of Engineers Field Survey Data
- MicroStation V8i model and sheet seed files

-
- Design files including cross-sections, alignments, and DTM files

Civil engineering plans prepared concurrent with this report are included in Attachment 1.

E.15 LIST OF FIGURES

<u>Figure No.</u>	<u>Figure Title</u>	<u>Page</u>
E-1	Diversion Alignment and Features.....	E-4

E.16 ATTACHMENTS

Attachment E-1: Quantity Summary

Attachment E-2: Calculations

Attachment E-3: Certification

Attachment E-1

Quantity Summary

	STATION	CUT CY	DITCHING CY	IMPERVIOUS FILL CY	RANDOM FILL CY	AGGREGATE SURFACE CY	R20 RIPRAP CY	R140 RIPRAP CY	R470 RIPRAP 54" CY	CL B1 BEDDING CY	CL B2 BEDDING CY	CL B3 BEDDING CY	GEOTEXTILE TYPE 1 SF	GEOTEXTILE TYPE 2 SF	12" TOPSOIL STRIPPING CY	TOPSOIL CY	DRY SEED ACRES	WET SEED MIX ACRES	MULCH ACRES	SIGNS EA	BARRICADES TYPE 3	6' SECURITY FENCING LF	SECURITY FENCE VEH GATE EA	SECURITY FENCE PED GATE EA	6' CONC. SIDEWALK SF	6' CONC. PAVEMENT SF	SETTLEMENT PLATES EA	PRELOAD INSTRUMENTATION LS	PRELOAD WICK DRAINS LF	GRANULAR BLANKET DRAIN CY	2.5" ASPHALT PAVEMENT TONS	2' HDPE WATER LINE LF				
DIVERSION STRUCTURE & DAM STRUCTURE				139288																				1												
DIVERSION CHANNEL							4462	2824	5430	2231	1017	1810	178458		23402			2.06																		
CONNECTING CHANNEL		362768						5600			2100		75604			4530		5.98																		
LT DAM EMBANKMENT				38462		223								9000	4113	2102	2.69																			
RT DAM EMBANKMENT				43798		258								10380	4573	939																				
EMBEDDED LEVEE				6486											1117																					
MAINTENANCE ROAD						210								8700																						
PARKING LOT				10718		169								8800	823					2		475	4	1		1154						110				
CONTROL BUILDING SITE																									340									1470		
LT EMB					22056												3.24																			
RT EMB					304490											37713	23.44																			
TEMPORARY DITCH		1491															0.52																			
STAGING AREA																	49.60																			
CTH 17																				2	2															
PRELOAD		41667	411	238752	326547	860	4462	8424	5430	2231	3117	1810	254062	150122	44760	45283	79.49	8.04	6.70	4	2	475	4	2	340	1154	6	1	264058	760.32	110		1470			
DEEP METHOD MIXING (DMM)																																				
TOTALS		405926	411	238752	326547	860	4462	8424	5430	2231	3117	1810	254062	150122	44760	45283	79.49	8.04	6.70	4	2	475	4	2	340	1154	6	1	264058	760	110		1470			

NOTES
 1. Available sherkack material is approximately 250,000 CY
 2. Required impervious material is approximately 126,000 CY

Attachment E-2

Quantity Calculations

UTILITIES

2" HDPE 3408 SDR7 WATER LINE	1470 LF
2" CURB STOP	2 EACH
4" DIA. PVC SEWER MAIN	10 LF
BURIED WASTE WATER TANK 2500 GAL	1 EACH

AGGREGATE SURFACE COURSE 8"

LOCATION	CY	
RT DAM EMBANKMENT	258	
LT DAM EMBANKMENT	223	
RT EMB MAINT ROAD	210	8700 SF
PARKING LOT	169	6800 SF
	860	CY

GEOTEXTILE 323870 SF

CHANNEL CUT

Triangle Volume Report

Report Created: 2/11/2016

Time: 11:18am

Mode: Entire Surface

Input Grid Factor: 1

Original Surface: Tie_Back_3

Description:

Preference: Default

Type: Existing

Design Surface: FMMDIS_CUT

Description:

Preference: Default

Type: Existing

Cut Factor: 1

Fill Factor: 1

Cut: 8252873.61 cu ft

Fill: 1327.81 cu ft

Net: 8251545.8 cu ft

Cut: 305661.99 cu yd

Fill: 49.18 cu yd

Net: 305612.81 cu yd

Triangle Volume Report

Report Created: 2/11/2016

Time: 12:40pm

Mode: Entire Surface

Input Grid Factor: 1

Original Surface: FMMDIS_CUT

Description:

Preference: Default

Type: Existing

Design Surface: FMMDIS_STRUCTURE_BOTTOM

Description: STRUCTURE BOTTOM SURFAC

Preference: Default

Type: Existing

Cut Factor: 1

Fill Factor: 1

Cut: 389006 cu ft

Fill: 0 cu ft

Net: 389006 cu ft

Cut: 14408 cu yd

Fill: 0 cu yd

Net: 14408 cu yd

SUBTOTAL 320020 CY

RIPRAP AND BEDDING 25473 CY

TOTAL CUT 362768 CY

TOPSOIL 4530 CY

SEEDING 5.62

TEMPORARY DITCH

Triangle Volume Report

Report Created: 2/11/2016

Time: 11:23am

Mode: Entire
Surface
Input Grid Factor: 1

Original Surface: Tie_Back_3

Description:
Preference: Default
Type: Existing

Design Surface: FMMDIS_TEMP_DITCH

Description: Created from roadway
designer
Preference: Civil
Type: Design

Cut Factor: 1
Fill Factor: 1

Cut: 27035.62 cu ft
Fill: 21.48 cu ft
Net: 27014.14 cu ft

Cut: 1001.32 cu yd
Fill: 0.8 cu yd
Net: 1000.52 cu yd

TOPSOIL	419 Cu yd
SEEDING	0.52 ACRES

CUT	1420 Cu yd
-----	------------

RIGHT DAM EMBANKMENT

Triangle Volume Report

Report Created: 10/20/2015

Time: 2:26pm

Mode: Entire Surface

Input Grid Factor: 1

Original Surface: Tie_Back_3

Description:

Preference: Default

Type: Existing

Design Surface: FMMDIS_RT_DAM_EMBANKMENT

Description:

Preference: Default

Type: Existing

Cut Factor: 1

Fill Factor: 1

Cut: 1.4 cu ft

Fill: 1091362.2 cu ft

Net: -1091360.8 cu ft

Cut: 0.1 cu yd

Fill: 40420.8 cu yd

Net: -40420.8 cu yd

TOPSOIL	939 Cu yd	
INSPECTION TRENCH	2398 Cu yd	CUT
STRIPPING	4573 Cu yd	CUT
AGGREGATE	258 Cu yd	
GEOTEXTILE TYPE 2	10380 SF	
IMPERVIOUS FILL	43798 Cu yd	

LEFT DAM EMBANKMENT

Triangle Volume Report

Report Created: 10/20/2015
 Time: 10:31am

Entire Surface

Mode: 1
Input Grid Factor:

Tie_Back_3

Original Surface:

Description: Default

Preference: Existing

Type: **FMMDIS_LT_DAM_EMBANKMENT**

Design Surface: Created from roadway designer

Description: Civil

Preference: Design

Type: 1

Cut Factor: 1

Fill Factor:

5 cu ft

Cut: 990877 cu ft

Fill: -990871 cu ft

Net:

0 cu yd

Cut: 36699 cu yd

Fill: -36699 cu yd

Net:

		2102 Cu yd	
TOPSOIL		2025 Cu yd	CUT
INSPECTION TRENCH		4088 Cu yd	CUT
STRIPPING		1700 Cu yd	RANDOM FILL
TURNAROUND		223 Cu yd	
AGGREGATE		9000 SF	
GEOTEXTILE TYPE 2			
		38462 Cu yd	
IMPERVIOUS FILL			

RT EMB

Triangle Volume Report

Report Created: 2/11/2016

Time: 9:44am

Mode: Entire Surface
Input Grid Factor: 1

Original Surface: Tie_Back_3

Description:
Preference: Default
Type: Existing

Design Surface: FMMDIS_RT_EMB

Description:
Preference: Default
Type: Existing

Cut Factor: 1
Fill Factor: 1

Cut: 12.67 cu ft
Fill: 9024780.43 cu ft
Net: -9024767.76 cu ft

Cut: 0.47 cu yd
Fill: 342588.33 cu yd
Net: -334250.66 cu yd

TOPSOIL	37713 Cu yd		AREA	1018644 FT2
INSPECTION TRENCH	0 Cu yd	CUT		
STRIPPING	0 Cu yd	CUT		
AGGREGATE	385 Cu yd		PARKING LOT	168.7407
GEOTEXTILE TYPE 2	15500 SF			
<hr/>				
RANDOM FILL	304490 Cu yd			
<hr/>				
CONCRETE PARKING	22 Cu yd			
CONCRETE SIDEWALK	10 Cu yd			
<hr/>				
SIGNS & POST	2 EACH			
PAVEMENT MARKING SYMBOL	1 EACH			
PAVEMENT MARKING 4" PAINT	65 LF			
<hr/>				
FENCING 6'	470 LF			
VEHICLE GATES 18'	4 EA			
PERSONNEL GATES 4'	1 EA			

EMBEDDED LEVEE

Triangle Volume Report

Report Created: 2/11/2016

Time: 8:44am

Mode: Entire Surface

Input Grid Factor: 1

Original Surface: Tie_Back_3

Description:

Preference: Default

Type: Existing

Design Surface: EMBEDDED LEVEE I

Description: Created from roadway designer

Preference: Civil

Type: Design

Cut Factor: 1

Fill Factor: 1

Cut: 0.21 cu ft

Fill: 144970.43 cu ft

Net: -144970.22 cu ft

Cut: 0.01 cu yd

Fill: 5369.28 cu yd

Net: -5369.27 cu yd

TOPSOIL	0 Cu yd	
INSPECTION TRENCH	849 Cu yd	CUT
STRIPPING	1117 Cu yd	CUT
AGGREGATE	0 Cu yd	

IMPERVIOUS FILL	6486 Cu yd	
-----------------	------------	--

Triangle Volume Report

Report Created: 2/11/2016

Time: 9:35am

Mode: Entire
Surface
Input Grid Factor: 1

Original Surface: Tie_Back_3

Description:
Preference: Default
Type: Existing

**Design Surface: FMMDIS_EX_MAT_PIL
E**

Description:
Preference: Default
Type: Existing

Cut Factor: 1
Fill Factor: 1

Cut: 84.67 cu ft
Fill: 1234372.36 cu ft
Net: -1234287.68 cu ft

Cut: 3.14 cu yd
Fill: 45717.49 cu yd
Net: -45714.36 cu yd

TOPSOIL	5316 Cu yd	
INSPECTION TRENCH	0 Cu yd	CUT
STRIPPING	0 Cu yd	CUT
AGGREGATE	0 Cu yd	

IMPERVIOUS FILL	40402 Cu yd	
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TOPSOIL (12" STRIPPING)

LOCATION	AREA FT2	THICKNESS FT	VOLUME FT3	VOLUME CY	
CHANNEL	631842	1	631842	23402	OPTIONAL
RT DAM EMBANKMENT	123477	1	123477	4573	
LT DAM EMBANKMENT	111046	1	111046	4113	
RT EMB	903325	1	903325	33456	OPTIONAL
LT EMB	141855	1	141855	5254	OPTIONAL
EMBEDDED LEVEE	30152	1	30152	1117	
			TOTAL	71915	CY

SEED, FERTILIZER, MULCH

LOCATION	WET SEED MIX ACRES	DRY SEED MIX ACRES
CONNECTING CHANNEL	5.98	
DIVERSION CHANNEL	2.06	
LT EMB		3.24
RT EMB		23.44
TEMP DITCH	0.52	
LT DAM EMBANKMENT		2.69
STAGING AREAS		49.60
	8.56	78.97

RIPRAP

	RIPRAP AREA SF	THICKNESS FT	VOLUME CY	BEDDING AREA SF	BEDDING THICKNESS FT	BEDDING VOLUME CY	BEDDING TYPE
CONNECTING R140	75604	2	5600	75604	0.75	2100	B2
DIVERSION R20	120467	1	4462	120467	0.50	2231	B1
DIVERSION R140	25413	3	2824	25413	1.08	1017	B2
DIVERSION R470	32578	5	5430	32578	1.50	1810	B3

GEOTEXTILE SF **254062** Total 18315 7157

Total cut for riprap 25473 cy

EARTH WORK

AREA	CUT CY	FILL CY
CHANNEL AND STRUCTURE	362768	0
INSPECTION TRENCHES	5271	0
DITCHING	1420	
RT DAM EMBANKMENT	0	43798
EMBEDDED LEVEE	0	6486
LT DAM EMBANKMENT	0	38462
	369459	88746

RANDOM FOR EMBS	322820 CY	15% expansion	
SPOIL FROM DSM	3727 CY	23 rows at 4 ft wide 35 ft deep, 25% spoil	SPOIL RANGES FROM 10 TO 40 %
AVAILABLE IN RT EMB	304490 CY		
FOR LT EMB	22056 CY		

PRELOAD CALCS FROM PAUL MORKEN

Wick Drains

	South Preload	North Preload
3' Spacing	1042	1966
4' Spacing	198	580
5' Spacing	126	347
Total	1366	2893
Each drain is 62' long		
Overall Length (LF) =	84692	179366

Borrow Area Excavation

Fill Required for South Preload =	0 cy
Fill Required for North Preload =	0 cy
Total Fill Required =	0 cy

Bottom width of excavation =	239 ft
Bottom length of excavation =	252 ft
Bottom Elevation =	904 ft
Top Elevation =	Existing Ground

Existing Ground - Excavation	Excavation (cy)
	41667.3

Excavation =	Excavation.dtm
Existing Ground =	FMMFRM_TIE_BACK_3.dtm
Triangle volume method	
XML Report =	Preload_borrowpit_quantities_Aug3_2015.html

Topsoil

Area of Excavation.dtm * 4"	1893.93 cy
-----------------------------	------------

Hydroseed

Area of Excavation.dtm	3.5 acres
------------------------	-----------

Stripping

Area of Excavation.dtm * 1'	5681.8 cy
-----------------------------	-----------

North Preload w/ Ditch

Excavation

North Preload Embankment (w/ ditch) - Existing Ground	Excavation (cy)	Fill (cy)
	302.3	27556.5

North Preload Embankment =	Design North Emb.dtm
Existing Ground =	FMMFRM_TIE_BACK_3.dtm
Triangle volume method	
XML Report =	Preload_design_quantities_Jul31_2015.html

Granular Blanket Fill

Granular Fill - Existing Ground	Fill (cy)
	302.2

Granular Fill =	Design North Emb - Gran
Existing Ground =	FMMFRM_TIE_BACK_3.dtm
Triangle volume method	
XML Report =	Preload_granular_quantities_Jul31_2015

Fill From Borrow Area

North Preload Embankment Fill - Granular Fill :	27254.3
---	---------

Geotextile

Area of Design North Emb - Gran.dtm	75861.9 SF
-------------------------------------	------------

Hydroseed

Area of Design North Emb.dtm	2.1 acres
------------------------------	-----------

Stripping

Area of Design North Emb.dtm * 1'	3351.3 cy
-----------------------------------	-----------

OLD STUFF NOT USED

Left Dam preload

Triangle Volume Report

South Preload w/ Ditch

Excavation

South Preload Embankment (w/ ditch) - Existing Ground	Excavation (cy)	Fill (cy)
	88.9	10805.4

South Preload Embankment =	Design South Emb.dtm
Existing Ground =	FMMFRM_TIE_BACK_3.dtm
Triangle volume method	
XML Report =	Preload_design_quantities_Jul31_2015.html

Granular Blanket Fill

Granular Fill - Existing Ground	Fill (cy)
	389

Granular Fill =	Design North Emb - Gran
Existing Ground =	FMMFRM_TIE_BACK_3.dtm
Triangle volume method	
XML Report =	Preload_granular_quantities_Jul31_2015

Fill From Borrow Area

South Preload Embankment	10416.4
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Geotextile

Area of Design South Emb - Gran.dtm	39380.4 SF
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Hydroseed

Area of Design South Emb.dtm	1.1 acres
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Stripping

Area of Design South Emb.dtm * 1'	1699.30 cy
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Parking lot and building site preload

Triangle Volume Report

Report Created: 1/11/2016
Time: 10:08am

Report Created: 1/11/2016
Time: 10:31am

Mode: Entire Surface

Input Grid Factor: 1

Original Surface: Tie_Back_3

Description:
Preference: Default
Type: Existing

Design Surface: FMMDIS_UPLIFT_LEFT DAM_DEC23

Description:
Preference: Default
Type: Existing

Cut Factor: 1
Fill Factor: 1

Cut: 0.1 cu ft
Fill: 198079 cu ft
Net: -198078.9 cu ft

Cut: 0 cu yd
Fill: 7336.3 cu yd
Net: -7336.3 cu yd

TEMPORARY SEEDING 0.7 ACRES

STRIPPING 1129 CY

TOTAL FILL 8465

PRELOAD FILL

24263 CY

Mode: Entire Surface

Input Grid Factor: 1

Original Surface: Tie_Back_3

Description:
Preference: Default
Type: Existing

Design Surface: FMMDIS_PRELOAD_RIGHT_JAN2016

Description:
Preference: Default
Type: Existing

Cut Factor: 1
Fill Factor: 1

Cut: 0.1 cu ft
Fill: 516509.5 cu ft
Net: -516509.5 cu ft

Cut: 0 cu yd
Fill: 19130 cu yd
Net: -19130 cu yd

TEMPORARY SEEDING 1.4 ACRES

STRIPPING
3' SAND LAYER 6497 CY

BELOW PRELOAD FILL

ADDITIONAL CUT AND FILL REQUIRED ASSUMING REACH 19 CONSTRUCTED AFTER THE INLET IS CONSTRUCTED

Triangle Volume Report

Report Created: 1/25/2016
Time: 3:09pm

Mode: Entire
Surface
Input Grid Factor: 1

Original Surface: Tie_Back_3

Description:
Preference: Default
Type: Existing

Design Surface: FMMDIS_US_END

Description:
Preference: Default
Type: Existing

Cut Factor: 1
Fill Factor: 1

Cut: 914598.9 cu ft
Fill: 225105.7 cu ft
Net: 689493.2 cu ft

Cut: 33874 cu yd
Fill: 8337.2 cu yd
Net: 25536.8 cu yd

TIMES 1.15 29367.32 CY WASTE PUT IN THE EXCAVATED MATERIAL PILE

ADDITIONAL CUT AND FILL REQUIRED ASSUMING REACH 19 CONSTRUCTED AFTER THE INLET IS CONSTRUCTED

Mode: Entire
Surface
Input Grid Factor: 1

Original Surface: Tie_Back_3

Description:
Preference: Default
Type: Existing

Design Surface: FMMDIS_EX_MAT_PILE

Description:
Preference: Default
Type: Existing

Cut Factor: 1
Fill Factor: 1

Cut: 2.7 cu ft
Fill: 1081964 cu ft
Net: -1081962 cu ft

Cut: 0.1 cu yd
Fill: 40072.8 cu yd
Net: -40072.7 cu yd

EXCESS MATERIAL PILE LOCATED WHERE REACH 19 EMB WOULD BE LOCATED

DIVERSION INLET SHERACK CALCULATIONS

END AREA CALCULATIONS

STATION	AREA (SF)	AVERAGE AREA (SF)	LENGTH (FT)	VOLUME (CF)	VOLUME (CY)
950	3108				
		5291.50	50	264,575	9799.07
1000	7475				
		8220.00	50	411,000	15222.22
1050	8965				
		9117.50	50	455,875	16884.26
1100	9270				
		9135.00	50	456,750	16916.67
1150	9000				
		8649.00	50	432,450	16016.67
1200	8298				
		8329.00	50	416,450	15424.07
1250	8360				
		8130.00	50	406,500	15055.56
1300	7900				
		7701.50	50	385,075	14262.04
1350	7503				
		6635.00	50	331,750	12287.04
1400	5767				
		5048.50	50	252,425	9349.07
1450	4330				
		4320.00	50	216,000	8000.00
1500	4310				
		4535.00	50	226,750	8398.15
1550	4760				
		4936.00	50	246,800	9140.74
1600	5112				
		5121.50	50	256,075	9484.26
1650	5131				
		5127.00	50	256,350	9494.44
1700	5123				
		5155.00	50	257,750	9546.30
1750	5187				
		5208.00	50	260,400	9644.44
1800	5229				
		5263.50	50	263,175	9747.22
1850	5298				
		5298.00	50	264,900	9811.11
1900	5298				
		5339.50	50	266,975	9887.96
1950	5381				
		5388.50	50	269,425	9978.70
2000	5396				
		5396.00	50	269,800	9992.59
2050	5396				
		5373.00	50	268,650	9950.00
2100	5350				
		3781.00	50	189,050	7001.85
2150	2212				
		1106.00	50	55,300	2048.15
2200	0				

273,343 CY

ROUGH CUT

MINUS 23,000 CY
 SHERACK FORMATION 250,343 CY
 BRENNA FORMATION 80,657 CY

TOPSOIL
 MINUS TOPOIL

DIVERSION INLET SHERACK CALCULATIONS TO EL. 889.0
 END AREA CALCULATIONS

STATION	AREA (SF)	AVERAGE AREA (SF)	LENGTH (FT)	VOLUME (CF)	VOLUME (CY)
950	3108				
		4947.00	50	247,350	9161.11
1000	6786				
		7609.50	50	380,475	14091.67
1050	8433				
		8291.50	50	414,575	15354.63
1100	8150				
		7870.00	50	393,500	14574.07
1150	7590				
		7836.00	50	391,800	14511.11
1200	8082				
		7734.00	50	386,700	14322.22
1250	7386				
		7086.00	50	354,300	13122.22
1300	6786				
		6464.50	50	323,225	11971.30
1350	6143				
		5764.50	50	288,225	10675.00
1400	5386				
		4858.00	50	242,900	8996.30
1450	4330				
		4320.00	50	216,000	8000.00
1500	4310				
		4535.00	50	226,750	8398.15
1550	4760				
		4936.00	50	246,800	9140.74
1600	5112				
		5121.50	50	256,075	9484.26
1650	5131				
		5127.00	50	256,350	9494.44
1700	5123				
		5155.00	50	257,750	9546.30
1750	5187				
		5208.00	50	260,400	9644.44
1800	5229				
		5263.50	50	263,175	9747.22
1850	5298				
		5298.00	50	264,900	9811.11
1900	5298				
		5339.50	50	266,975	9887.96
1950	5381				
		5388.50	50	269,425	9978.70
2000	5396				
		5396.00	50	269,800	9992.59
2050	5396				
		5373.00	50	268,650	9950.00
2100	5350				
		3781.00	50	189,050	7001.85
2150	2212				
		1106.00	50	55,300	2048.15

2200	0			
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	258,906 CY	ROUGH CUT
MINUS	23,000 CY	TOPSOIL
SHERACK FORMATION	<hr/> 235,906 CY	MINUS TOPOIL
BRENNA FORMATION	95,094 CY	

PARKING LOT IMPERVIOUS

Triangle Volume Report

Report Created: 3/1/2016

Time: 10:00am

Mode: Entire Surface
Input Grid Factor: 1

Original Surface: FMMDIS_TIEBACK-
RT_DAM_EMBEDDED
LEVEE_MERGED

Description:
Preference: Default
Type: Existing

Design Surface: FMMDIS_PARKING_IMPERVIOUS

Description:
Preference: Default
Type: Existing

Cut Factor: 1
Fill Factor: 1

Cut: 980.39 cu ft
Fill: 268468.36 cu ft
Net: -267487.97 cu ft

Cut: 36.31 cu yd
Fill: 9943.27 cu yd
Net: -9906.96 cu yd

FOOT PRINT 20900 SF
TOPSOIL STRIPPING 775 CY

IMPERVIOUS 10718 CY

Triangle Volume Report

Report Created: 4/7/2016

Time: 12:02pm

Mode: Entire Surface

Input Grid Factor: 1

Original Surface: FMMDIS_MERGED_PARKING
AREA_SMALL

Description:

Preference: Default

Type: Existing

Design Surface: FMMDIS_PARKING_IMPERVIOUS

Description:

Preference: Default

Type: Existing

Cut Factor: 1

Fill Factor: 1

Cut: 982.24 cu ft

Fill: 268422.23 cu ft

Net: -267439.99 cu ft

Cut: 36.38 cu yd

Fill: 9941.56 cu yd

Net: -9905.18 cu yd

ASPHALT PAVEMENT

2.5" ASPHALT PAVEMENT

6916 SF

53 CY

OR

104 TONS

SAY

110 TONS

STRUCTURE FILL

	AVE AREA	LENGTH	FT3	CY
LT DAM WALL	150	299	44850	1661
RT DAM WALL	150	299	44850	1661
LT STRUCTURE	100	250	25000	926
RT STRUCTURE	100	250	25000	926

6209

Attachment E-3

Quantity Certification



US Army Corps of Engineers

MVP - Design Branch

Section: Civil

Calculation Cover Sheet and Design Check Documentation



Project Name:	FMM Diversion Inlet Structure	Date:	4/13/2016
Project Location:	Fargo, ND	District/Customer:	MVP
Project Manager:	Bonnie Greenleaf		

File Location:

Designer/Checker Information	Title of Calculations to be checked:	FMMDIS_QUANTITIES_APRIL_7_2016.xlsx
	Number of pages Including Cover Sheet	21
	Assigned Checker:	Paul Morken
	Designer/Originator(of calculations):	Greg Fischer
	Additional Information:	

Check Box 1 or 2

1. All items have been checked in accordance with District QMP and found to be correct. Checker has no comments.

Checker's Signature: _____ Date: _____

OR

2. Checker's comments have been provided on: Calculations Other _____ Attached

If box 2 is checked above, the section below to be completed after backcheck of any comments.

Check Box 3, OR go on to Box 4 AND Box 5

3. Checker's comments have been adequately addressed by Designer/Originator and all issues have been resolved between Checker and Designer. The checker has backchecked all comments and reviewed all revised calculations to assure incorporation into final document.

OR

4. There are unresolved comments, and these have been submitted to the Section Chief or designee for resolution.

AND

5. Comments have been resolved by Section Chief or designee. The checker has backchecked comments and reviewed all revised calculations to assure that resolved comments have been incorporated into final document.

Checker's Signature: Paul Morken Date: 4/13/16

QA Sign-Off

The Design/Calculation Check is complete and all comments have been resolved and closed out.

QA Signature: [Signature] Date: 4/18/16
 Section Chief or Designee

Quantity Check ✓