RED RIVER DIVERSION

FARGO – MOORHEAD METRO FLOOD RISK MANAGEMENT PROJECT, FEASIBILITY STUDY, PHASE 4

APPENDIX D – CIVIL AND GEOTECHNICAL DESIGN

Report for the US Army Corps of Engineers, and the cities of Fargo, North Dakota & Moorhead, Minnesota

REVISED: April 11, 2011

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D1.0 PROJECT LAYOUT AND TOPOGRAPHY

D1.1 TOPOGRAPHY

The Fargo-Moorhead area is characterized by relatively flat topography deposited by glacial Lake Agassiz. The flat topography results in the Red River having very little slope, generally less than one half of a foot per mile from south to north. While the flat terrain contributes to the potential for widespread flooding, it also allows for the potential to construct diversion channels around the community either to the east or to the west without creating extremely deep excavations. A more detailed discussion of the alignments follows.

D1.2 CONSIDERATIONS IN ALIGNMENT SELECTION

The general concepts for the alignments were provided by the US Army Corps of Engineers (Corps of Engineers). Modifications to those concepts, done during previous phases of feasibility, were based on a number of considerations. The main considerations used in the selection of alignments follow:

1. Alignments were shortened where reasonable to reduce footprint and cost.
2. Alignments were moved to relatively lower ground to minimize the excavation required.
3. Alignments cross roads and railroads at or as close to 90 degrees as possible to minimize bridge lengths.
4. Alignment avoids populated areas to minimize buyouts where possible.
5. North Dakota alignment crosses rivers at or as close to 90 degrees as possible to minimize hydraulic structure size and cost.
6. Alignments were located in areas that minimize geotechnical concerns related to know aquifers.

D1.3 MINNESOTA SHORT ALIGNMENT (FCP)

The Minnesota Short Alignment serves as the FCP for Phase 4 of this study. The FCP design was not changed from the Phase 3.1 design. However, the FCP was analyzed as part of Phase 4 in order to determine the project impacts based on the updated unsteady flow models. For background information and documentation on the development of the Minnesota Short Alignment, refer to the Attachment C2 in Appendix C.

D1.4 NORTH DAKOTA DIVERSION ALIGNMENT (LPP)

The North Dakota Diversion Alignment (LPP), shown in Figure D1, starts approximately four miles south of the confluence of the Red and Wild Rice Rivers and extends west and north around the Cities of Horace, Fargo, West Fargo, and Harwood and ultimately re-enters the Red River north of the confluence of the Red and Sheyenne Rivers near the City of Georgetown, MN. The alignment is approximately 36 miles long. The background information on the development and previous changes to the alignment can be found in the reports for first three phases of this study. While the alignment has remained largely unchanged from its initial layout, some modifications were made to the North Dakota Diversion (LPP) alignment during Phase 4, although they do not have a sizeable impact on the project. The north end of the alignment was adjusted near

Argusville to avoid interference with Cass County Drain 13. It was determined that Drain 13 was already an efficiently functioning legal drain so it could be utilized for its capacity separately from the diversion. The alignment was shifted to the south and east to accommodate this change. In other areas, minor changes were also incorporated where existing homes and buildings could be reasonably avoided. The LPP diversion channel will incorporate the existing Horace Diversion channel, so the alignment was adjusted so that the east side of the LPP diversion matched the existing Horace Diversion channel.

The Phase 4 LPP design includes storage and staging on the upstream side of the project. This storage reduces the discharge that must pass through the diversion to the downstream end of the project. Thus, the size of diversion channel was reduced to handle the smaller discharges associated with the Phase 4 design. The configuration of the channel cross section was determined through a combination of the hydraulic capacity, geotechnical constraints, and minimum depth constraints related to the tributary hydraulic structures, specifically the Sheyenne and Maple River structures.

A combination of control structures on the Red and Wild Rice Rivers at the south end of the project, along with a weir on the diversion channel, control the flow split between the Red and Wild Rice River channels and the diversion channel and produce the required staging. Additionally, the alignment crosses several rivers, including the Sheyenne, Maple, Lower Rush, and Rush Rivers. Aqueducts are necessary at the point where the diversion channel crosses the Sheyenne and Maple Rivers. The purpose of these aqueducts is to allow a minimum of a 50-percent chance event to continue down the various rivers while diverting excess water during flood events to the diversion channel. The result of this is added flood protection along all of the affected rivers. The Rush and Lower Rush Rivers, which currently consist of constructed trapezoidal channels, would be allowed to flow into the diversion channel resulting in cutting off the downstream portion of these rivers. The tie-back levee associated with this alternative extends east from the Red River control structure to high ground on the Minnesota side. Additionally, tie-back levees on the North Dakota side contain the flows within the designated staging and storage areas. Further discussion of these structures is included in Appendix F.

D1.5 PROJECT LAYOUT

The North Dakota Diversion (LPP) layout for Phase 4 is depicted in the drawings attached to this appendix (Appendix D). For the FCP project layout, refer to Appendix D.

D2.0 UTILITIES

As would be expected with any project of this scale, each of the proposed diversion alternatives impact existing utilities. The utilities impacted by the diversion alignments include electric, natural gas, petroleum transmission, water supply, wastewater transmission, and various communication utilities. An inventory of existing utilities was obtained from the various providers. The locations of these utilities are included on the project drawings attached to this appendix.

D3.0 OTHER LOCAL IMPACTED STRUCTURES AND FEATURES

D3.1 IMPACTS ON STRUCTURES AND PROPERTY

While efforts were made to minimize impacts to existing homes and other structures, each of the diversion alternative alignments studied impacts existing structures. Any realistic diversion alignments would require acquisition and relocation. The main feature impacted by a diversion alternative besides existing structures is agricultural land. As the proposed diversion alternatives generally avoid the developed metropolitan area, agricultural land would be removed from production to accommodate a diversion.

D3.2 TRIBUTARY AND DRAINAGE INFRASTRUCTURE IMPACTS

As discussed in the description of the North Dakota East Alignment, a North Dakota diversion alternative would impact several other regional rivers, including the Sheyenne, Maple, and Rush and Lower Rush Rivers. Due to the proximity of these rivers to the Fargo Moorhead Metro area, any North Dakota diversion alignment would cross these rivers. The alignment chosen cross each of these rivers a single time. Generally, the diversion alignment crosses the Sheyenne River near Horace and continues northward paralleling the Sheyenne River. The design of these river crossings is discussed in detail in Appendices C and F.

All of the diversion alternatives studied also impact existing local drainage facilities. On both sides of the Red River, a significant drainage system is maintained throughout the region. Impacts to the existing system, generally consisting of open ditches, should be minimal. Existing drains would simply be allowed to flow into the diversion channel rather than continuing into what would be the protected area. A control structure for each significant drainage area intersected by the diversion alignment would be included along with additional collector drainage channels in locations where existing localized drainage is blocked. A more detailed discussion of the side ditch inlets is found in Appendices C and F.

D3.3 TRANSPORTATION INFRASTRUCTURE IMPACTS

The construction of the proposed North Dakota Diversion (LPP) and Minnesota Diversion (FCP) channels will require the construction of bridges at major roadways and railroads. For the LPP, 20 highway and 4 railroad bridges will be constructed, while for the FCP, 19 highway and 4 railroad bridges will be constructed. Design and cost information for the bridge structures is discussed in Appendix E – Bridge Structures. The major impacts as a result of the construction of these bridge structures will involve temporary closures or detours during construction activities.

As part of the Phase 4 feasibility study, upstream staging and off-channel storage features (Storage Area 1) have been added to the project design for the North Dakota Diversion (LPP). The design of these features is discussed in detail in Appendices C and F. The addition of upstream staging and Storage Area 1 (SA1) will cause impacts to transportation routes upstream from the diversion channel and in SA1. Major transportation routes that will be impacted include Interstate 29; U.S. Highway 75; Cass County Highways 16, 18, 21, 25, and 81; Clay County Highways 2, 58, and 59; the Burlington Northern and Santa Fe (BNSF) railroad grade from Breckenridge, MN to Moorhead, MN; and several township roads. It should be noted that several of these transportation routes are impacted and in many cases inundated by floodwaters during existing conditions.

It is anticipated that a majority of the structures in the staging area and SA1 will be purchased and removed as part of the project. Therefore, only critical transportation routes, including Interstate 29, U.S. Highway 75, and the BNSF railway line were included as grade raises through the staging area. For cost estimating purposes, it was assumed the driving lanes of the roads would be raised to the 1-percent chance flood staged level. Similarly, the BNSF railroad grade was elevated above the 1-percent chance flood staged level. Interstate 29 interchange 50 at Cass County Highway 18 will also need to be reconstructed to accommodate the road raise. Grade raises were also included for roads crossing the levees for SA1 at Cass County Highways 16 and 21 along with for all roads crossing the tie-back levees.

Impacts to downstream transportation infrastructure will be minor. For the LPP, the upstream staging and SA1 will mitigate downstream stage increases, however, the duration of flooding for transportation infrastructure that currently floods will be extended. For the FCP, the impacts to stage may increase the frequency of flooding for some transportation infrastructure in areas where downstream impacts are experienced. Information concerning impacts to stage as a result of the LPP and FCP diversion alternatives is presented in Appendix C.

D4.0 GEOTECHNICAL CONSIDERATIONS

With the reduction in the required capacity of the channel due to the upstream staging component, the bottom of the diversion channel was raised from the Phase 3.1 design. Along with this, the raising of the channel bottom also limited the amount of excavation that will be required within the Brenna formation, which will have an impact on the constructability and cost of the project.

The basic cross section geometry for Phase 4 was determined based on hydraulic capacity and then modified based on geotechnical analysis at various reaches along the diversion. A channel with a bottom width of 250 feet was determined to be the appropriate design for Phase 4, based on the following criteria: (1) allowed design to meet goal of zero impacts downstream; (2) allowed design to meet targeted 1-percent chance profile in the diversion channel; (3) did not increase the volume of excavation with respect to other (wider bottom width) options; (4) resulted in a channel with invert elevations above the Brenna formation for a significant length of the diversion alignment. As was done with the Phase 3.1 design, the proposed channel design for the LPP diversion was provided to the Corps of Engineers for stability analysis during the design. While the stability issues still required benching in some locations, the extent of the benching was far less with the Phase 4 design. The Corps' geotechnical analysis called for benching in five sections along the diversion alignment. The benches were all set at eight feet above the bottom of the main channel and varied in width from 15 to 40 feet. The side slopes above and below the benches all remained at 7:1 (H:V) throughout the length of the diversion. The low flow channel included in Phase 3, which had a depth of three feet, 4:1 (H:V) side slopes and a 10 foot bottom, was also incorporated into the channel geometry. The cross section geometries for the diversion are summarized in Table D2 with the locations shown in Figure D2. The size of the channel in the reach between the Wild Rice River and the diversion inlet weir was reduced for the final Phase 4 design. Within this reach, the channel has a 100 foot bottom and 7:1 (H:V) side slopes.

Construction of a diversion alternative would require considerable space for disposal of excess soil. Excess soil would be disposed of adjacent to the diversion channel. The geotechnical parameters provided by the Corps of Engineers define the side slopes as well as the maximum embankment height of the spoil piles. The spoil slopes are 7:1 (H:V) and 10:1 (H:V) for the diversion side and outside slopes respectively and the maximum spoil height is generally 15 feet. There are areas in which the geotechnical conditions limit the height of spoil immediately adjacent to the diversion channel. The width of the spoil piles is controlled by the total volume of material to be disposed of. The project layout drawings included in this appendix show the spoil pile footprints that factor in all of these design constraints.

D5.0 RIGHT OF WAY

The proposed diversion alternatives will require acquisition of a right of way corridor wide enough to allow for the footprint of the diversion channel as well as the adjacent spoil piles. Additional right of way will also be necessary for tie-back levees. The Corps of Engineers provided the following parameters for right of way acquisition:

1. Permanent easement to 30' outside the toe of spoil or levee
2. Temporary easement 15' beyond the permanent easement for construction limits

The easement area required for the North Dakota Diversion alignment is summarized in Table D1 below. It should be noted that these numbers include the area required for Storage Area 1, which was added to the LPP for Phase 4, so the numbers appear considerably higher than those included for Phase 3.

Table D1- Easement Area Summary for LPP Diversion and Hydraulic Structures

Structure	Easements Areas (Acres)		
	Permanent	Temporary	Total
Red River Control Structure	110	4	114
Wolverton Creek	4	0	4
Wild Rice River	114	2	116
Storage Area 1	4,484	7	4,490
Inlet	13	1	15
Sheyenne River	158	4	162
Maple River	151	4	155
Lower Rush River	122	2	124
Rush River	126	3	129
Outlet	76	2	78
LPP Diversion Channel	5,944	107	6,051
TOTALS=	**11,302**	**136**	**11,438**

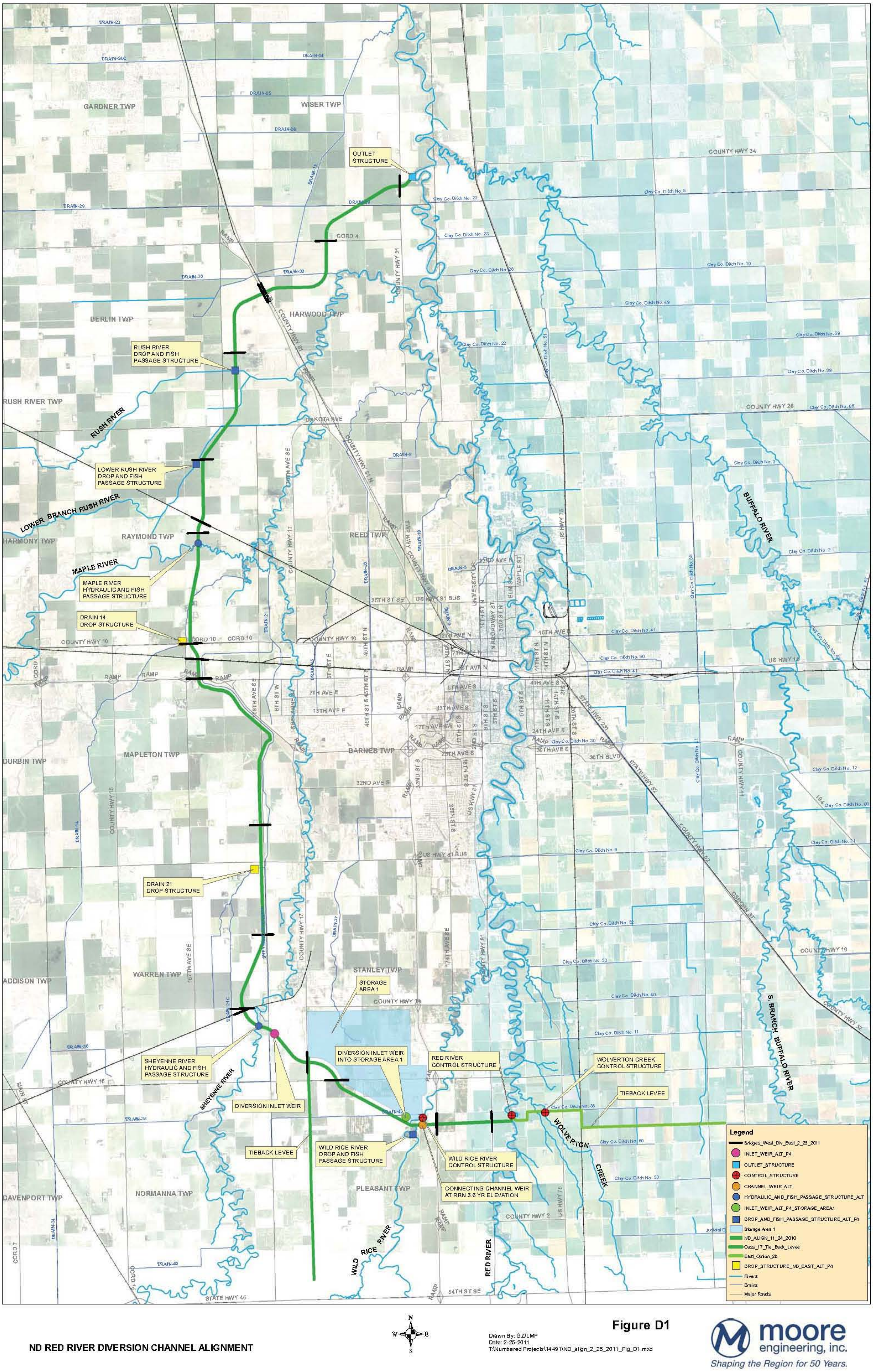


Figure D1- North Dakota Diversion LPP Alignment

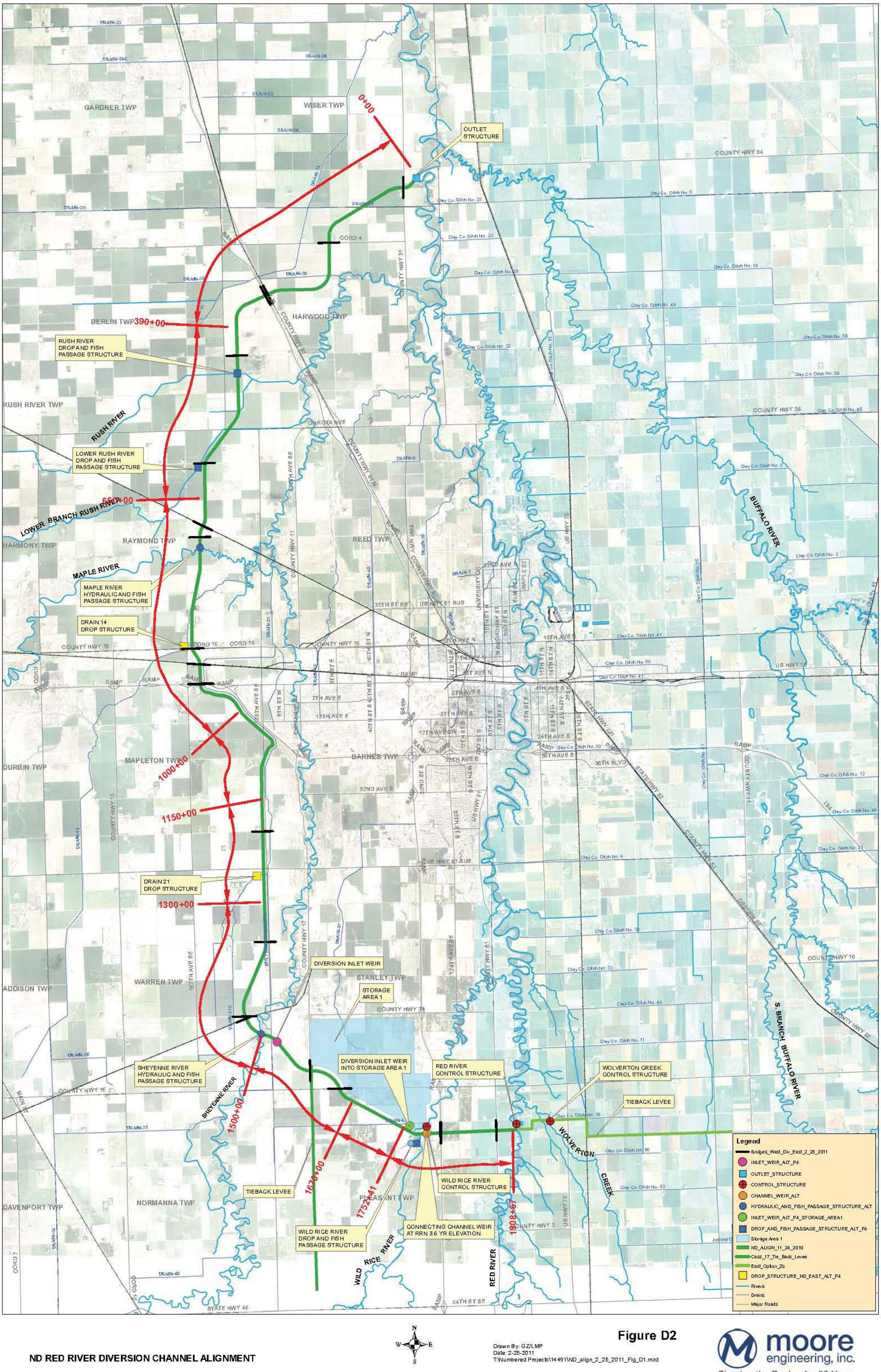


Figure D2- North Dakota Diversion LPP Alignment-Channel Cross Section Locations

Table D2- LPP Cross Sections By Station

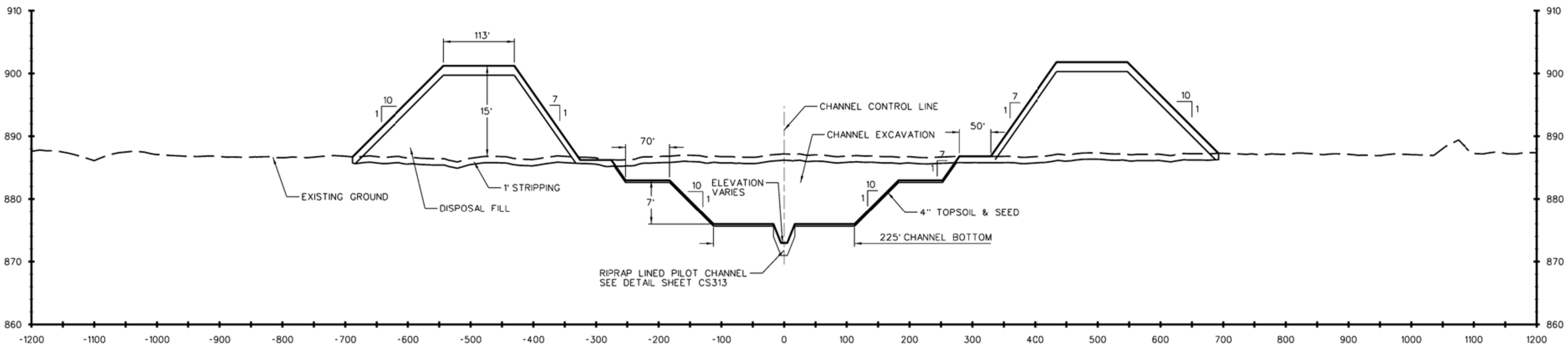
						Channel Configuration					Bench Configuration				Spoil Pile Surcharge		Stability Analysis: Min FS				
Filename	Station	Start	End	Length (ft)	Length (mi)	Ground Surface	Bottom Elev.	Depth	Δ Phase 3.1 vs 4.4	Bottom Width	Bench Width	Bench Height	Bench Slope	Channel Slope	Setback	Height	(A) Global Entry/Exit	(B) Wedge	(C) Lower Localized	(D) Upper Localized	(2) Undrained Global
FM_P4_ND_Div_Sect-01_P4_vr4	STA 120+00	0+00	390+00	39,000	7.4	882	865	17	8	250				7	50	8	1.554	1.558	1.793	2.206	1.345
FM_P4_ND_Div_Sect-02_P4_vr4	STA 545+00	390+00	660+00	27,000	5.1	890	868	22	3	250	**15**	**8**	**7**	**7**	50	11	1.431	1.437	1.508	1.957	1.315
FM_P3_ND_Div_Sect-03_P4_vr4	STA 940+00	660+00	1000+00	34,000	6.4	900	877	23	4	250	**25**	**8**	**7**	7	50	15	1.421	1.411	1.710	1.794	1.332
FM_P3_ND_Div_Sect-04_P4_vr4	STA 1080+00	1000+00	1150+00	15,000	2.8	900	879	21	3	250	**20**	**8**	**7**	7	50	15	1.429	1.425	1.611	1.882	1.364
FM_P3_ND_Div_Sect-05_P4_vr4	STA 1225+00	1150+00	1300+00	15,000	2.8	903	881	22	2	250	**40**	**8**	**7**	7	50	12	1.411	1.412	1.418	1.640	1.306
FM_P3_ND_Div_Sect-05B_P4_vr4	STA 1445+00	1300+00	1490+00	19,000	3.6	913	885	28	2	250	**40**	**8**	**7**	**7**	50		1.416	1.415	1.208	1.407	1.507
FM_P3_ND_Div_Sect-06B_P4_vr4	STA 1550+00	1490+00	1550+00	6,000	1.1	920	903	17	18	250				7	50		1.512	1.513	1.782	2.866	1.563
FM_P3_ND_Div_Sect-06C_P4_vr4	STA 1720+00	1670+00	1770+00	10,000	1.9	913	905	8	16	250				7	50		2.353	2.350	2.637	4.330	2.092
FM_P3_ND_Div_Sect-07_P4_vr4	STA 1810+00	1770+00	1922+00	15,200	2.9	912	901	11	5	250				7	50		2.201	2.173			2.000

** NOTES **

1) "Bottom Elev." indicates the invert elevation of the main channel bottom. The low flow channel invert elevation is 3 feet less.

2) Low Flow channel analyzed without riprap.

3) Constant channel slope of 1V on 7H was used for both the bench and the slope above the bench.



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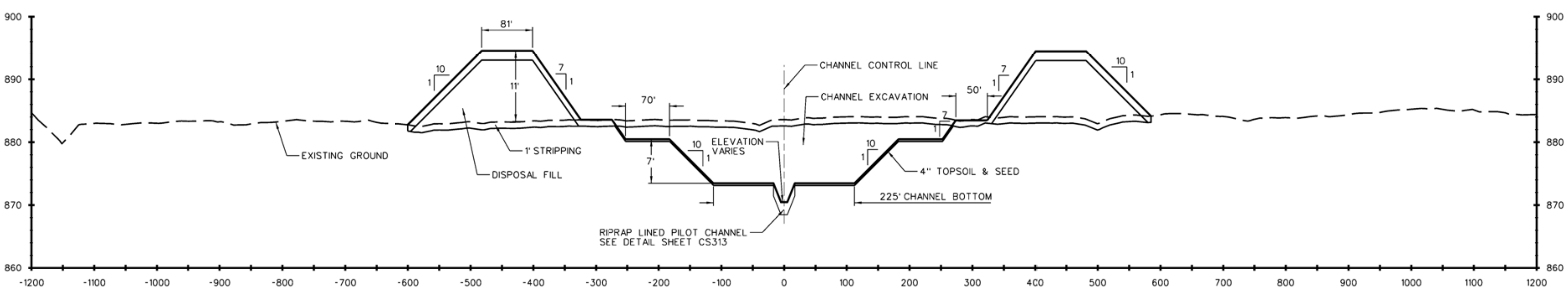

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CHANNEL AND SPOIL PILES
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SIZE: ANSI D	FILE NAME: FMM-CS301.dgn	

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MINNESOTA DIVERSION (FCP)
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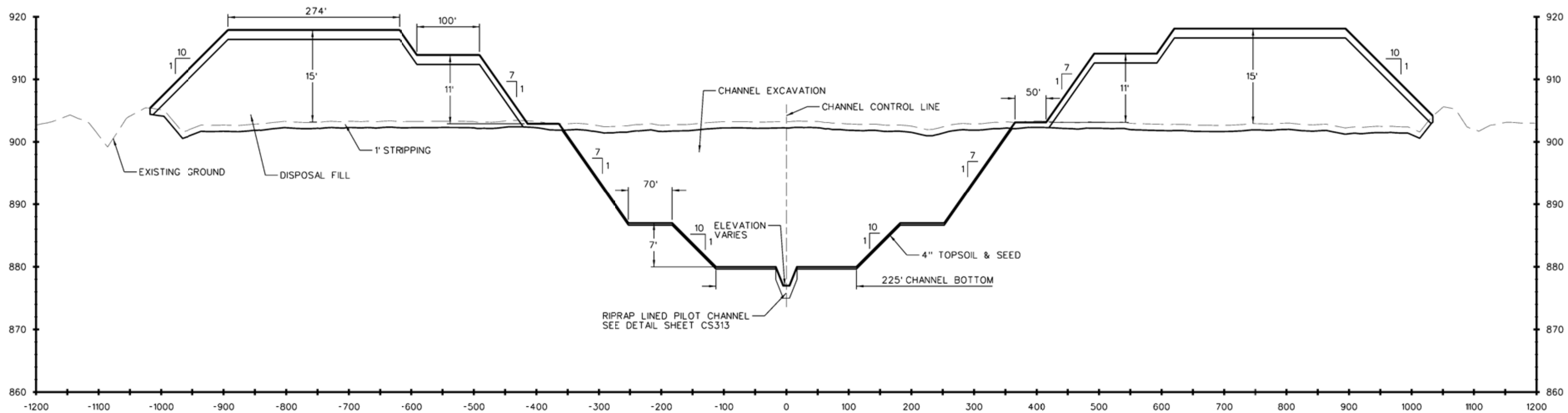

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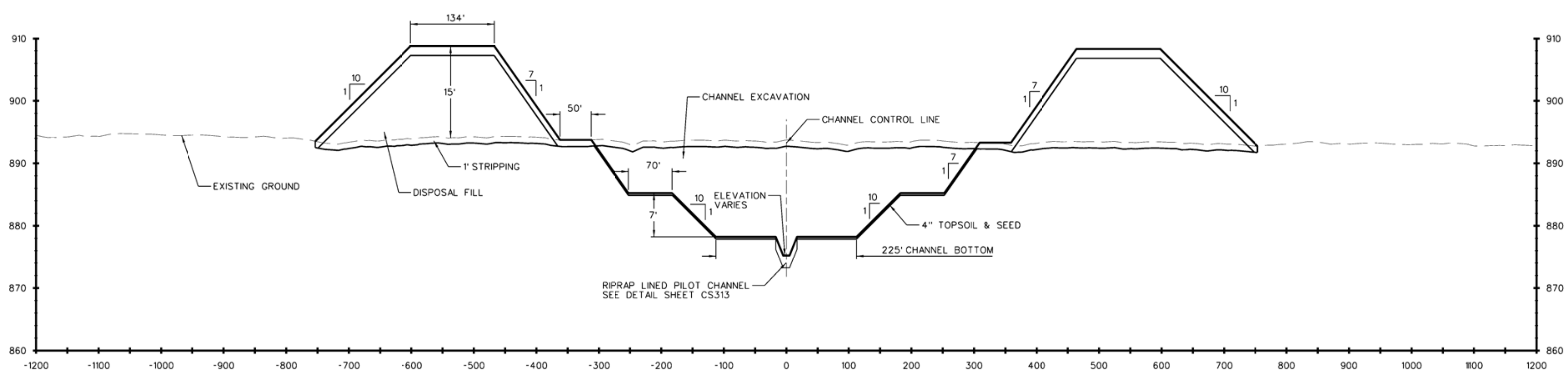

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TYPICAL SECTION – MINNESOTA DIVERSION (FCP)

CHANNEL AND SPOIL PILES
STA. 220+00 TO STA. 440+00

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MINNESOTA DIVERSION (FCP)
TYPICAL SECTIONS

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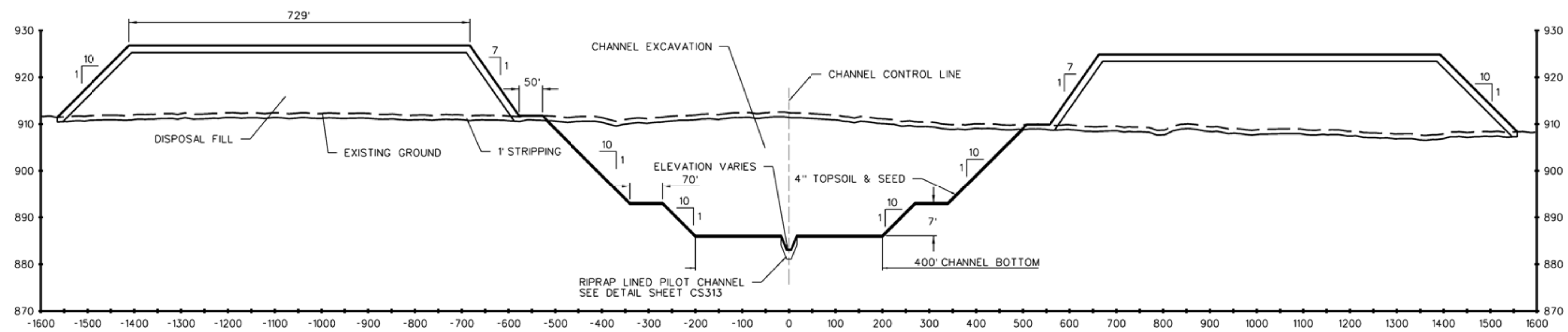

F / CS104 TYPICAL SECTION – MINNESOTA DIVERSION (FCP)

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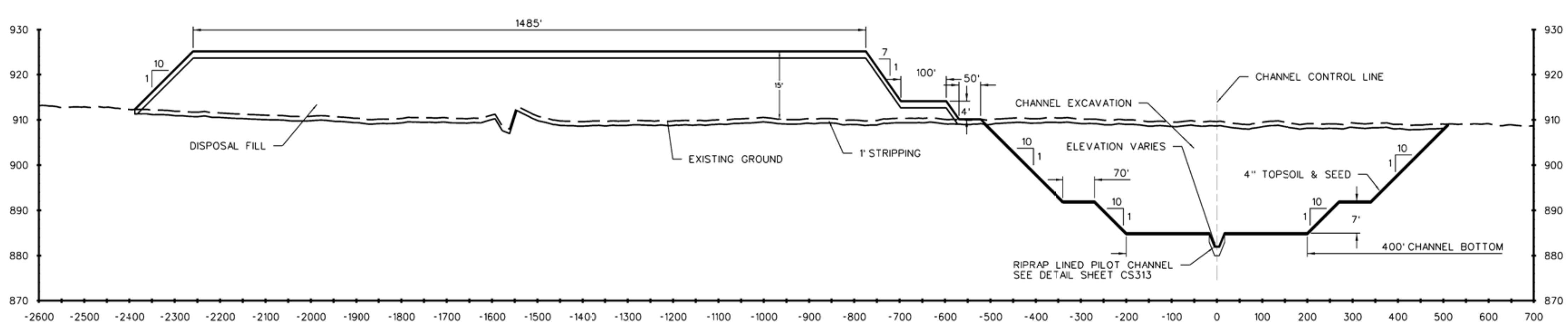

E / CS104 TYPICAL SECTION – MINNESOTA DIVERSION (FCP)

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MINNESOTA DIVERSION (FCP)
TYPICAL SECTIONS

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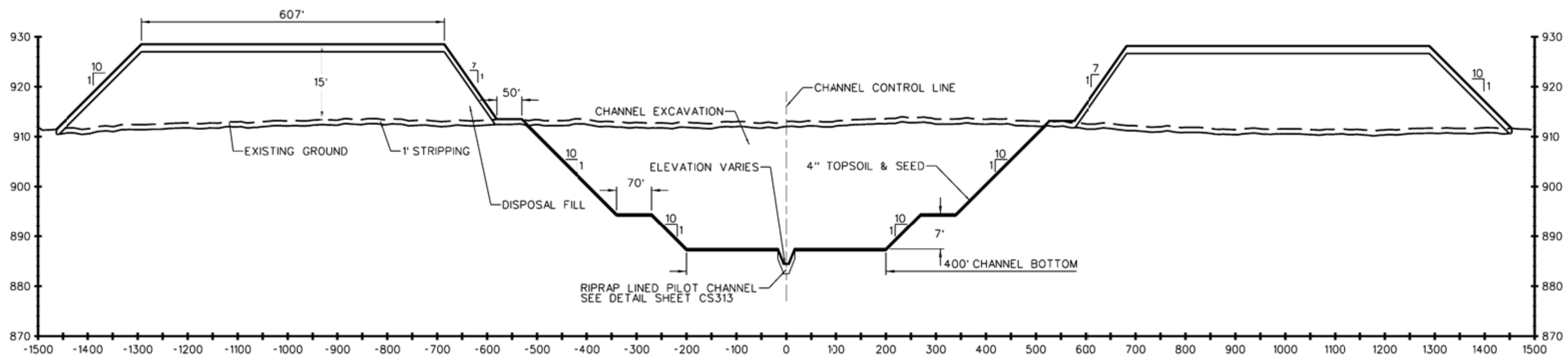

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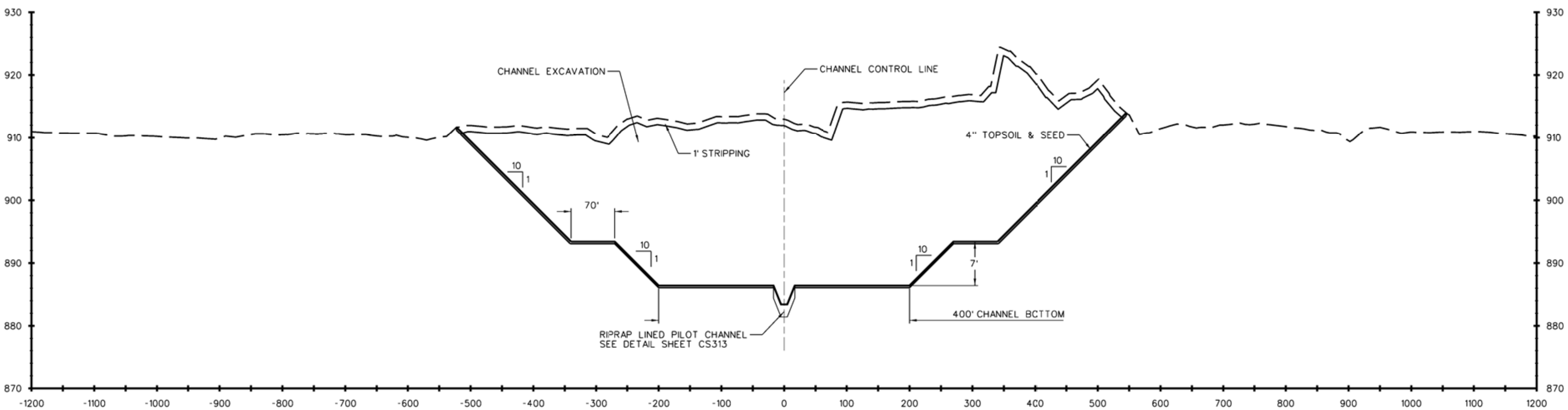

G / CS104 TYPICAL SECTION – MINNESOTA DIVERSION (FCP)

CHANNEL AND SPOIL PILES
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TYPICAL SECTIONS

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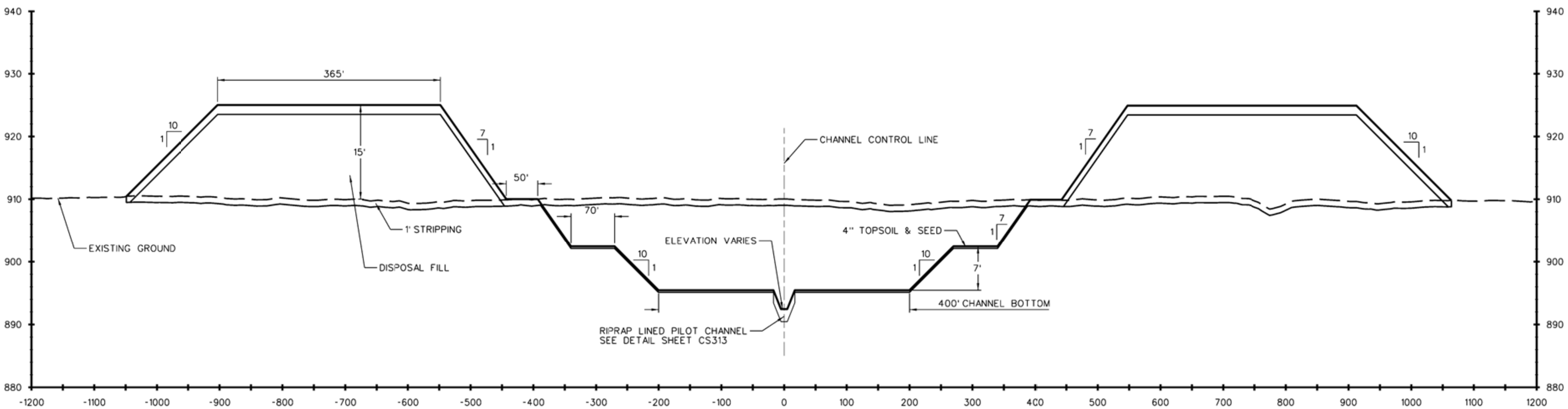

J / CS106 — TYPICAL SECTION – MINNESOTA DIVERSION (FCP)

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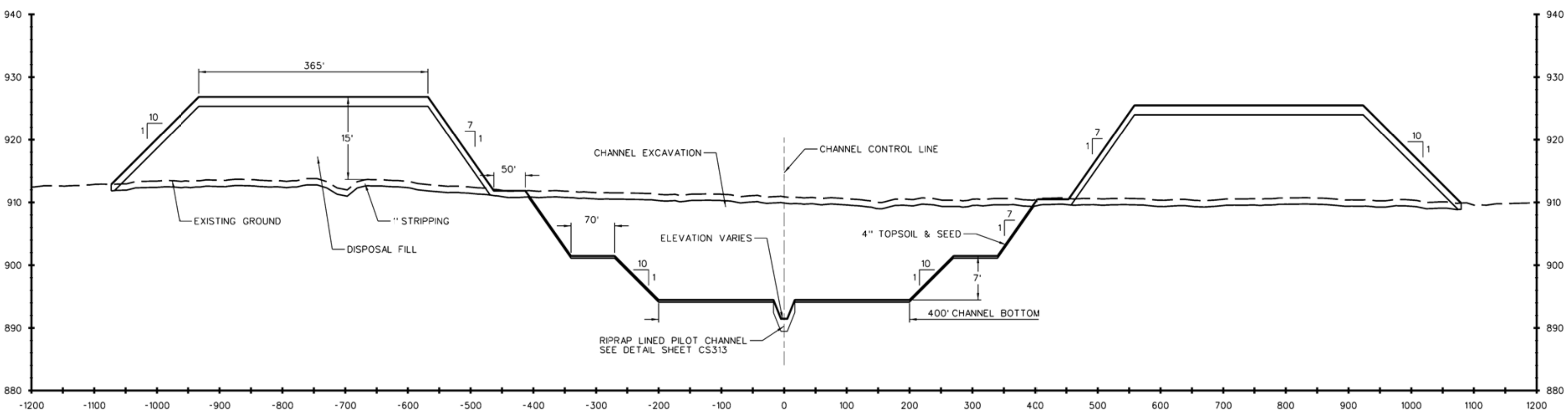

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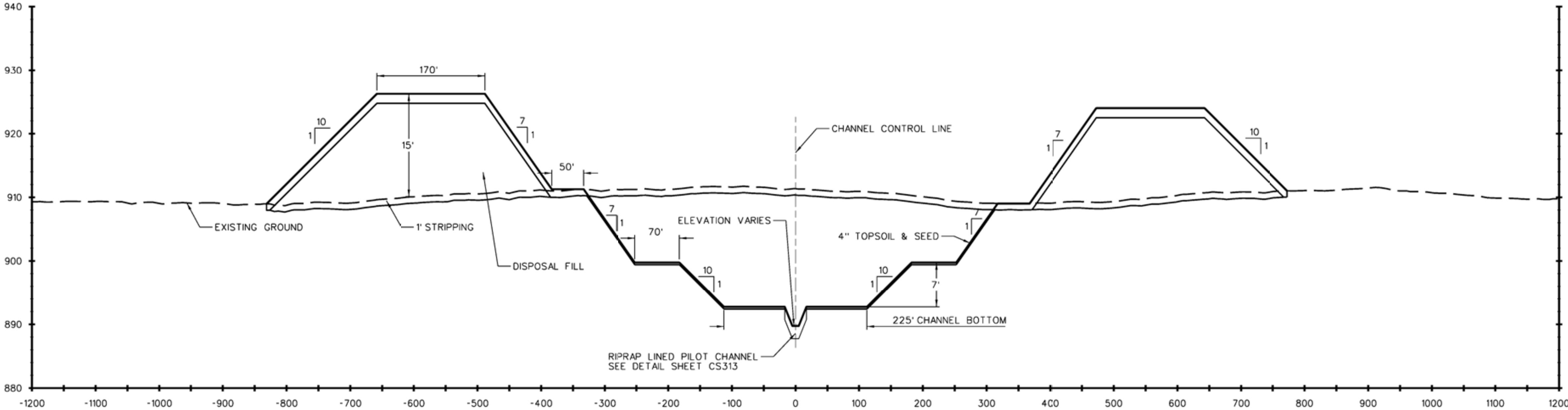

TYPICAL SECTION – MINNESOTA DIVERSION (FCP)

L / CS106

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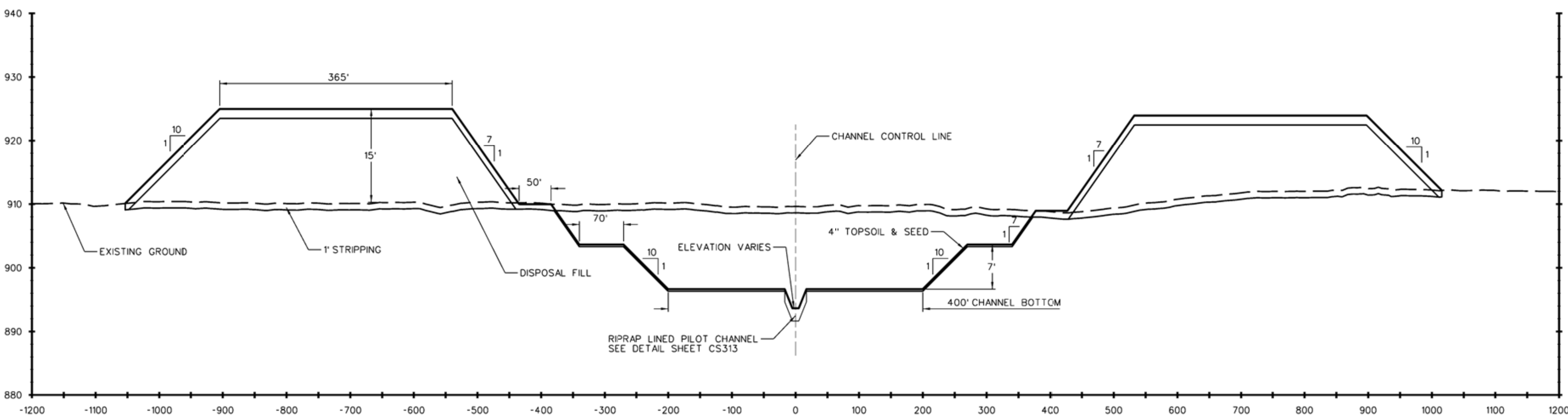

TYPICAL SECTION – MINNESOTA DIVERSION (FCP)

K / CS106

CHANNEL AND SPOIL PILES
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MINNESOTA DIVERSION (FCP)
TYPICAL SECTIONS

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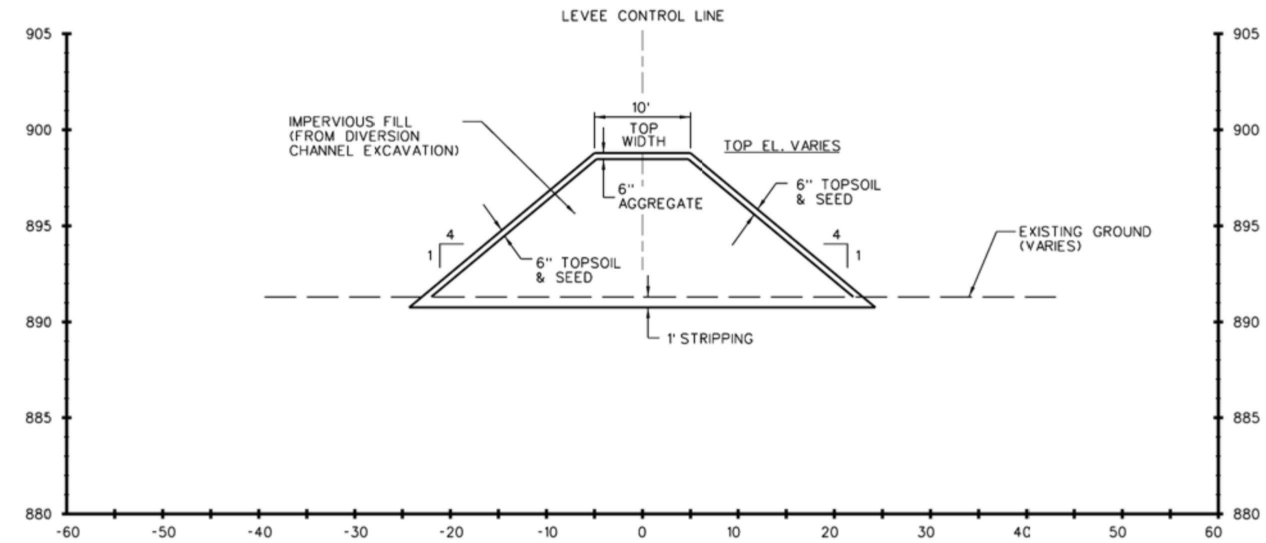
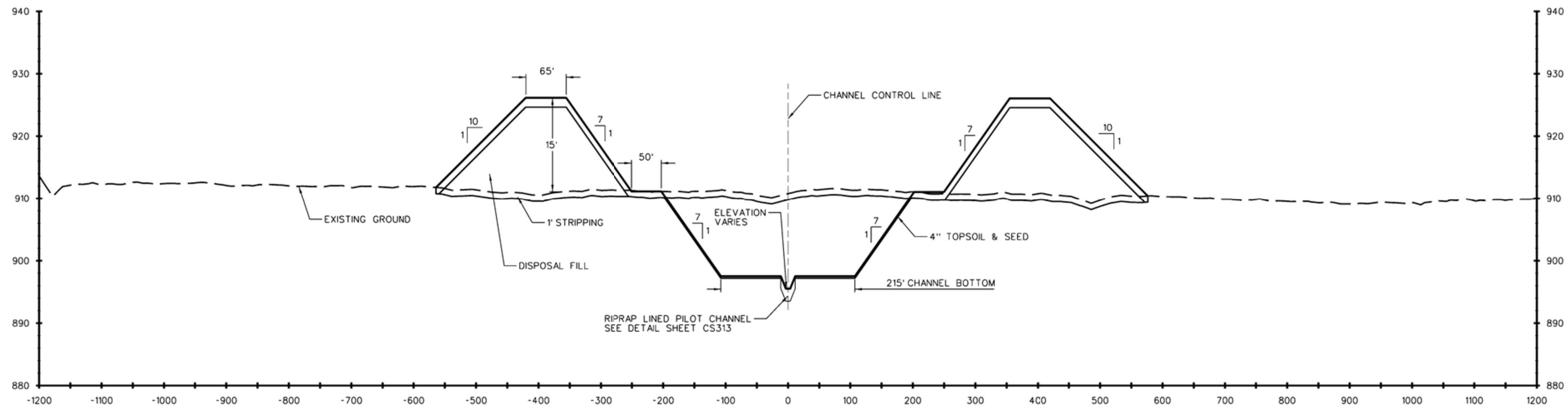


TYPICAL SECTION – FCP
TIEBACK LEVEE



M
CS106

TYPICAL SECTION – MINNESOTA DIVERSION (FCP) EXTENSION CHANNEL
CHANNEL AND SPOIL PILES
STA. 0+00 TO STA. 162+00

HORIZONTAL COORDINATE SYSTEM:
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NAD 1983, US SURVEY FEET

VERTICAL COORDINATE SYSTEM:
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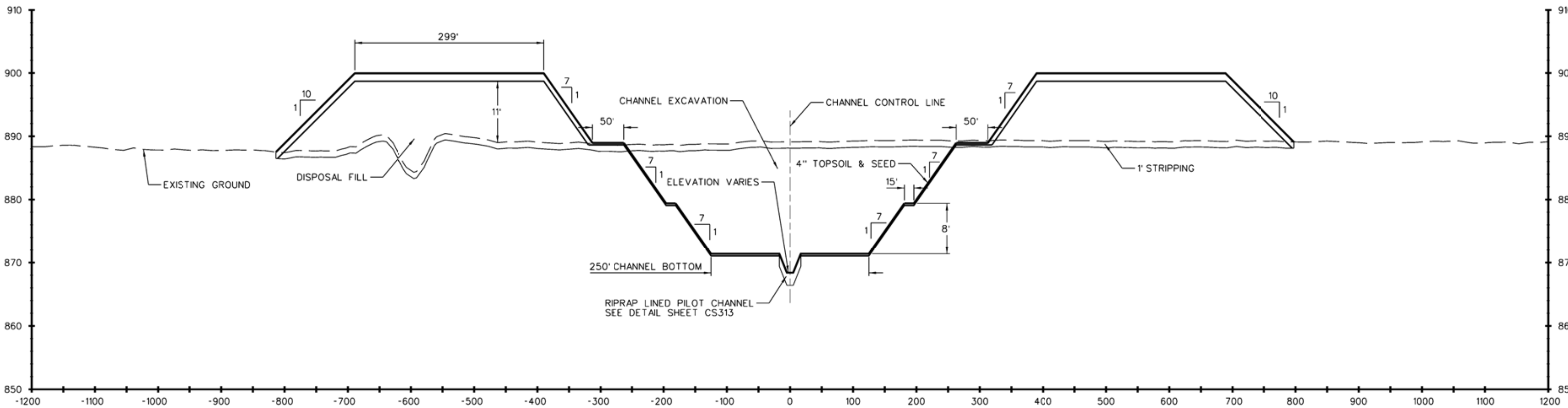
FARGO, ND 58102

DESIGNED BY: MEI/HEI		DATE: 2011/02/24
DWN BY: MLI	CKD BY: CGT	SOLICITATION NO.:
SUBMITTED BY: Matthew L. Isley		CONTRACT NO.:
PLOT SCALE: 1" = 100'	PLOT DATE: 2011/02/28	FILE NUMBER:
SIZE: ANSI D	FILE NAME: FMM-CS307.dgn	

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 4

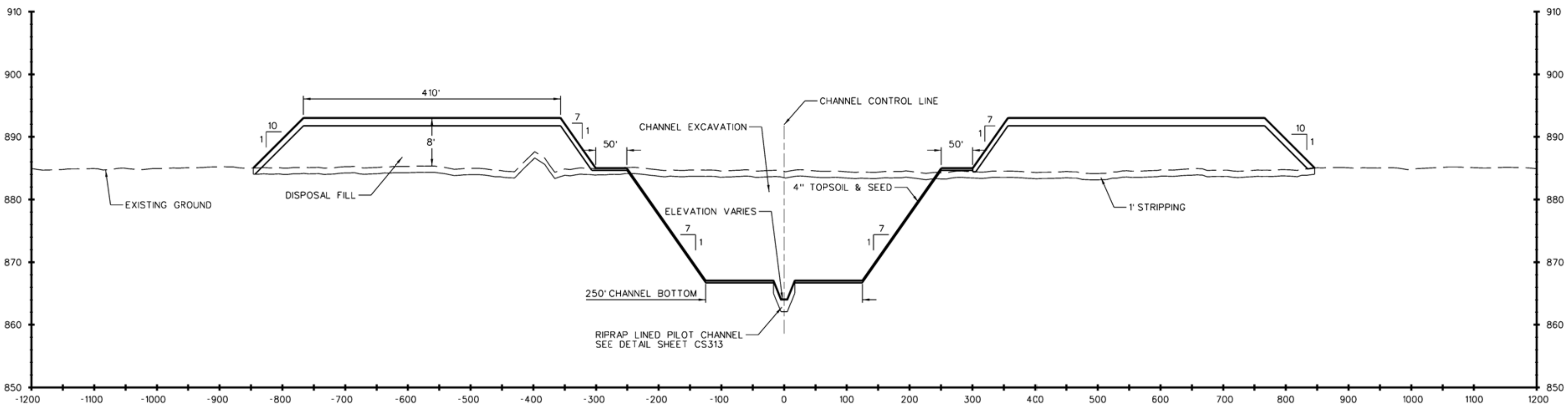
MINNESOTA DIVERSION (FCP)
TYPICAL SECTIONS

SHEET IDENTIFICATION
CS307



B / CS109 TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

CHANNEL AND SPOIL PILES
STA. 390+00 TO STA. 660+00



A / CS108 TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

CHANNEL AND SPOIL PILES
STA. 0+00 TO STA. 390+00

HORIZONTAL COORDINATE SYSTEM:
STATE PLANE - ND SOUTH
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VERTICAL COORDINATE SYSTEM:
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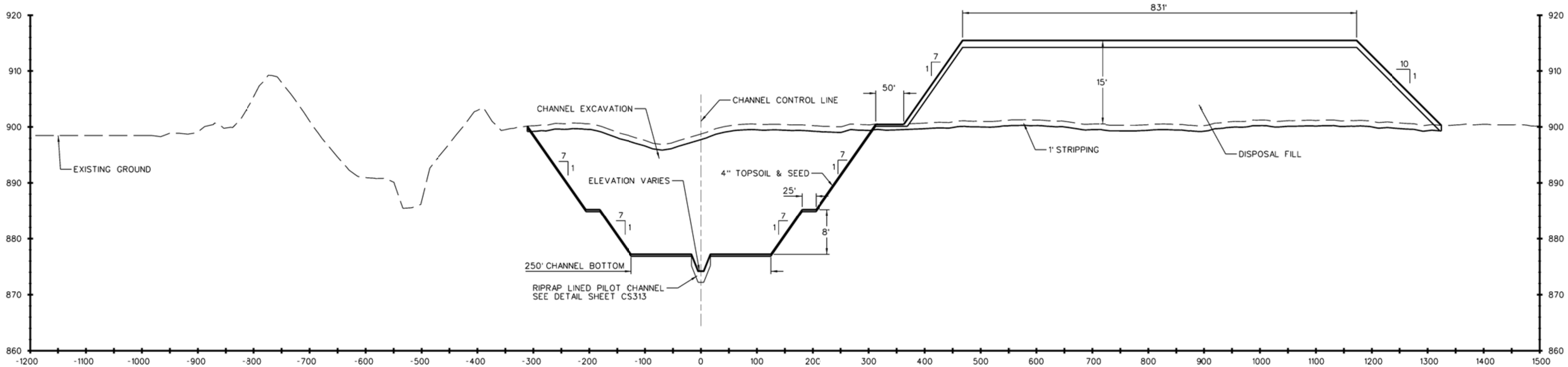
SOLICITATION NO.:
SUBMITTED BY: Matthew L. Isley
CONTRACT NO.:
PLOT SCALE: 1" = 100'
PLOT DATE: 2011/02/28
FILE NUMBER:
SIZE: ANSI D
FILE NAME: FMM-CS308.dgn

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 3

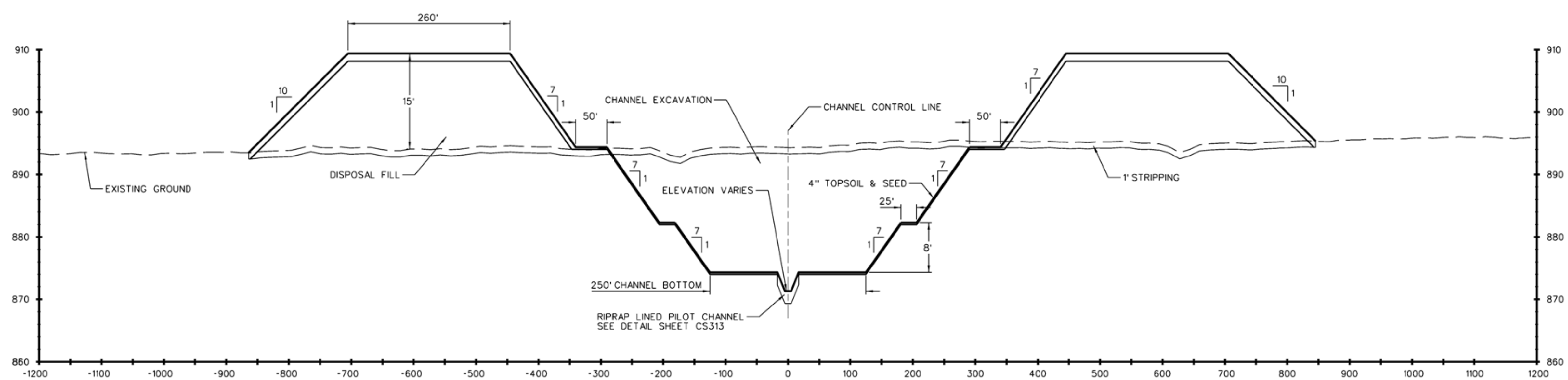
NORTH DAKOTA DIVERSION (LPP)
TYPICAL SECTIONS

SHEET IDENTIFICATION
CS308



D / CS111 TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

CHANNEL AND SPOIL PILES
STA. 885+00 TO STA. 1000+00



C / CS110 TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

CHANNEL AND SPOIL PILES
STA. 660+00 TO STA. 885+00

HORIZONTAL COORDINATE SYSTEM:
STATE PLANE - ND SOUTH
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SOLICITATION NO.:
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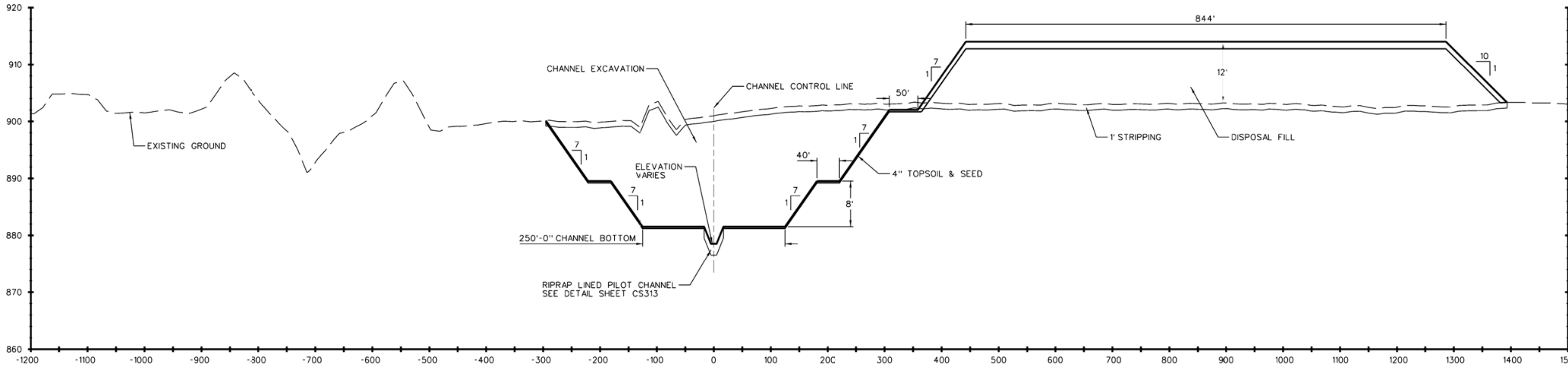
CONTRACT NO.:
PLOT SCALE: 1" = 100'
PLOT DATE: 2011/02/28
FILE NUMBER:
SIZE: ANSI D
FILE NAME: FMM-CS309.dgn

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 3

NORTH DAKOTA DIVERSION (LPP)
TYPICAL SECTIONS

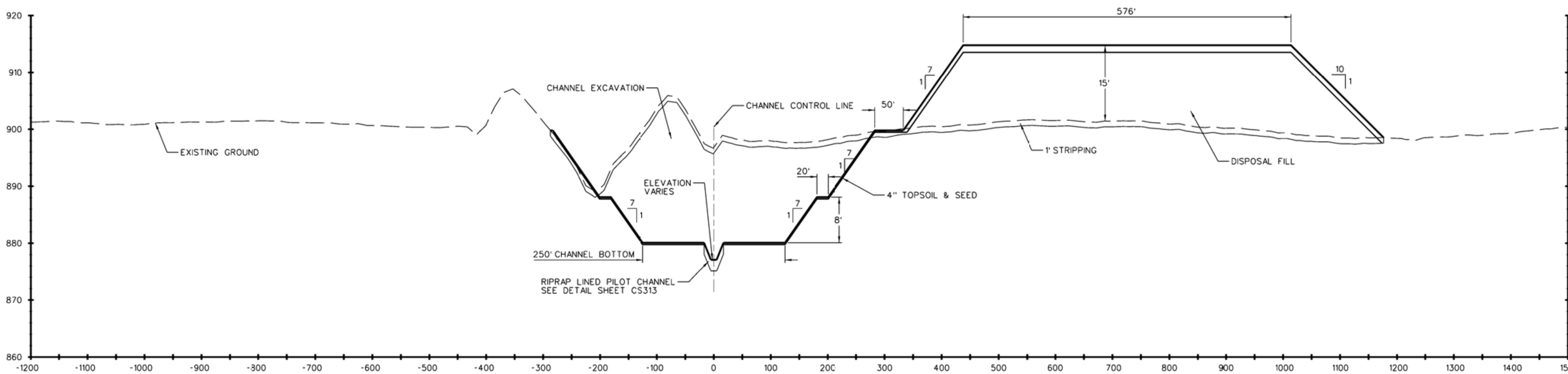
SHEET IDENTIFICATION
CS309



F / CS112

TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

CHANNEL AND SPOIL PILES
STA. 1150+00 TO STA. 1300+00



E / CS111

TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

CHANNEL AND SPOIL PILES
STA. 1000+00 TO STA. 1150+00

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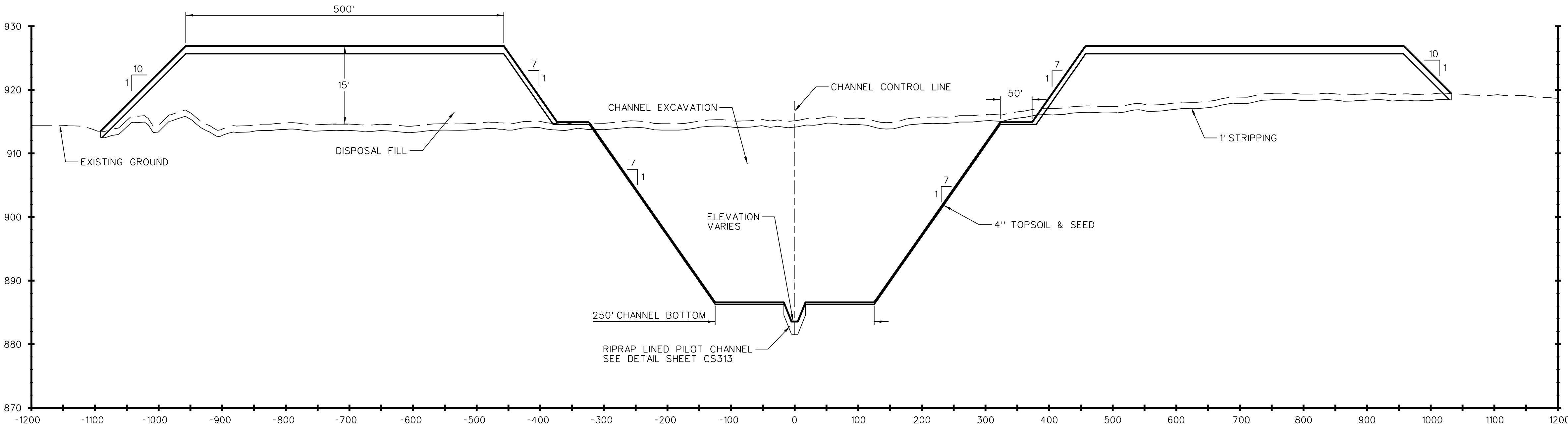
SOLICITATION NO.:
SUBMITTED BY: Matthew L. Isley
CONTRACT NO.:
PLOT SCALE: 1" = 100'
PLOT DATE: 2011/02/28
FILE NUMBER:
SIZE: ANSI D
FILE NAME: FMM-CS310.dgn

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 3

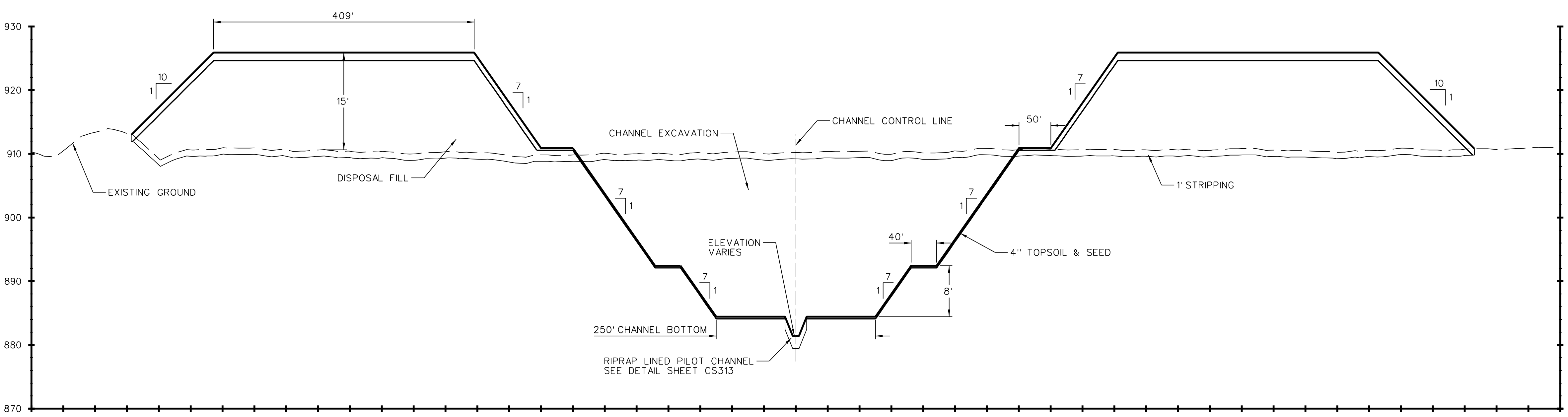
NORTH DAKOTA DIVERSION (LPP)
TYPICAL SECTIONS

SHEET IDENTIFICATION
CS310



H / CS113 TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

CHANNEL AND SPOIL PILES
STA. 1514+00 TO STA. 1585+00



G / CS112 TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

CHANNEL AND SPOIL PILES
STA. 1300+00 TO STA. 1490+00

HORIZONTAL COORDINATE SYSTEM:
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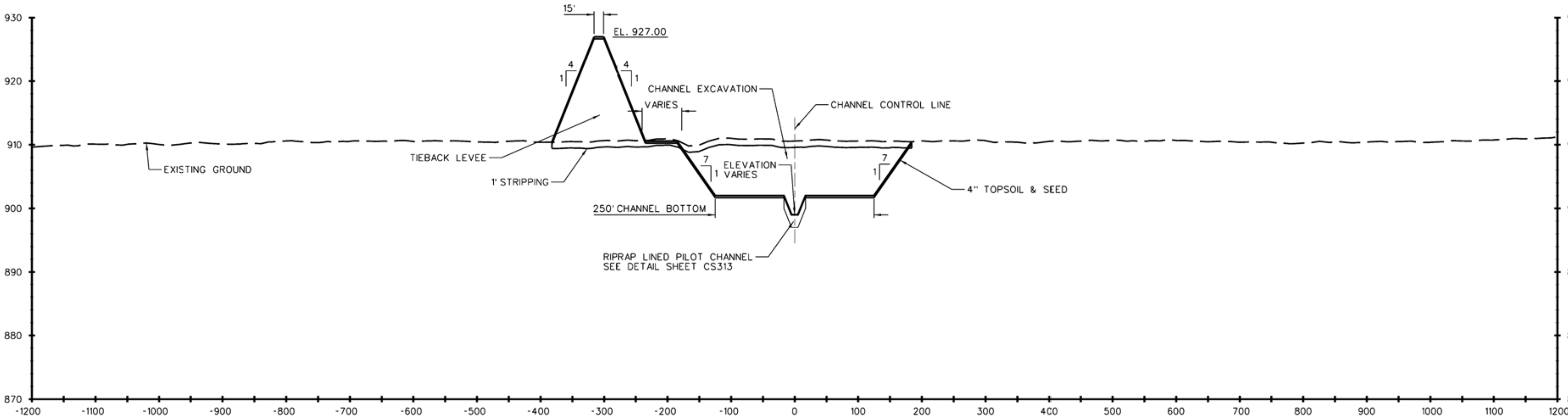
SUBMITTED BY: Matthew L. Isley		CONTRACT NO.:
PLOT SCALE: 1" = 100'	PLOT DATE: 2011/02/28	FILE NUMBER:
SIZE: ANSI D	FILE NAME: FMM-CS311.dgn	

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 3

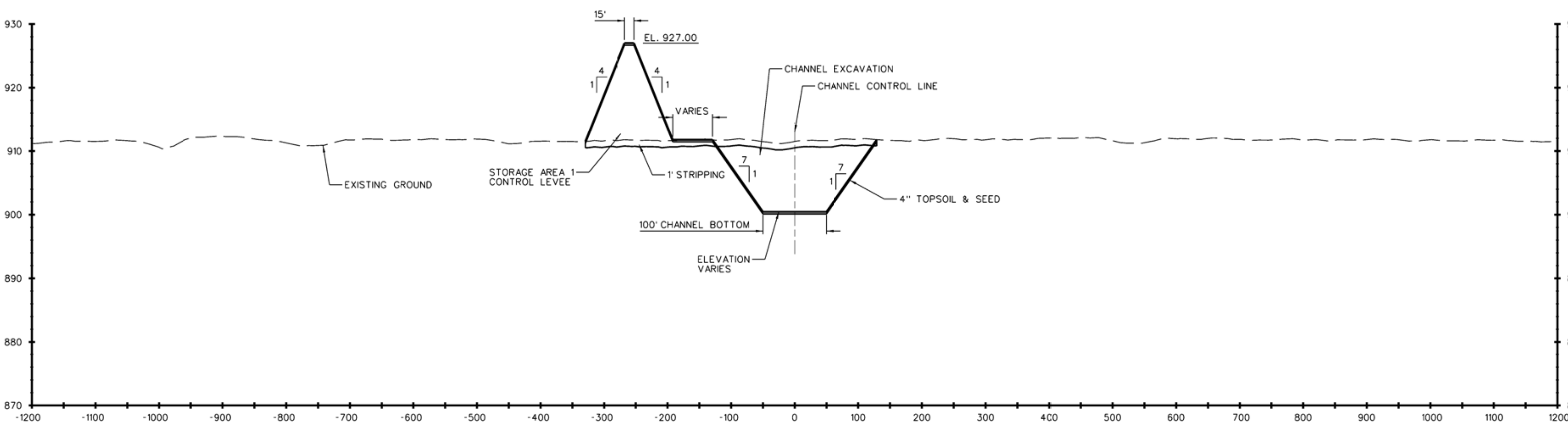
NORTH DAKOTA DIVERSION (LPP)
TYPICAL SECTIONS

SHEET IDENTIFICATION
CS311



J / CS114 — TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

CHANNEL AND SPOIL PILES
STA. 1803+00 TO STA. 1905+00



I / CS114 — TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

CHANNEL AND SPOIL PILES
STA. 1595+00 TO STA. 1766+50

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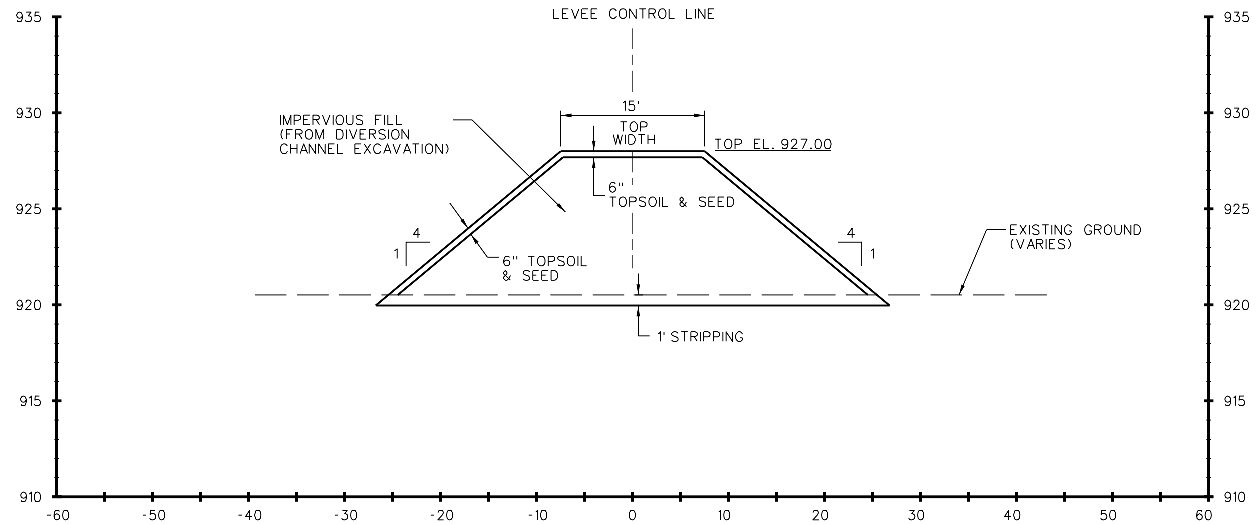
SUBMITTED BY: Matthew L. Isley		CONTRACT NO.:
PLOT SCALE: 1" = 100'	PLOT DATE: 2011/02/28	FILE NUMBER:
SIZE: ANSI D	FILE NAME: FMM-CS312.dgn	

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 3

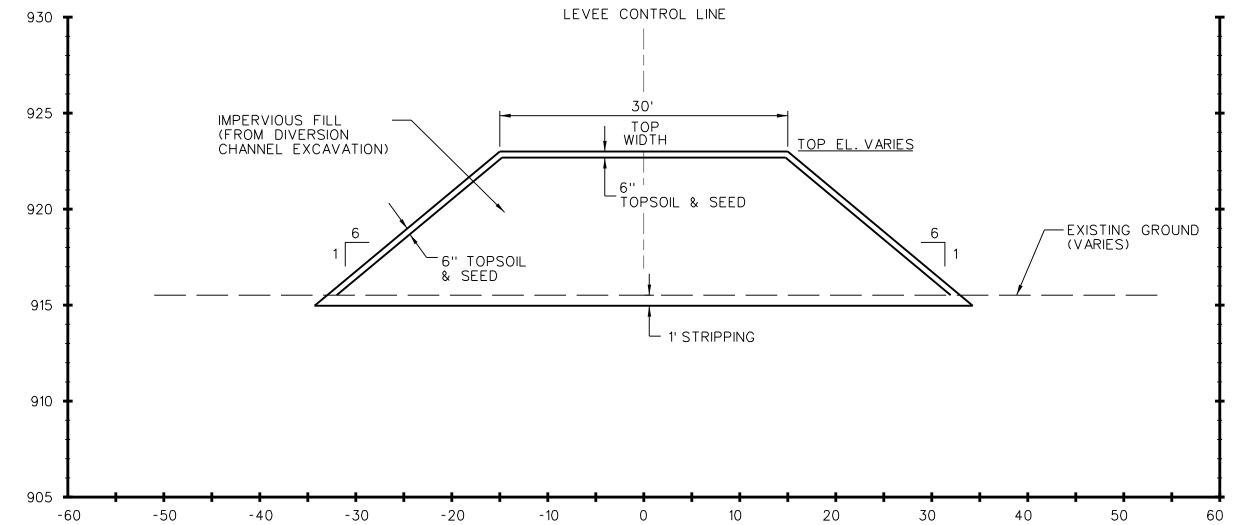
NORTH DAKOTA DIVERSION (LPP)
TYPICAL SECTIONS

SHEET IDENTIFICATION
CS312



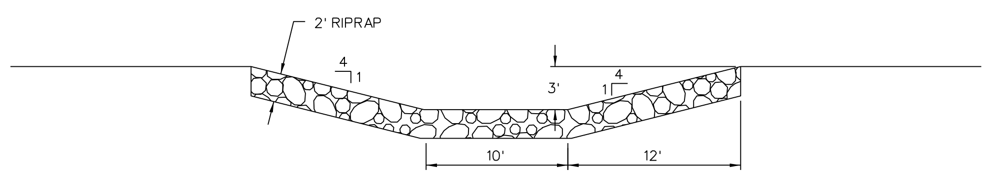
TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

EAST OPTION 2B TIEBACK LEVEE



TYPICAL SECTION – NORTH DAKOTA DIVERSION (LPP)

CASS 17 TIEBACK LEVEE



PILOT CHANNEL RIPRAP DETAIL

HORIZONTAL COORDINATE SYSTEM:
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NAD 1983, US SURVEY FEET

VERTICAL COORDINATE SYSTEM:
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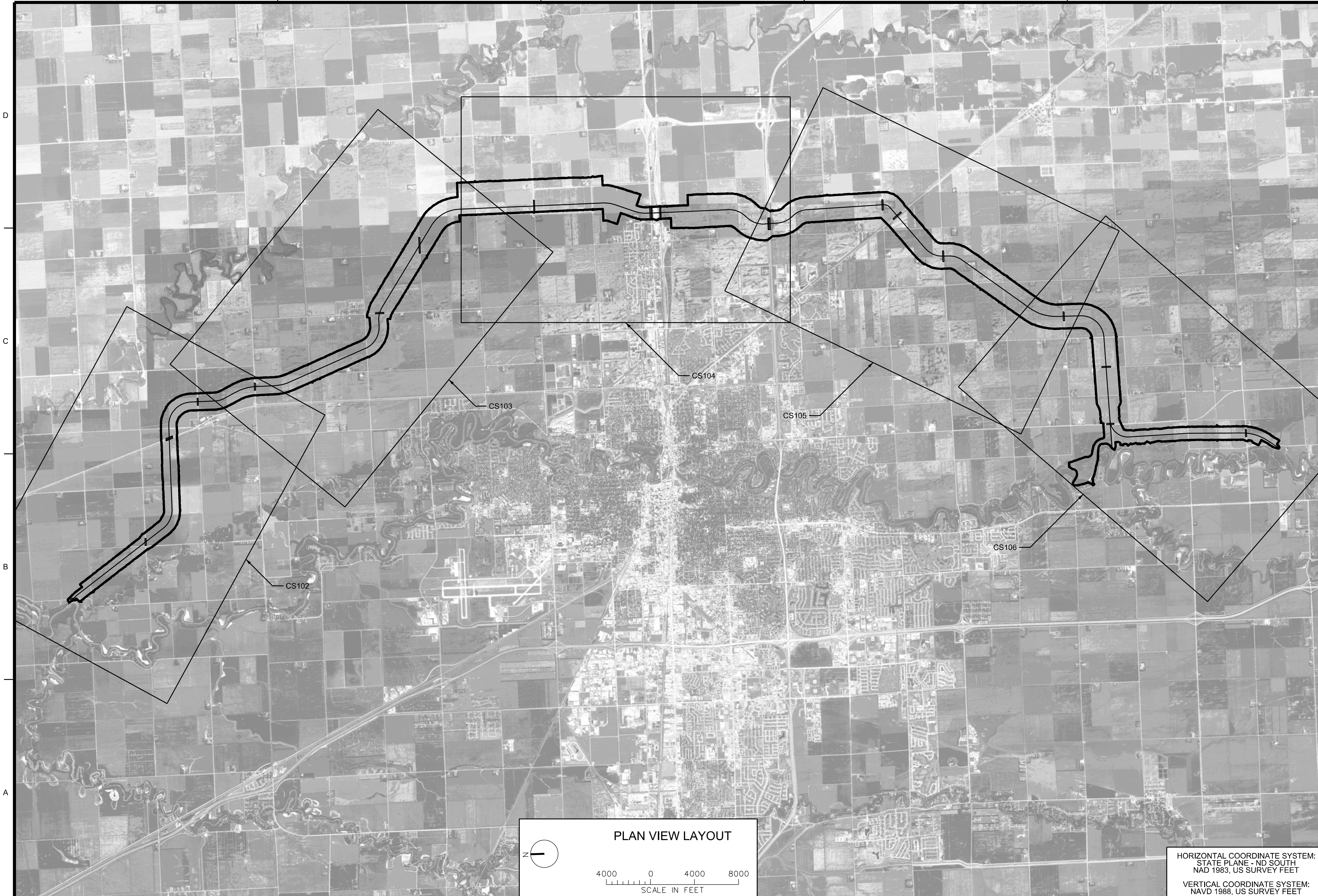
CKD BY: CGT
SUBMITTED BY: Matthew L. Isley
PLOT SCALE: 1" = 100'
PLOT DATE: 2011/02/28
SIZE: ANSI D
FILE NAME: FMM-CS313.dgn
DATE: 2011/02/24
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 3

NORTH DAKOTA DIVERSION (LPP)
TYPICAL SECTIONS

SHEET IDENTIFICATION
CS313



HORIZONTAL COORDINATE SYSTEM:
STATE PLANE - ND SOUTH
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VERTICAL COORDINATE SYSTEM:
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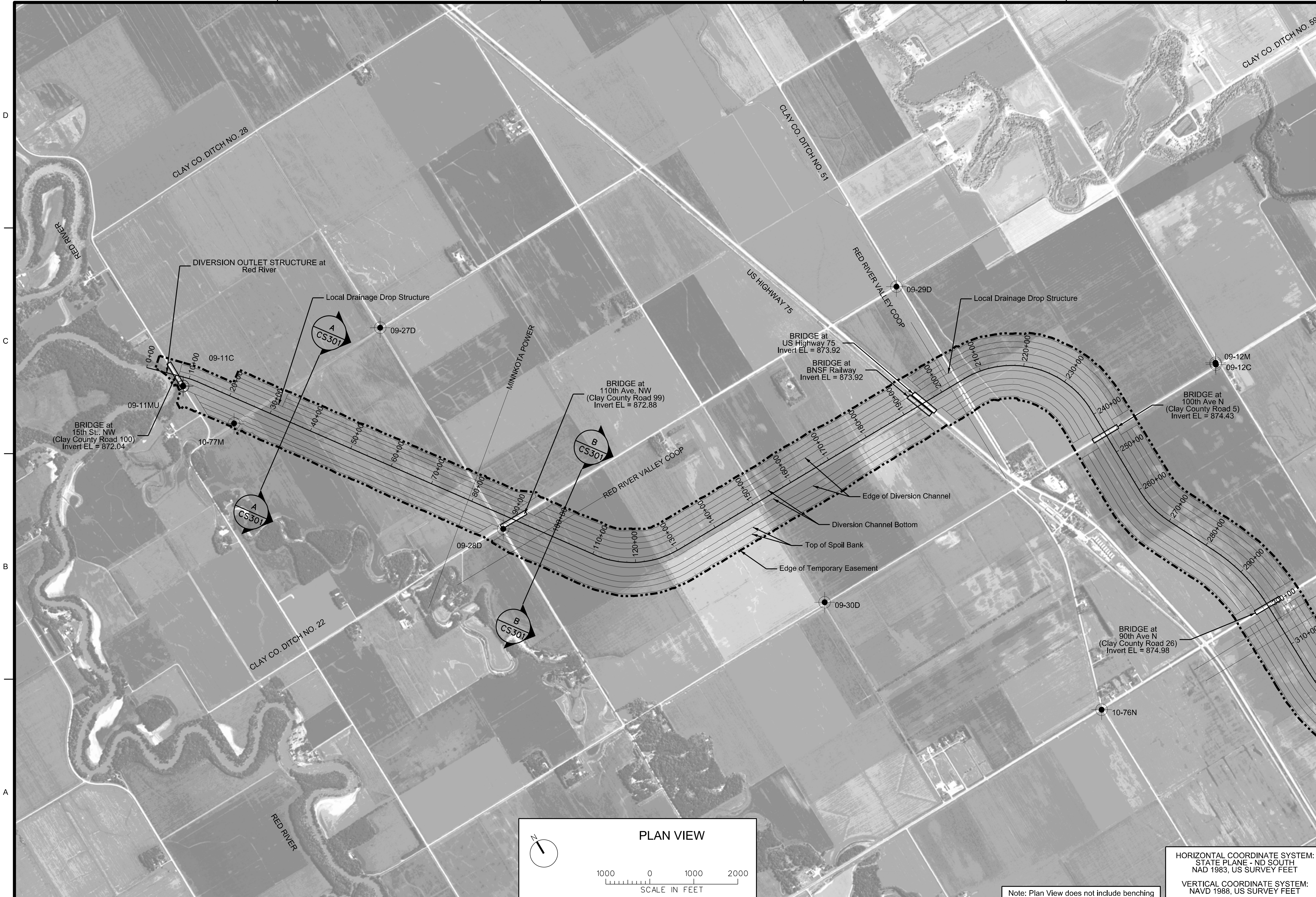
DESIGNED BY: MEI/HEI
DATE: 2011/02/24
DWN BY: MLI
CKD BY: CGT
SOLICITATION NO.:
SUBMITTED BY: Matthew L. Isley
CONTRACT NO.:
PLOT SCALE: 1" = 4000'
PLOT DATE: 2011/02/28
FILE NUMBER:
SIZE: ANSI D
FILE NAME: FMM-CS101.dgn

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 4

MINNESOTA DIVERSION (FCP)

PLAN VIEW LAYOUT

SHEET IDENTIFICATION
CS101



HORIZONTAL COORDINATE SYSTEM:
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VERTICAL COORDINATE SYSTEM:
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DWN BY: MLI	CKD BY: CGT	SOLICITATION NO.:
SUBMITTED BY: Matthew L. Isley		CONTRACT NO.:
PLOT SCALE: 1" = 1000'	PLOT DATE: 2011/02/28	FILE NUMBER:
SIZE: ANSI D	FILE NAME: FMM-CS102.dgn	

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FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 4

MINNESOTA DIVERSION (FCP)

PLAN VIEW 1 OF 5

SHEET IDENTIFICATION
CS102

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DWN BY: MLI	CKD BY: CGT	SOLICITATION NO.:
SUBMITTED BY: Matthew L. Isley		CONTRACT NO.:
PLOT SCALE: 1" = 1000'	PLOT DATE: 2011/02/28	FILE NUMBER:
SIZE: ANSI D	FILE NAME: FMM-CS103.dgn	

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 4

MINNESOTA DIVERSION (FCP)

PLAN VIEW 2 OF 5

SHEET IDENTIFICATION
CS103

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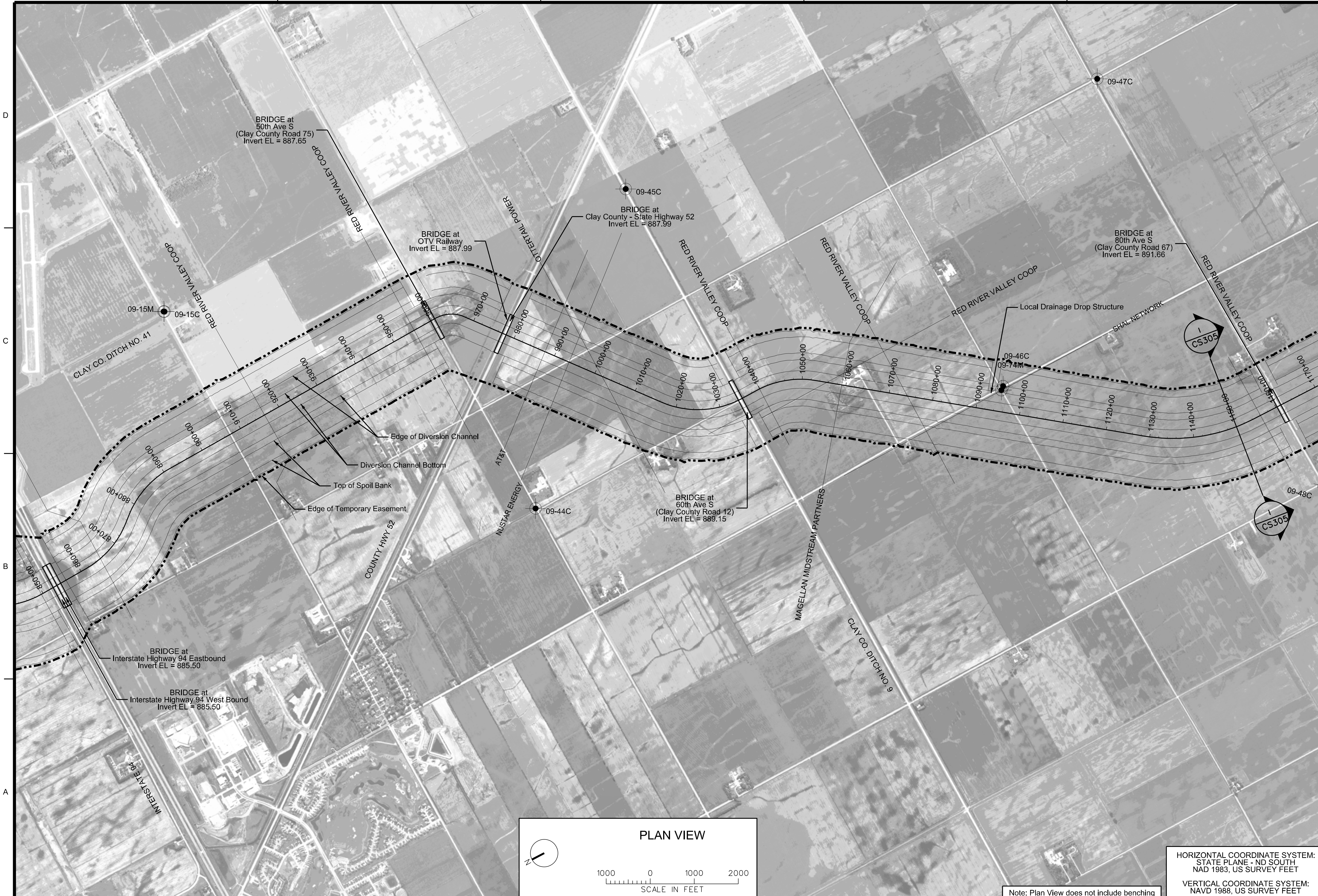
FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 4

MINNESOTA DIVERSION (FCP)

PLAN VIEW 3 OF 5

SHEET IDENTIFICATION
CS104



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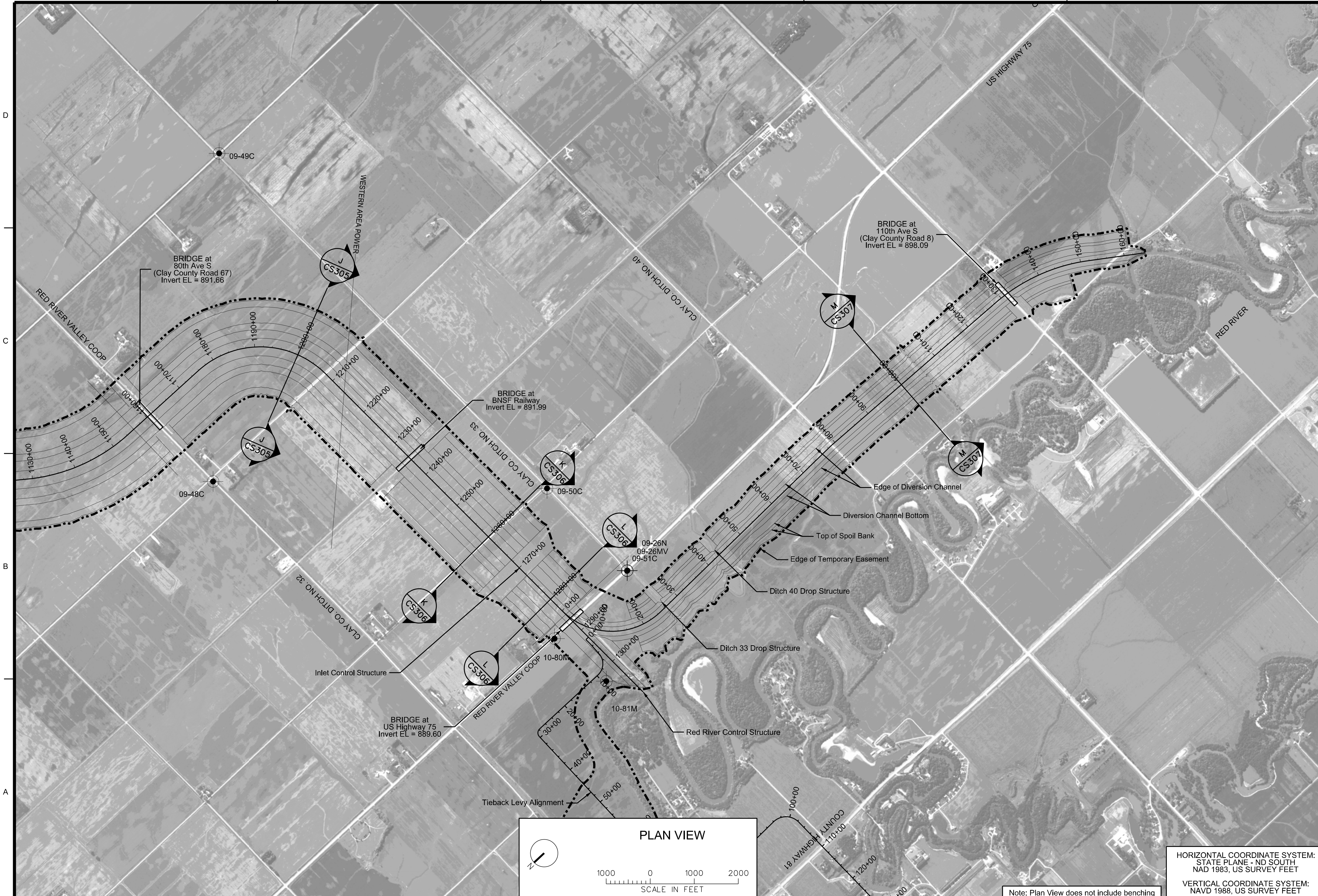
CKD BY: CGT
SOLICITATION NO.:
SUBMITTED BY: Matthew L. Isley
CONTRACT NO.:
PLOT SCALE: 1" = 1000'
PLOT DATE: 2011/02/28
FILE NUMBER:
SIZE: ANSI D
FILE NAME: FMM-CS105.dgn

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 4

MINNESOTA DIVERSION (FCP)

PLAN VIEW 4 OF 5

SHEET IDENTIFICATION
CS105



PLAN VIEW

1000 0 1000 2000
SCALE IN FEET

Note: Plan View does not include benching

HORIZONTAL COORDINATE SYSTEM:
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NAD 1983, US SURVEY FEET

VERTICAL COORDINATE SYSTEM:
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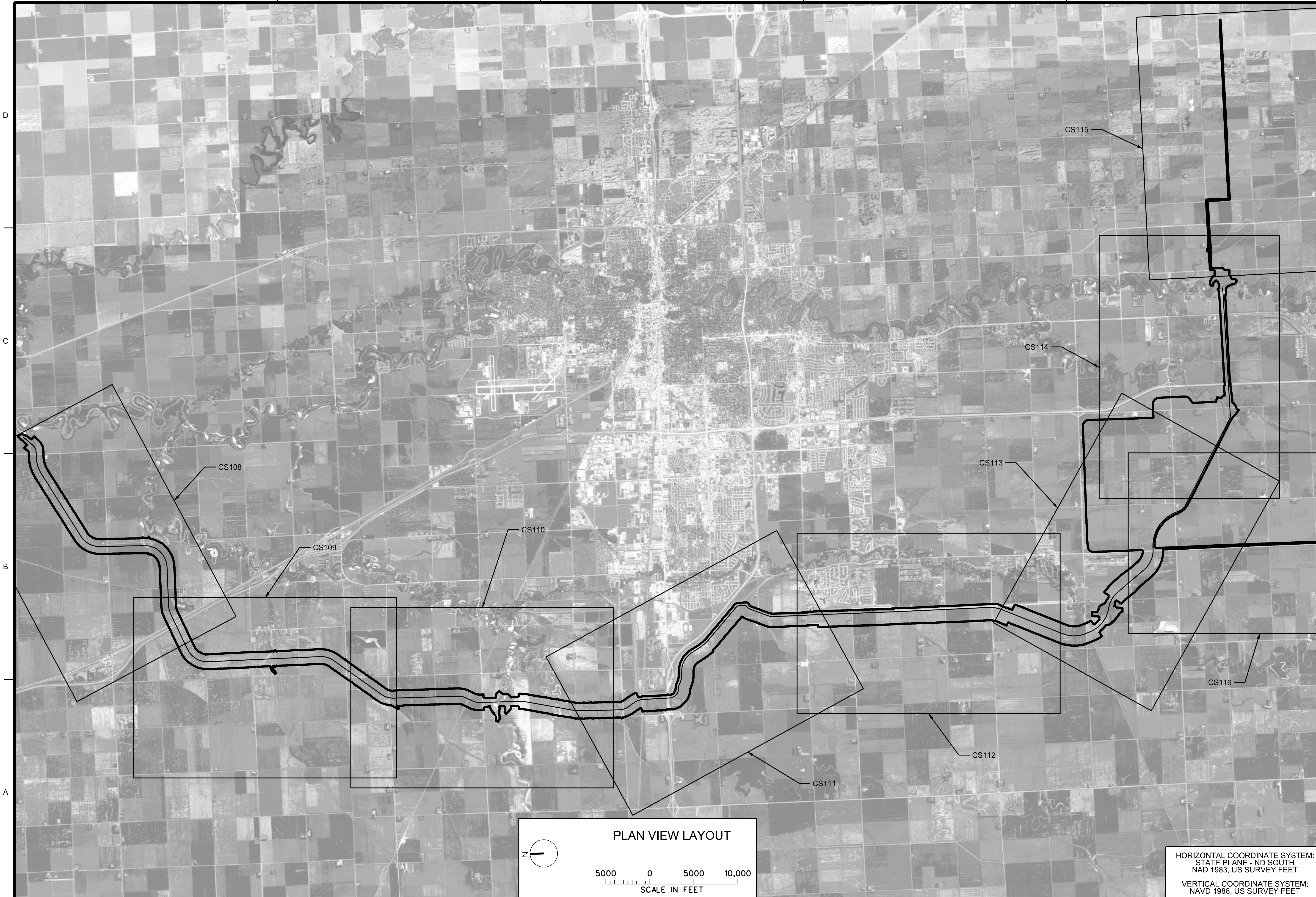
DWN BY: MJJ	CKD BY: CGT	SOLICITATION NO.:
SUBMITTED BY: Matthew L. Isley		CONTRACT NO.:
PLOT SCALE: 1" = 1000'	PLOT DATE: 2011/02/28	FILE NUMBER:
SIZE: ANSI D	FILE NAME: FMM-CS106.dgn	

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 4

MINNESOTA DIVERSION (FCP)

PLAN VIEW 5 OF 5

SHEET IDENTIFICATION
CS106



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CKD BY: CGT
SUBMITTED BY: Matthew L. Isley
PLOT SCALE: 1" = 5000'
PLOT DATE: 2011/02/28
SIZE: ANSI D
FILE NAME: FMM-CS107.dgn
DATE: 2011/02/24
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 4

NORTH DAKOTA DIVERSION (LPP)

PLAN VIEW LAYOUT

SHEET
IDENTIFICATION
CS107

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DWN BY: MLI	CKD BY: CGT	SOLICITATION NO.:
SUBMITTED BY: Matthew L. Isley		CONTRACT NO.:
PLOT SCALE: 1" = 1000'	PLOT DATE: 2011/02/28	FILE NUMBER:
SIZE: ANSI D	FILE NAME: FMM-CS108.dgn	

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 4

NORTH DAKOTA DIVERSION (LPP)

PLAN VIEW 1 OF 9

SHEET IDENTIFICATION
CS108

HORIZONTAL COORDINATE SYSTEM:
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VERTICAL COORDINATE SYSTEM:
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MARK	DESCRIPTION	DATE	APPR

DESIGNED BY: MEI/HEI		DATE: 2011/02/24	
DWN BY: MLI	CKD BY: CGT	SOLICITATION NO.:	
SUBMITTED BY: Matthew L. Isley		CONTRACT NO.:	
PLOT SCALE: 1" = 1000'	PLOT DATE: 2011/02/28	FILE NUMBER:	
SIZE: ANSI D	FILE NAME: FMM-CS109.dgn		

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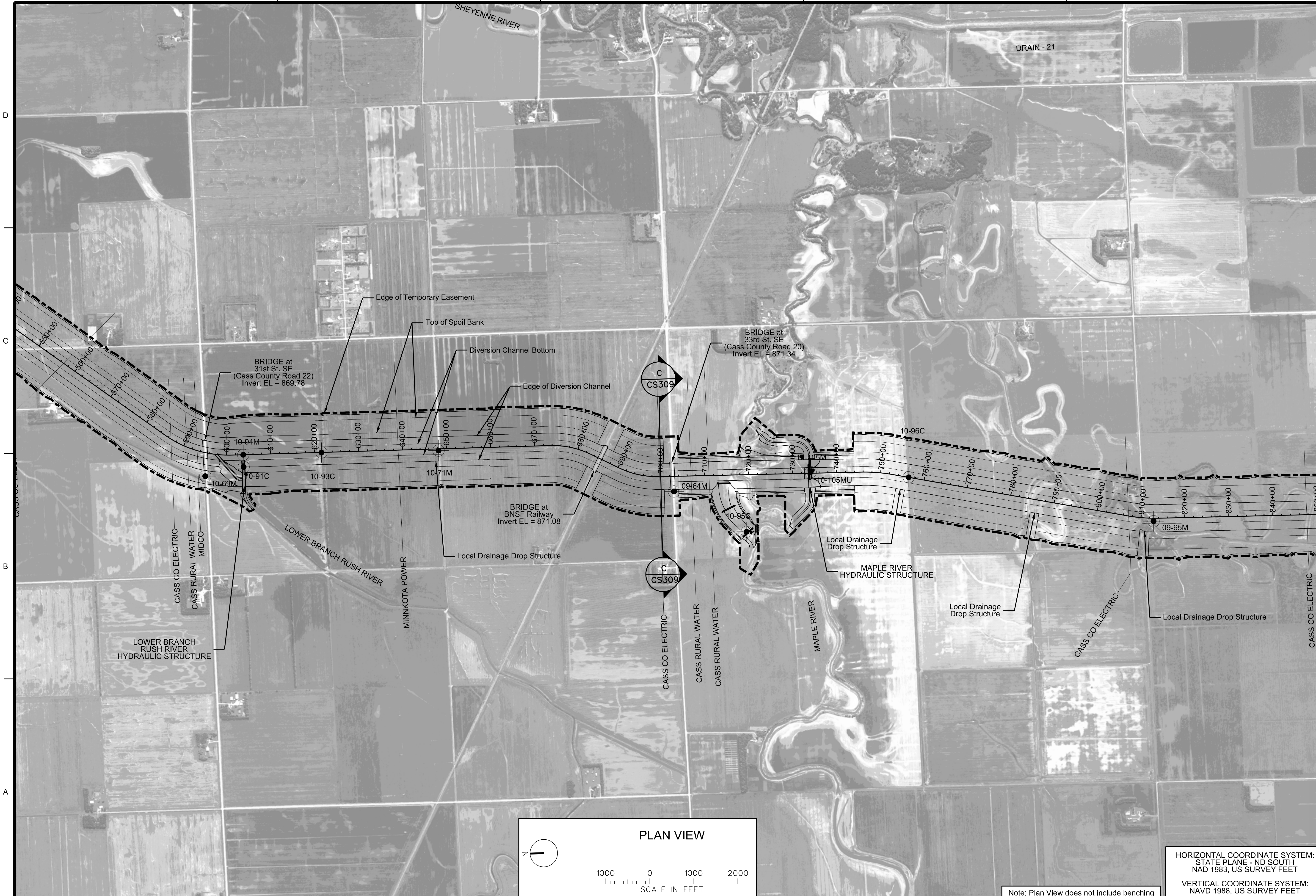
FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 4

NORTH DAKOTA DIVERSION (LPP)

PLAN VIEW 2 OF 9

SHEET IDENTIFICATION
CS109



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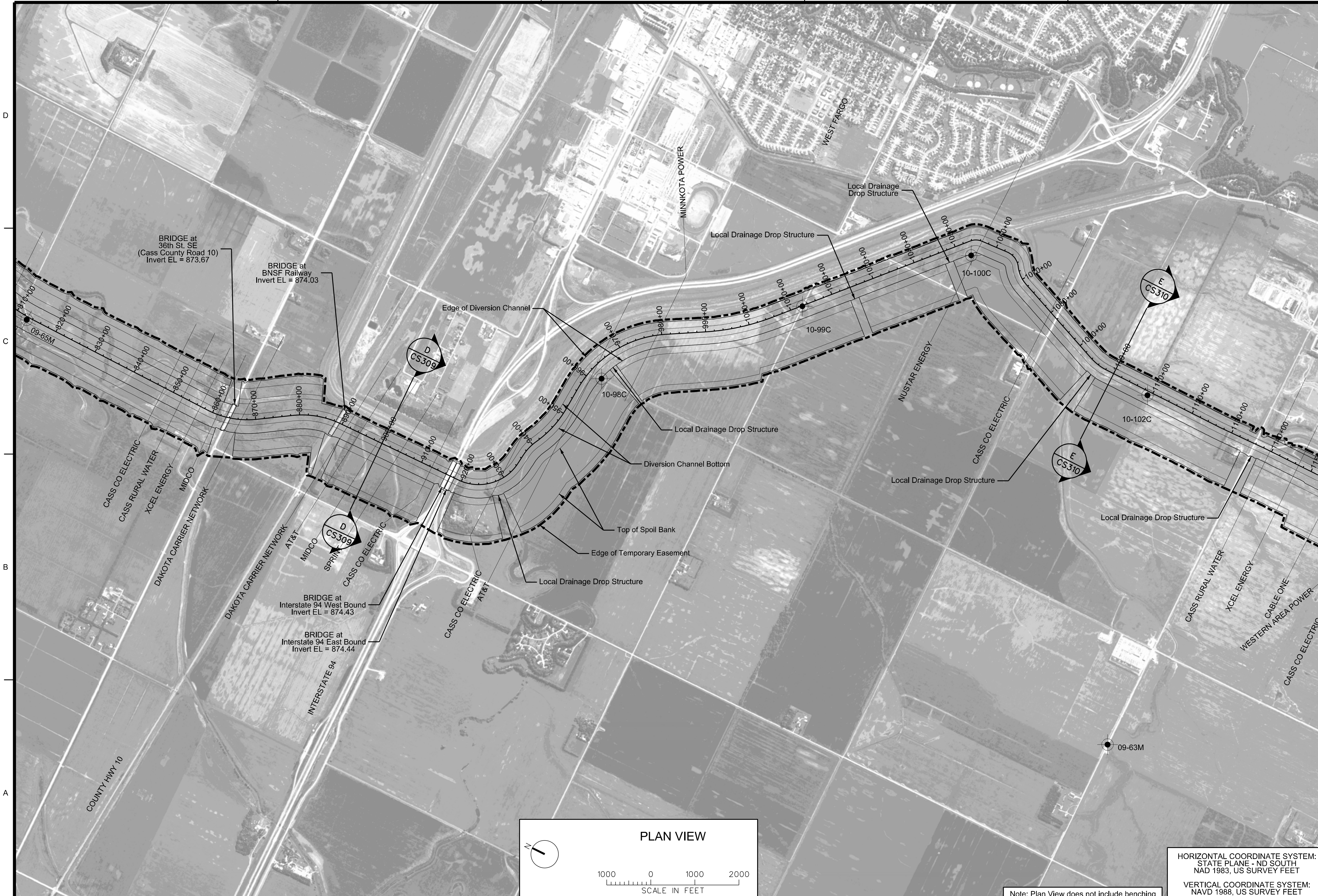
SIZE: ANSI D
FILE NAME: FMM-CS110.dgn

FARGO-MOORHEAD METRO
FEASIBILITY STUDY, PHASE 4

NORTH DAKOTA DIVERSION (LPP)

PLAN VIEW 3 OF 9

SHEET IDENTIFICATION
CS110



Note: Plan View does not include benching

HORIZONTAL COORDINATE SYSTEM:
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NAD 1983, US SURVEY FEET

VERTICAL COORDINATE SYSTEM:
NAVD 1988, US SURVEY FEET

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DWN BY: MJJ	CKD BY: CGT	CONTRACT NO.:	
SUBMITTED BY: Matthew L. Ritchey		FILE NUMBER:	
PLOT SCALE: 1" = 1000'	PLOT DATE: 2011/02/28		
SIZE: ANSI D	FILE NAME: FMM-CS111.dgn		

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NORTH DAKOTA DIVERSION (LPP)

PLAN VIEW 4 OF 9

SHEET IDENTIFICATION
CS111

PLAN VIEW

1000 0 1000 2000
SCALE IN FEET

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CKD BY: CGT
SUBMITTED BY: Matthew L. Isley
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FILE NAME: FMM-CS112.dgn
DATE: 2011/02/24
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FILE NUMBER:

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PLAN VIEW 5 OF 9

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SIZE: ANSI D	FILE NAME: FMM-CS113.dgn	

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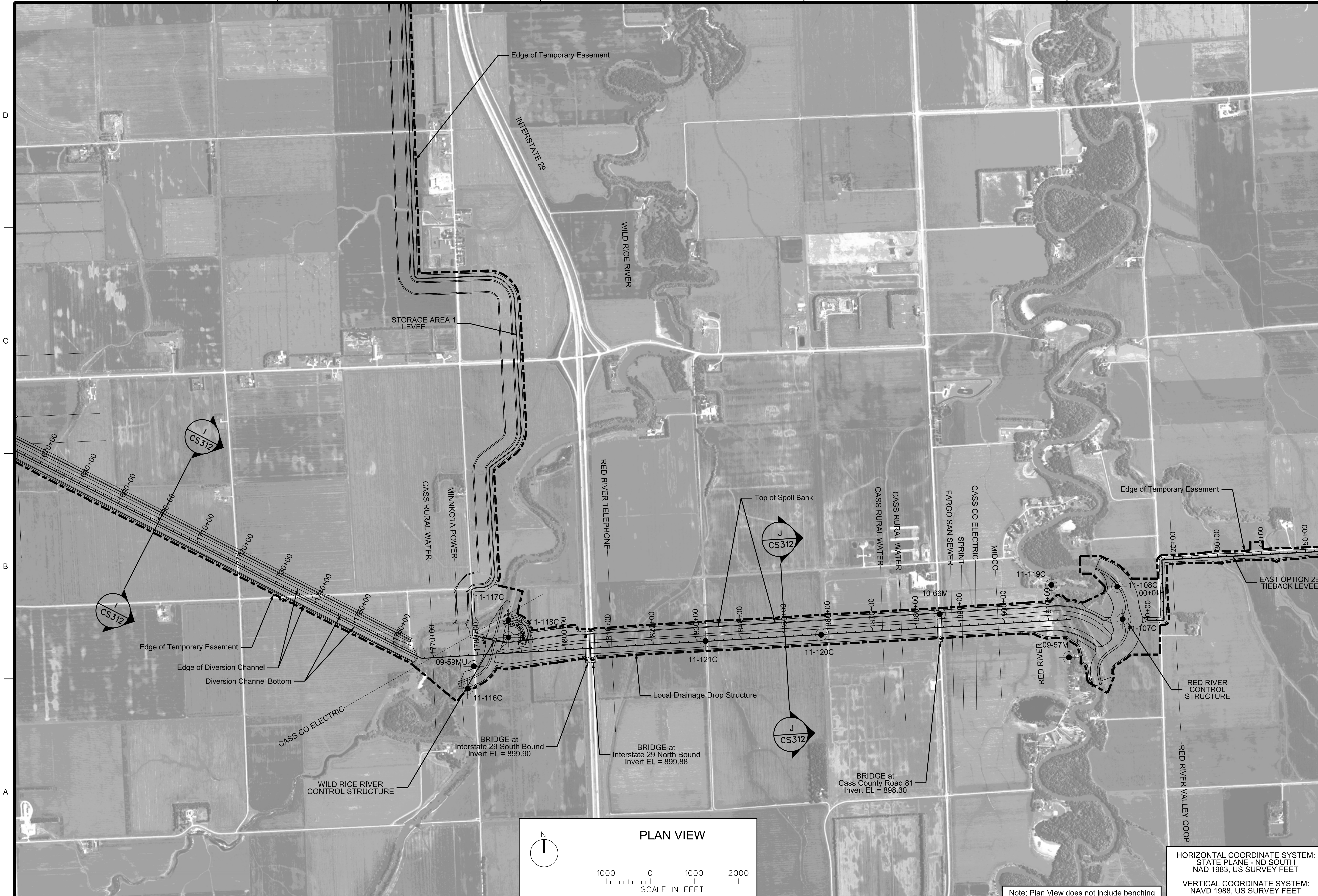
NORTH DAKOTA DIVERSION (LPP)

PLAN VIEW 6 OF 9

SHEET IDENTIFICATION
CS113



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SIZE: ANSI D	FILE NAME: FMM-CS114.dgn	

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PLAN VIEW 7 OF 9

SHEET IDENTIFICATION
CS114

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PLOT SCALE: 1" = 1000'	PLOT DATE: 2011/02/28	FILE NUMBER:
SIZE: ANSI D	FILE NAME: FMM-CS115.dgn	

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NORTH DAKOTA DIVERSION (LPP)

PLAN VIEW 8 OF 9

SHEET IDENTIFICATION
CS-115

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PLOT SCALE: 1" = 1000'	PLOT DATE: 2011/02/28	FILE NUMBER:
SIZE: ANSI D	FILE NAME: FMM-CS116.dgn	

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NORTH DAKOTA DIVERSION (LPP)

PLAN SHEET (9 OF 9)

SHEET IDENTIFICATION
CS-116