BUREAU OF RECLAMATION

Final Environmental Impact Statement

Eastern North Dakota Alternate Water Supply Project

Volume 2: Appendix A

McClusky Canal, Garrison Diversion Unit, North Dakota

Missouri Basin Region
Dakotas Area Office
Bismarck, North Dakota

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U.S. Department of the Interior

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Mission Statements

The Department of the Interior (DOI) conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Appendix A

Appraisal-Level Design Engineering Report

Eastern North Dakota Alternate Water Supply Project
Environmental Impact Statement

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APPRAISAL-LEVEL DESIGN ENGINEERING REPORT

Eastern North Dakota Alternate Water Supply

B&V PROJECT NO. 403070
B&V FILE NO. 40.7200

PREPARED FOR

BUREAU OF RECLAMATION

US Department of the Interior

15 APRIL 2020

PREPARED BY

BLACK & VEATCH

GARRISON DIVERSION

AE2S

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Acronyms and Abbreviations

AF/yr	acre feet per year
AACEI	Association for the Advancement of Cost Estimating International
AIS	aquatic invasive species
B&V, BV	Black & Veatch Corporation
BWTP	Biota Water Treatment Plant
cfs	cubic feet per second
CNDIPS	Central North Dakota Intake Pumping Station
CNDWSP	Central North Dakota Water Supply Project
CMF	cloth media filtration
CVS	Control Valve Structure
cT	contact time
CY	cubic yards
DBP	disinfection byproducts
DCB	Disinfection Contact Basin(s)
DOC	dissolved organic carbon
DS	Discharge Structure
EIS	Environmental Impact Statement
ENDAWS	Eastern North Dakota Alternate Water Supply
GAC	granular activated carbon
GDCD	Garrison Diversion Conservancy District or Garrison Diversion
GDU	Garrison Diversion Unit
GMF	granular media filtration
HBT	Hydraulic Break Tanks
HP	Horse Power
LAWA	Lake Agassiz Water Authority
MAF	million-acre feet
McIPS1	McClusky Canal Intake and Pumping Station
McIPS2	McClusky Canal Intake and Pumping Station
McMPS	McClusky Canal Main Pumping Station
McMPS1	McClusky Canal Main Pumping Station 1
McMPS2	McClusky Canal Main Pumping Station 2
MF	microfiltration
Mg-min/L	milligram minutes per liter
mg/L	milligrams per liter
MG	million gallons
mJ/cm^2	millijoules per square centimeter
MM	mile marker
MPS	Main Pumping Station

MPS1	Main Pumping Station 1
MPS2	Main Pumping Station 2
MRI	Missouri River Intake
MRIPS	Missouri River Intake and Pumping Station
msl	mean sea level
NDPDES	North Dakota Pollutant Discharge Elimination System
NDDEQ	North Dakota Department of Environmental Quality
NTU	nephelometric turbidity unit
O&M	operation and maintenance
psig	pounds per square inch gauge
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Report	Appraisal-Level Design Engineering Report
RRVWSP	Red River Valley Water Supply Project
SRP	Sediment Removal Plant
TDS	total dissolved solids
TOC	total organic carbon
UF	ultrafiltration
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
UV	ultraviolet light
UVT	ultraviolet light transmittance
VFD	Variable Frequency Drive
WAPA	Western Area Power Administration
WTP	Water Treatment Plant
yr	year

Executive Summary

ES-1 PURPOSE OF REPORT

This Appraisal-Level Design Engineering Report (Report) summarizes the design approach and assumptions used in developing each of the route options and treatment facilities for the Eastern North Dakota Alternate Water Supply (ENDAWS) Project. The engineering features, the spatial layout, and the estimated costs are presented for all ENDAWS route options, as well as the State led Red River Valley Water Supply Project (RRVWSP), and the Central North Dakota 6-mile extension to the State RRVWSP. The main objective of this Report is to provide information and data to support the development of various alternatives to be evaluated in the ENDAWS Environmental Impact Statement (EIS).

ES-2 PROJECT BACKGROUND AND OVERVIEW

To understand the basis of the ENDAWS options, this Report describes the State RRVWSP, as well the in-basin partial water option supply previously studied by Reclamation, referred to as the Central North Dakota Water Supply Project (CNDWSP).

ES-2.1 Red River Valley Water Supply Project

The State RRVWSP is a State and local project developed by the State of North Dakota by and through the Garrison Diversion Conservancy District (Garrison Diversion, GDCD), designed to meet the future municipal, rural, and industrial water needs for participating communities in central and eastern North Dakota. This is not a Federal project, nor does the Bureau of Reclamation (Reclamation) have a role in its development. The State RRVWSP provides 165 cubic feet per second (cfs) of water from the Missouri River to central and eastern North Dakota. Figure ES-1 shows the pipeline alignment and major hydraulic structures for the State RRVWSP.

Sizing and design requirements for the State RRVWSP were determined based on several variables including, but not limited to: projected water demands in 2075, source water availability/quality, the StateMod water balance model, land use requirements, and construction conditions. These considerations are detailed in this Report and in the Red River Valley Water Supply Project Preliminary Design Report (Black & Veatch, 2018).

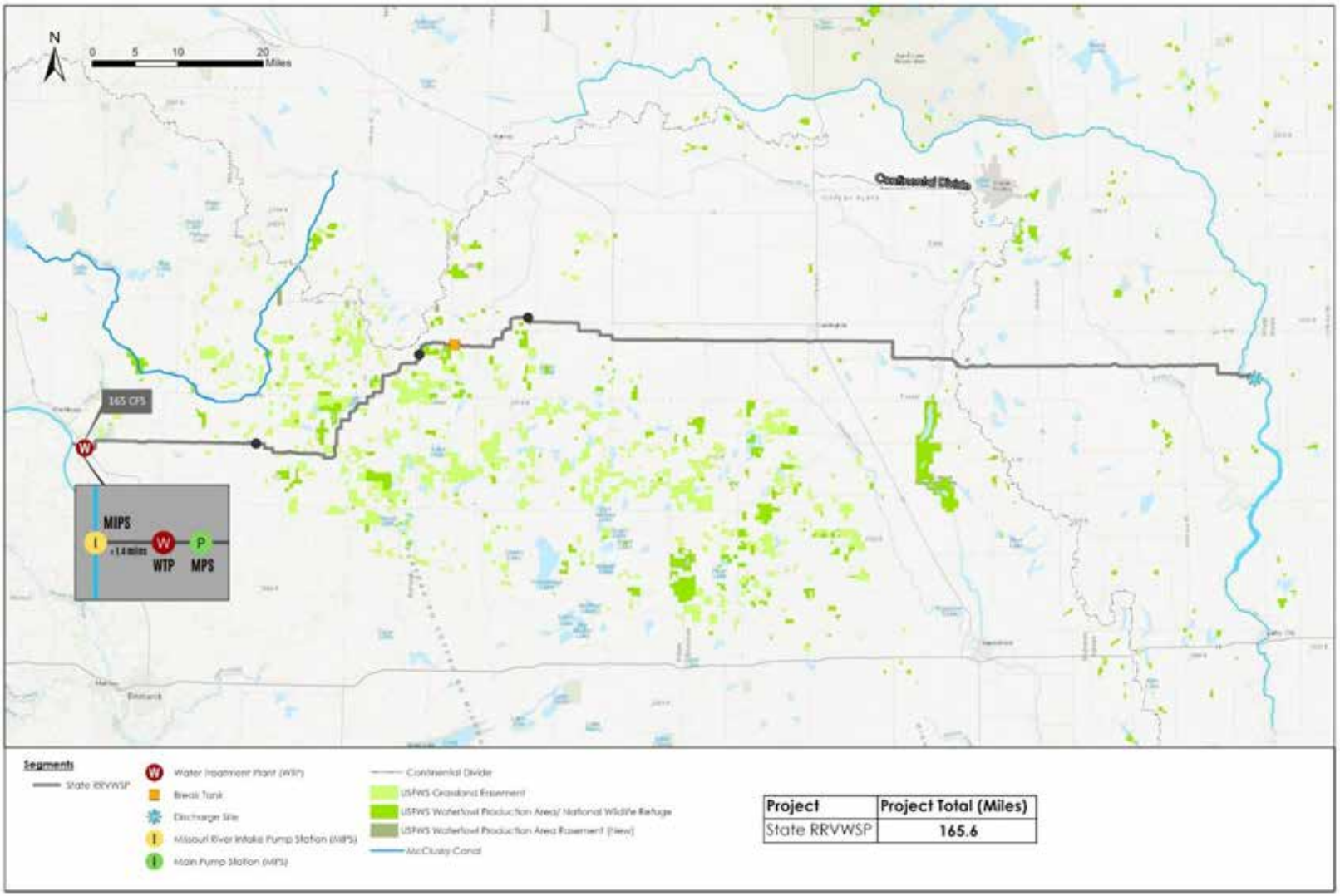
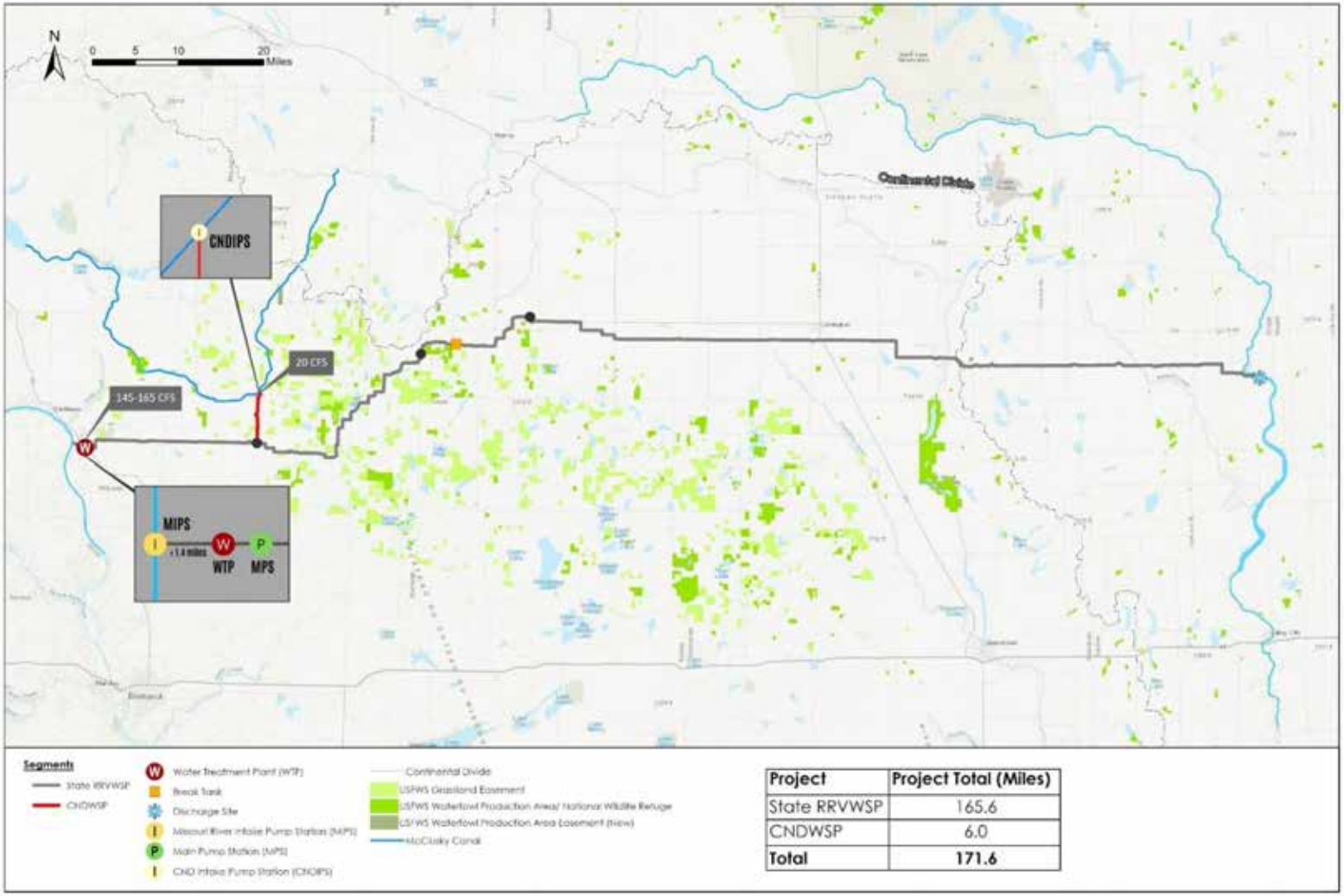


Figure ES-1 State Red River Valley Water Supply Project Map

ES-3 CENTRAL NORTH DAKOTA WATER SUPPLY PROJECT

As a potential cost-saving measure, Garrison Diversion requested a 20 cfs water service contract from the McClusky Canal to provide the portion of State RRVWSP needs that exist in the Missouri River Basin. This entailed adding an intake into the McClusky Canal and a six-mile pipeline connection between the McClusky Canal and the State RRVWSP (shown as Segment E on Figure 1-3). This intake and the additional six-mile pipeline segment are referenced in this Report as the CNDWSP. The 20 cfs of water taken from the McClusky Canal can only be supplied to users within the Missouri River Basin. Reclamation conducted an Environmental Assessment on the CNDWSP to study Garrison Diversion's request for a water service contract for 20 cfs, resulting in a Finding of No Significant Impact (FONSI) in September 2018. For the purposes of this Report, the State RRVWSP supplemented with a water supply option that provides 20 cfs from the McClusky Canal, through an intake and six-mile pipeline extension to connect to the State RRVWSP, will be referred to herein as the "State RRVWSP/CNDWSP."



Project	Project Total (Miles)
State RRVWSP	165.6
CNDWSP	6.0
Total	**171.6**

Figure ES-2 State RRVWSP/CNDWSP

ES-3.1 Eastern North Dakota Alternate Water Supply

ENDAWS was developed as an alternate water source for the State RRVWSP to use the McClusky Canal to supplement or replace the Missouri River. ENDAWS would provide an additional 145 cfs water service contract, in addition to the 20 cfs water service contract previously subjected to Reclamation's environmental review in the CNDWSP, for a total of 165 cfs. ENDAWS would include an intake on the McClusky Canal, a Biota Water Treatment Plant (BWTP), a pumping station, and a pipeline, which would terminate where it intersects with the State RRVWSP pipeline.

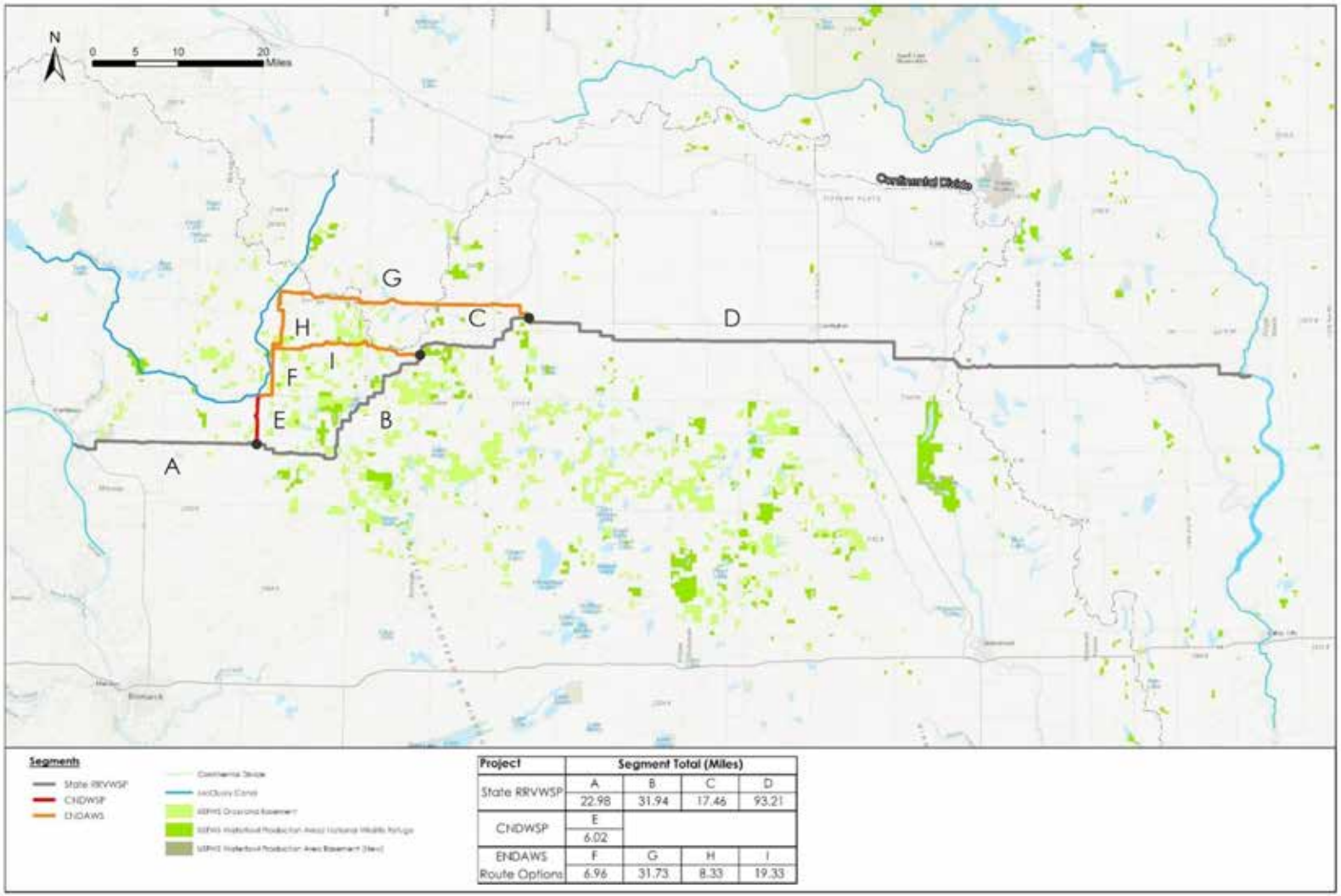
This Report identifies various ENDAWS route options, which vary in pipeline segment length and route between the intake on the McClusky Canal and the connection with the State RRVWSP. Two ENDAWS options provide redundancy by including the full State RRVWSP taking water from the Missouri River at Washburn, as well as one of the two ENDAWS connections to the McClusky Canal intake. A total of four unique ENDAWS route options have been identified in this Report using the designations of "ENDAWS Canal Only North", "ENDAWS Canal Only South"," ENDAWS Canal and River North", and "ENDAWS Canal and River South".

Route options for each of the alternatives were developed using various combinations of pipeline segments and hydraulic facilities. Figure ES-3 names the various pipeline segments used throughout this Report. The State RRVWSP consists of segments A, B, C, and D. The CNDWSP is depicted as segment E, which connects the McClusky Canal to the State RRVWSP. The ENDAWS project includes various combinations of pipeline segments. F, G, H, and I, which also connect the McClusky Canal to the State RRVWSP.

The various facilities described in this report include: pump stations, treatment facilities, and hydraulic control structures. Similarly, to the use of pipeline segments, each route alternative developed for this analysis uses a specific combination of hydraulic facilities to meet the design requirements detailed in this Report and in the Red River Valley Water Supply Project Preliminary Design Report.

ES-4 ROUTE OPTIONS OVERVIEW AND SUMMARY

This section provides an overview of each of the route options developed for this Report along with an overall summary of the pipeline and facility components associated with each route option. Components included in each route option are shown in Table ES-1.



Project	Segment Total (Miles)			
State RRVWSP	A	B	C	D
	22.98	31.94	17.46	93.21
CNDWSP	E			
	6.02			
ENDAWS Route Options	F	G	H	I
	6.96	31.73	8.33	19.33

Figure ES-3 Pipeline Segments and Route Names

Table ES-1 Summary of Components Included in Each Project or Route Option

Major Components	Abbrev.	Estimated Size	Alterantive/Route Option					
			CNDWSP	RRVWSP	Canal Only North	Canal Only South	Canal & River North	Canal & River South
Pipeline Segment A	Seg A	23.0 miles/72-inch	•	•			•	•
Pipeline Segment B	Seg B	31.9 miles/72-inch	•	•				
Pipeline Segment C	Seg C	17.5 miles/72-inch	•	•		•		•
Pipeline Segment D	Seg D	93.2 miles/72-inch	•	•	•	•	•	•
Pipeline Segment E	Seg E	6.0 miles/30-inch	•					
Pipeline Segment E	Seg E	6.0 miles72-inch					♦	♦
Pipeline Segment F	Seg F	7.0 miles/72-inch					♦	♦
Pipeline Segment G	Seg G	31.7 miles/72-inch			♦		♦	
Pipeline Segment H	Seg H	8.3 miles72-inch					♦	
Pipeline Segment I	Seg I	19.3 miles/72-inch				♦		♦
Missouri River Intake and Pumping Station	MRIPS	165 cfs	•	•			•	•
Water Treatment Plant (State)	WTP	165 cfs	•	•				
Sedimentation Treatment Plant (State)	SRP	165 cfs					•	•
Main Pumping Station *(to Break Tanks)*	MPS1	165 cfs	•	•				
Main Pumping Station *(to BWTP)*	MPS2	165 cfs					•	•
Central North Dakota Intake & Pump Station	CNDIPS	20 cfs	•					
McClusky Canal Intake Pumping Station (MM 57)	McIPS1	165 cfs			♦		♦	
McClusky Canal Intake Pumping Station (MM 49)	McIPS2	165 cfs				♦		♦
Biota Water Treatment Plant (federal)	BWTP	165 cfs			♦	♦	♦	♦
McClusky Canal Main Pumping Station (MM 57)	McMPS1	165 cfs			♦		♦	
McClusky Canal Main Pumping Station (MM 49)	McMPS2	165 cfs				♦		♦
Hydraulic Break Tanks	HBT	Two 5 MG Tanks	•	•	•	•	•	•
Control Valve Structure and Discharge Structure	CVS	145 cfs	•	•	•	•	•	•

• - Included in "No Action" Alternative
♦ - ENDAWS Route Option Component

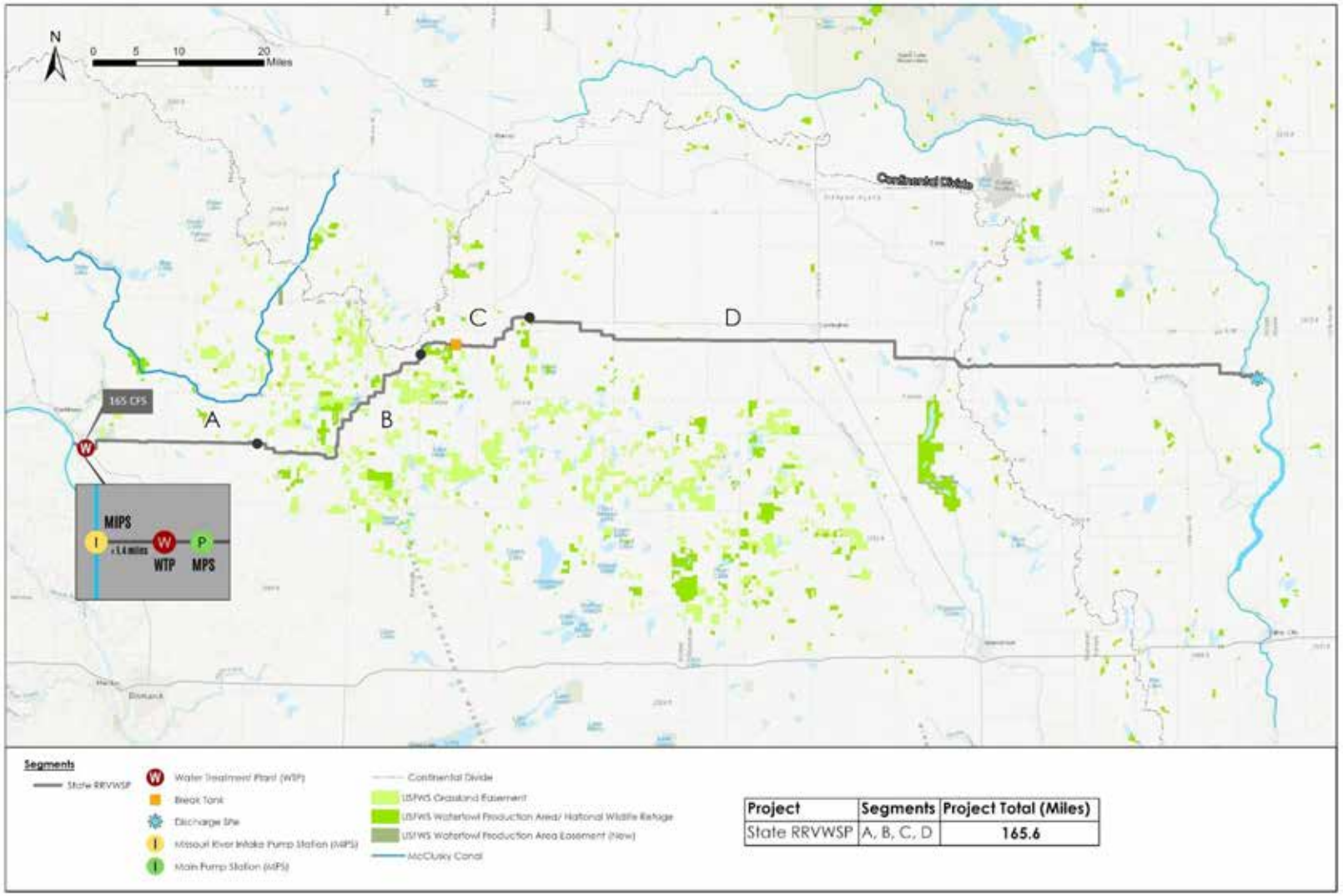
Opinions of probable construction and Operation and Maintenance (O&M) costs were developed as part of this report. Construction costs include labor, equipment, materials, incidentals, and appurtenances required to comply with typical Reclamation construction specifications. The construction costs summarized in this Report also include mobilization, unlisted costs, contract costs, contingencies, and non-contract costs. O&M costs include power and chemicals. The labor and materials with O&M were not included as they are similar for each option. Power costs for State RRVWSP and State RRVWSP/CNDWSP are based on expected power rates for large industrial users. Power costs for the rest of the ENDAWS route options assume that the cost of power is based on rates from the Western Authority Power Authority preferred rates per the requirements of the Dakota Water Resource Act Section 6.

In addition, EDAWS Biota Water Treatment Plant Report presented a range of BWTP options and costs as shown below.

Option	Construction Cost	Annual O&M
A	$56M	$3,500,000
B	$70M	$4,100,000
C	$220M	$8,400,000
D	$240M	$9,400,000

ES-4.1 State Red River Valley Water Supply Project Alternative (Current State Plan)

This alternative (Figure ES-4) is the current State RRVWSP. It includes a raw water intake and pump station on the Missouri River south of Washburn, ND. The Missouri River Intake and Pumping Station (MRIPS) facility will pump 165 cfs of water to a State Water Treatment Plant (WTP) approximately two miles east of the intake. The peak flow rate of 165 cfs will provide 20 cfs to central North Dakota users in the MRB from the pipeline, 5 cfs to users on the pipeline after the continental divide between the MRB and Hudson Bay Basin (HBB), and 140 cfs to the Sheyenne River above Lake Ashtabula. Main Pumping Station 1 (MPS1) adjacent to the State WTP will pump to a set of Hydraulic Break Tanks (HBT) located approximately 60 miles east. Water will then flow by gravity from the HBT to the Control Valve Structure (CVS) and Discharge Structure (DS) on the Sheyenne River approximately six miles south of Cooperstown, ND. The State RRVWSP includes pipeline segments A, B, C, and D, totaling 165.6 miles in length. The proposed pipeline is 72 inches in diameter.



Project	Segments	Project Total (Miles)
State RRVWSP	A, B, C, D	165.6

Figure ES-4 State RRVWSP Layout

The estimated capital cost is shown on Table ES-2.

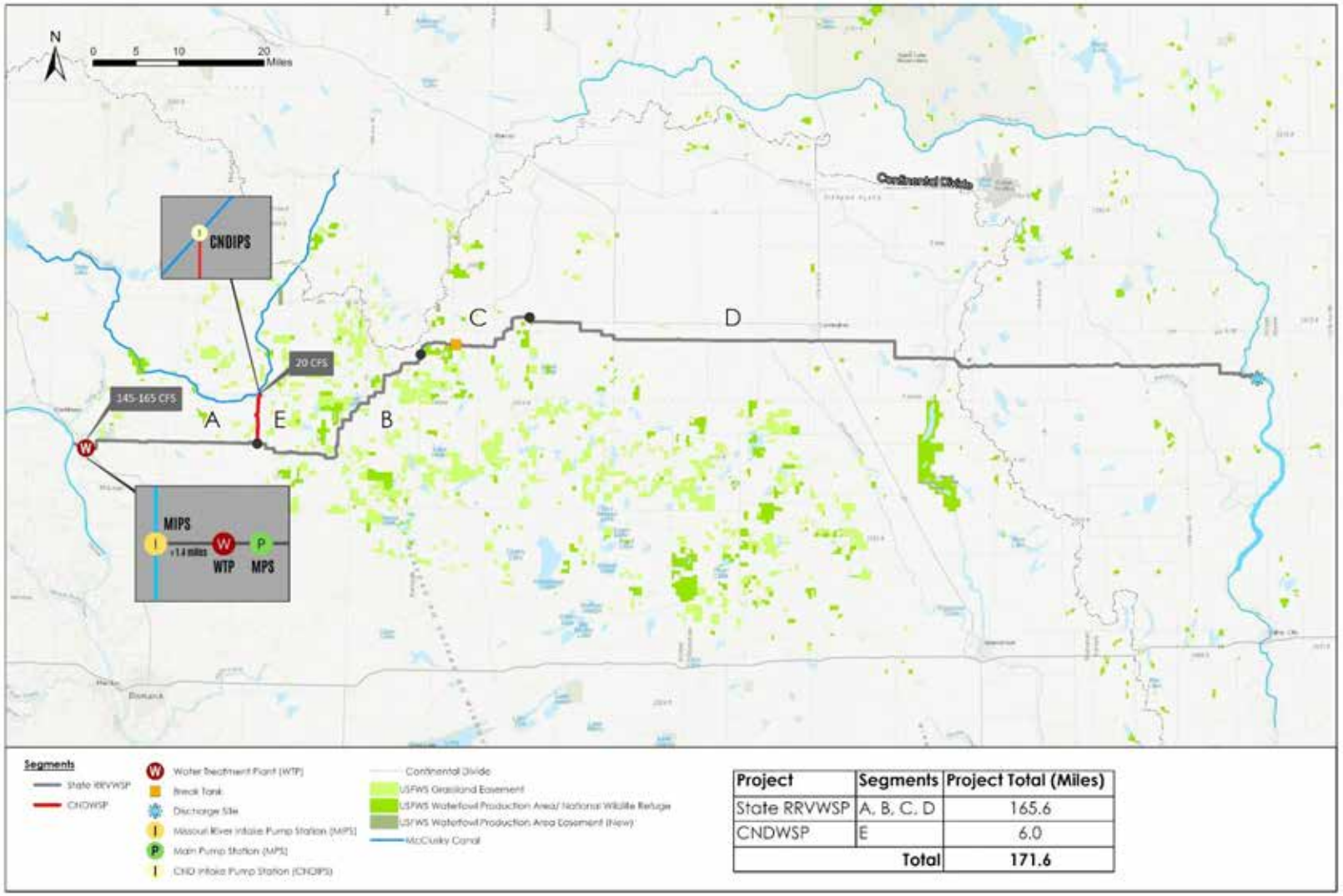
Table ES-2 State RRVWSP Estimated Cost Summary

	Size	Capital Cost
State Components		
MRIPS	165 cfs/2,000 HP	$57,773,000
WTP (state)	165 cfs	$38,555,000
MPS1	165 cfs/20,000 HP	$36,908,000
HBT	10 MG	$16,507,000
CVS & DS	140 cfs	$9,963,000
Pipeline Seg. A	72-inch	$130,210,000
Pipeline Seg. B	72-inch	$168,213,000
Pipeline Seg. C	72-inch	$91,939,000
Pipeline Seg. D	72-inch	$544,020,000
Totals		**$1,094,000,000**

ES-4.2 Central North Dakota Water Supply Project Alternative (Together with RRVWSP Represents No Action Alternative)

This alternative (Figure ES-5) was previously evaluated and approved by Reclamation under the CNDWSP FOSI. CNDWSP provides 20 cfs of raw water from the McClusky Canal at Mile Marker (MM) 42.5 for in-basin use within Central North Dakota. A combined State RRVWSP/CNDWSP can provide 145 cfs from the Missouri River for out-of-basin users, with an additional 20 cfs more economically provided at appropriate times from the Canal if needed for in-basin uses. When out-of-basin water supplies are needed, the CNDWSP will not operate and the State RRVWSP will provide up to 165 cfs from the Missouri River.

The CNDWSP is connected to the State RRVWSP with a 6-mile long, 30-inch diameter pipeline (Segment E). The CNDWSP includes a Central North Dakota Intake and Pumping Station (CNDIPS) located on the McClusky Canal near MM 42.5 that will pump 20 cfs to the HBT. When combined with the State RRVWSP pipeline segments A, B, C, and D, the total pipeline length is 171.7 miles.



Project	Segments	Project Total (Miles)
State RRVWSP	A, B, C, D	165.6
CNDWSP	E	6.0
	Total	171.6

Figure ES-5 State RRVWSP with CNDWSP Layout

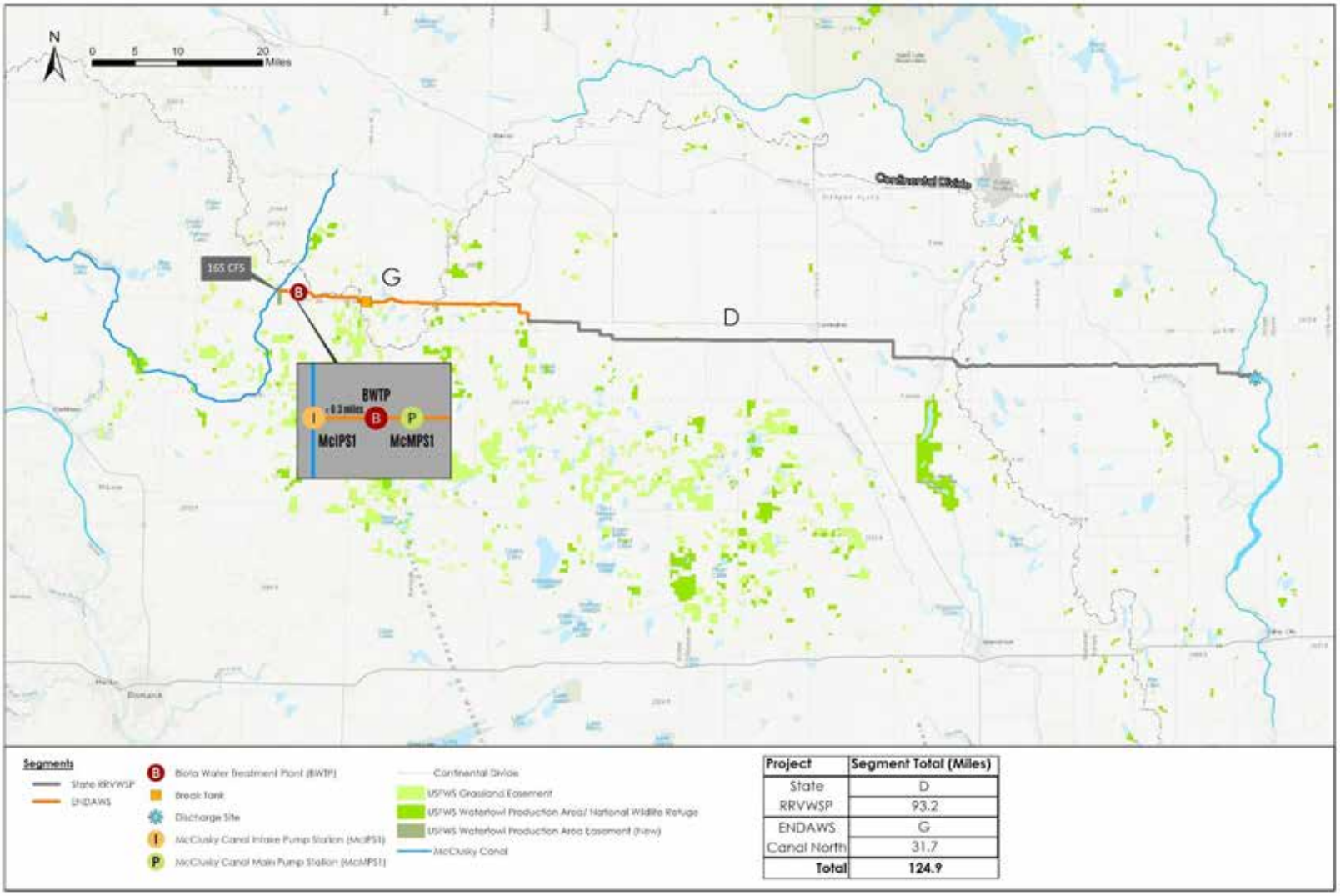
Table ES-3 presents the estimated capital cost.

Table ES-3 State RRVWSP/CNDWSP Estimated Cost Summary

	Size	Capital Cost
State Components		
MRIPS	145 cfs/2,000 HP	$57,773,000
WTP (state)	165 cfs	$38,555,000
MPS1	145 cfs/20,000 HP	$36,908,000
HBT	10 MG	$16,507,000
CVS & DS	140 cfs	$9,963,000
Pipeline Seg. A	72-inch	$130,210,000
Pipeline Seg. B	72-inch	$168,213,000
Pipeline Seg. C	72-inch	$91,939,000
Pipeline Seg. D	72-inch	$544,020,000
Subtotal		$1,094,088,000
CNDWSP Components		
CNDIPS	20 cfs/2,100 HP	$8,662,000
Pipeline Seg. E	30-inch	$15,506,000
Subtotal		**$24,168,000**
Totals		**$1,118,000,000**

ES-4.3 ENDAWS Route Option Canal Only North

This ENDAWS route option (Figure ES-6) would provide 165 cfs from the McClusky Canal approximately 1.5 miles northwest of McClusky, ND near MM 57. The McClusky Canal Intake and Pumping Station 1 (McIPS1) would pump water from the McClusky Canal to a BWTP immediately adjacent to the intake facilities. The McClusky Canal Main Pumping Station 1 (McMPS1) downstream of the BWTP will pump approximately 10.5 miles east to relocated HBT from the State RRVWSP HBT near the intersection of ND Highway 14 and ND Highway 200, then flow by gravity 21.2 miles to the intersection with the State RRVWSP. The State RRVWSP continues to the CVS and DS on the Sheyenne River approximately 6 miles southeast of Cooperstown, ND. This ENDAWS route option includes pipeline segment G. When combined with the pipeline segment D from the State RRVWSP, the pipeline totals 124.9 miles in length. The proposed pipeline is 72 inches in diameter.



Project	Segment Total (Miles)
State RRVWSP	D 93.2
ENDAWS	G
Canal North	31.7
Total	**124.9**

Figure ES-6 ENDAWS Route Option Canal Only North Layout

Table ES-4 shows the estimated capital cost.

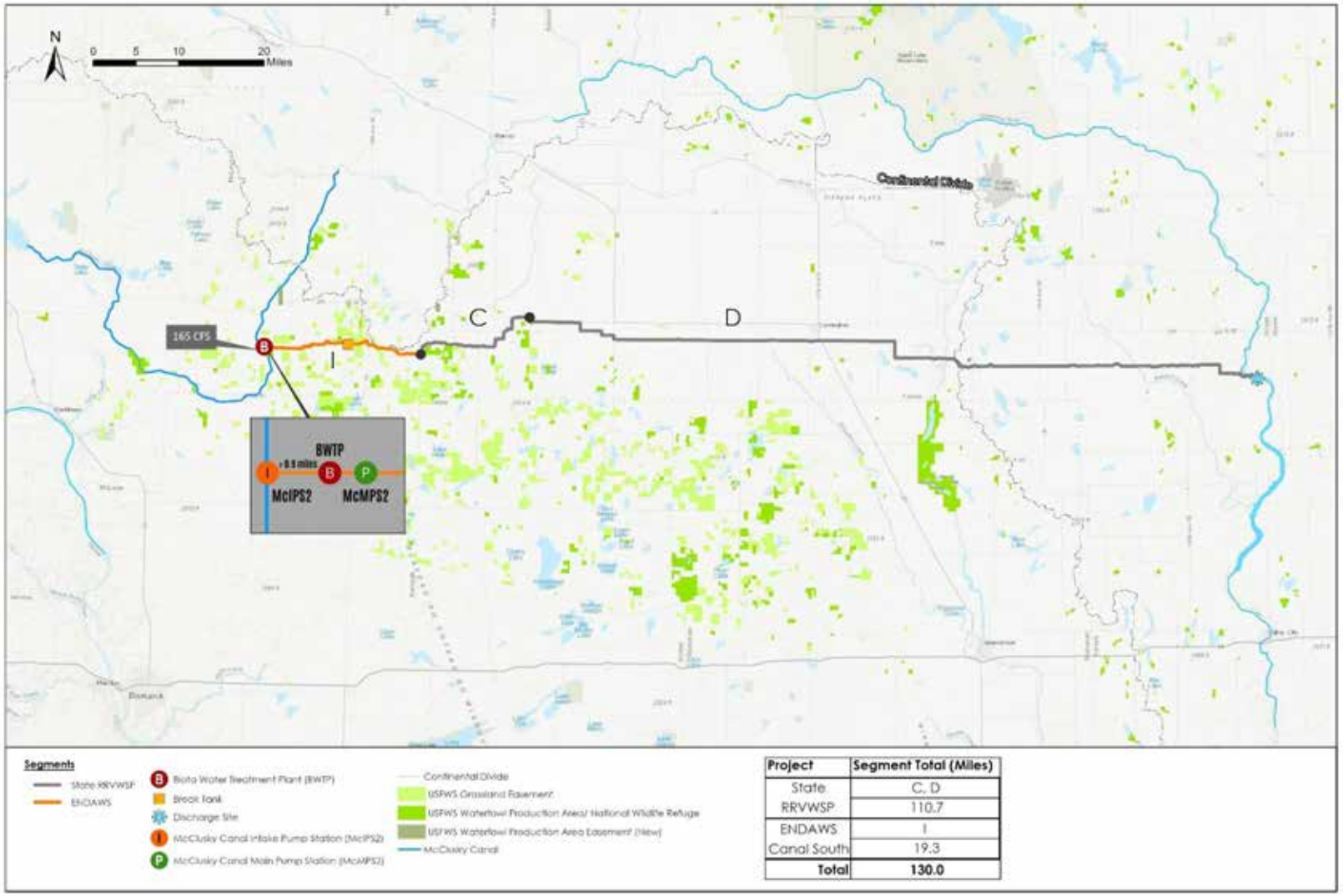
Table ES-4 ENDAWS Route Option McClusky Canal North Estimated Cost Summary

	Size	Capital Cost
Route Components		
McIPS1	165 cfs/2,000 HP	$28,246,000
McMPS1	165 cfs/20,000 HP	$34,545,000
Pipeline Seg. G	72-inch	$189,735,000
Subtotal		$252,526,000
Common Components		
HBT	10 MG	$16,461,000
CVS & Discharge Structure	140 cfs	$9,963,000
Pipeline Seg. D	72-inch	$544,020,000
Subtotal		**$570,444,000**
Totals(1)		**$823,000,000**

(1) Route Option Total does not include BWTP capital cost. Route Option Total increases to $879M with BWTP Option #1; $893M with BWTP Option #2; $1,043M with BWTP Option #3; and $1,063M with BWTP Option #4.

ES-4.4 ENDAWS Route Option Canal Only South

This ENDAWS route option (Figure ES-7) would provide 165 cfs from the McClusky Canal approximately 6 miles southwest of McClusky, ND near MM 49 on the McClusky Canal. The McClusky Canal Intake and Pumping Station 2 (McIPS2) would pump water from the McClusky Canal to a BWTP approximately one mile east of the intake facilities. The McClusky Canal Main Pumping Station 2 (McMPS2) adjacent to the BWTP will pump approximately 19.3 miles to the intersection with segment C of the State RRVWSP and then continue another 5.7 miles east to the HBT from the State RRVWSP. Water will then flow by gravity from the HBT to the State RRVWSP CVS and DS on the Sheyenne River approximately 6-miles south of Cooperstown, ND. This ENDAWS route option includes pipeline segment I. When combined with segments C and D from the State RRVWSP, the pipeline totals 130.0 miles in length. The proposed pipeline is 72 inches in diameter.



Project	Segment Total (Miles)
State RRVWSP	C, D 110.7
ENDAWS	I
Canal South	19.3
Total	**130.0**

Figure ES-7 ENDAWS Route Option Canal Only South Layout

Table ES-5 shows the estimated capital cost associated with the ENDAWS Canal Only South route option.

Table ES-5 ENDAWS Route Option McClusky Canal South Estimated Cost Summary

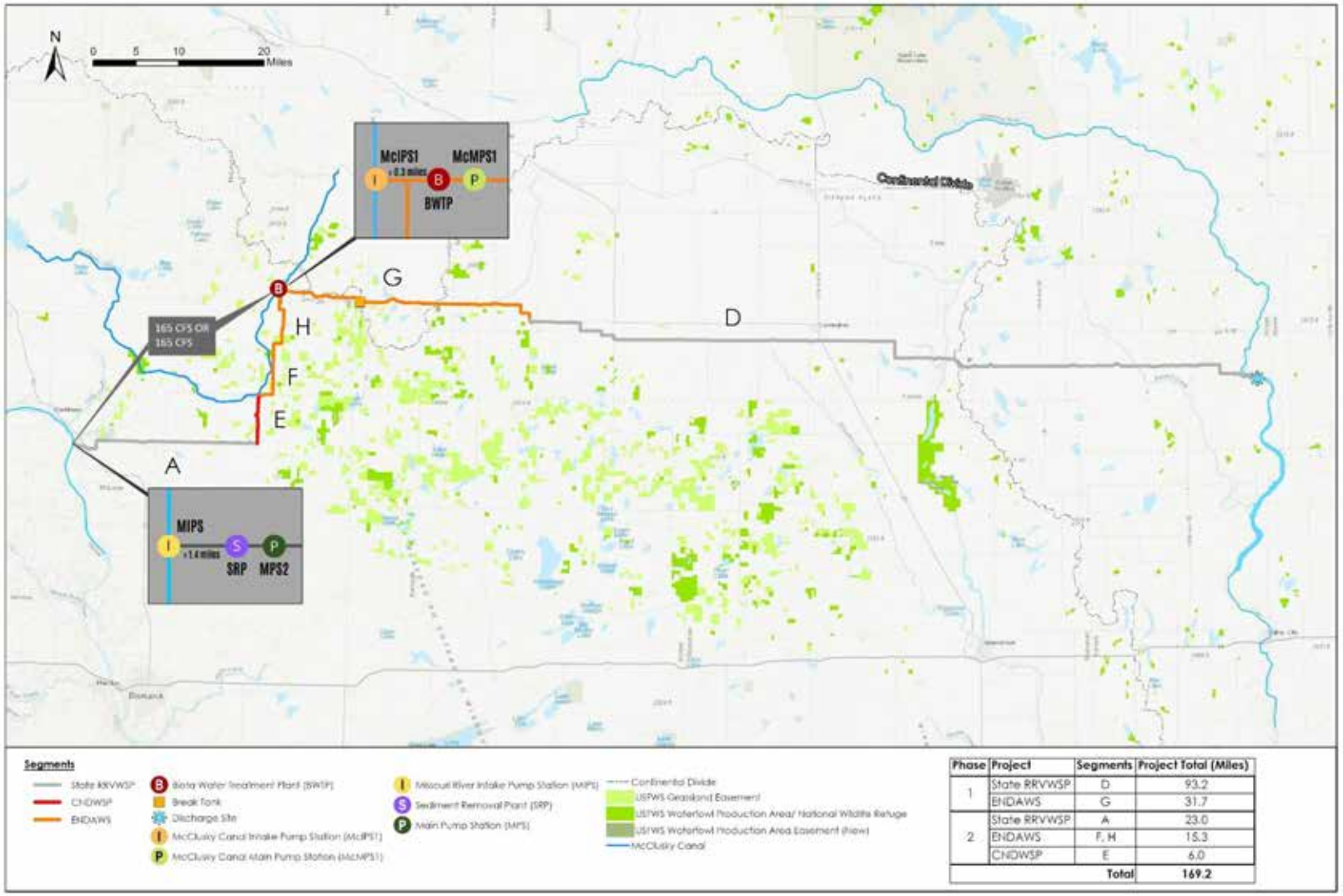
	Size	Capital Cost
Route Components		
McIPS2	165 cfs/2,000 HP	$31,953,000
McMPS2	165 cfs/20,000 HP	$35,258,000
Pipeline Seg. I	72-inch	$103,307,000
Subtotal		$170,518,000
Common Components		
HBT	10 MG	$16,778,000
CVS & DS	140 cfs	$9,963,000
Pipeline Seg. C	72-inch	$91,939,000
Pipeline Seg. D	72-inch	$544,020,000
Subtotal		**$662,700,000**
Totals(1)		**$833,000,000**

(1) Route Option Total does not include BWTP capital costs. Route Option Total increases to $889M with BWTP Option #1; $903M with BWTP Option #2; $1,053M with BWTP Option #3; and $1,073M with BWTP Option #4.

ES-4.5 ENDAWS Route Option Canal and Missouri River North

This ENDAWS route option (Figure ES-8), when combined with the State RRVWSP/CNDWSP, would provide full redundancy by either taking 165 cfs from the McClusky Canal near MM 57 (approximately 1.5 miles northwest of McClusky, ND), or taking 165 cfs from the Missouri River south of Washburn, ND, or any combination thereof, for a maximum total of 165 cfs. The pipeline diameter for segments C and D of the State RRVWSP limit the total capacity of water crossing the continental divide to 165 cfs, with two alternative water sources developed to provide this full capacity under this ENDAWS option. Phase 1 would develop the facilities required to utilize the McClusky Canal, and Phase 2 would develop the facilities needed to utilize the Missouri River. For utilization of the McClusky Canal, a McIPS1 near MM 57 would pump water from the McClusky Canal to a BWTP immediately adjacent to the Canal. To utilize the Missouri River, the MRIPS facility would pump 165 cfs of water to a Sediment Removal Plant (SRP) approximately 2 miles east of the intake. The SRP is intended to provide sand/grit removal only. After grit removal, the Main Pumping Station 2 (MPS2) will pump to the BWTP adjacent to the McClusky Canal. The McMPS1 adjacent to the BWTP will pump approximately 10.5 miles east to the relocated HBT from the State RRVWSP near the intersection of ND Highway 14 and ND Highway 200, then flow by gravity 21.2 miles to the intersection with the State RRVWSP. The State RRVWSP continues to the CVS and DS on the Sheyenne River approximately 6 miles southeast of Cooperstown, ND.

In Phase 1, this route option will utilize ENDAWS pipeline segments G and the State RRVWSP segment D, totaling 124.9 miles in length. Phase 2 will utilize State RRVWSP pipeline segment A, CNDWSP pipeline segment E, and ENDAWS pipeline segments F and H, totaling 44.3 miles. The total pipeline system for this route option is 169.3 miles. All proposed pipelines are 72 inches in diameter.



Phase	Project	Segments	Project Total (Miles)
1	State RRVWSP	D	93.2
	ENDAWS	G	31.7
2	State RRVWSP	A	23.0
	ENDAWS	F, H	15.3
	CNDWSP	E	6.0
		Total	169.2

Figure ES-8 ENDAWS Route Option Canal and Missouri River North Layout

Table ES-6 shows the estimated capital cost for this option. The estimated costs are broken out by the phases described previously.

Table ES-6 ENDAWS Route Alternative McClusky Canal and Missouri River North Estimated Cost Summary

Phase 1	Size	Capital Cost
ENDAWS Route Option Components		
McIPS1	165 cfs/2,000 HP	$28,246,000
McMPS1	165 cfs/20,000 HP	$34,545,000
Pipeline Seg. G	72-inch	$189,735,000
Subtotal		**$252,526,000**
State RRVWSP Components		
HBT	10 MG	$16,461,000
CVS & DS	140 cfs	$9,963,000
Pipeline Seg. D	72-inch	$544,020,000
Subtotal		**$570,444,000**
Phase 1 Subtotals		**$823,000,000**
Phase 2		
ENDAWS Route Option Components		
Pipeline Seg. E	72-inch	$43,971,000
Pipeline Seg. F	72-inch	$35,673,000
Pipeline Seg. H	72-inch	$51,702,000
Subtotal		**$131,346,000**
State RRVWSP Components		
MRIPS	165 cfs	$57,773,000
SRP	165 cfs	$12,976,000
MPS2	165 cfs	$36,114,000
Pipeline Seg. A	72-inch	$130,210,000
Subtotal		**$237,073,000**
Phase 2 Subtotals		**$368,419,000**
Totals(1)		**$1,191,000,000**

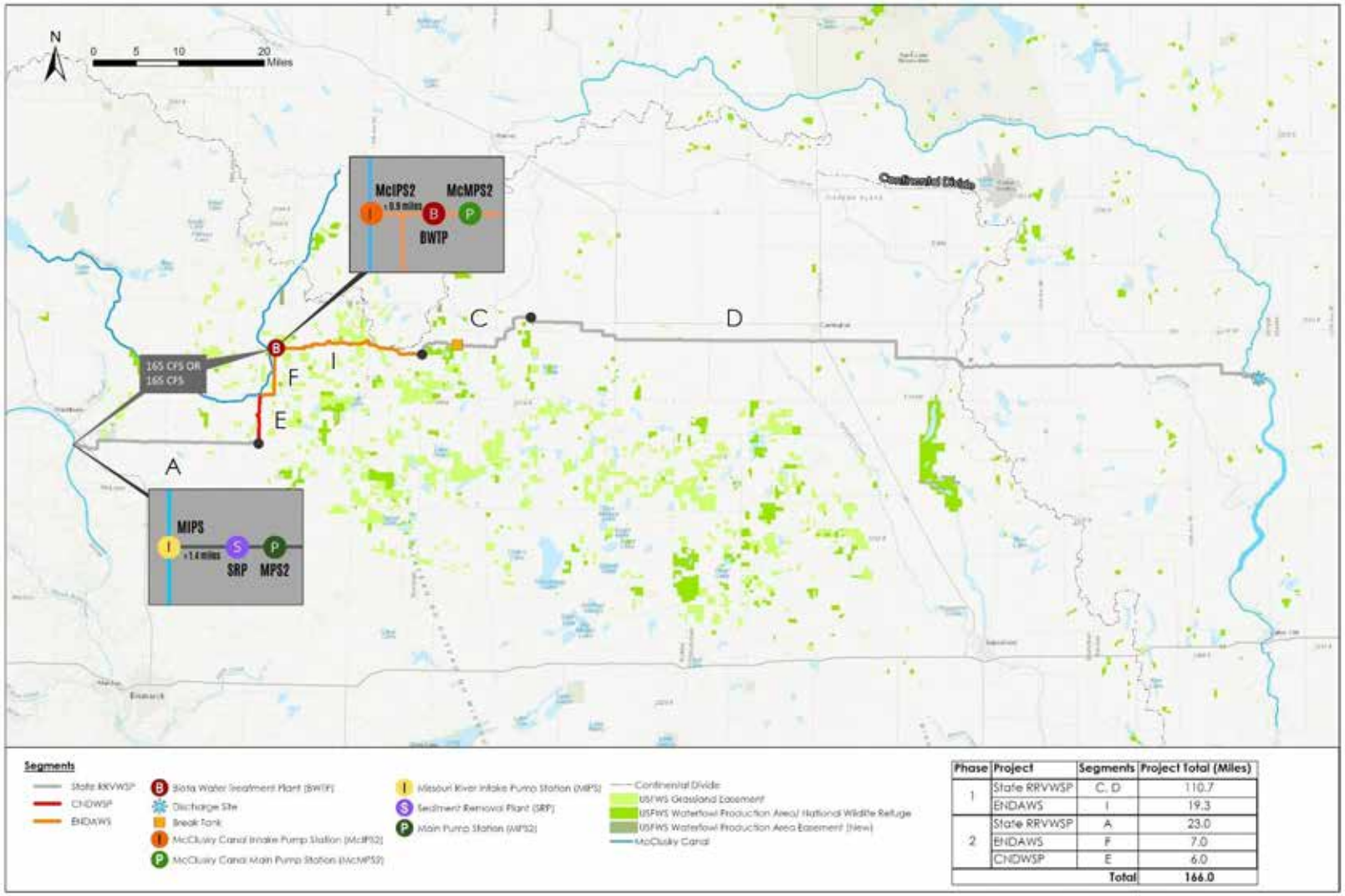
(1) Route Option Total does not include BWTP capital costs. Route Option Total increases to $1,247M with BWTP Option #1; $1,261M with BWTP Option #2; $1,411M with BWTP Option #3; and $1,431M with BWTP Option #4.

ES-4.6 ENDAWS Route Option Canal and Missouri River South

This ENDAWS route option (Figure ES-9) also would provide full redundancy by taking 165 cfs from near MM 49 on the McClusky Canal approximately 6 miles southwest of McClusky, ND, taking 165 cfs from the Missouri River south of Washburn, ND, or any combination thereof, for a total of 165 cfs. Phase 1 would develop the facilities required to utilize the McClusky Canal, and Phase 2 would develop the facilities needed to utilize the Missouri River. For utilization of the McClusky Canal, the McIPS2 would pump water from the McClusky Canal to a BWTP approximately one mile east of the intake. To utilize the Missouri River, the MRIPS facility would pump 165 cfs of water to an SRP approximately two miles east of the intake. The SRP is intended to provide sand/grit removal only. After grit removal, the MPS2 will pump to the BWTP near MM 49 on the McClusky Canal. The McMPS2 adjacent to the BWTP will pump approximately 19.3 miles to the intersection with segment C of the State RRVWSP and then continue 5.7 miles east to the HBT from the State RRVWSP. Water will then flow by gravity from the HBT to the State RRVWSP CVS and DS on the Sheyenne River approximately six miles south of Cooperstown, ND.

Phase 1 includes ENDAWS pipeline segment I and State RRVWSP pipeline segments C, and D, totaling 130.0 miles in length. Phase 2 includes State RRVWSP pipeline segments A, CNDWSP pipeline segment E, and ENDAWS pipeline segment F, totaling 36.0 miles. The total pipeline system for this route option is 166.0 miles. All proposed pipelines are 72-inch diameter.

Table ES-7 shows the estimated capital cost for this option. The costs are broken out by the phases described previously.



Phase	Project	Segments	Project Total (Miles)
1	State RRVWSP	C, D	110.7
	ENDAWS	I	19.3
2	State RRVWSP	A	23.0
	ENDAWS	F	7.0
	CNDWSP	E	6.0
		Total	166.0

Figure ES-9 ENDAWS Route Option Canal and Missouri River South Layout

Table ES-7 ENDAWS Route Option McClusky Canal and Missouri River South Estimated Cost Summary

Phase 1	Size	Capital Cost
ENDAWS Route Option Components		
McIPS2	165 cfs/2,000 HP	$31,953,000
McMPS2	165 cfs/20,000 HP	$35,258,000
Pipeline Seg. I	72-inch	$103,307,000
Subtotal		**$170,518,000**
State RRVWSP Components		
HBT	10 MG	$16,778,000
CVS & DS	140 cfs	$9,963,000
Pipeline Seg. C	72-inch	$91,939,000
Pipeline Seg. D	72-inch	$544,020,000
Subtotal		**$662,700,000**
Phase 1 Subtotals		**$833,218,000**
Phase 2		
ENDAWS Route Option Components		
Pipeline Seg. E	72-inch	$43,971,000
Pipeline Seg. F	72-inch	$35,673,000
Subtotal		**$79,644,000**
State RRVWSP Components		
MRIPS	165 cfs	$57,773,000
SRP	165 cfs	$12,976,000
MPS2	165 cfs	$36,114,000
Pipeline Seg. A	72-inch	$130,210,000
Subtotal		**$237,073,000**
Phase 2 Subtotals		**$316,717,000**
Totals(1)		**$1,150,000,000**

(1) Route Option Total does not include BWTP capital costs. Route Option Total increases to $1,206M with BWTP Option #1; $1,220M with BWTP Option #2; $1,370M with BWTP Option #3; and $1,390M with BWTP Option #4.

ES-4.7 O&M Costs

The route options have a wide range of anticipated O&M costs depending upon the water source, the facilities utilized by the route, the hydraulic profile of the route, and the selected treatment option. The ability to utilize WAPA power also has a significant impact on the annual O&M costs. The costs listed in Table ES-8 represent the total annual O&M cost for the route while operating at full flow capacity.

Table ES-8 Annual O&M Summary for Routes

Route Option	Total O&M	Total O&M with BWTP			
		Option 1	Option 2	Option 3	Option 4
Red River Valley Water Supply Project	$14,710,000	-	-	-	-
Central North Dakota Water Supply Project	$13,550,000	-	-	-	-
ENDAWS Alternate Route Option - McClusky Canal North	-	$6,540,000	$7,140,000	$11,440,000	$12,440,000
ENDAWS Alternate Route Option - McClusky Canal South	-	$7,440,000	$8,040,000	$12,340,000	$13,340,000
ENDAWS Alternate Route Option - McClusky Canal and River North					
With Source from Missouri River	-	$15,970,000	$16,570,000	$20,870,000	$21,870,000
With Source from McClusky Canal	-	$6,540,000	$7,140,000	$11,440,000	$12,440,000
Blended Source Water (90% McClusky Canal; 10% Missouri River)	-	$7,640,000	$8,240,000	$12,540,000	$13,540,000
ENDAWS Alternate Route Option - McClusky Canal and River South					
With Source from Missouri River	-	$15,880,000	$16,480,000	$20,780,000	$21,780,000
With Source from McClusky Canal	-	$7,440,000	$8,040,000	$12,340,000	$13,340,000
Blended Source Water (90% McClusky Canal; 10% Missouri River)	-	$8,440,000	$9,040,000	$13,340,000	$14,340,000

1.0 Introduction

1.1 PURPOSE OF THE REPORT

This Report summarizes the design approach and assumptions used in developing each of the route options and treatment facilities for the ENDAWS Project. The engineering features, the spatial layout and the estimated costs are presented for all ENDAWS route options, as well as the State led RRVWSP, and the Central North Dakota 6-mile extension to the State RRVWSP. The main objective of this Report is to provide information and data to support the development of various alternatives to be evaluated in the ENDAWS EIS.

1.2 ENDAWS PROJECT OVERVIEW

ENDAWS was developed as an alternate water source for the State RRVWSP to use the McClusky Canal to supplement or replace the Missouri River. ENDAWS would provide an additional 145 cubic feet per second (cfs) water service contract, in addition to the 20 cfs water service contract previously subjected to Reclamation's environmental review in the CNDWSP, for a total of 165 cfs. ENDAWS would include an intake on the McClusky Canal, a Biota Water Treatment Plant (BWTP), a pumping station, and a pipeline, which would terminate where it intersects with the State RRVWSP pipeline. Figure 1-1 shows the ENDAWS route options. For context, the State RRVWSP route is also shown in grey. This Report analyzes various route options for ENDAWS, which vary in pipeline length and route between the McClusky Canal and the State RRVWSP.

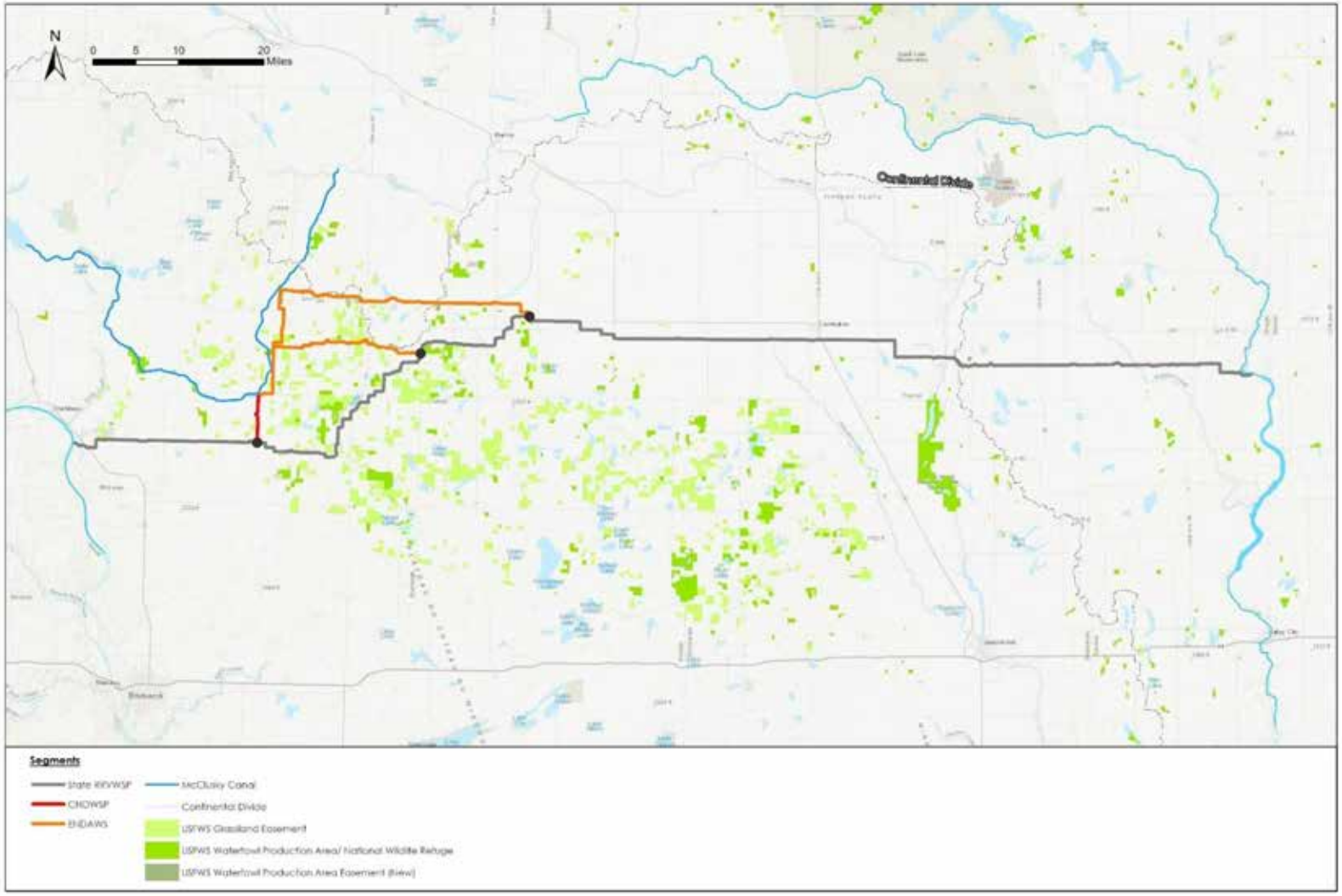


Figure 1-1 Overview ENDAWS Route Options

1.3 BACKGROUND

To understand the basis of the ENDAWS options, this section describes the State RRVWSP, as well the in-basin partial water option supply previously studied by Reclamation, referred to as the CNDWSP. Figure 1-2 shows the pipeline alignment and major hydraulic structures for the State RRVWSP. Water is pumped from the Missouri River to the State RRVWSP high point at the hydraulic break tank, and then flows by gravity to the Sheyenne River. There are various pumping stations and control structures along the way to control the water flow.

The State RRVWSP is a State and local project developed by the State of North Dakota by and through the Garrison Diversion, designed to meet the future municipal, rural, and industrial water needs for participating communities in central and eastern North Dakota. The State RRVWSP provides 165 cfs of water from the Missouri River to central and eastern North Dakota. The State RRVWSP intake is near Washburn, North Dakota and discharges the water into the Sheyenne River above Lake Ashtabula. This is not a Federal project, nor does Reclamation have a role in its development.

The discharged water flows into Lake Ashtabula, which serves as a regulating reservoir, and then into the lower Sheyenne and Red Rivers where the water can be used by project users. The State RRVWSP involves the transfer of water from the Missouri River Basin to the Hudson Bay Basin. The State RRVWSP would be used to supply direct pipeline users and to supply Lake Ashtabula during times of drought when the flows in the Sheyenne and Red Rivers are not adequate to support the demands.

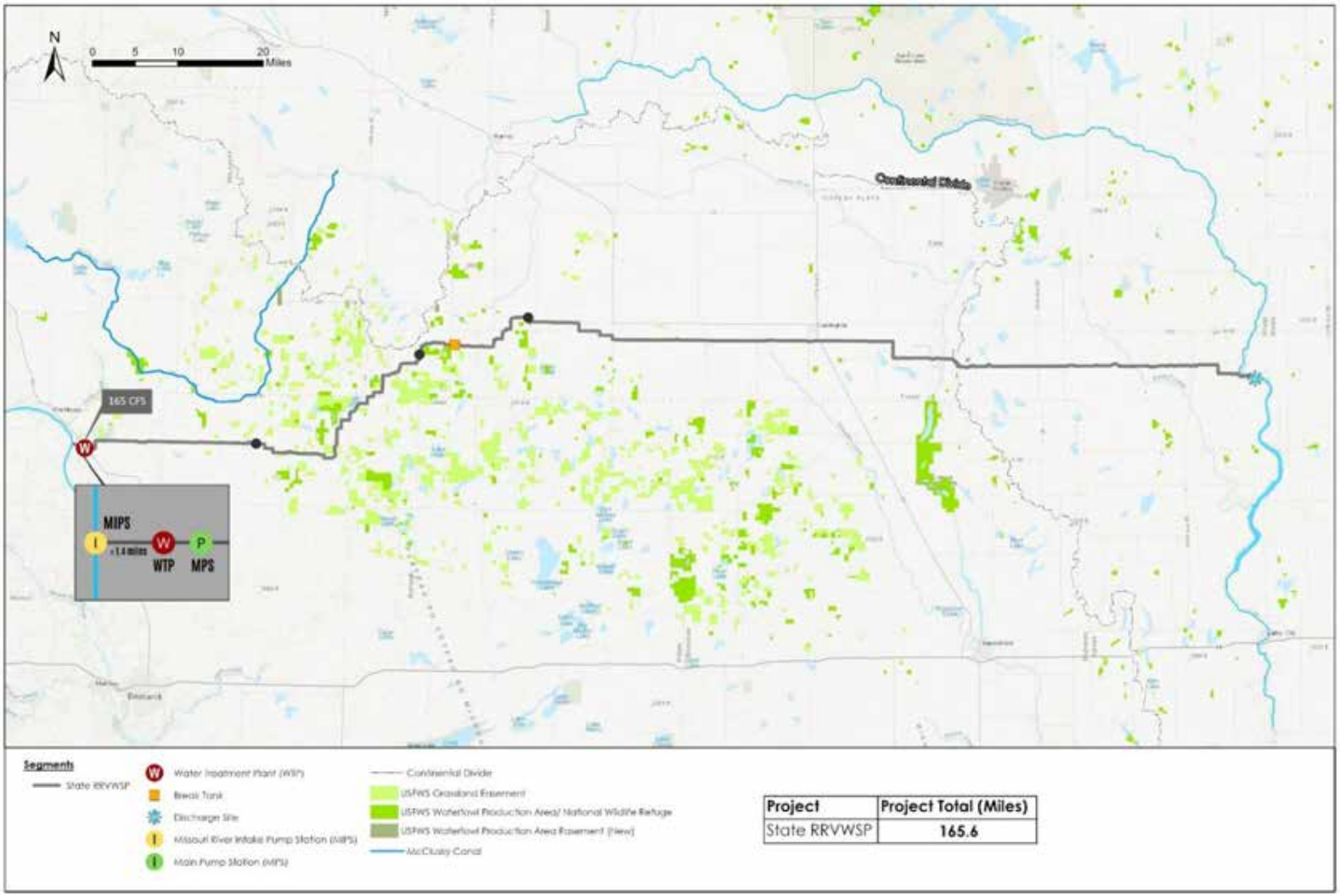
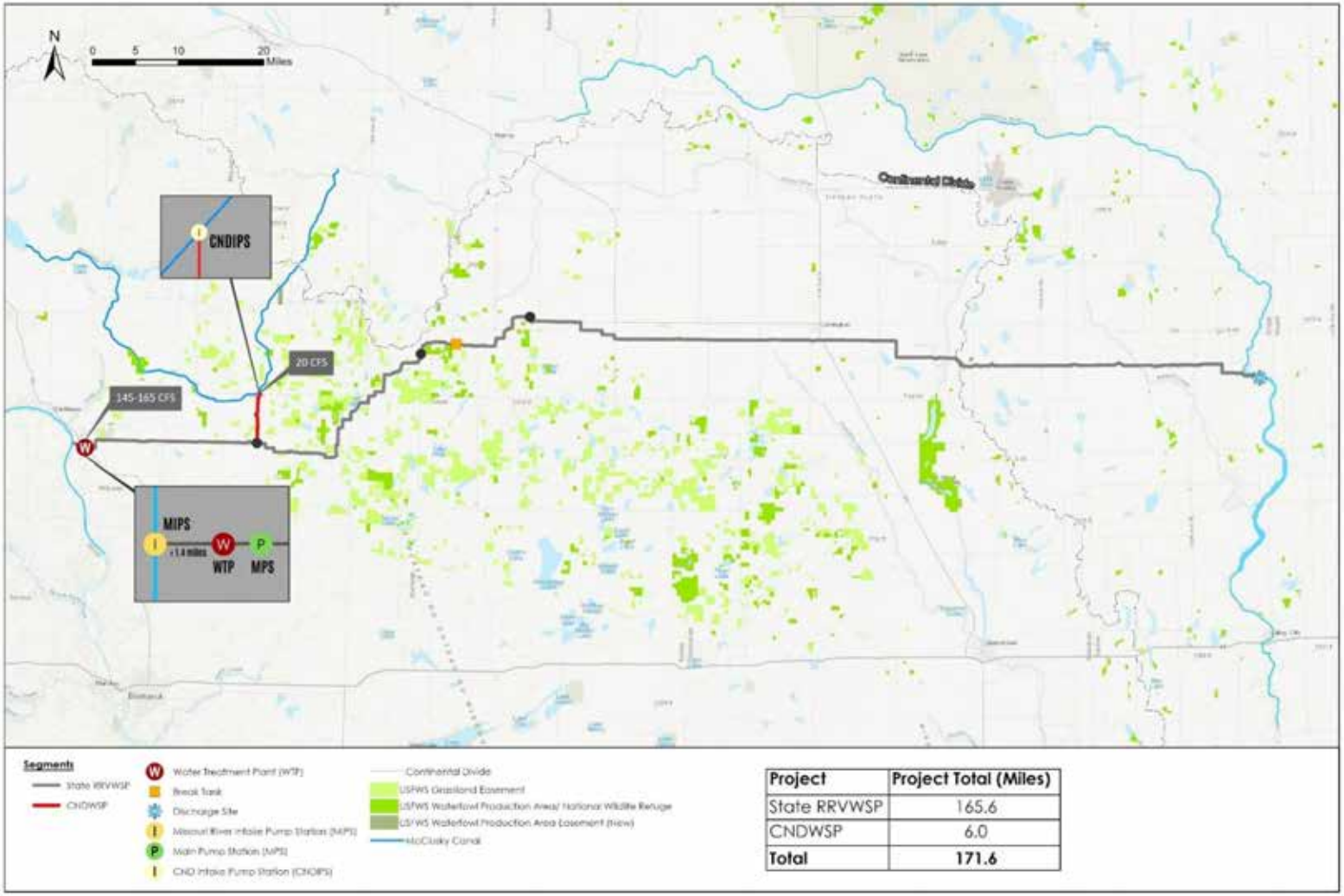


Figure 1-2 State Red River Valley Water Supply Project Map

As a potential cost-saving measure, Garrison Diversion requested a 20 cfs water service contract from the McClusky Canal to provide the portion of State RRVWSP needs that exist in the Missouri River Basin. This entailed adding an intake into the McClusky Canal and a six-mile pipeline connection between the McClusky Canal and the State RRVWSP (shown as Segment E on Figure 1-3). This intake and the additional six-mile pipeline segment are referenced in this Report as the CNDWSP. The 20 cfs of water taken from the McClusky Canal can only be supplied to users within the Missouri River Basin. Reclamation conducted an Environmental Assessment on the CNDWSP to study Garrison Diversion's request for a water service contract for 20 cfs, resulting in a FONSI in September 2018. For the purposes of this Report, the State RRVWSP supplemented with a water supply option that provides 20 cfs from the McClusky Canal, through an intake and six-mile pipeline extension to connect to the State RRVWSP, will be referred to herein as the "State RRVWSP/CNDWSP."



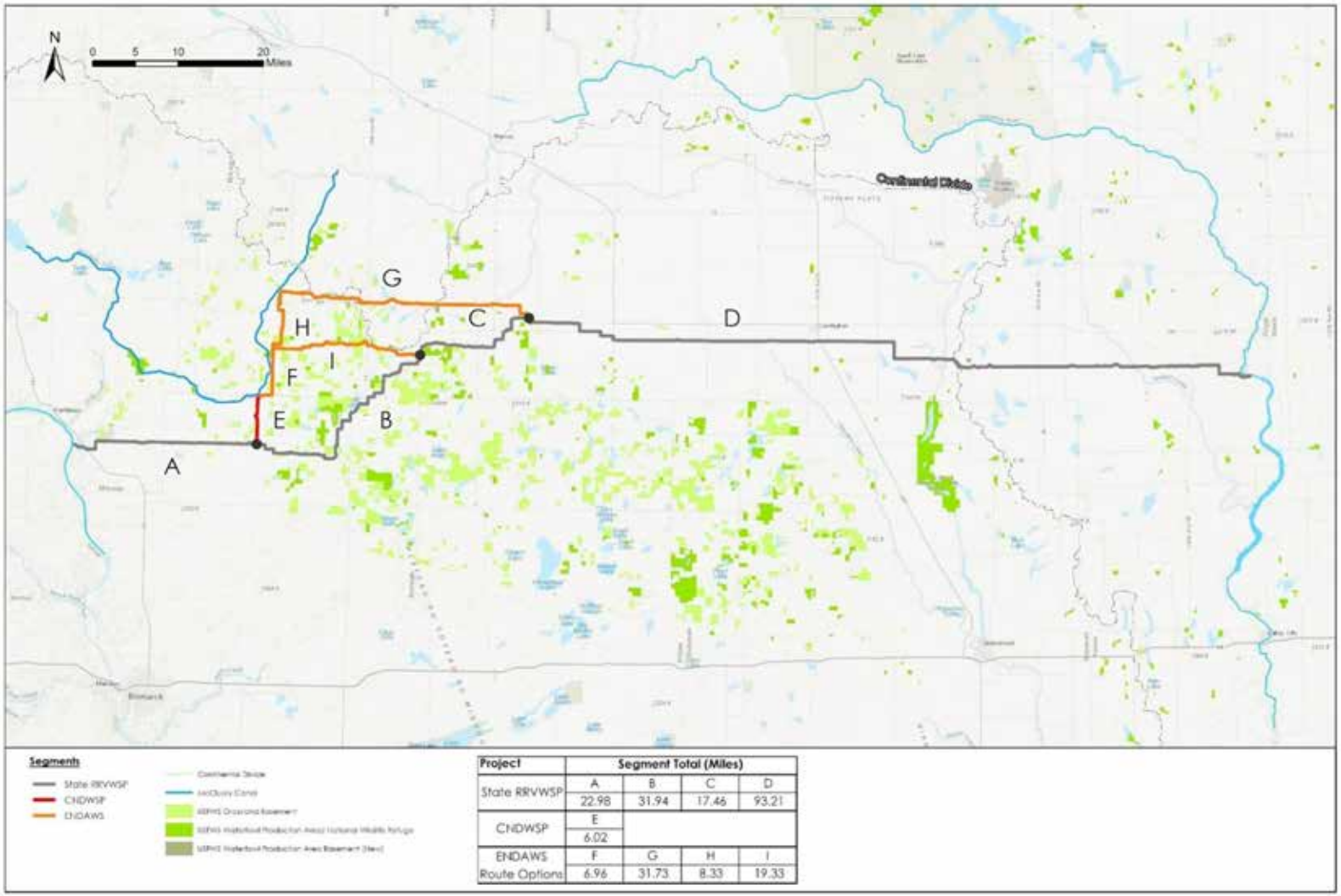
Project	Project Total (Miles)
State RRVWSP	165.6
CNDWSP	6.0
Total	**171.6**

Figure 1-3 State RRVWSP/CNDWSP

After the CNDWSP FONSI was finalized, Garrison Diversion asked Reclamation to consider another cost-saving option that would allow Garrison Diversion to supplement or replace the full State RRVWSP water supply (165cfs) from the McClusky Canal. Garrison Diversion requested a water service contract from Reclamation for the additional 145cfs of water, delivered through an intake on the McClusky Canal and a pipeline connecting the intake to the State RRVWSP transmission pipeline. Reclamation refers to Garrison Diversion's request for this additional 145 cfs from the McClusky Canal as ENDAWS or the "Project".

This Report identifies various ENDAWS route options, which vary in pipeline segment length and route between the intake on the McClusky Canal and the connection with the State RRVWSP. Two ENDAWS options provide redundancy by including the full State RRVWSP taking water from the Missouri River at Washburn, as well as one of the two ENDAWS connections to the McClusky Canal intake. Various routes will be identified by designations such as "ENDAWS Canal Only North", "ENDAWS Canal Only South", "ENDAWS Canal and River North" and "ENDAWS Canal and River South". The route options are presented more completely in Chapter 2.

Figure 1-4 identifies the route option names and the various pipeline segments included in each route, as discussed throughout this Report. The State RRVWSP consists of segments A, B, C, and D. The CNDWSP is depicted as segment E, which connects the McClusky Canal to the State RRVWSP. The ENDAWS project includes various combinations of pipeline segments. F, G, H, and I, which also connect the McClusky Canal to the State RRVWSP.



Project	Segment Total (Miles)			
State RRVWSP	A	B	C	D
	22.98	31.94	17.46	93.21
CNDWSP	E			
	6.02			
ENDAWS Route Options	F	G	H	I
	6.96	31.73	8.33	19.33

Figure 1-4 Pipeline Segments and Route Names

1.4 REPORT ORGANIZATION AND TERMINOLOGY

The Report is organized as follows:

- Chapter 1 – Introduction – Provides overall report context and purpose.
- Chapter 2 – Route Options Overview – Summarizes the State RRVWSP, State RRVWSP/CNDWSP and the ENDAWS route options.
- Chapter 3 – Major Design Assumptions – Lists major assumptions about the overall basis for demands, pipeline construction, and cost estimating.
- Chapter 4 – Water Availability – Describes the water availability from the Missouri River and the McClusky Canal.
- Chapter 5 – Summary of Biota Water Treatment Plant Options – Provides an Overview of the Biota Water Treatment Plant process options.
- Chapter 6 – Summary of Individual Components – Gives design basis and details for each pipeline segment and each individual hydraulic facility, such as pumping stations and hydraulic break tanks.
- Chapter 7 – Route Option Summaries – Builds on the detail of individual pipeline segments and hydraulic facilities in Chapter 6. This Chapter presents the layout and cost of each route option.
- Chapter 8 - References.
- Attachment A – Pipeline Alignment Maps.
- Attachment B – Facility Drawings.
- Attachment C – Cost Estimates.

This Report references Garrison Diversion and the Lake Agassiz Water Authority (LAWA). Garrison Diversion is the project sponsor for the State RRVWSP. LAWA is a political subdivision created by the State that represents the end users who will pay for the local share of the State RRVWSP project costs.

2.0 Route Options Overview

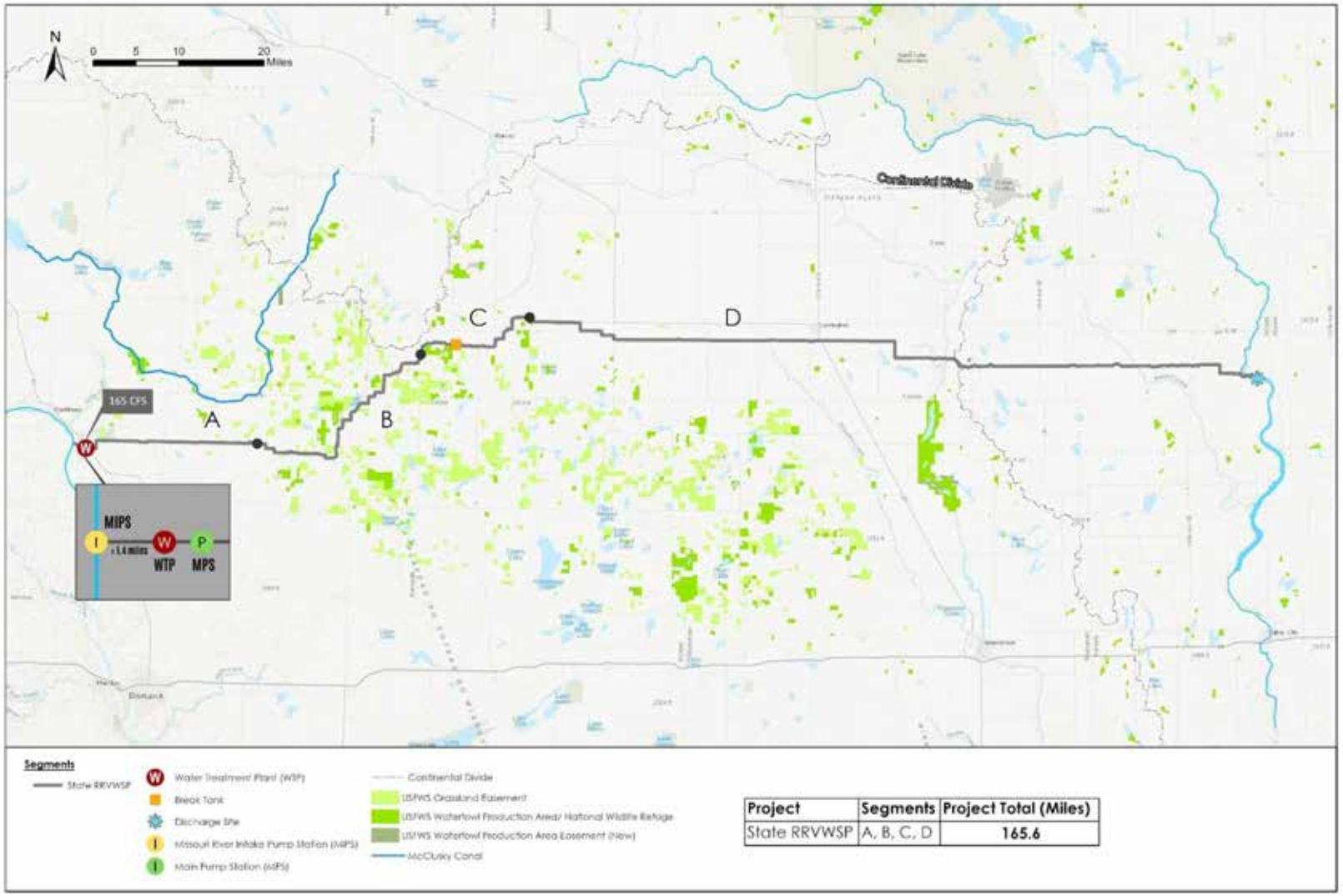
This Chapter provides a summary of each of the four ENDAWS route options, generally describes each route options layout and shows how it is different from other route options. To add context, this Chapter also includes a summary of the State RRVWSP and State RRVWSP/CNDWSP. Later Chapters will describe each of the route options in more detail.

2.1 STATE RED RIVER VALLEY WATER SUPPLY PROJECT (CURRENT STATE PLAN)

Figure 2-1 shows the State RRVWSP. It includes a raw water intake and pumping station on the Missouri River south of Washburn, ND. The MRIPS facility will pump 165 cfs of water to a State WTP approximately two miles east of the intake. The peak flow rate of 165 cfs will provide 20 cfs to central North Dakota users in the MRB from the pipeline, 5 cfs to users on the pipeline after the continental divide between the MRB and HBB, and 140 cfs to the Sheyenne River above Lake Ashtabula. The State WTP is intended to provide basic sedimentation (sand/grit removal) and chlorine disinfection for three-log *Giardia* and four-log virus removal/inactivation. The State WTP will utilize a combination of contact basins and pipeline residence time to obtain the required chlorine disinfection contact time. MPS1 adjacent to the State WTP will pump to a set of HBT located approximately 60 miles east. Water will then flow by gravity from the HBT to the CVS and DS on the Sheyenne River approximately six miles south of Cooperstown, ND. The State RRVWSP includes pipeline segments A, B, C, and D, totaling 165.6 miles in length. The proposed pipeline is 72 inches in diameter.

State RRVWSP Components:

- MRIPS
- WTP
- MPS1
- 72-inch Diameter pipeline segments A, B, C, D (165.6± miles)
- HBT
- CVS and DS



Project	Segments	Project Total (Miles)
State RRVWSP	A, B, C, D	165.6

Figure 2-1 State RRVWSP Layout

2.2 CENTRAL NORTH DAKOTA WATER SUPPLY PROJECT (TOGETHER WITH STATE RRVWSP REPRESENTS NO ACTION ALTERNATIVE)

The CNDWSP water supply option (Figure 2-2) was previously evaluated and approved by Reclamation under the CNDWSP FONSI. Incorporating the CNDWSP and the State RRVWSP represents the "no action" alternative for the ENDAWS EIS. CNDWSP provides 20 cfs of raw water from the McClusky Canal at MM 42.5 for in-basin use within Central North Dakota. A combined State RRVWSP/CNDWSP can provide 145 cfs from the Missouri River for out-of-basin users, with an additional 20 cfs more economically provided at appropriate time from the Canal if needed for in-basin uses. When out of basin water supplies are needed, the CNDWSP will not operate and the State RRVWSP provides up to 165 cfs from the Missouri River.

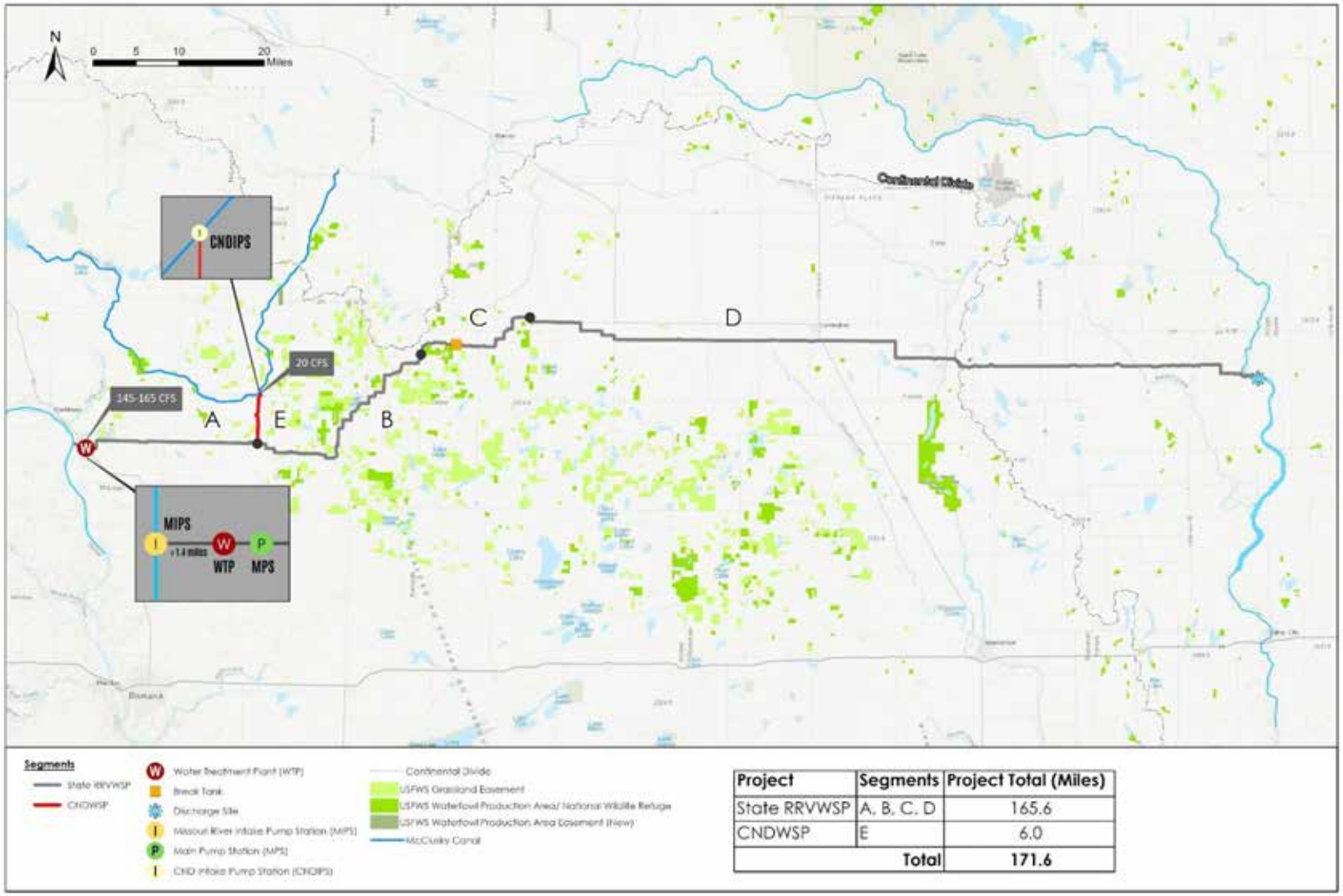
The State RRVWSP is described in Section 2.1. The CNDWSP is connected to the State RRVWSP with a 6-mile long, 30-inch diameter pipeline (Segment E). The CNDWSP includes a CNDIPS located on the McClusky Canal near MM 42.5 that will pump 20 cfs to the HBT. When combined with the State RRVWSP pipeline segments A, B, C, and D, the total pipeline length is 171.7 miles.

State RRVWSP Components:

- MRIPS
- WTP
- MPS1
- 72-inch Diameter pipeline segments A, B, C, D (165.6 ± miles)
- HBT
- CVS and DS

CNDWSP Components:

- CNDIPS
- 30-inch Diameter pipeline segment E (6.0± miles)



Project	Segments	Project Total (Miles)
State RRVWSP	A, B, C, D	165.6
CNDWSP	E	6.0
	Total	171.6

Figure 2-2 State RRVWSP with CNDWSP Layout

2.3 ENDAWS ROUTE OPTION CANAL ONLY NORTH

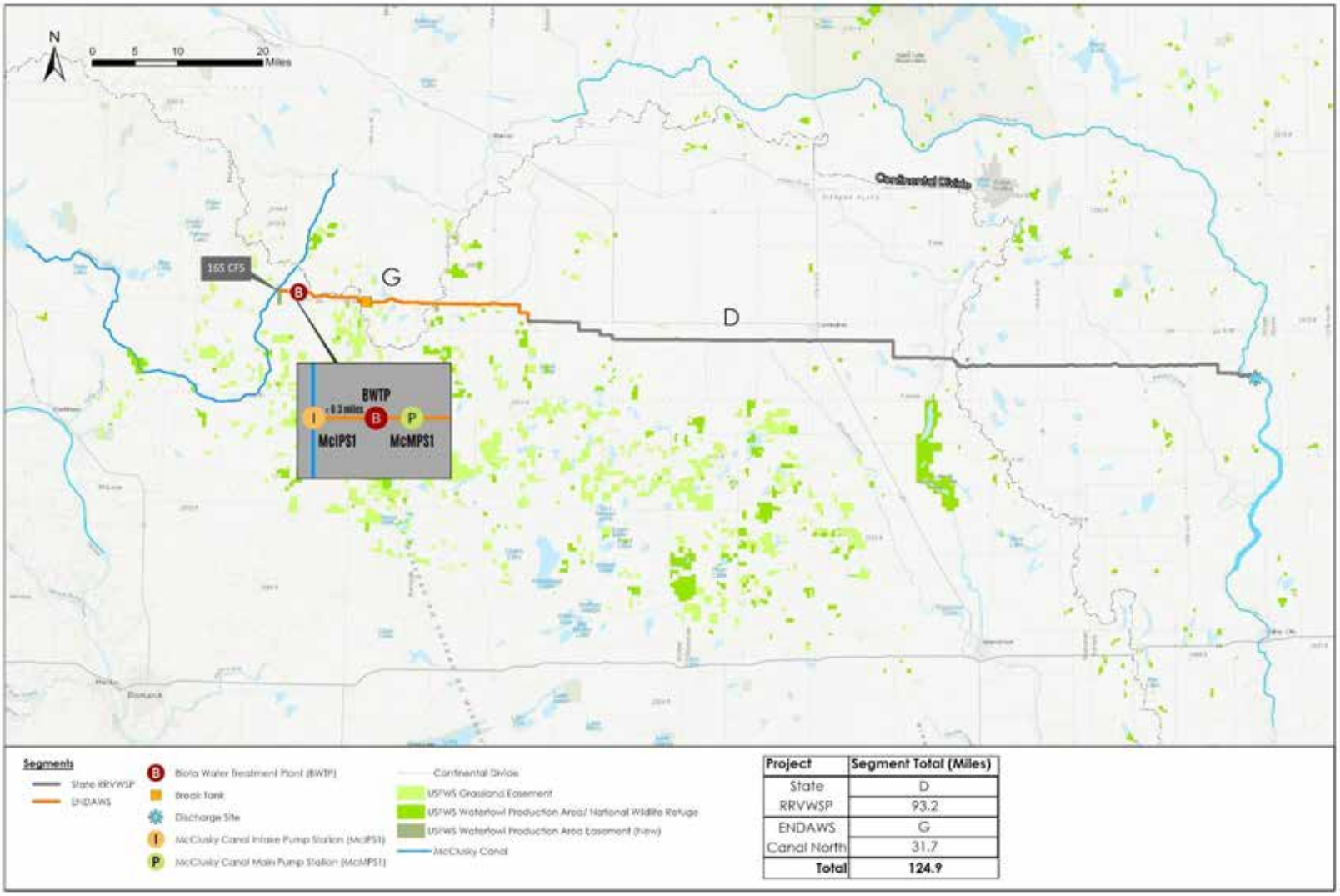
This ENDAWS route option (Figure 2-3) would provide 165 cfs from the McClusky Canal approximately 1.5 miles northwest of McClusky, ND near MM 57. The McIPS1 would pump water from the McClusky Canal to a BWTP immediately adjacent to the intake facilities. The McMPS1 downstream of the BWTP will pump approximately 10.5 miles east to relocated HBT from the State RRVWSP near the intersection of ND Highway 14 and ND Highway 200, then flow by gravity 21.2 miles to the intersection with the State RRVWSP. The State RRVWSP continues to the CVS and DS on the Sheyenne River approximately 6 miles southeast of Cooperstown, ND. This ENDAWS route option includes pipeline segment G. When combined with pipeline segment D from the State RRVWSP, the pipeline totals 124.9 miles in length. The proposed pipeline is 72 inches in diameter.

State RRVWSP Components:

- 72-inch Diameter pipeline segment D (93.2± miles)
- HBT
- CVS and DS

ENDAWS Route Option Components:

- McIPS1
- BWTP
- McMPS1
- 72-inch Diameter pipeline segments G (31.7± miles)



Project	Segment Total (Miles)
State RRVWSP	D 93.2
ENDAWS	G
Canal North	31.7
Total	**124.9**

Figure 2-3 ENDAWS Route Option Canal Only North Layout

2.4 ENDAWS ROUTE OPTION CANAL ONLY SOUTH

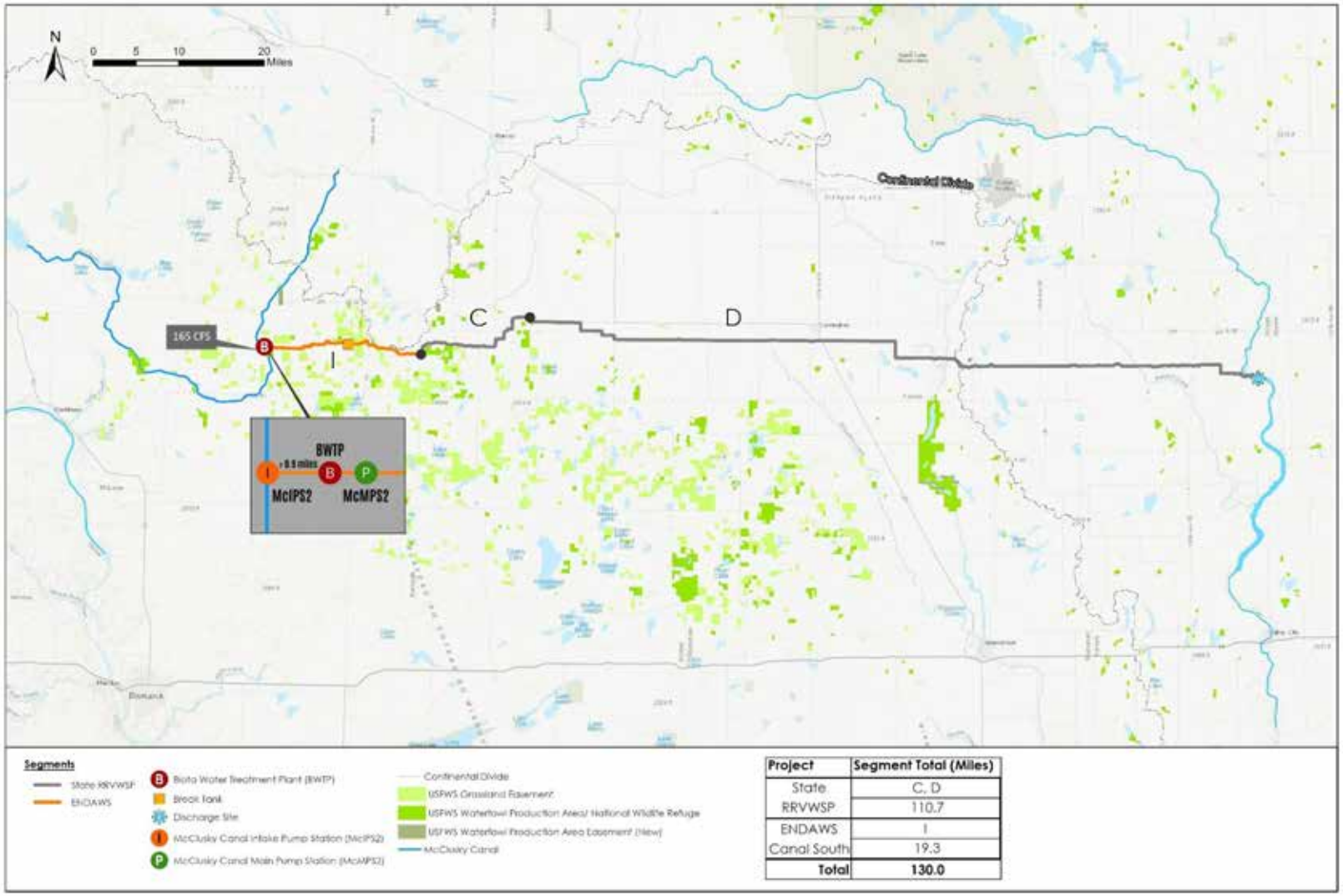
This ENDAWS route option (Figure 2-4) would provide 165 cfs from the McClusky Canal approximately 6 miles southwest of McClusky, ND near MM 49 on the McClusky Canal. The McIPS2 would pump water from the McClusky Canal to a BWTP approximately one mile east of the intake facilities. The McMPS2 adjacent to the BWTP will pump approximately 19.3 miles to the intersection with Segment C of the State RRVWSP and then continue another 5.7 miles east to the HBT from the State RRVWSP. Water will then flow by gravity from the HBT to the State RRVWSP CVS and DS on the Sheyenne River approximately 6-miles south of Cooperstown, ND. This ENDAWS route option includes pipeline segment I. When combined with segments C and D from the State RRVWSP, the pipeline totals 130.0 miles in length. The proposed pipeline is 72 inches in diameter.

State RRVWSP Components:

- 72-inch Diameter pipeline segments C and D (110.7± miles)
- HBT
- CVS and DS

ENDAWS Route Option Components:

- McIPS2
- BWTP
- McMPS2
- 72-inch Diameter pipeline segment I (19.3± miles)



Project	Segment Total (Miles)
State RRVWSP	C, D 110.7
ENDAWS	I
Canal South	19.3
Total	**130.0**

Figure 2-4 ENDAWS Route Option Canal Only South Layout

2.5 ENDAWS ROUTE OPTION CANAL AND MISSOURI RIVER NORTH

This ENDAWS route option (Figure 2-5), when combined with the State RRVWSP/CNDWSP, would provide full redundancy by either taking 165 cfs from the McClusky Canal near MM 57 (approximately 1.5 miles northwest of McClusky, ND) or taking 165 cfs from the Missouri River south of Washburn, ND, or any combination thereof, for a maximum total of 165 cfs. The pipeline diameter for segments C and D of the State RRVWSP limit the total capacity of water crossing the continental divide to 165 cfs, with two alternative water sources developed to provide this full capacity under this ENDAWS option. Phase 1 would develop the facilities required to utilize the McClusky Canal, and Phase 2 would develop the facilities needed to utilize the Missouri River. For utilization of the McClusky Canal, a McIPS1 near MM 57 would pump water from the McClusky Canal to a BWTP immediately adjacent to the Canal. To utilize the Missouri River, the MRIPS facility would pump 165 cfs of water to a SRP approximately 2 miles east of the intake. The SRP is intended to provide sand/grit removal only. After grit removal, the Main Pumping Station 2 (MPS2) will pump to the BWTP adjacent to the McClusky Canal. The McMPS1 adjacent to the BWTP will pump approximately 10.5 miles east to the relocated HBT from the State RRVWSP near the intersection of ND Highway 14 and ND Highway 200, then flow by gravity 21.2 miles the intersection with the State RRVWSP. The State RRVWSP continues to the CVS and DS on the Sheyenne River approximately 6 miles southeast of Cooperstown, ND.

In Phase 1, this route option will utilize ENDAWS pipeline segment G and the State RRVWSP segment D, totaling 124.9 miles in length. Phase 2 will utilize State RRVWSP pipeline segment A, CNDWSP pipeline segment E, ENDAWS pipeline segments F and H, totaling 44.3 miles. The total pipeline system for this route option is 169.3 miles. All proposed pipelines are 72 inches in diameter.

State RRVWSP Components:

- Phase 1
  - 72-inch Diameter pipeline segment D (93.2± miles)
  - HBT
  - CVS and DS
- Phase 2
  - MRIPS
  - SRP
  - MPS2
  - 72-inch Diameter pipeline segment A (23.0± miles)

CNDWSP Components:

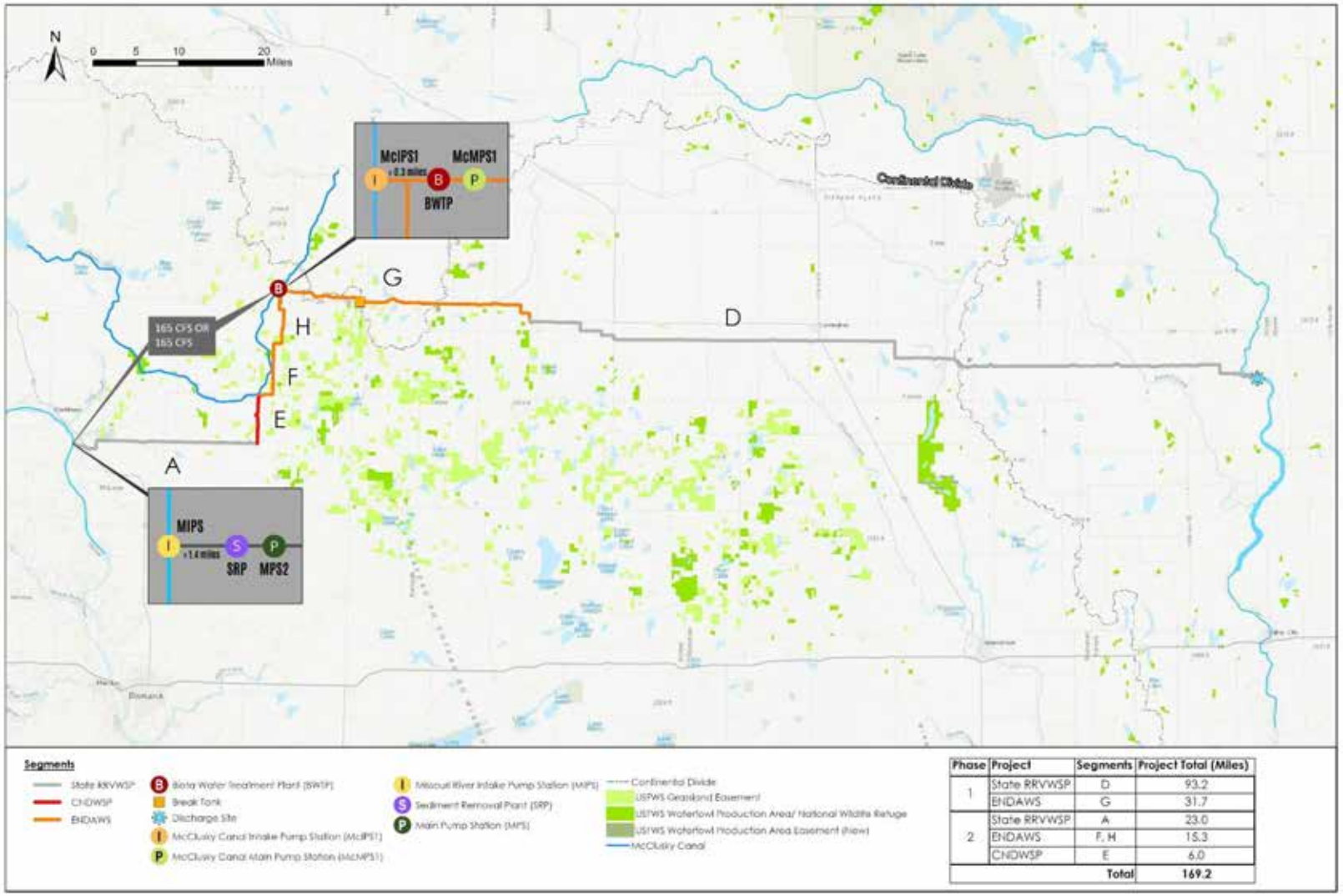
- Phase 2
  - 72-inch Diameter pipeline segment E (6 miles)

ENDAWS Route Option Components:

- Phase 1
  - McIPS1

- BWTP
- McMPS1
- 72-inch Diameter pipeline segment G (31.7± miles)

- Phase 2
  - 72-inch Diameter pipeline segments F and H (15.3± miles)



Phase	Project	Segments	Project Total (Miles)
1	State RRVWSP	D	93.2
	ENDAWS	G	31.7
2	State RRVWSP	A	23.0
	ENDAWS	F, H	15.3
	CNDWSP	E	6.0
		Total	169.2

Figure 2-5 ENDAWS Route Option Canal and Missouri River North Layout

2.6 ENDAWS ROUTE OPTION CANAL AND MISSOURI RIVER SOUTH

This ENDAWS route option (Figure 2-6) also would provide full redundancy by taking 165-cfs from near MM 49 on the McClusky Canal approximately 6 miles southwest of McClusky, ND, taking 165-cfs from the Missouri River south of Washburn, ND, or any combination thereof, for a total of 165 cfs. Phase 1 would develop the facilities required to utilize the McClusky Canal, and Phase 2 would develop the facilities needed to utilize the Missouri River. For utilization of the McClusky Canal, the McIPS2 would pump water from the McClusky Canal to a BWTP approximately one mile east of the intake. To utilize the Missouri River, the MRIPS facility would pump 165 cfs of water to a SRP approximately two miles east of the intake. The SRP is intended to provide sand/grit removal only. After grit removal, the MPS2 will pump to the BWTP near MM 49 on the McClusky Canal. The McMPS2 adjacent to the BWTP will pump approximately 19.3 miles to the intersection with Segment C of the State RRVWSP and then continue 5.7 miles east to the HBT from the State RRVWSP. Water will then flow by gravity from the HBT to the State RRVWSP CVS and DS on the Sheyenne River approximately six miles south of Cooperstown, ND.

Phase 1 includes ENDAWS pipeline segment I and State RRVWPS pipeline segments C and D, totaling 130.0 miles in length. Phase 2 includes State RRVWSP pipeline segment A, CNDWSP pipeline segment E, and ENDAWS pipeline segment F, totaling 36.0 miles. The total pipeline system for this route option is 166.0 miles. All proposed pipelines are 72-inch diameter.

State RRVWSP Components:

- Phase 1
  - 72-inch Diameter pipeline segments C and D (110.7± miles)
  - HBT
  - CVS and DS
- Phase 2
  - MRIPS
  - SRP
  - MPS2
  - 72-inch Diameter pipeline segment A (23.0± miles)

CNDWSP Components:

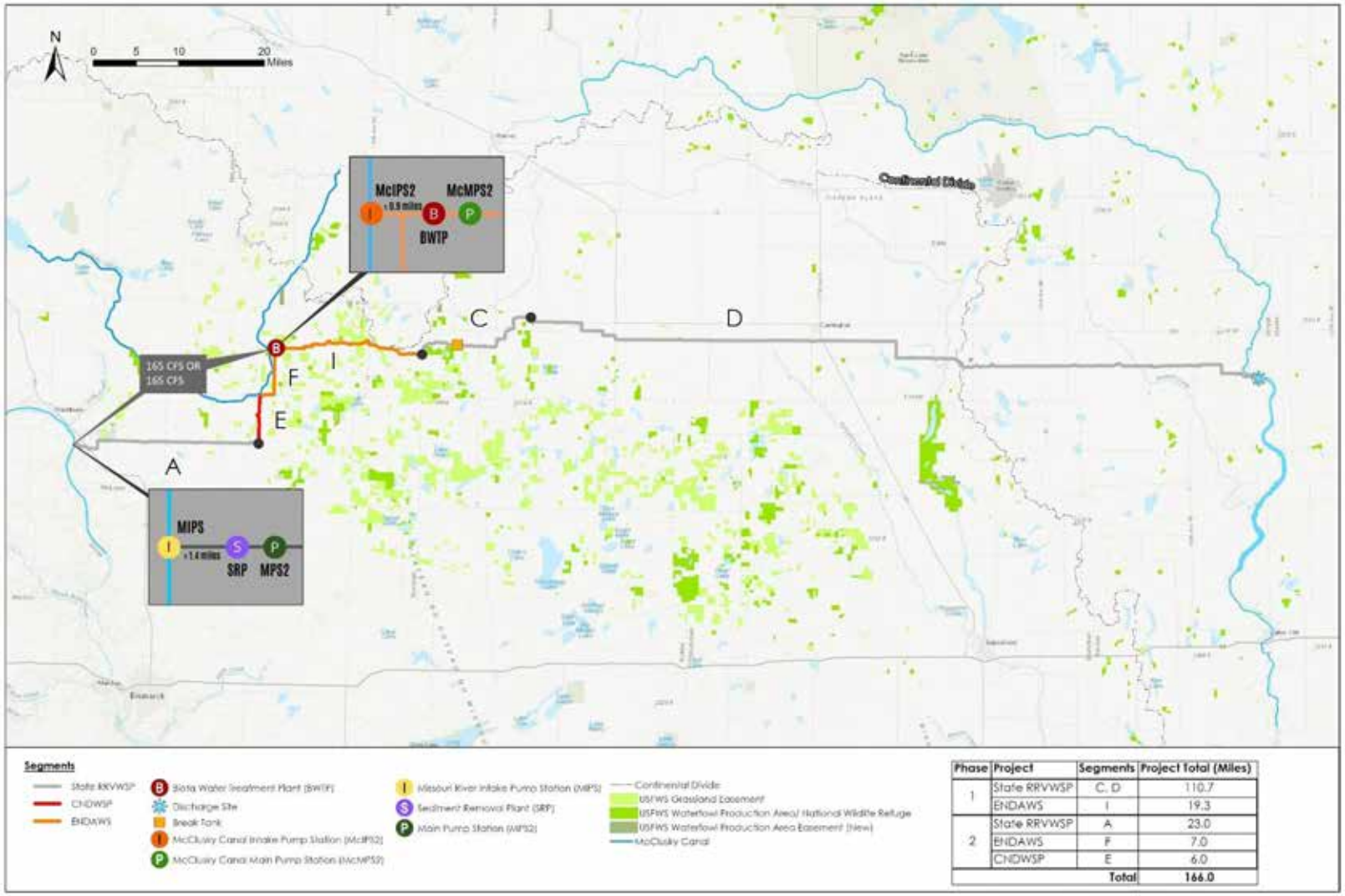
- Phase 2
  - 72-inch Diameter pipeline segment E (6 miles)

ENDAWS Route Option Components:

- Phase 1
  - McIPS2
  - BWTP
  - McMPS2

- 72-inch Diameter pipeline segment I (19.3± miles)

- Phase 2
  - 72-inch Diameter pipeline segment F (7.0± miles)



Phase	Project	Segments	Project Total (Miles)
1	State RRVWSP	C, D	110.7
	ENDAWS	I	19.3
2	State RRVWSP	A	23.0
	ENDAWS	F	7.0
	CNDWSP	E	6.0
		Total	166.0

Figure 2-6 ENDAWS Route Option Canal and Missouri River South Layout

3.0 Major Design Assumptions

There are several design assumptions related to the State RRVWSP, CNDWSP, and each of ENDAWS route options described in Chapter 2. The design assumptions for user demands, required import flow rates and pipeline sizing, pipeline construction, land disturbance, and the basis for cost estimating are summarized in this chapter and described in more detail in the State Red River Valley Water Supply Project Preliminary Design Report (Black & Veatch, 2018)

3.1 USER DEMANDS

3.1.1 Updated Average Day Demands

The ENDAWS Project is proposed as an alternate source for the State RRVWSP, and therefore is based on the same demands that had been estimated for the State RRVWSP. Approximately 15 years have elapsed since Reclamation projected average day water demands for the Federal RRVWSP in its 2005 Report on Red River Valley Water Needs and Options that was part of the Final Environmental Impact Statement (FEIS) (Reclamation, December 2007). These demands were based on a 2050 planning horizon.

To update the State RRVWSP demand projections, Garrison Diversion set out to secure nominations during the summer and fall of 2016 on behalf of LAWA from potential domestic and industrial water users. Garrison Diversion and prospective users changed the planning horizon from 2050 to 2075 to account for the years that had elapsed and the anticipated duration of project development and construction, desiring to maintain a 50-year project life. Over 100 meetings were held with representatives from municipalities and rural water districts, and RRVWSP water nominations were obtained from 35 water users in central and eastern North Dakota These nominations were obtained from users who were part of the previous Federal RRVWSP, central North Dakota users, and users who were previously independent but could now obtain State RRVWSP as a result of a mandate from the North Dakota State Legislature to be as inclusive as possible.

Recent average-day water demands for these users were gathered from North Dakota State Water Commission water permit annual usage reports. The 2005 Final Needs and Options report contained a population projection for 2050. With current Reclamation data, the data from the 2005 study was combined with separate linear and exponential projections according to each user's historical populaton trend to develop a range of 2075 population projections. Each of these population projections were multiplied by each user's recent (generally the average from 2010 to the present) gallons per capita per day water use to predict a range of 2075 average day water demands. Municipal and rural nominations obtained in 2016 were based on these 2075 projected average day water demands. Future industrial demand estimates were based on existing industrial water use and projected industrial growth within each user's region. Additional details about the RRVWSP water nominations are as follows:

Domestic nominations were quantified according to the user's water source:

- Users currently served with groundwater generally identified their 2075 domestic water needs from a proposed project as the difference between their 2075 average day projected water demand and their current groundwater permit allocation(s).
- Users currently served by surface water (Sheyenne River, Red River of the North, or Red Lake River) opted to receive their entire 2075 average day projected water demand from

the State RRVWSP because these rivers are highly susceptible to extreme drought conditions.

Industrial nominations were generally quantified according to current industrial water use and the level of anticipated future industrial growth in each region of the project service area, identification of existing water supplies available for industrial use, coordination amongst the various water users in each region, and informed decisions about future water needs by the water users:

- Given the projected industrial water uses often dwarfed the entire permitted allocation(s) of many of the rural communities and rural water districts in the project service area, many users served by groundwater considered their 2075 average day projected domestic demand as a guide and nominated for an industrial flow that matched it to guard against the possibility that their current water source would become unavailable. Therefore, the industrial nomination, although limited, could also be used as a domestic backup.
- Many other users also considered a specific industrial demand based on: cropping, livestock production, and past industrial development; historical interest in industrial development: and industrial development in similar regions across the state and country. These considerations included a wide array of industries, varying ranges of production sizes, and average water usage per production unit. Users were able to anticipate future industrial water demands on the basis of existing industrial development, industrial growth of industries currently in the region, and anticipation of specific future industry.

Table 3-1 alphabetically lists all current prospective State RRVWSP users and their domestic, industrial, and total nominations.

Table 3-1 Prospective State RRVWSP Users' Nomination Values

PROSPECTIVE USERS	DOMESTIC NOMINATION (CFS)	INDUSTRIAL NOMINATION (CFS)	TOTAL NOMINATION (CFS)
Agassiz Water Users District	0.50	0.50	1.00
Barnes Rural Water District	0.00	0.50	0.50
Carrington	0.00	2.50	2.50
Cass Rural Water Users District	8.00	2.00	10.00
Central Plains Water District	0.00	0.60	0.60
Cooperstown	0.00	0.20	0.20
Dakota Rural Water District	0.00	0.70	0.70
Devils Lake	0.00	1.00	1.00
East Grand Forks	1.60	0.50	2.10
Fargo	58.30	15.40	73.70
Forman	0.00	0.01	0.01
Grafton	0.90	1.10	2.00
Grand Forks	12.20	13.80	26.00

PROSPECTIVE USERS	DOMESTIC NOMINATION (CFS)	INDUSTRIAL NOMINATION (CFS)	TOTAL NOMINATION (CFS)
Grand Forks Trail Water District	1.00	2.00	3.00
Greater Ramsey Water District	0.00	1.00	1.00
Hannaford	0.00	0.05	0.05
Hillsboro	0.00	0.50	0.50
Langdon	0.00	0.20	0.20
Larimore	0.00	0.30	0.30
Lisbon	0.00	0.33	0.33
Mayville	0.00	0.50	0.50
McLean-Sheridan Rural Water	0.00	0.42	0.42
McVille	0.00	0.10	0.10
Northeast Regional Water District	0.00	3.00	3.00
Park River	0.00	0.40	0.40
Richland County Jobs Development Authority (JDA)	0.00	2.00	2.00
South Central Regional Water District	0.00	0.50	0.50
Southeast Water Users District – Central	0.06	0.24	0.30
Southeast Water Users District – East	0.24	0.94	1.18
Southeast Water Users District – West	0.20	0.82	1.02
Stutsman Rural Water District/Jamestown	0.00	15.00	15.00
Trail Rural Water Users	0.00	1.10	1.10
Tri-County Rural Water District	0.50	0.50	1.00
Tuttle	0.00	0.02	0.02
Valley City	1.00	0.50	1.50
Wahpeton	1.50	3.00	4.50
Walsh Rural Water District	0.00	1.00	1.00
TOTAL	86.00	73.23	159.23

3.1.2 FEIS Demand Comparison

As indicated in Table B.1.2 of the FEIS, Appendix B.1 (Reclamation, December 2007), the 2050 water demand projections for RRVWSP surface water users totaled a maximum monthly annual

average of 101,023 acre-feet per year (AF/yr). This value, which originated from the 2005 Final Needs and Options report, equates to a maximum monthly annual average of 139.5 cfs. Figure 3-1 shows Reclamation's monthly distribution of 139.5 cfs for the 2050 demands.

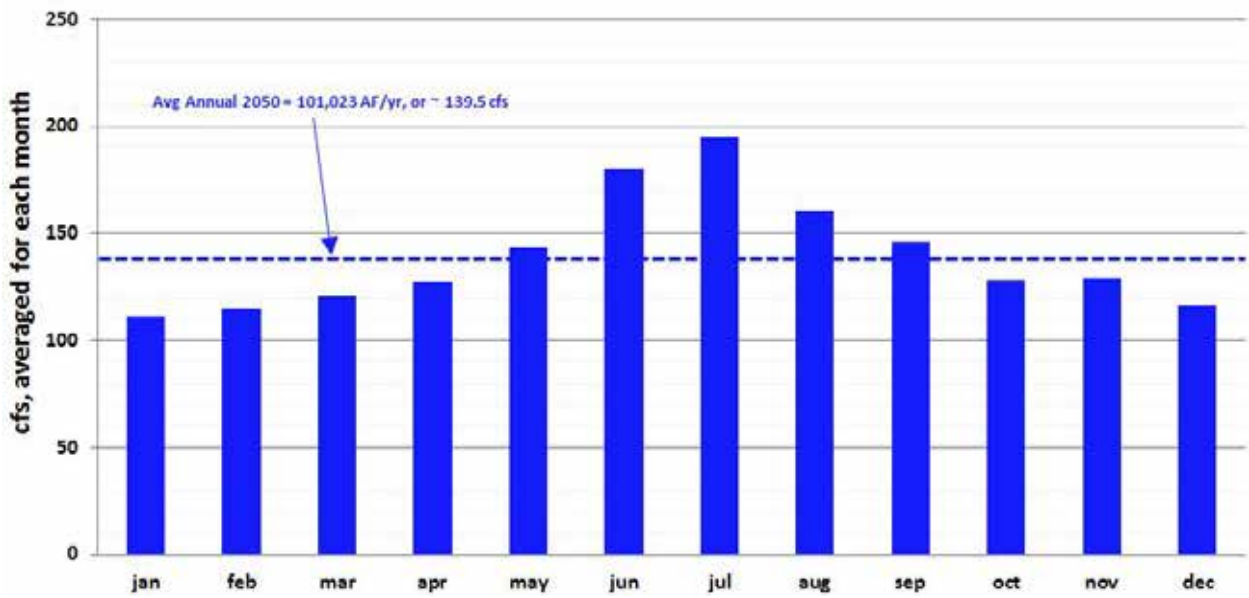


Figure 3-1 2050 Average Surface Water Demand Projections (Table B.1.4 of 2005 Needs and Options Report)

Table 3-2 compares Reclamation's previous 2050 water demand projections to the updated 2075 water nominations. While several significant prior users have elected not to participate in the project, the increased demand, from the remaining existing users associated with the extended planning horizon and new users, results in an increased overall projected demand from 139.5 cfs to 159 cfs, an increase of 19.5 cfs, or 14 percent.

Table 3-2 FEIS 2050 Maximum Monthly Annual Average Demands Compared to the 2075 Average Annual Nominations

PREVIOUS AND PROSPECTIVE USERS	2050 FEIS WATER DEMANDS			2075 WATER NOMINATIONS		
	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE DOMESTIC (CFS)	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE INDUSTRIAL (CFS)	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE TOTAL (CFS)	2075 DOMESTIC NOMINATION (CFS)	2075 INDUSTRIAL NOMINATION (CFS)	2075 TOTAL NOMINATION (CFS)
ADM Corn Processing (Walhalla)	-	0.41	0.41	-	-	-
Agassiz Water Users District	-	-	-	0.50	0.50	1.00
American Crystal Sugar (Drayton)	-	1.60	1.60	-	-	-
American Crystal Sugar (Hillsboro)	-	1.01	1.01	-	-	-
American Crystal Sugar (Moorhead)	-	0.14	0.14	-	-	-
Barnes Rural Water District	-	-	-	-	0.50	0.50
Breckenridge	-	-	-	-	-	-
Cargill Corn Processing (Wahpeton)	-	2.91	2.91	-	-	-
Cargill Inc. (West Fargo)	-	0.22	0.22	-	-	-
Carrington	-	-	-	-	2.50	2.50
Cass-Clay Creamery, Inc.	-	0.21	0.21	-	-	-
Central Livestock	-	0.50	0.50	-	-	-
Central Plains Water District	-	-	-	-	0.60	0.60
Dakota Rural Water District	-	-	-	-	0.70	0.70
Cooperstown	-	-	-	-	0.20	0.20
Devils Lake	-	-	-	-	1.00	1.00
Drayton	0.84	-	0.84	-	-	-
East Grand Forks	3.29	-	3.29	1.60	0.50	2.10

PREVIOUS AND PROSPECTIVE USERS	2050 FEIS WATER DEMANDS			2075 WATER NOMINATIONS		
	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE DOMESTIC (CFS)	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE INDUSTRIAL (CFS)	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE TOTAL (CFS)	2075 DOMESTIC NOMINATION (CFS)	2075 INDUSTRIAL NOMINATION (CFS)	2075 TOTAL NOMINATION (CFS)
Enderlin	-	-	-	-	-	-
Fargo/West Fargo/Horace/Harwood/ Cass Rural	58.90	-	58.90	-	-	-
Fargo	52.04	-	52.04	58.30	15.40	73.70
West Fargo	5.89	-	5.89	-	-	-
Cass Rural Water Users District	0.97	-	0.97	8.00	2.00	10.00
Harwood	-	-	-	-	-	-
Horace	-	-	-	-	-	-
Forman	-	-	-	-	0.01	0.01
Future Industrial (Cass County)	-	10.06	10.06	-	-	-
Future Industrial (Clay County)	-	1.59	1.59	-	-	-
Future Industrial Grand Forks County	-	9.35	9.35	-	-	-
Future Recreational (Cass/Clay/Ottertail County)	-	0.51	0.51	-	-	-
Future Recreational (Grand Forks County)	-	-	0.07	-	-	-
Grafton	1.28	-	1.28	0.90	1.10	2.00
Grand Forks	26.53	-	26.53	12.20	13.80	26.00
Grand Forks-Trail Water District	0.84	-	0.84	1.00	2.00	3.00

PREVIOUS AND PROSPECTIVE USERS	2050 FEIS WATER DEMANDS			2075 WATER NOMINATIONS		
	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE DOMESTIC (CFS)	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE INDUSTRIAL (CFS)	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE TOTAL (CFS)	2075 DOMESTIC NOMINATION (CFS)	2075 INDUSTRIAL NOMINATION (CFS)	2075 TOTAL NOMINATION (CFS)
Greater Ramsey Water District	-	-	-	-	1.00	1.00
Gwinner	-	-	-	-	-	-
Hannaford	-	-	-	-	0.05	0.05
Langdon	0.80	-	0.80	-	0.20	0.20
Larimore	-	-	-	-	0.30	0.30
Lisbon	-	-	-	-	0.33	0.33
McLean-Sheridan Rural Water	-	-	-	-	0.42	0.42
McVille	-	-	-	-	0.10	0.10
Minn-Dak Farmers Coop	-	-	-	-	-	-
Moorhead (including industrial)	11.94	-	11.94	-	-	-
Northeast Regional Water District	0.20	-	0.20	-	3.00	3.00
North Valley (including Pembina)	-	-	-	-	-	-
Pembina	0.00	0.00	0.00			
Langdon Rural Water	0.20	-	0.20	-	-	-
Park River	-	-	-	-	0.40	0.40
RDO Foods Co.	-	-	-	-	-	-
Richland County JDA	-	5.12	5.12	-	2.00	2.00
South Central Regional Water District	-	-	-	-	0.50	0.50

PREVIOUS AND PROSPECTIVE USERS	2050 FEIS WATER DEMANDS			2075 WATER NOMINATIONS		
	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE DOMESTIC (CFS)	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE INDUSTRIAL (CFS)	2050 SURFACE WATER DEMAND MAX MONTHLY ANNUAL AVERAGE TOTAL (CFS)	2075 DOMESTIC NOMINATION (CFS)	2075 INDUSTRIAL NOMINATION (CFS)	2075 TOTAL NOMINATION (CFS)
Southeast Water Users District – East	-	-	-	0.24	0.94	1.18
Hankinson	-	-	-	-	-	-
Lidgerwood	-	-	-	-	-	-
Wyndmere	-	-	-	-	-	-
Southeast Water Users District – Central	-	-	-	0.06	0.24	0.30
Southeast Water Users District – West	-	-	-	0.20	0.82	1.02
Stutsman Rural Water District/ Jamestown	-	-	-	-	15.00	15.00
Trail Rural Water Users	-	-	-	-	1.10	1.10
Mayville	-	-	-	-	0.50	0.50
Hillsboro	-	-	-	-	0.50	0.50
Tri-County Rural Water District	-	-	-	0.50	0.50	1.00
Tuttle	-	-	-	-	0.02	0.02
Valley City	1.23	-	1.23	1.00	0.50	1.50
Wahpeton	-	-	-	1.50	3.00	4.50
Walsh Rural Water District	-	-	-	-	1.00	1.00
Minto	0.00	0.00	0.00	-	-	-
TOTAL	105.8	33.6	139.5	86.0	73.2	159.23

The updated total average annual 2075 water demand of 159.23 cfs, which was based on recent water nominations, was distributed on a monthly basis using the same weightings as Reclamation's monthly distribution of 139.5 cfs, as shown on Figure 3-2.

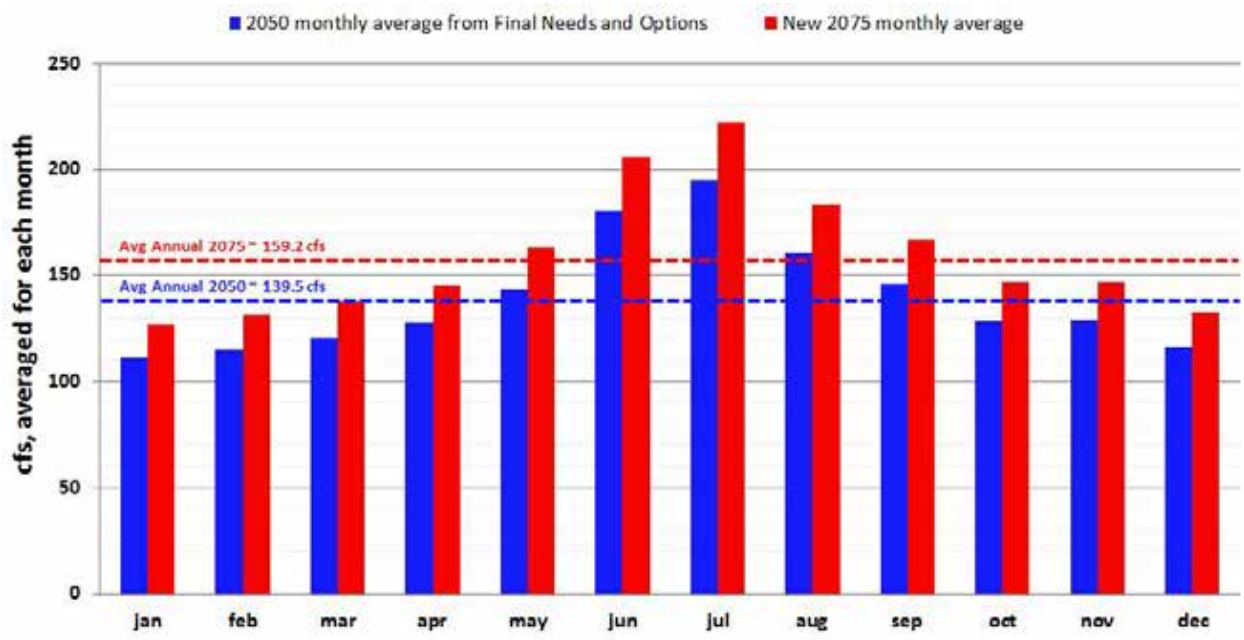


Figure 3-2 Average Monthly/Annual Water Demand Flow Rate Comparison for 2050/2075 Water Demands

The 2075 average monthly demands on Figure 3-2 use the same methodology for converting annual demands to variable monthly demands as Reclamation's original methodology for projecting maximum monthly annual average demands.

In many cases, the locations of communities nominating for water has changed since the FEIS. Figure 3-3 shows the locations of the 2075 demands from users signing agreements nominating water needs for the State RRVWSP.

Figure 3-3 Location of Preliminary Water Nominations for State RRVWSP

3.2 BASIS FOR PIPELINE SIZING AND REQUIRED FLOWS

The average annual water demand projected for the users is approximately 159.2 cfs as described previously. This demand varies by month. For all projects and options described in this report, Lake Ashtabula operates as a regulating reservoir, meaning that more water will be supplied to Lake Ashtabula than is used in some months and years, and less water will be supplied than used in other months and years. However, the Project is sized such that Lake Ashtabula will contain adequate water to meet the user's projected 2075 water demands when projected over a 1930's type drought without dropping below the operating pool on Lake Ashtabula.

The purpose of this Chapter is to describe how the required annual average water import flow rates were calculated and how the pipeline size was determined using the same commercial water balance model originally used by Reclamation called StateMod.

3.2.1 Model History and Documentation

The StateMod water balance model was built in the early 2000's by Reclamation to support the Federal RRVWSP, which at that time was a federally led project. All available model documentation - such as the project users that were served through the project and their future water demands - was contained in the FEIS.

The Federal RRVWSP was reconfigured and updated starting in 2012 as a North Dakota state led project. To support the reconfigured project, the model was updated to reflect new project user nominations and permitted water withdrawals for non-project users. Permitted uses for non-project users had changed over the years since the model was originally developed.

3.2.2 Model Software

StateMod is a widely used water allocation modeling platform. It includes a suite of software tools and data that can be used in conjunction with StateMod. The software is general-purpose and may be used to represent any stream network in which demands are met with water allocated by a ranked priority system.

The received model from Reclamation was built on StateMod Version 10, the current version at the time. The model was updated to StateMod Version 15 to run on the current software version and take advantage of the accompanying data input and output processing tools that had been developed since Version 10.

3.2.3 Model Extent and Network

The model maintains a water mass balance along a network of connected nodes, representing points along the Red River, Sheyenne River, and their tributaries. The area included in the model is represented in Figure 3-4, and the model network of nodes is shown in Figure 3-5. Most nodes represent diversions where water is withdrawn by project users or others to meet demands. Reservoirs and locations with minimum instream flow requirements are also represented by nodes.

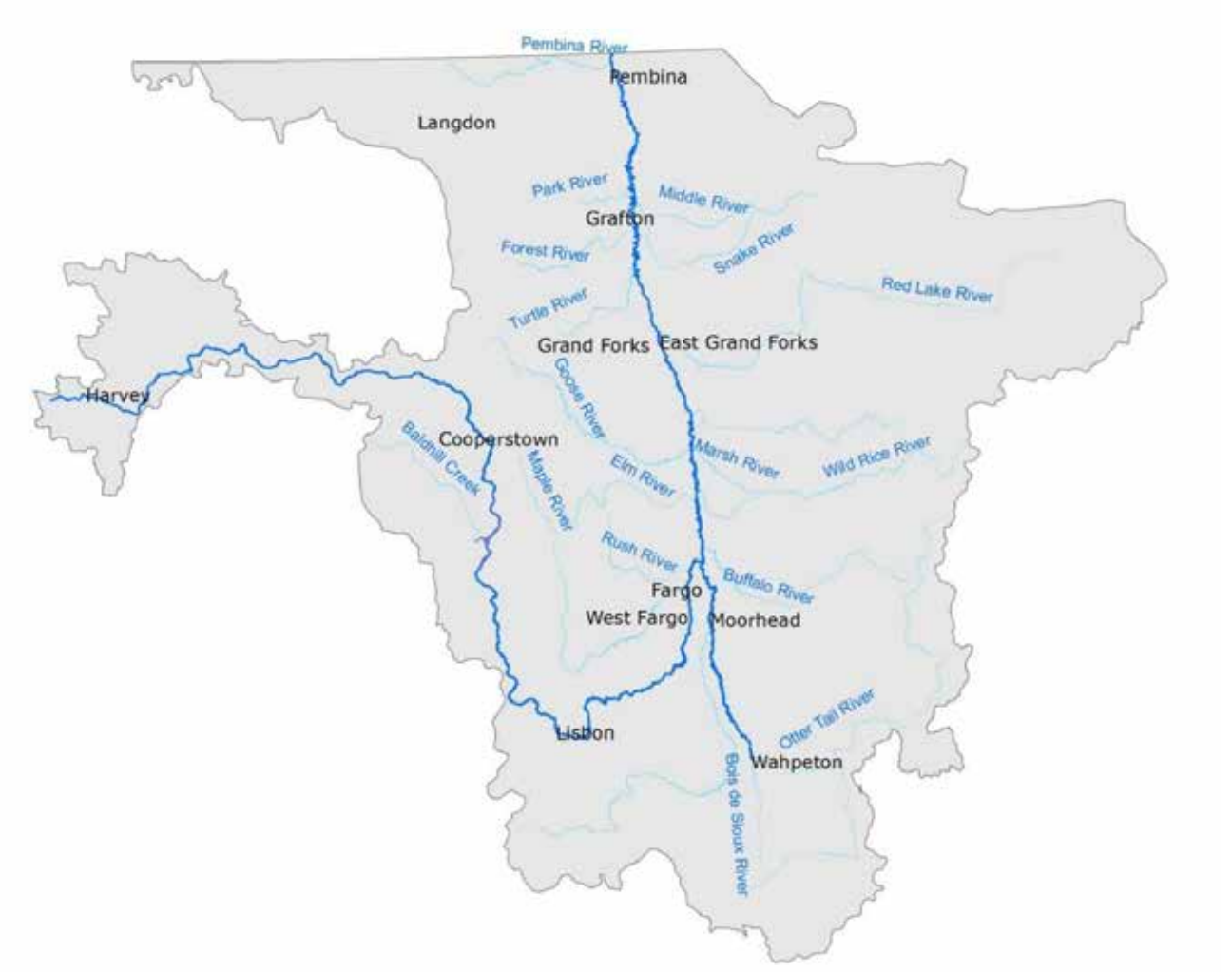


Figure 3-4 Modeled Extent with StateMod

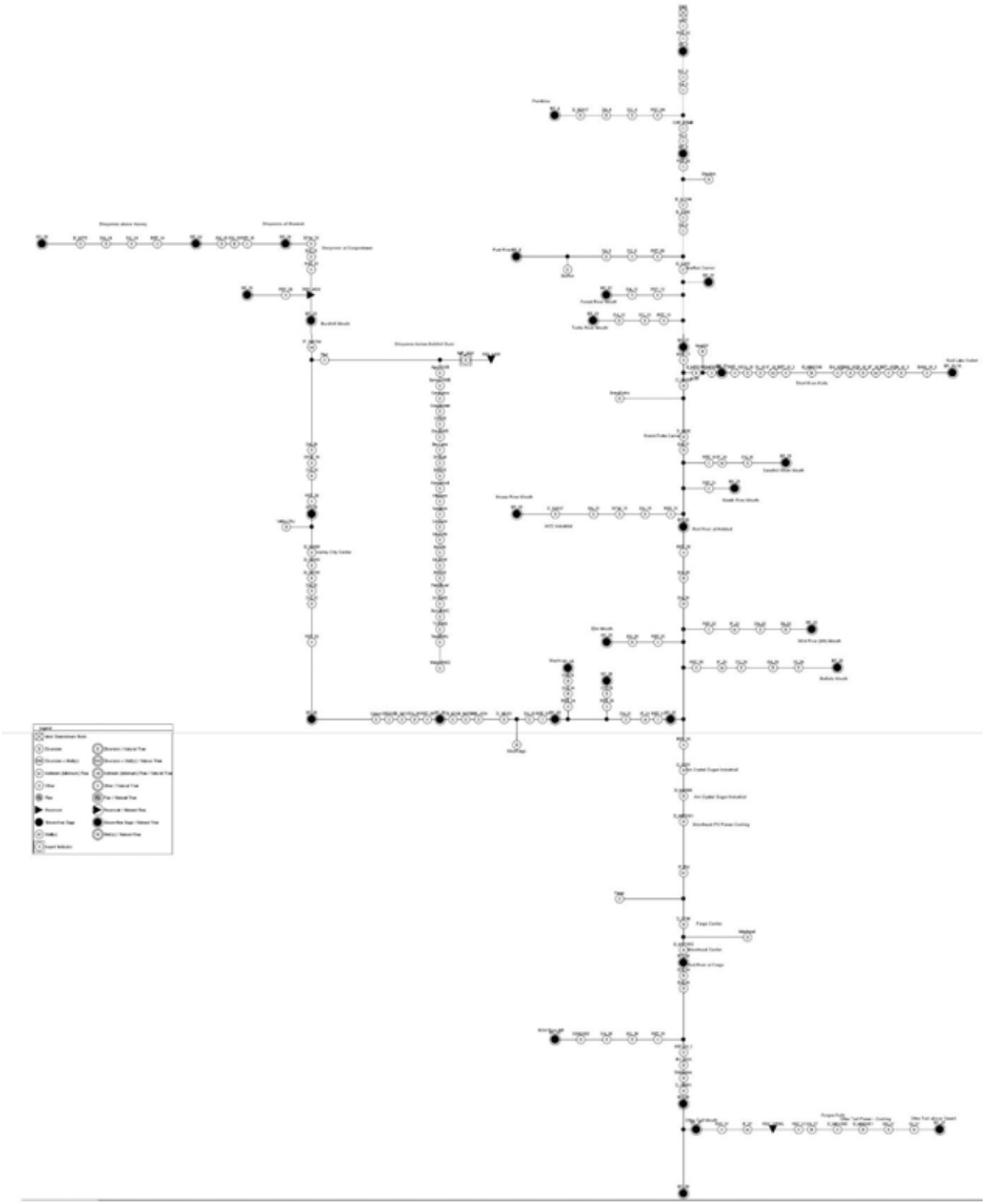


Figure 3-5 Modeled Network Schematic with StateMod

3.2.4 Hydrology

Model elements are grouped into numbered watersheds called Doug Emerson Basins (Figure 3-6), named after a USGS hydrologist who developed stream gage data for the original RRVWSP planning effort. The basins are tributaries to modeled stream gages, and nodes within the basins are frequently referenced by their basin number.

The model uses naturalized flow inputs or stream flows, which would have occurred during the model simulation period without human influences such as diversions to meet demands or reservoir operations. Naturalized flows were developed from a set of historical gage records of varying length and completeness. The procedures and statistical techniques used to develop naturalized flows and to project them to un-gaged locations for modeling are described in the USGS report *Historic and Naturalized Monthly Streamflow for Selected Sites in the Red River of the North Basin in North Dakota, Minnesota, and South Dakota, 1931-2001.*

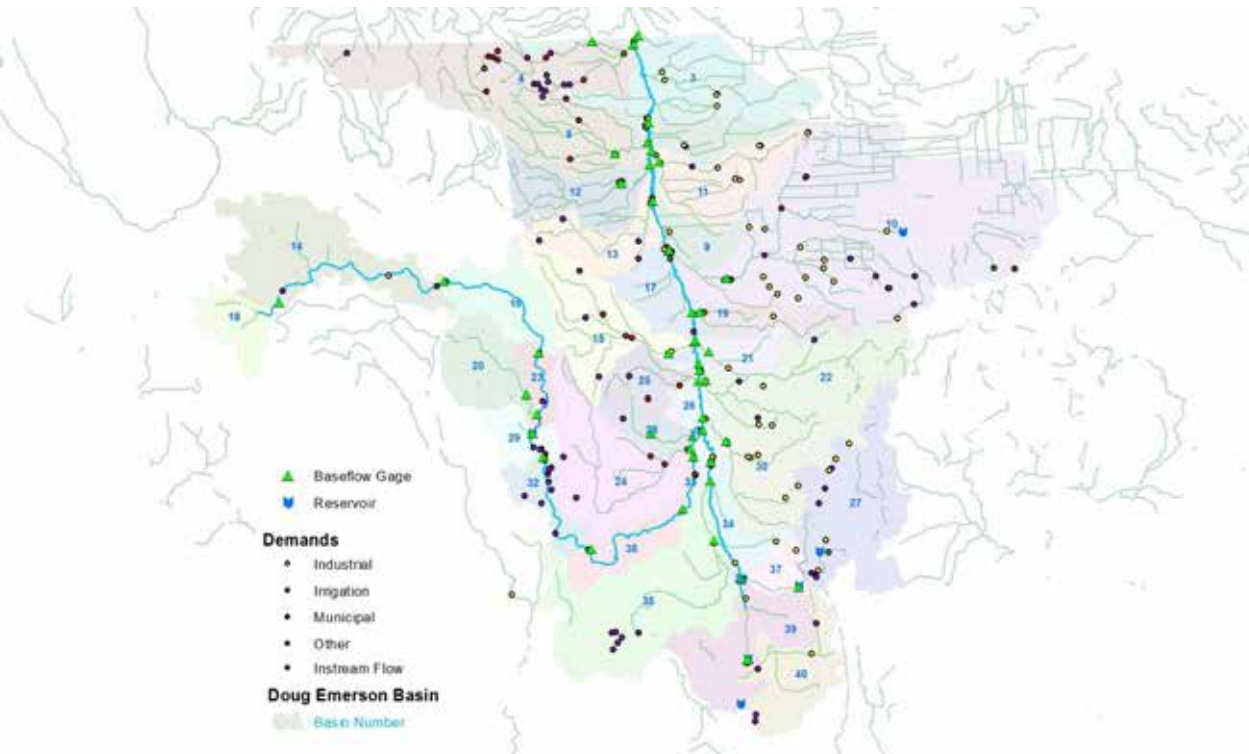


Figure 3-6 Doug Emerson Basins, Modeled Baseflow Gages, and Demands

3.2.5 Design Criteria

Design criteria were established to determine the required import flow:

1. Project infrastructure is sized to meet performance criteria during the 1930's drought of record.
2. Minimum streamflow requirements had been previously established by Reclamation in the Final Environmental Impact Statement (Reclamation, 2007). The first four listed requirements on the Sheyenne and Red Rivers were based on recommendations from the North Dakota Game and Fish Department. Minnesota Q90 flows were requirements of the Minnesota Department of Natural Resources.

- Year-round minimum release from Baldhill Dam of 23 cfs.
- Minimum of 69 cfs below Baldhill Dam throughout month of April.
- Year-round instream flows of 23 cfs below Fargo intake on Sheyenne River.

In addition, operational rules for Lake Ashtabula are set up in the model. The operational rules were established in the Water Control Manual Baldhill Dam and Lake Ashtabula (US Army Corps of Engineers Revised March 2007).

Figure 3-7 shows the various water allocations in Lake Ashtabula. The Lake Ashtabula operating rules are as follows:

- Maintain existing storage accounts for Grand Forks, West Fargo, Fargo, Valley City, and Lisbon.
- Store and release State RRVWSP water to project participants.
- Always maintain Lake Ashtabula levels above the Fish and Wildlife Conservation Pool (28,000 acre-feet).

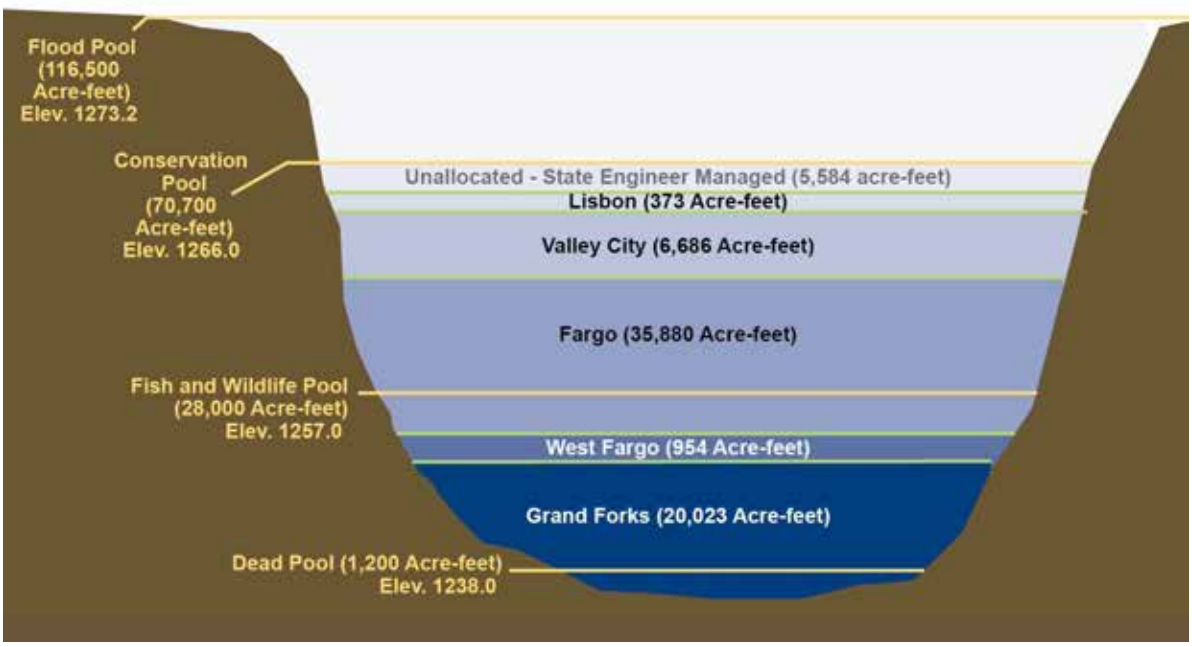


Figure 3-7 Lake Ashtabula Thomas-Acker Allocations

3.2.6 Model Results to Determine the Required Import Flows

Figures 3-8 and 3-9 contrast system performance with water imports to results with no imports. Figure 3-8 shows that Lake Ashtabula fails to maintain its minimum required volume (28,000 acre-feet) for years without the water imports. With any variation of project that imports of 165 cfs, the 28,000 acre-foot storage target is maintained throughout the 1930s drought period.

Figure 3-9 shows that Sheyenne River minimum flows fall to nearly zero without a project and shows how minimum Sheyenne River flows are maintained with a project.

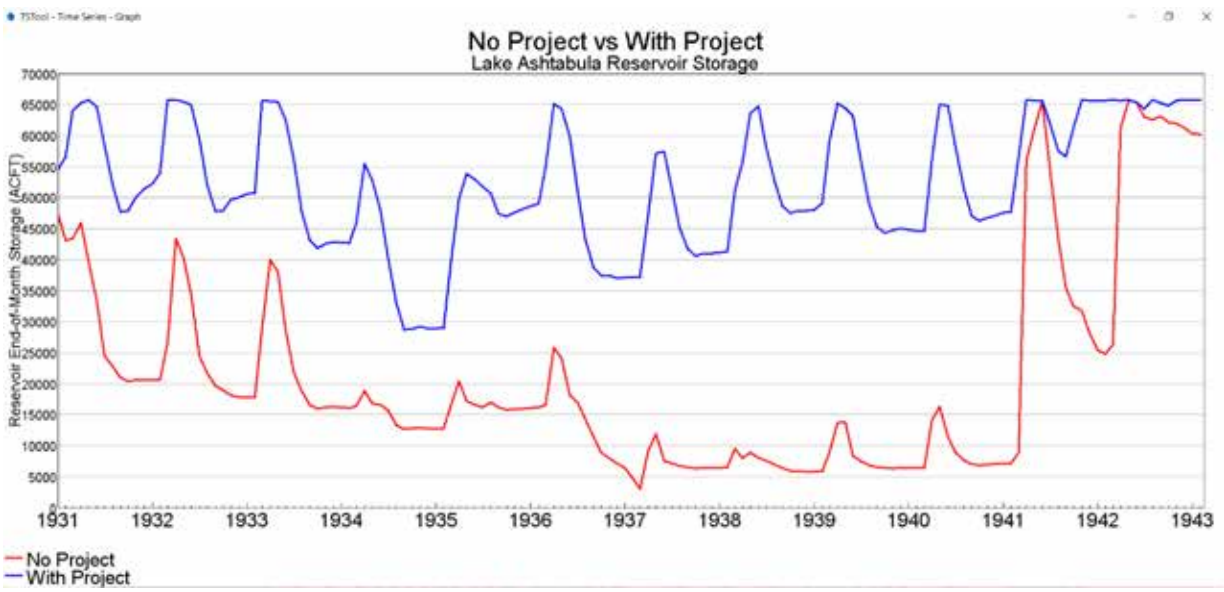


Figure 3-8 Lake Ashtabula Levels With and Without a 165 cfs Import Project

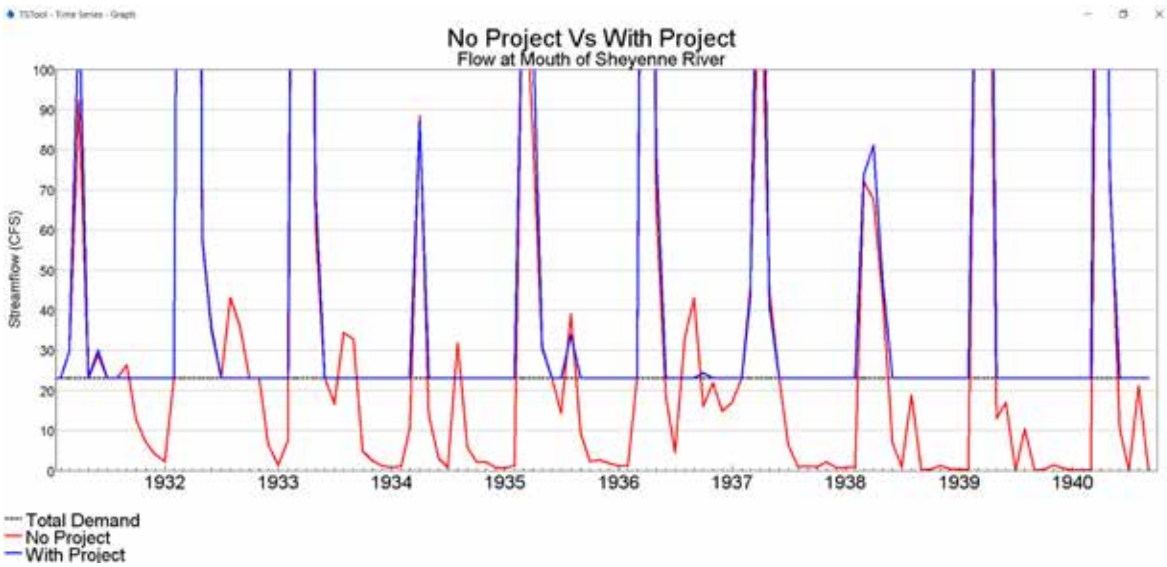


Figure 3-9 Sheyenne River Flows With and Without 165 cfs Import Project

3.2.7 Required Flow and Pipeline Sizing

The pipeline sizing was based on hydraulic modeling and limiting the pipe velocity to between 5 and 6 feet per second. Based on this criterion, the pipeline was sized at 72 inches.

3.3 PIPELINE CONSTRUCTION AND LAND DISTURBANCE

The pipeline will be buried at a minimum depth of 5 feet to the top of pipe. The pipeline will be constructed in a 150-foot easement, as shown on Figure 3-10. Excavated topsoil will be segregated from the subsurface soils and used to restore land.

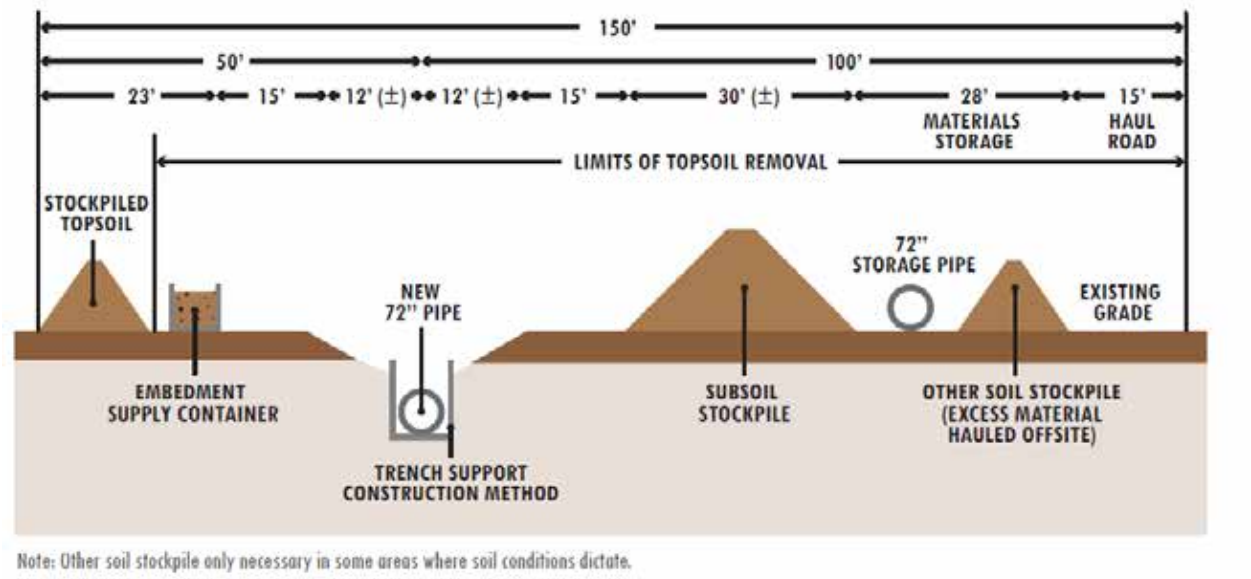


Figure 3-10 Typical Pipeline Construction

3.4 BASIS FOR PIPELINE ALIGNMENT

The pipeline alignment for pipeline segments associated with the State RRVWSP and the State RRVWSP/CNDWSP (Segments A, B, C, D, and E) meets the criteria necessary for the pipeline to be constructed under a United States Army Corps of Engineers (USACE) nation-wide permit without requiring notification. The most significant criterion was to avoid impacts to jurisdictional wetlands.

The pipeline alignment for the pipeline segments associated with ENDAWS (Segments F, G, H and I) meet environmental commitments that have been developed in consultation with Federal and State agencies (in response to construction activities and scoping over the last decade of rural water system development in North Dakota by Reclamation). The commitments include the protection of surface water and wetlands and the protection of other environmental, cultural, and historical resources.

3.5 BWTP

The regulatory context and basis of design for the BWTP is described in greater detail in Chapter 5.

3.6 COST ESTIMATING STRATEGY

Cost estimates were developed in general accordance with guidelines established by the Association for the Advancement of Cost Estimating International (AACEI) and are most accurately described as Class 4 estimates to form the basis for budget authorization, appropriation and/or funding. The cost estimates presented in this Report are recommended to have an accuracy of +/- 30 percent based on AACEI guidelines.

4.0 Source Water Availability

4.1 INTRODUCTION

This Chapter describes the availability of source water from the Missouri River and the McClusky Canal.

4.2 MISSOURI RIVER WATER AVAILABILITY

The Missouri River extends 2,619 miles from its source at Hell Roaring Creek in Montana to its confluence with the Mississippi River in the state of Missouri. The Missouri River is the longest river in the United States draining one-sixth of the country. It is the main river in the Missouri River Drainage Basin. The USACE operates six dams and reservoirs on the Missouri River that are located in Montana, North Dakota, South Dakota, and Nebraska (Figure 4-1). This system of dams and reservoirs has a capacity to store 73.4 million-acre feet of water, which makes it the largest reservoir system in North America. The USACE operates the system to serve congressionally authorized project purposes of flood control, navigation, irrigation, hydropower, water supply, water quality, recreation, and fish and wildlife.

Figure 4-1 Missouri River Basin and Location of Garrison Dam

As the proposed Missouri River intake is just downstream of the Garrison Dam, Missouri River water availability was evaluated from the following flows in Table 4-1, near Washburn, ND, upstream of the proposed water intake.

Table 4-1 Historic Missouri River Flows (1959 – 2012) Near Washburn

EXCEEDANCE	FLOWS (CFS)	PERCENT OF FLOW USED BY ENDAWS
1%	50,295	0.3%
50%	19,925	0.8%
99%	8,194	2.0%

Source: USACE daily average flow from Garrison Dam combined with USGS daily average flow measured at the Knife River near Stanton, ND.

Based on this analysis, it was concluded that the Missouri River could adequately supply the required water 165-cfs of water. The intake location and proposed intake screen as part of the State RRVWSP have been permitted by the USACE (Under Nation-wide Permit No. 12)) and are not discussed in detail.

4.3 MCCLUSKY CANAL WATER AVAILABILITY

The McClusky Canal is best understood in the context of the Garrison Diversion Unit (GDU) Principal Supply Works, which includes Snake Creek Pumping Plant, Lake Audubon, McClusky Canal, and the Chain of Lakes (Figure 4-2). The GDU was authorized in 1965 and construction began in 1967. The GDU project was designed to divert Missouri River water to central and eastern North Dakota for irrigation, municipal and industrial water supply, fish and wildlife conservation and development, recreation, flood control, and other project purposes. The project, however, was not completed, and the Canal is plugged at the MM 59.

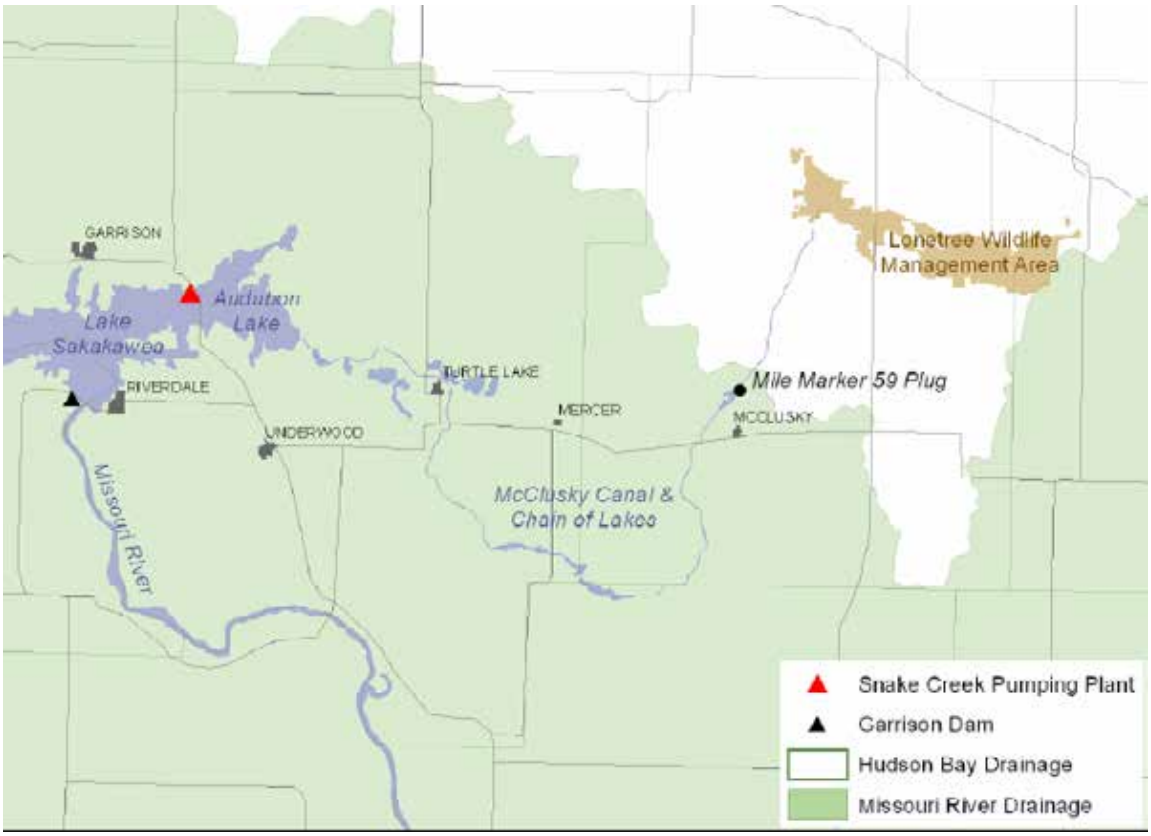


Figure 4-2 McClusky Canal and Related Water Systems

4.3.1 Lake Audubon

Lake Audubon, originally known as Snake Creek Reservoir, was created in 1953 when the USACE constructed the Snake Creek Embankment. The embankment dividing Lake Sakakawea from Lake Audubon provides a crossing for U.S. Highway 83, the Canadian Pacific Rail System, and utilities. The embankment also provides a means for managing water levels in Lake Audubon for recreation, fish and wildlife resources, and diversion of Missouri River water via the McClusky Canal. At the time of construction, a gated control structure was incorporated into the embankment to allow water level management by gravity flow between Lake Audubon and Lake Sakakawea.

The Snake Creek Pumping Plant was completed in 1975 in order to pump water from Lake Sakakawea to Lake Audubon and to manage Lake Audubon at a higher level than Lake Sakakawea. Lake Audubon has a capacity of 340,700 ac-ft at elevation 1847.2 feet mean sea level (msl), surface area of 18,000 acres, a maximum depth of 68 feet, and approximately 120 miles of shoreline (of which 80 miles are on the mainland and the remaining 40 miles are islands). The lake water level is managed between elevation 1,845.0 and 1,847.2 ft msl in accordance with the current Snake Creek Dam and Lake Audubon Reservoir Water Control Manual (USACE 2019). Management of the lake is as follows:

(1) Starting in the spring, the water level in Lake Audubon is raised to 1,847.2 ft msl using pumps at the Snake Creek Pumping Plant. The rise in water levels occurs as rapidly as possible during the period from ice out until the first week in May.

(2) The water surface elevation is maintained at 1,847.2 ft msl from May until September.

(3) Beginning in September of each year, Lake Audubon is gradually lowered to approximately 1,845.0 ft msl. The drawdown is completed prior to freeze-up to minimize negative impacts to fish and wildlife and to maximize potential for removing silt from walleye spawning areas,

In November and early December 2006, Lake Audubon was drawn down by the USACE an additional 2 feet to elevation 1,843.0 ft msl to limit the water surface level difference between it and Lake Sakakawea to 36.5 feet as a safety measure for the Snake Creek Embankment. Later, as part of the USACE Dam Safety Risk Management Process, a seepage analysis of the Snake Creek embankment was completed in 2007. This analysis determined that the risk of dam failure from under seepage is increased with head differentials greater than 43 feet. Based on this analysis, and a subsequent analysis completed in 2013, an Interim Risk Reduction Measure was applied, limiting the head differential to 43 feet. The Interim Risk Reduction Measure is temporary and will be further clarified through the continuation of the Dam Safety Risk Management Process.

4.3.2 Existing McClusky Canal Operations

The McClusky Canal is approximately 74 miles long, has a partial to full clay lining in selected areas, a bottom width of 25 feet, an original design operating water depth of 17 feet and an original design capacity of 1,950 cfs with an elevation of 1,850 ft msl on Lake Audubon and a channel N value of 0.020. The first 59 miles of the Canal in the Missouri River Basin are supplied with water through the Canal head-works from Lake Audubon. Lake Audubon is currently operated at 1,847.2 ft msl, which reduces the maximum capacity down the McClusky Canal to 1,350 cfs. The goals of water operations on the Canal are:

- Maintain target water elevations within different reaches of the Canal.
- Maintain acceptable total dissolved solids (TDS) levels.
- Meet requests for water use.

In 2018, an operational analysis of the Canal was completed to assess the Canal's ability to convey existing and future water demands, including 165-cfs for the RRVWSP (*Technical Memorandum – McClusky Canal Operations Hydraulic Model*, AE2S 2018). The water demands used in the analysis included:

- Surface evaporation (assumed 10-inches per month).
- Infiltration losses (assumed 1.4 cfs).
- Current irrigation flow allocation.
- Proposed 165 cfs for the RRVWSP.

The 2018 Hydraulic Model did not specifically consider the impacts of the McClusky Slide on the Canal operations, but the slide is currently being repaired with a goal of re-establishing a minimum of 500 cfs hydraulic capacity.

As described in Chapter 2, two potential canal intake areas were identified for the CNDWSP and various ENDAWS route options. The two intake options are summarized below and shown on Figure 4-3.

- Mile Marker 42 to 49: Used in CNDWSP, ENDAWS Route Options Canal South, and Missouri River and Canal South.

- Mile Marker 57: Used in ENDAWS Route Options Canal North, and Missouri River and Canal North.

Within the Canal, there are seven structures that limit or control flow. These structures are listed below starting at Lake Audubon moving downstream and shown on Figure 4-3.

- Headworks: MM 0.
- Goven Radial Gates: MM: 19.
- MM 28 Dike.
- New Johns Radial Gates: MM: 38.
- MM 52 Plug.
- Highway 200 Tunnel: MM 55.
- Hoffer Lake Plug: MM 59.

Figure 4-3 McClusky Canal Control Structures

The 2018 McClusky Canal Operations Analysis developed rating curves for each structure. These curves were compared to operational demands to determine the capacity limitations of each structure. Based on the structures' rating curves and the proposed ENDAWS intake locations, the following canal structure modifications will need to take place to provide the needed capacity.

4.3.3 Mile Marker 42 - 49 Withdrawal Location

At Mile Marker 28, water is conveyed through two parallel culverts – one 24 inches and one 36 inches that were temporarily installed by Garrison Diversion to provide access across the Canal. Removal or modification of the MM 28 dike/culverts is required to meet the existing water demands plus the 165-cfs CNDWSP and ENDAWS flow to the State RRVWSP. Note that the MM 28

culverts cannot provide the existing irrigation allocation but can provide the existing irrigation flow demand because the downstream customers do not use their full allocation. The culverts would be replaced with an 8-foot by 8-foot box culvert. The estimated cost for this is $470,000 and has been included in the overall cost estimate the McClusky Canal Intake Pumping Stat ion.

4.3.4 Mile Marker 57 Withdrawal Location

The Canal requires the following modifications to provide the total capacity:

- Removal or modification of the MM 28 dike/culverts as noted above. Removal of the MM 52 plug (there is an existing earthen plug at MM 52 that would need to be removed). The plug located at MM 52 completely blocks the flow of Lake Audubon water from the downstream sections of the Canal. There are no existing irrigation demands downstream of this point, so the plug would need to be removed to supply water for the ENDAWS North Canal options. The estimate for this this is $250,000 and has been included in the overall cost estimate for the McClusky Canal Intake Pumping Station.
- The Highway 200 tunnel, which is actually a large inverted siphon, could provide the needed flow for the ENDAWS North Canal options if the operating elevation of the Canal is raised one foot from 1840.5 to 1841.5. Otherwise, the tunnel would need to be upsized.

5.0 Biota Water Treatment Plant

5.1 WATER QUALITY

5.1.1 Missouri River Water Quality

Water quality samples from the Missouri River are routinely collected by the United State Geologic Survey (USGS) and the results are available to the public. Water quality sample information is available at approximately 40 sites, during varying periods of record, along the Missouri River and from within Lake Sakakawea.

5.1.2 McClusky Canal Water Quality

Canal water quality is monitored by the Garrison Diversion and USGS. The Garrison Diversion collects water samples at the following locations in the spring and fall of each year:

- Lake Sakakawea
- Lake Audubon
- Canal Headworks
- MM 31.75
- Painted Woods Outlet from New Johns Lake
- Highway 200 Tunnel
- Hoffer Lake

The USGS collected samples along the Canal during the period of 2007 through 2011. They collected roughly 4 samples per year at the following locations:

- Lake Sakakawea
- Snake Creek Pumping Plant
- Lake Audubon near Snake Creek Pumping Plant
- Lake Audubon near Bouy 17
- Lake Audubon in the Game Management Area
- Canal Headworks
- New Johns Lake
- Painted Woods Outlet from New Johns Lake
- Bridge downstream of Radial Gates
- MM 52 Plug
- Hoffer Lake

A detailed review of the expected water quality is presented in the ENDAWS Biota Water Treatment Plant Report.

5.2 BIOTA WATER TREATMENT PROCESSES

The rest of this chapter presents a summary of four BWTP options, the level of treatment achieved, and how residuals would be handled in each option. Treatment processes selected vary from basic

sand/grit removal and free chlorine disinfection to conventional and enhanced water treatment designs that include additional physical removal and inactivation of biological pathogens. Table 5-1 provides a summary of the treatment options and their respective purposes. Table 5-2 presents a summary of the treatment processes associated with each option.

Table 5-1 Treatment Capabilities for Various Options

OPTION	PURPOSE	CAPABILITIES OF BIOTA TREATMENT PLANT COMPONENTS	
		Biological Removal	Biological Inactivation
1	Macro-organisms (greater than 100 microns) and Primary Biological Constituents	Sand/Grit Removal (macro)	Chlorine
2	Macro-organisms (greater than 100 microns) and Primary Biological Constituents	Sand/Grit Removal (macro)	UV, Chlorine
3	Macro-organisms, Primary Biological Constituents and Natural Organic Matter	Coagulation/Flocculation, Sedimentation, and Granular Media Filtration	UV, Chlorine
4	Macro-organisms (greater than 100 microns), Primary Biological Constituents, and Natural Organic Matter	Sand/Grit Removal (macro), Coagulation/Flocculation, and Membrane Filtration	UV, Chlorine

Table 5-2 Treatment Processes for Various Options

TREATMENT PROCESS	BIOTA TREATMENT OPTION			
	1	2	3	4
Main Process				
Intake Fine Screening	■	■	■	■
Sand/Grit Removal	■	■		■
High-Rate Sedimentation			■	
Media Filtration			■	
Membrane Filtration				■
UV Disinfection		■	■	■
Chlorine Disinfection	■	■	■	■
Residuals Treatment				
Solids Equalization			■	■
High-Rate Sedimentation			■	■

TREATMENT PROCESS	BIOTA TREATMENT OPTION			
	1	2	3	4
Residuals Lagoon			■	■

Process flow diagrams for the four biota treatment options are shown in **Figure 5-1**; brief descriptions of each option follow in this chapter. Option 1 is the most basic biota treatment option. Options 2, 3, and 4 include UV disinfection as well as additional pretreatment processes to improve the effectiveness of aquatic invasive species (AIS) removal. As the biota treatment options progress, additional levels of treatment capabilities are added. The treatment options are discussed in further detail in the following sections.

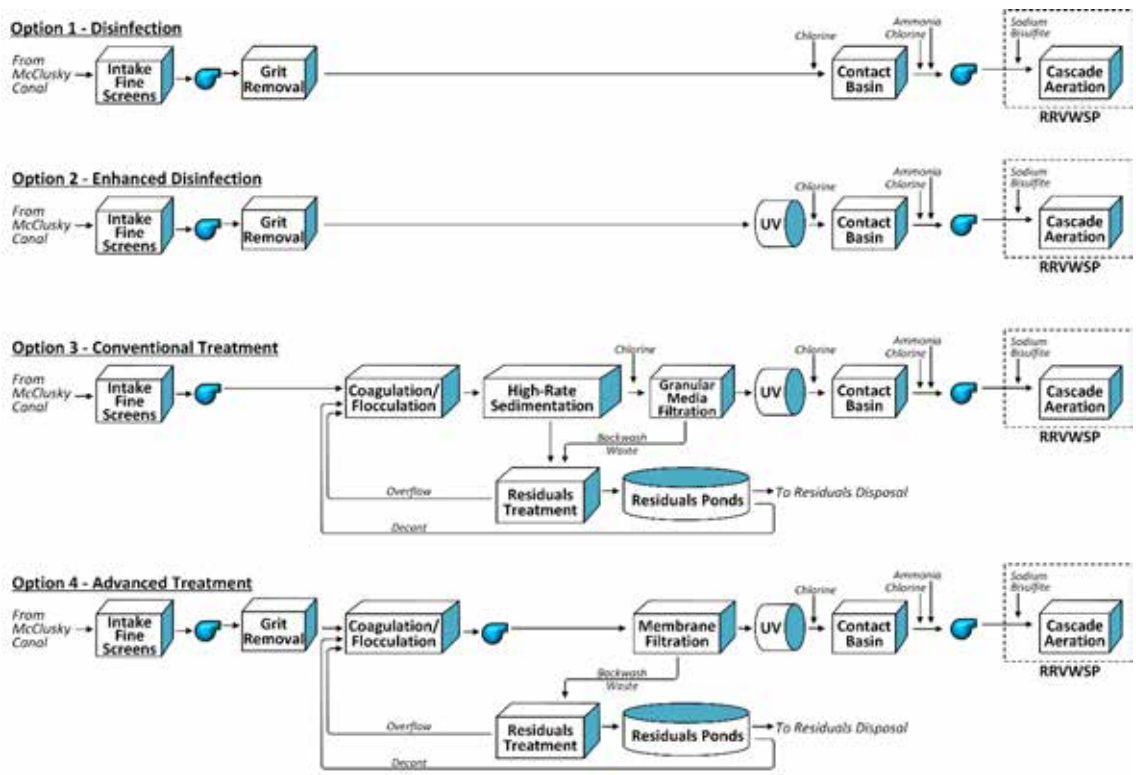


Figure 5-1 Biota Water Treatment Options

5.3 OPTION 1 – DISINFECTION

Option 1 provides water treatment through sand/grit removal and chlorine disinfection for removal of AIS. Sand/grit removal physically separates macro-organisms and fine material from the inflow before continuing to chlorine disinfection. Removing macro-organisms such as mollusks and mud snails reduces the chlorine demand as well as time required to maintain the treatment equipment. The chlorine disinfection process is designed to meet 3-log *Giardia* and 4-log virus inactivation. Chlorine disinfection provides both the log-inactivation credit and disinfectant residual to reduce the opportunity for re-growth of organisms in the pipeline.

5.3.1 Sand/Grit Removal

Sand/grit includes sand, gravel, or other heavy solid materials that have a higher density than water, which enables it to be physically separated from the raw water inflow. Sand/grit removal can be achieved through several means, the most common of which are with hydraulic settling, aerated grit chambers, mechanical-forced vortex units, and gravity-forced vortex units. Due to the ability to achieve higher removals of smaller particles only vortex removal processes were considered for this project. A mechanical-forced vortex unit uses a paddle to create a vortex that separates sand/grit from the raw water. Gravity-forced units have no moving parts; they passively split the sand/grit from inlet flow using a pressure drop applied over a stack of cones providing a high surface area. Both mechanical forced and gravity forced vortex units have been used for sand/grit removal at water production facilities. To enhance the capture and removal of AIS of concern, the sand grit system has been designed to remove 95 percent of all particles with a specific gravity greater than 2.1 and size greater than or equal to 100 microns. This conceptual design has been developed using the gravity-forced vortex units selected as the basis of design to achieve the greatest removal through either settling or adsorption of AIS on to the sand/grit particle for removal. Once removed, the sand/grit is pumped to a classifying unit where it is washed, cleaned, concentrated, and dewatered. Dewatered grit is typically collected in a roll-off dumpster and trucked to a landfill. A landfill in the MRB would be used for this application.

5.3.2 Chlorine Disinfection

Free chlorine disinfection will be the primary disinfectant in this option to meet the targeted inactivation. The chlorine disinfection system proposed for the State RRVWSP relies upon a combination of contact basins and pipeline volume to achieve the targeted chlorine residual contact times. For the ENDAWS options, the target chlorine contact times will be achieved only through contact basins. At the discharge of the contact basins, ammonia will be added to consume the free chlorine and generate chloramines. Chloramines are a more stable chlorine residual, and eliminating free chlorine significantly reduces potential disinfection by-products (DBP) formation.

5.3.3 Residual Chlorine

This option provides basic disinfection with 215 minutes of free chlorine contact time at an expected residual of 3.0 mg/L in a serpentine disinfection contact basin with a baffling factor of 0.8, which calculates to a contact time (cT) of 516 mg-min/L. A cT of 516 mg-min/L is required to achieve greater than 3-log removal/inactivation of *Giardia*, as well as provide greater than 4-log removal/inactivation of viruses. Free chlorine disinfection is followed by ammonia addition to form chloramines.

A chlorine residual will be maintained entering the transmission pipeline for this Option 1 and all subsequent biota treatment options discussed in Chapter 5 (Options 2, 3, and 4). Furthermore, a detectable residual may be present throughout the water delivery pipeline in all options. Therefore, prior to the transferred water entering the receiving natural water source, any remaining disinfection residual will be quenched and removed by the State RRVWSP. This is accomplished using a quenching chemical, sodium bisulfite. Additional chemical feed and storage systems will be required at the discharge location to achieve proper quenching of the disinfectant residual before discharge.

5.4 OPTION 2 – ENHANCED DISINFECTION

Option 2 is an enhanced disinfection process, including sand/grit removal and UV light irradiation and free chlorine disinfection and chloramine formation. UV is an effective disinfection process that provides significant inactivation of *Giardia, Cryptosporidium*, and other chlorine resistant AIS with

minimal DBP formation. It provides system flexibility by decreasing the necessary chlorine contact time due to its efficacy at *Giardia* inactivation compared to the sole use of chlorine (Option 1). Unlike chlorine disinfection, UV disinfection is not as effective against viruses at typical UV dosages and does not provide a disinfection residual in the effluent. Post UV chlorine application is necessary to establish a residual in the transmission pipeline. Virus inactivation is possible using UV disinfection, but at the cost of significantly increasing energy usage by an approximate factor of three. Therefore, the UV system will not be designed for virus inactivation. The UV and chlorine disinfection systems are designed for a peak flow of 107 mgd.

5.4.1 UV Disinfection

The UV system capacity is designed to provide a dose of 40 millijoules per square centimeter (mJ/cm^2) at a peak flow of 107 mgd. UV dose requirements are selected in order to achieve greater than 3-log removal/inactivation of *Giardia* based upon tables provided by the EPA. In addition, the UV system has been designed to achieve 4-log removal/inactivation of *Myxobolus cerebralis* (Hedrick 2007, Hedrick 2008, Hedrick 2012). In order to provide consistent pathogen removal capabilities, the maximum capacity of the UV system designed for Option 2 is also proposed as the UV system for Options 3 and 4.

5.4.2 Chlorine Disinfection

UV disinfection is followed by chlorination in a contact basin, which provides the log-inactivation of viruses that is not achieved in the UV reactors. The additional disinfection/AIS removal provided by UV reduces the *Giardia* log-inactivation potentially required by the chemical chlorine disinfection alone. In accordance with a conservative approach, the same disinfection contact basin (DCB) design for the chlorine disinfection described in Option 1 will be used in Option 2 as well to provide full disinfection redundancy to the UV system. As with Option 1, this treatment design provides a calculated cT of 516 mg-min/L based on 215 minutes of free chlorine contact time in a serpentine disinfection contact basin with a baffling factor of 0.8 at an expected residual of 3.0 mg/L. Following chlorine disinfection, ammonia is fed into the chlorinated water stream to form chloramines before entering the transmission line.

Enhanced disinfection consisting of UV irradiation followed by chlorination is also proposed as the disinfection/AIS inactivation process for Options 3 and 4.

5.5 OPTION 3 – CONVENTIONAL TREATMENT

Option 3 consists of coagulation, flocculation, high-rate sedimentation, and filtration (granular media filtration (GMF) considered as a representative process) followed by advanced disinfection processes (UV irradiation and chlorination) for AIS inactivation.

5.5.1 Coagulation/Flocculation

Removal of total organic carbon (TOC), turbidity, and AIS of concern in the treatment process begins with the addition of a coagulant - such as aluminum salts, ferric chloride and/or polymer - mixed in a rapid mix chamber. Rapid mix is followed by flocculation with vertical shaft equipment. This allows for AIS of concern to be attached to the particles being formed so that removal can be enhanced through sedimentation and filtration.

5.5.2 High-Rate Sedimentation

A large percentage of the flocculated particles are then removed in a sedimentation basin equipped with plate settlers, where the floc meets the plates and sluffs off to the bottom of the basin. The basin is equipped with a solids removal system, such as a hose-less vacuum system, that removes

settled solids accumulated at the bottom of the basin. The pre-treatment process is optimized to remove as much natural organic matter and AIS of concern, particulates, and other solid material as possible. The use of a coagulant results in additional solids generation and disposal. Plate settlers are a type of high-rate sedimentation and an option to conventional gravity sedimentation. Plate settlers are a proven technology with many successful installations in North Dakota drinking water treatment plants.

5.5.3 Media Filtration

Most surface water treatment facilities in the U.S. generally include a filtration process, such as GMF or cloth media filtration (CMF). Filtration has the benefits of removing a significant percentage of algae, sediment, AIS of concern, and other inorganic and organic particles from the surface water source.

GMF is the process of removing suspended solids passing water through a porous granular medium. The removal of particles is performed by several mechanisms: sedimentation, interception, diffusion, and straining. The use of multiple stratified layers of media with increasing density and decreasing size removes larger solids near the bed top and smaller solids further down the filter bed. Filtration is commonly the final polishing step in the conventional water treatment process. It is designed to meet final treated water turbidity limits. GMF meets the requirements of EPA's drinking water regulations for achieving log-removal credits for *Giardia* and viruses, allowing for removal credits ahead of disinfection and a reduction of required inactivation from the disinfection processes.

The GMF process provided for Option 3 is dual media filtration. Dual media filtration is proven to have high particle removal and filtered water quality. Dual media filtration typically uses a combination of sand and carbon media (anthracite or granular activated carbon (GAC)) with support media and underdrains at the base of the filter bed. This form of conventional media filtration is widely used in North Dakota for drinking water treatment and has been a standard drinking water treatment process in the U.S. for decades. Granular media filters provide good removal of particles, AIS of concern, and eliminate the potential shielding issue of particulates and organics associated with undesirable microbes. Properly operated GMF systems can be expected to produce a filtered water turbidity of less than 0.3 NTU. The filtration process results in a gradual accumulation of entrapped solids within the granular media, which require intermittent removal by means of a filter backwash cycle. This cycle typically comprises both air scour and water wash phases to effectively loosen and flush out the retained solids.

CMF utilizes an engineered cloth media made from thick pile fibers. The fibers provide filtration over the surface area and depth of the media. Historically, this process has been used solely in tertiary wastewater treatment processes for the removal of phosphorus and solids in stormwater and wastewater systems. Recently, select manufacturers have begun producing cloth media filtration process units designed for primary wastewater treatment applications. One significant disadvantage of cloth filtration for biota treatment is that no credit is currently given for log-inactivation of the constituents targeted in this treatment unit. CMF vendors indicate that data is available and could be submitted to regulatory agencies to receive the log-removal/inactivation credits. CMF system have shown to have the capability of achieving effluent levels of less than 1 NTU.

Backwash water and solids captured from the sedimentation basin are further concentrated by a side stream plate settler sedimentation basin. The overflow from the sedimentation process will be returned to the head of the plant. The underflow from the sedimentation process will flow by

gravity to a lagoon for decanting. The thickened solids in the lagoon are trucked offsite to the nearest landfill in the MRB. Decanted water from the lagoon is also pumped back to the head of the plant.

5.5.4 UV and Chlorine Disinfection

As with Option 2, enhanced disinfection consists of UV disinfection followed by chlorination in contact basins. UV disinfection supplements the filters upstream by adding to the removal/inactivation of Giardia, and chlorine disinfection provides the log-inactivation of viruses and AIS of concern that are not achieved by the UV reactors.

Given the additional removal/inactivation of *Giardia* provided by filtration, the UV system is not required to provide the same dose required in Option 2. The UV system is being designed to provide the same 40 mJ/cm^2 identified in Option 2 in order to provide the Giardia removal/inactivation necessary in the unlikely event that the entire filtration process needs to be bypassed. Although the UV system is designed for 40 mJ/cm^2, it would operate at 25 mJ/cm^2 if the filtration process remains effective. The system would be designed to increase the UV dose to 40 mJ/cm^2 if water quality monitoring (i.e. turbidity or ultraviolet light transmittance (UVT)) indicates limited filtration functionality.

The additional water treatment and disinfection provided by UV reduces the *Giardia* log-inactivation and AIS removal potentially required by the chemical chlorine disinfection process. The serpentine contact basin included in this option is like that of Option 1, with the main difference being a smaller capacity and lower baffling factor as a lower contact time is necessary in this option due to the *Giardia* removal provided by filtration and the inactivation provided by the UV disinfection process. This option provides basic disinfection with 20.2 minutes of free chlorine contact time in a basin with a baffling factor of 0.66 at an expected residual of 1.0 mg/L in a serpentine disinfection contact basin with a calculated cT of 13.3 mg-min/L. Although the target chlorine residual is only 1.0 mg/L, the same chlorine storage capacity and transfer capacity is being assumed as for Options 1 and 2. Following chlorine disinfection, ammonia is fed into the chlorinated water stream to form chloramines in similar fashion to Option 1.

5.6 OPTION 4 – ADVANCED TREATMENT

Option 4 involves sand/grit removal, coagulation, flocculation, and membrane filtration followed by an enhanced disinfection process as defined in Option 3. The process begins with sand/grit removal to help protect the membranes followed by the addition of coagulant(s) in a rapid mix chamber and flocculation to form pin floc. The coagulant is added with enough time to form pin floc that is not large enough to settle but can be easily removed by the membrane. The pin floc increases organic matter removal by the membranes and can also improve flux through the membrane. As is the case with Option 3, the use of a coagulant and a filtration process that will be backwashed requires solids separation and disposal. The membrane process is also an effective barrier for the removal of AIS of concern.

5.6.1 Membrane Filtration

Membrane treatment technologies may be used for particulate or dissolved constituent removal from drinking water, depending on the membrane pore size and material used. Microfiltration (MF) and ultrafiltration (UF) membrane systems, which have pore sizes in the range of 0.1 µm and 0.01 µm, respectively, are used for particulate removal, but do not remove dissolved constituents such as dissolved organic carbon (DOC), hardness, salts, taste and odor compounds, and organic chemicals without the addition of coagulations ahead of the membranes. Pretreatment of low-pressure

membrane feedwater is required for source waters that commonly have elevated turbidity or TOC levels. Prior to the MF or UF membranes, the pretreatment processes of coagulation and flocculation will create pin floc enhancing the ability of the membrane system to capture larger sized particles. Membrane filtration systems are very effective barriers against microorganisms such as *Giardia* as well as many of the AIS of concern identified in this study. Ultrafiltration membranes typically remove particles, sediment, algae, protozoa, bacteria, AIS of concern, and viruses. Each individual membrane product, dependent on supplier and model, is certified for a specific log-removal/inactivation of both *Giardia* and viruses.

MF and UF systems typically operate at trans-membrane pressures of 8 pounds per square inch gauge (psig) to 30 psig and are thus classified as low-pressure technologies. Typical average flux rates are in the range of 30 to 70 gallons per square foot of membrane surface per day (gfd) for polymer-based membrane systems; however, ceramic membrane systems may have flux rates of 100 gal/ft^2·d or more. Overall recovery from low-pressure membrane systems is typically 90 to 95 percent depending on membrane material and configuration and source water quality. Because low-pressure membrane filtration provides an absolute barrier to particulates based on membrane pore size and integrity, filtered water turbidity of less than 0.1 NTU is readily achieved.

There are two primary types of membrane systems used in water treatment, pressurized and submerged. Submerged configurations use open basins to house racks of membrane modules and drive water through the membranes using the static pressure provided by the water column in the basin and use of a vacuum pump. These submerged membrane systems are best used in waters with high solids loading rates. Their use, however, is limited due to the need to operate at atmospheric pressure. This factor reduces flexibility of the membrane system to adjust pressure for situations such as process upsets, a change in inlet water quality, or other changes in plant operation.

In comparison to submerged systems, pressure membrane systems provide a host of benefits specific to the requirements of this project. Pressure membrane systems are comprised of several tubular membranes arranged in racks or skids. These tubular membranes are an engineered compact product, which provides a high density of filter area within each membrane. This provides a significant capacity in a relatively small footprint without the need for basins. The operating pressure of tubular pressurized membranes builds a safety factor into the design allowing for greater ranges of operating pressure to cope with changes in water quality. Pressurized systems also have the benefit of being impacted less by cold water conditions due to the ability of the pressurized system to accommodate the higher viscosity water – a feature that submerged systems do not have. Regarding operation and maintenance, breaches in membrane integrity or broken fibers can be identified easily and replaced without significant downtime.

At this stage of the appraisal-level design, pressurized UF membranes are being considered based on their ability to provide a high degree of particulate and AIS of concern removal prior to the disinfection processes. The higher level of treatment with UF membranes provides many benefits to the biota treatment goals of this proposed BWTP, including virus removal. The membrane product used in this initial appraisal-level design is certified for 4-log removal/inactivation of Giardia and 1.5-log removal/inactivation of viruses. This is subject to change dependent on the final membrane filter product used in the final design. Additionally, the removal of TOC and other organic constituents with UF membranes pretreated with coagulants may reduce the formation of DBPs during disinfection and improve UV disinfection performance through potential impacts on UVT. In the event Option 4 is the treatment technology selected, further consultation with membrane manufacturers and suppliers will be completed to identify the most effective membrane treatment solution to meet the requirements of the BWTP and removal of AIS of concern.

Membrane filtration backwash water will be further concentrated in a side stream plate settler sedimentation basin. The overflow from the sedimentation process will be returned to head of the plant. The underflow from the sedimentation process flows by gravity to a lagoon for decanting. The thickened solids in the lagoon are trucked offsite to the nearest landfill in the MRB. Decanted water from the lagoon is also pumped back to the front of the plant. Cleaning waste generated during normal monthly maintenance of the UF system is neutralized and disposed. An air scour system is typically used to prevent solids buildup on the membrane surface.

5.7 RESIDUALS TREATMENT

The additional water treatment processes incorporated in Options 3 and 4 result in the generation of additional residual solids. Residual solids include organic solids, metal precipitates, and additive chemicals used to assist in the settling processes (e.g., aluminum salts, ferric chloride, and/or polymer). The expected concentrations and rates of residual production are summarized for each process in Table 5-3.

Table 5-3 Estimated BWTP Residuals Generation

BIOTA TREATMENT OPTION(S)	PROCESS	SOLIDS STREAM
3	High-Rate Sedimentation	0.25 – 3.5 percent solids 890 gpm daily average (all units in service) Generated continuously or periodically at staff discretion
3	Granular Media Filtration	<0.1 percent solids 1.1 – 5.4 MG generated daily(1) One backwash per filter per day 15- to 30-minute backwash cycle
4	Membrane Filtration	0.25 – 3.5 percent solids 400 gpm daily average Generated continuously or periodically at staff discretion

Note:
(1) 1 to 5 percent of plant throughput at 107 mgd.

The residual waste streams contain such a low concentration of solids that sending all underflow directly to a lagoon would require a significant amount of land area for storage. Initially, the underflow and backwash waste streams would flow by gravity to a flow equalization tank. Submersible pumps in the equalization tank would continuously feed residuals to a high-rate settling basin, such as an inclined plate settler.

The combined waste flow would be clarified, and the overflow returned to the head of the plant or otherwise utilized as reuse water. The remaining solids underflow would be concentrated (ranging from 2 to 4 percent solids) and would be pumped to residuals lagoons for gravity settling.

Residuals lagoons are an inexpensive and effective non-mechanized form of solids treatment and residuals management in projects where land is readily available and inexpensive. Residuals lagoons are often built directly into the ground onsite and are simple in construction and operation. Lagoons are equipped with basic controls such as inlet control devices and overflow structures. Residuals streams generated from the sedimentation process underflow and the filter backwashes at the plant are discharged, after clarification and solids concentration, into the lagoons where the solids are separated by gravity sedimentation.

Two pairs of two decant ponds would both be sized to provide seven days of detention time. The decant water from the ponds can either be returned to the head of the biota treatment train or used for irrigation on the plant site or a nearby field. The use of residuals lagoons provides passive gravity thickening and the residual solids would be hauled offsite either for disposal at a landfill or for land application within the MRB.

5.8 BIOTA TREATMENT

The treatment options developed here would address biota treatment using several different unit process combinations and treatment strategies. Biota treatment for *Giardia,* AIS of concern, and viruses was considered as part of the conceptual design of facilities. Cryptosporidium and whirling disease serve as surrogates for other potential AIS that may be present in McClusky Canal source water or the Missouri River water.

Biota treatment options assessed in this analysis rely upon chlorine disinfection for the 4-log inactivation credit of viruses, cryptosporidium, and whirling disease, although Option 4 provides some virus removal through UF and partial credit for 3-log inactivation of *Giardia* (apart from Option 1, which achieves 3-log inactivation of *Giardia* from solely chlorine contact).

The appraisal-level assessment of the estimated log-removal/inactivation credit for each option is based upon established EPA drinking water regulatory criteria as well as a literature review of the removal of AIS of concern identified in this study. Additionally, for this assessment, the cold-water temperature of 0.5°C and high pH of 8.8 from the McClusky Canal were chosen based upon analysis of the available source water quality data. Log-inactivation credit is calculated for disinfectant contact in the UV and DCB only, not including any additional contact in the pipeline at the exit of the BWTP.

Further bench-scale testing of the source water is necessary to better gauge potential water quality interferences with the UV system and chlorine demand of the source water. Bench scale testing will also need to be completed to verify the UV doses for various AIS of concern identified in this study.

The conceptual level estimated log-inactivation of biological contaminants with each option is shown in Table 5-4.

Table 5-4 Biota Treatment Options and Associated Log-Removal/Inactivation

BIOTA TREATMENT OPTION	PATHOGEN	INTAKE FINE SCREEN REMOVAL	CONVENTIONAL MEDIA FILTRATION REMOVAL(1)	MEMBRANE FILTRATION REMOVAL(2)	UV LIGHT INACTIVATION (3)	CHLORINE DISINFECTION INACTIVATION	TOTAL
1	*Giardia*	0	0	0	0	>3.0	>3.0
	Cumulative	0	0	0	0	>3.0	
	Viruses	0	0	0	0	> 4.0	> 4.0
	Cumulative	0	0	0	0	> 4.0	

BIOTA TREATMENT OPTION	PATHOGEN	INTAKE FINE SCREEN REMOVAL	CONVENTIONAL MEDIA FILTRATION REMOVAL(1)	MEMBRANE FILTRATION REMOVAL(2)	UV LIGHT INACTIVATION (3)	CHLORINE DISINFECTION INACTIVATION	TOTAL
	Cryptosporidium	0	0	0	0	0	0
	Cumulative	0	0	0	0	0	
	Myxobolus cerebralis(6)	1.0	0	0	0	>3.0	>4.0
	Cumulative	1.0	1.0	1.0	1.0	>4.0	
2	*Giardia*	0	0	0	>3.0	>3.0	>3.0
	Cumulative(5)	0	0	0	>3.0	>3.0	
	Viruses	0	0	0	0	>4.0	>4.0
	Cumulative	0	0	0	0	>4.0	
	Cryptosporidium	0	0	0	3.0	0	3.0
	Cumulative	0	0	0	3.0	3.0	
	Myxobolus cerebralis(6)	1.0	0	0	>4.0	>3.0	>4.0
	Cumulative(5)	1.0	1.0	1.0	>4.0	>4.0	
3	*Giardia*	0	2.5	0	3.0	0.1	>3.0
	Cumulative(5)	0	2.5	2.5	>3.0	>3.0	
	Viruses	0	2.0	0	0	4.0	>4.0
	Cumulative(5)	0	2.0	2.0	2.0	>4.0	
	Cryptosporidium	0	2.5	0	3.0	0	>3.0
	Cumulative(5)	0	2.5	2.5	>3.0	>3.0	
	Myxobolus cerebralis	0	2.5	0	4.0	0	>4.0
	Cumulative(5)	0	2.5	2.5	>4.0	>4.0	
4	*Giardia*	0	0	4.0	3.0	0.1	>3.0
	Cumulative(5)	0	0	>3.0	>3.0	>3.0	
	Viruses	0	0	1.5	0	4.0	>4.0

BIOTA TREATMENT OPTION	PATHOGEN	INTAKE FINE SCREEN REMOVAL	CONVENTIONAL MEDIA FILTRATION REMOVAL(1)	MEMBRANE FILTRATION REMOVAL(2)	UV LIGHT INACTIVATION (3)	CHLORINE DISINFECTION INACTIVATION	TOTAL
	Cumulative(5)	0	0	1.5	1.5	>4.0	
	Cryptosporidium	0	0	4.0	3.0	0	>3.0
	Cumulative(5)	0	0	>3.0	>3.0	>3.0	
	Myxobolus cerebralis	1.0	0	4.0	4.0	0	>4.0
	Cumulative(5)	1.0	1.0	>4.0	>4.0	>4.0	

Notes:

1. Includes coagulation, flocculation, and sedimentation processes.
2. Includes sand/grit removal, coagulation, and flocculation processes and UF membranes.
3. UV log-inactivation is based on an applied dose of 40 mJ/cm^2 for Option 2 and 25 mJ/ cm^2 for Options 3 and 4.
4. The log-inactivation/removal credits shown above are based upon 'expected values' for appraisal-level BWTP designs and are subject to change as the design is further refined.
5. Actual cumulative log-inactivation and/or log-removal values are likely to be higher than the minimum totals shown for each treatment option. Bench- and/or pilot-scale testing would be necessary to confirm higher cumulative values (e.g., *Giardia* removal/inactivation for membrane filtration, UV disinfection, and chlorine disinfection is 4.0-, 3.0-, and 0.1-log, respectively, for Option 4. Total committed cumulative log-removal/inactivation for this approach is >3.0, which is the same as for the single process of UV disinfection in the Enhanced Disinfection approach.).
6. In Options 1 and 2, the log-inactivation is based on the design cT being in excess of literature values for whirling disease removal.

6.0 Individual Project and Route Option Components

This Chapter presents a description of each individual component of the State RRVWSP, CNDWSP, and ENDAWS route options. All the pipeline segments are described first followed by each individual hydraulic and treatment facility. The individual components are combined from various project summaries and route options presented in Chapter 2. Not all components are used with each project or route option. Table 6-1 shows all the pipeline segments described below.

6.1 CONSIDERATIONS COMMON TO ALL PIPELINE SEGMENTS

The pipeline segment descriptions in this chapter focus on the horizontal pipeline alignment. The pipeline size, material of construction, and depth of burial have been previously described and are common to all pipeline segments. All pipeline segments include a 150-foot easement. Attachment A presents detailed pipeline alignment maps for each pipeline segment described below.

6.2 HYDRAULIC CONSIDERATIONS COMMON TO ALL FACILITIES

The hydraulic and treatment facility descriptions presented in this chapter focus on the facilities function, size, and layout. Preliminary engineering drawings for each facility are presented in Attachment B.

All facilities (pumping stations, HBT, treatment plants, discharge structure) are based on three sets of conditions, including a set for high flow (165-cfs), a set normal “in basin” operating flow (20 cfs), and a set for low flow (4 cfs). The 4 cfs flow is intended to keep the water in the pipeline from becoming anaerobic during periods in which the pipeline is not operating at high flow or “in basin” operating flow conditions. With such a wide range of flows, the facilities must be flexible and robust enough to safely operate throughout this range. For example, the CVS - which regulates flow throughout the system - is designed with high flow and low flow sleeve valve trains to accommodate the flow range. Likewise, pumping stations were designed to achieve the required flow rates and still have one reserve pump. The pumping stations are designed with a series of pumps used for high flow and a series of smaller pumps used for low flow.

As described in the State RRVWSP Preliminary Design Report, the hydraulic model and development of the system curves were based on the topography along the pipeline alignment. To build the hydraulic model, system flows were evaluated using the standard Hazen-Williams hydraulic formula and the estimated C factors. The target velocity used in sizing the pipeline was between 5 and 6 fps at peak flow.

The horsepower requirements for each pumping station are provided in Table 6-1, and are based on the pumping station being operated at 165-cfs (except where noted).

Table 6-1 Sizing Summary for Pumping Stations

HYDRAULIC FACILITY	FUNCTION	MAXIMUM FLOW (CFS)	BRAKE HORSE POWER	INSTALLED HORSE POWER
Missouri River Intake and Pumping Station (MIPS)	Pump from Missouri River to the WTP	165	1,520	2,400
Main Pumping Station 1 (MPS1)	Pump from the WTP to the HBT	165	15,857	24,000
Main Pumping Station 2 (MPS2)	Pump from the SRP to the Biota WTP	165	11,717	18,000
Central North Dakota Intake and Pumping Station (CNDIPS)	Pump from the McClusky Canal to the HBT	20	1,287	2,100
McClusky Canal Intake and Pumping Station 1 (McIPS1)	Pump from the McClusky Canal to the BWTP	165	1,520	2,400
McClusky Canal Main Pumping Station 1 (McMPS1)	Pump from the BWTP to the HBT	165	6,034	9,000
McClusky Canal Intake and Pumping Station 2 (McIPS2)	Pump from the McClusky Canal to the BWTP	165	2,290	3,600
McClusky Canal Main Pumping Station 2 (McMPS2)	Pump from the Biota WTP to the HBT	165	7,488	11,000

6.3 COST ESTIMATING ASSUMPTIONS AND DOCUMENTATION

Attachment C presents a cost estimate for each of the pipeline segments and hydraulic facilities described below. Chapter 7 combines the costs for individual pipeline segments and hydraulic facilities into total project or route option costs.

6.4 PIPELINE SEGMENT A

Pipeline Segment A is part of the State RRVWSP and is a 23.0-mile segment running east from the intake on the Missouri River, approximately 4.5 miles southeast of Washburn, ND (at the intersection of 171st Street NE and 396th Avenue NE in Burleigh County). This segment runs through two unorganized townships in McLean County and Grass Lake, Wilson, and Steiber Townships in Burleigh County. The terrain is quite rugged in portions of this segment as the route transitions through the "Missouri Breaks" and into the prairies. Land uses are a mix of cultivated fields and pasture land. Elevations within this segment range from a low of approximately 1656 feet msl to a high of 1979 feet msl, generally rising from west to east. To the extent possible, the route parallels existing roadways. The segment stays south of the Lost Lake Wildlife Refuge. Numerous tributaries of Painted Woods Creek and Yanktonai Creek are crossed along the route. Major tunnel crossings include US Highway 83, ND Highway 41, and the Dakota Missouri Valley & Western railroad. Five major electric transmission lines are crossed within this segment: McLean Electric Cooperative, Otter Tail Power Company, Western Area Power Administration (WAPA), Minnkota Power Cooperative, and Great River Energy. Finally, one 12-inch gas pipeline (WBI Energy), seven jurisdictional wetlands, and 14 gravel township/county roads are crossed within this segment. Figure 6-1 depicts the overall segment; detailed alignment drawings are included in Attachment A.

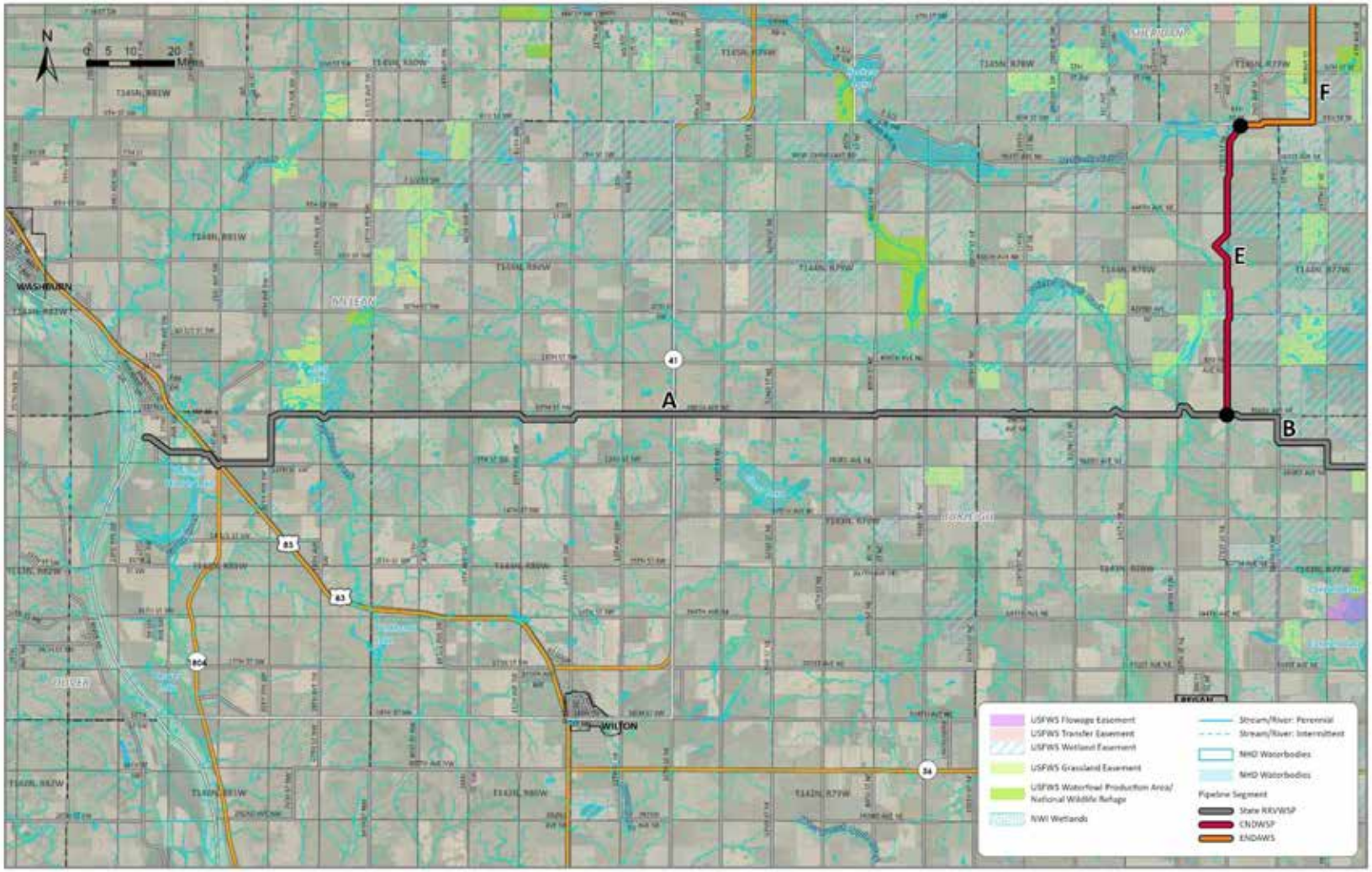


Figure 6-1 Pipeline Segment A: State RRVWSP

6.5 PIPELINE SEGMENT B

Pipeline Segment B is part of the State RRVWSP and is a 31.9-mile segment running east from the intersection of 171st Street NE and 396th Avenue NE in Burleigh County to 1st Street SE (east of 20th Avenue SE) in Sheridan County, approximately 5.5 miles south of Goodrich, ND. This segment runs through Esterville, Canfield, Richmond, Florence Lake, and Hazel Grove Townships in Burleigh County. In Sheridan County, the segment runs through an unorganized township and a portion of Mauch Township. The route is primarily cultivated fields on the west half of the segment and primarily pasture land on the eastern half. Where possible, the route parallels existing roadways, but several winding cross-country runs are necessary through this portion of the Prairie Pothole Region. Numerous potholes and sloughs are present within this segment. Where possible, the route has jogged around these wetlands to minimize impacts. Elevations within this segment range from a low near 1900 ft msl to a high of approximately 2103 ft msl. Major tunneled crossings include three crossings of ND Highway 14 and four jurisdictional wetland crossings. A single major electric transmission line and 11 gravel township/county roads are also crossed within this segment. Figure 6-2 depicts the overall segment, and detailed alignment drawings are included in Attachment A.

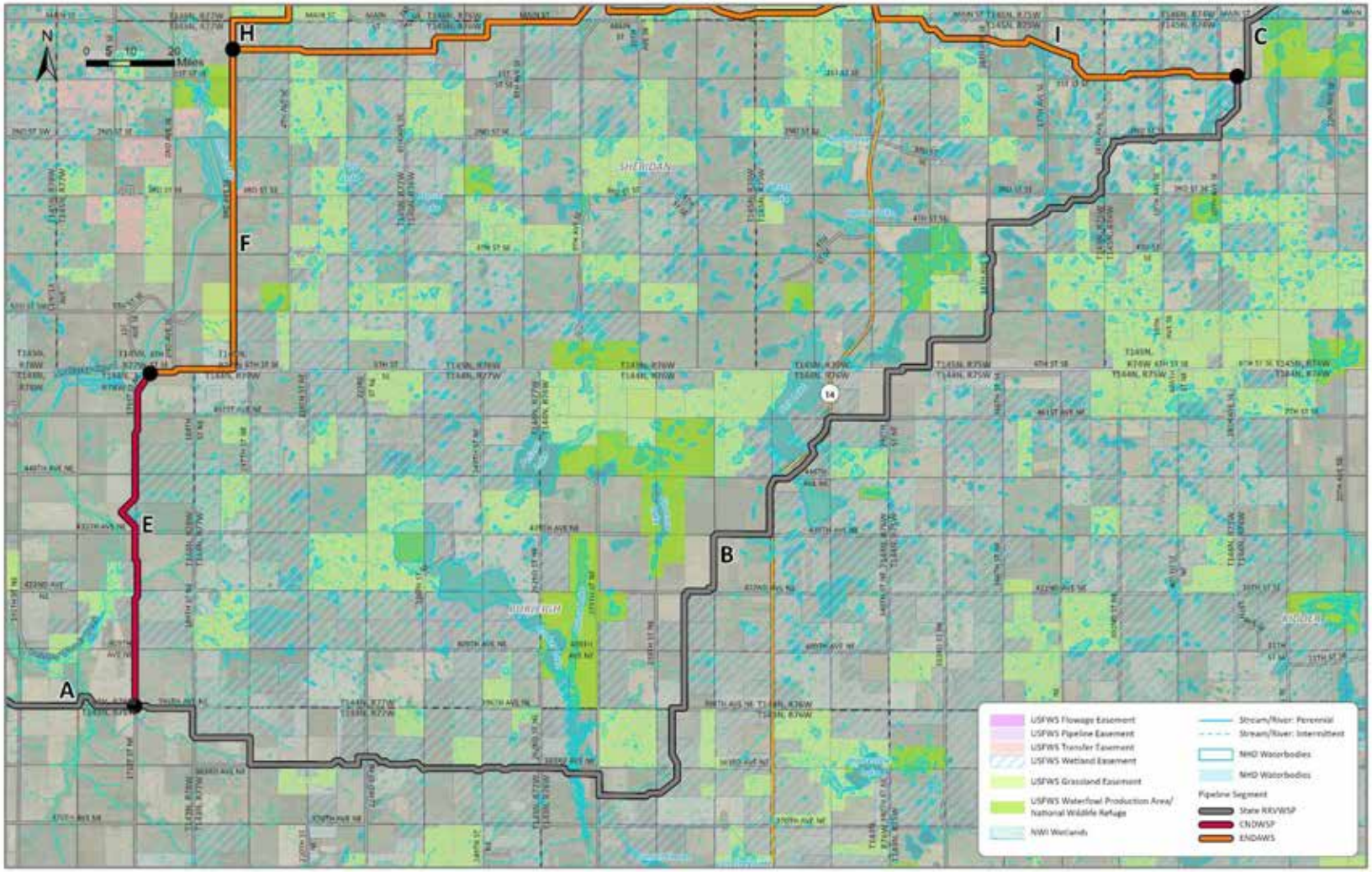


Figure 6-2 Pipeline Segment B: State RRVWSP

6.6 PIPELINE SEGMENT C

Pipeline Segment C is part of the State RRVWSP and is a 17.5-mile segment running east from near 1st Street SE (east of 20th Avenue SE) in Sheridan County to 33rd Avenue NE, approximately 1.5 miles northwest of Chaseley, ND in Wells County. This segment runs through Mauch and Goodrich Townships in Sheridan County. It continues into Bull Moose and Chaseley Townships in Wells County. This segment winds through the Prairie Pothole Region, jogging around numerous wetlands. The land affected is a mix of pasture land with some cultivated fields. Elevations range from a low near 1843 ft msl to a high near 2046 ft msl, with the slope generally falling from west to east. Major tunneled crossings include ND Highway 3, ND Highway 200, and four jurisdictional wetlands. Six gravel township/county roads are also crossed within this segment. Figure 6-3 depicts the overall segment, and detailed alignment drawings are included in Attachment A.

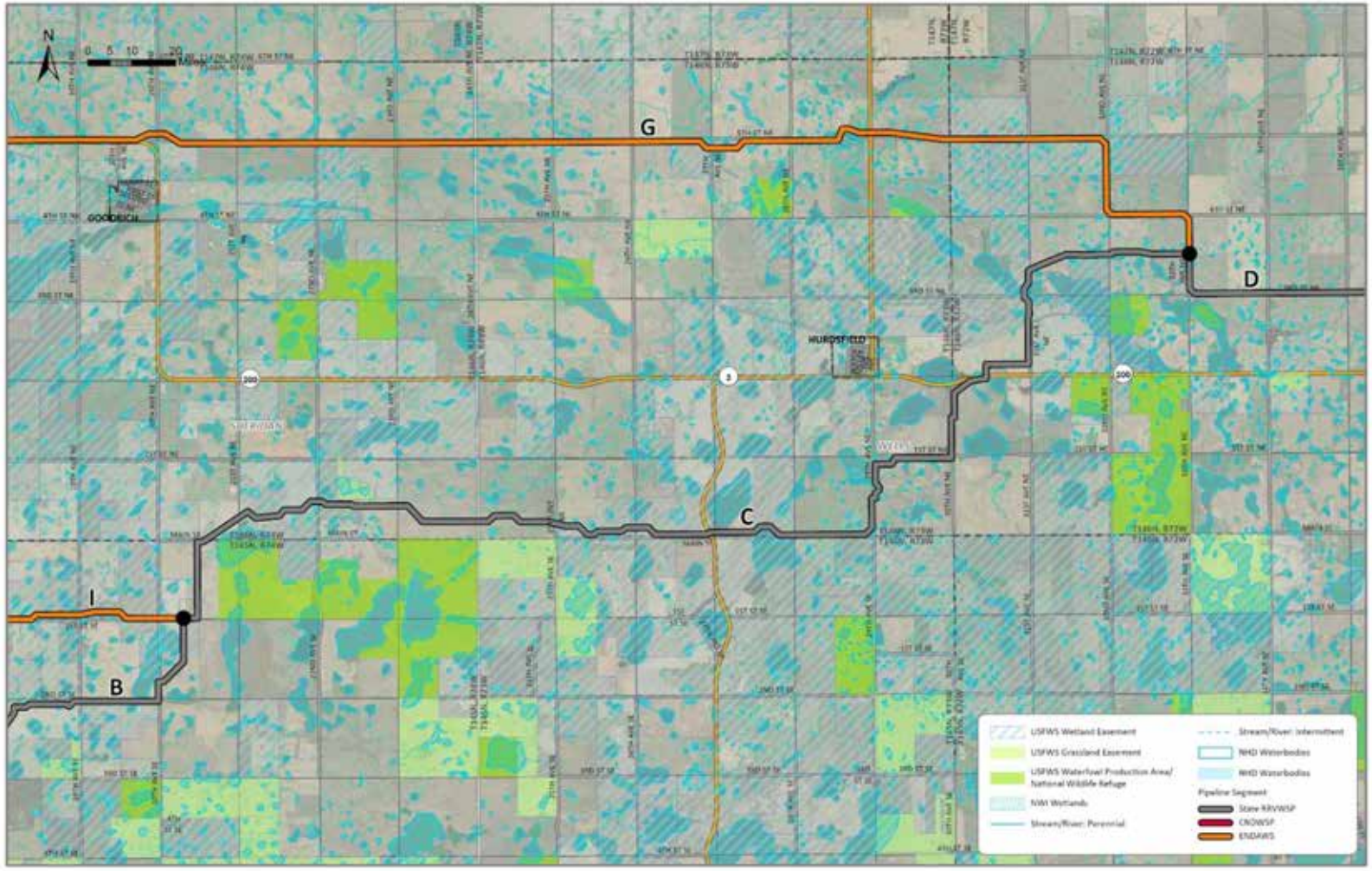


Figure 6-3 Pipeline Segment C: State RRVWSP

6.7 PIPELINE SEGMENT D

Pipeline Segment D is part of the State RRVWSP and is a 93.2-mile pipeline segment running east from to 33rd Avenue NE northwest of Chaseley, ND to the Sheyenne River, approximately 6 miles southeast of Cooperstown, ND. . The segment runs through Chaseley, Haaland, Speedwell, Sykeston, and Bilodeau Townships in Wells County. The segment continues through Wyards, Carrington, Rose Hill, Bordulac, Bucephalia, McKinnon, and Eastman Townships in Foster County. The final portion runs through Mabel, Ball Hill, Sverdrup, and Helena Townships in Griggs County. This segment begins to transition out of the Prairie Pothole Region, but a significant number of wetlands are jogged around where possible. Much of this segment is cultivated land or pasture land and parallels existing roadways. The continental divide between the MRB and HBB is crossed in Foster County just east of the James River. Elevations range from a low near 1304 ft msl to a high near 1862 ft msl, with the slope generally falling from west to east. This segment includes crossing of US Highway 281/52, ND Highway 200, ND Highway 20, and ND Highway 1. There are 13 paved county roads and 52 gravel township/county roads crossed in this segment. Crossings of the Red River Valley and Western, Canadian Pacific, and BNSF railroads are encountered within this stretch, along with four crossings of high-pressure oil/gas pipelines and two major electric transmission lines. Crossings of Pipestem Creek, Kelly Creek, Baldhill Creek, the James River, and 18 additional jurisdictional wetlands are also within this segment. Figure 6-4 depicts the overall segment; detailed alignment drawings are included in Attachment A.

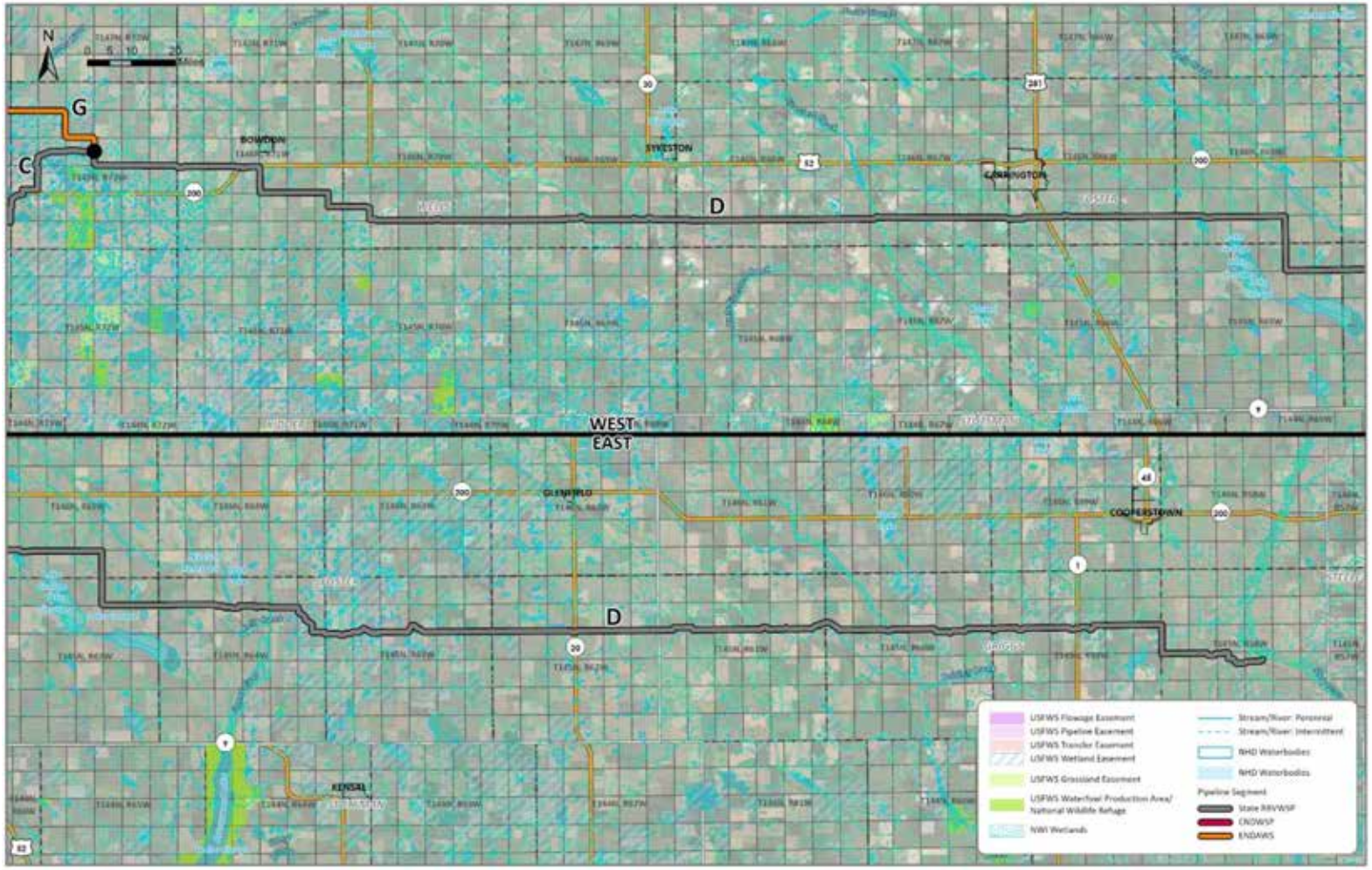


Figure 6-4 Pipeline Segment D: State RRVWSP

6.8 PIPELINE SEGMENT E

Pipeline Segment E is part of the CNDWSP and is a 6.0-mile pipeline segment in Burleigh County, ND running south from the McClusky Canal, generally parallel to 171st Street NE from the intersection of 171st Street NE and 6th Street SE (near MM 42.5 on the McClusky Canal) to the intersection of 171st Street NE and 396th Avenue NE in Burleigh County. The segment is entirely within Steiber Township in Burleigh County. Elevations range from a low near 1855 ft msl to a high near 1926 ft msl, with rolling terrain along the route. The route is primarily through cultivated land with some pasture land. No major roadways or utilities are encountered within this segment. Four gravel township/county roads will be crossed. Two wetland crossings are anticipated. The pipeline segment is a ductile iron pipe with cement mortar lining and 30 inches in diameter for the CNDWSP and a steel pipe with cement mortar lining and 72 inches in diameter in the ENDAWS route options. Figure 6-5 depicts the overall segment, and detailed alignment drawings are included in Attachment A.

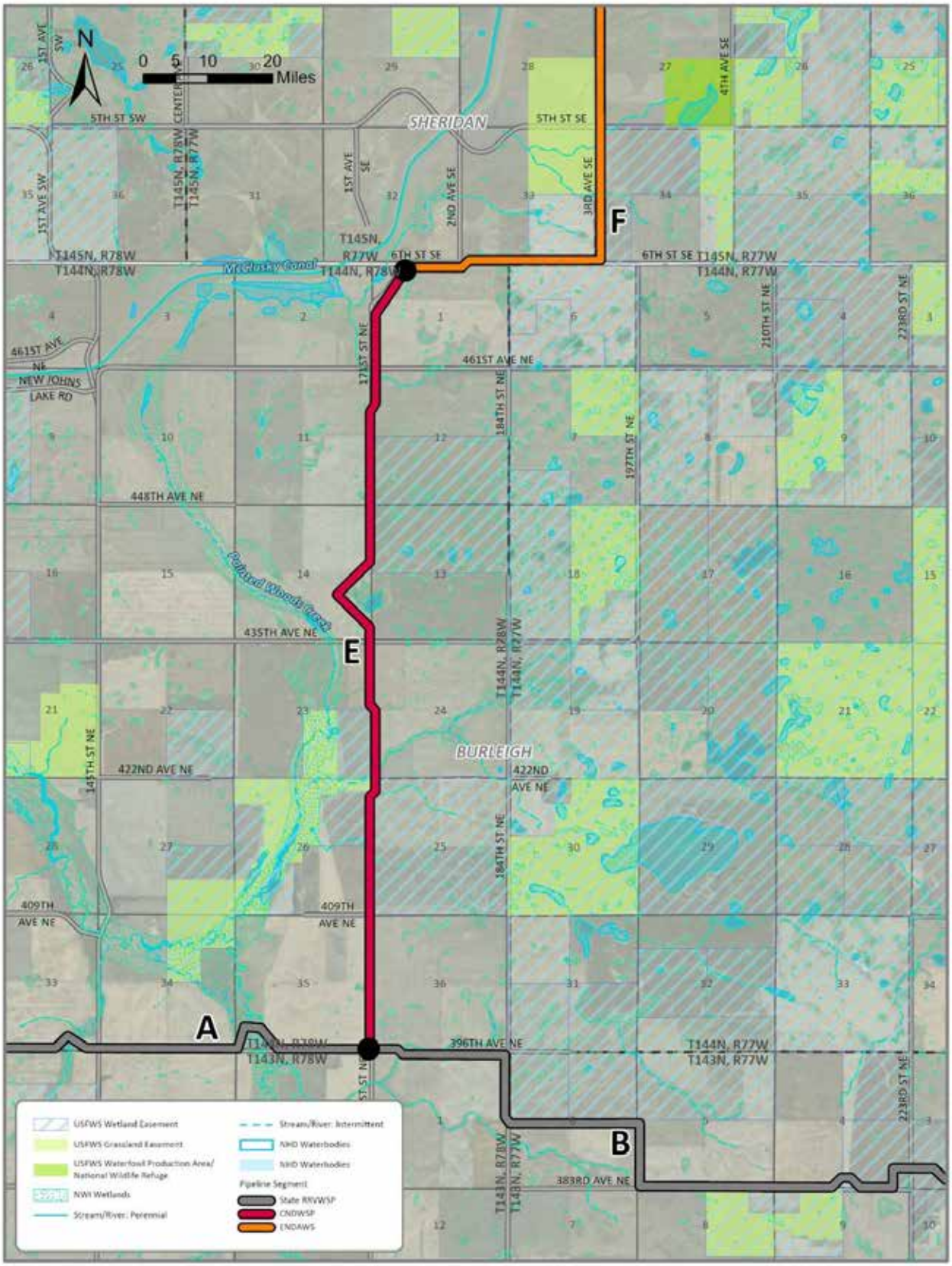


Figure 6-5 Pipeline Segment E: CNDWSP (30-inch) and ENDAWS (72-inch) Options

6.9 PIPELINE SEGMENT F

Pipeline Segment F is part of some of the ENDAWS route options and is a 7.0-mile pipeline segment running north from the intersection of 171st Street NE and 6th Street SE (near MM 42.5 on the McClusky Canal) to approximately 0.5 miles north of 1St Street SE along 3rd Avenue SE near MM 46 on the McClusky Canal. The segment runs through a small portion of Steiber Township in Burleigh County, with the majority being in an unincorporated township within Sheridan County. Land found along the route is primarily pasture land. Elevations range from a low near 1848 ft msl to a high near 2016 ft msl, with rolling terrain along the route. No major roadways or utilities are encountered within this segment. Four gravel township/county roads will be crossed. The route traverses an estimated three jurisdictional wetlands. Figure 6-6 depicts the overall segment; detailed alignment drawings are included in Attachment A.

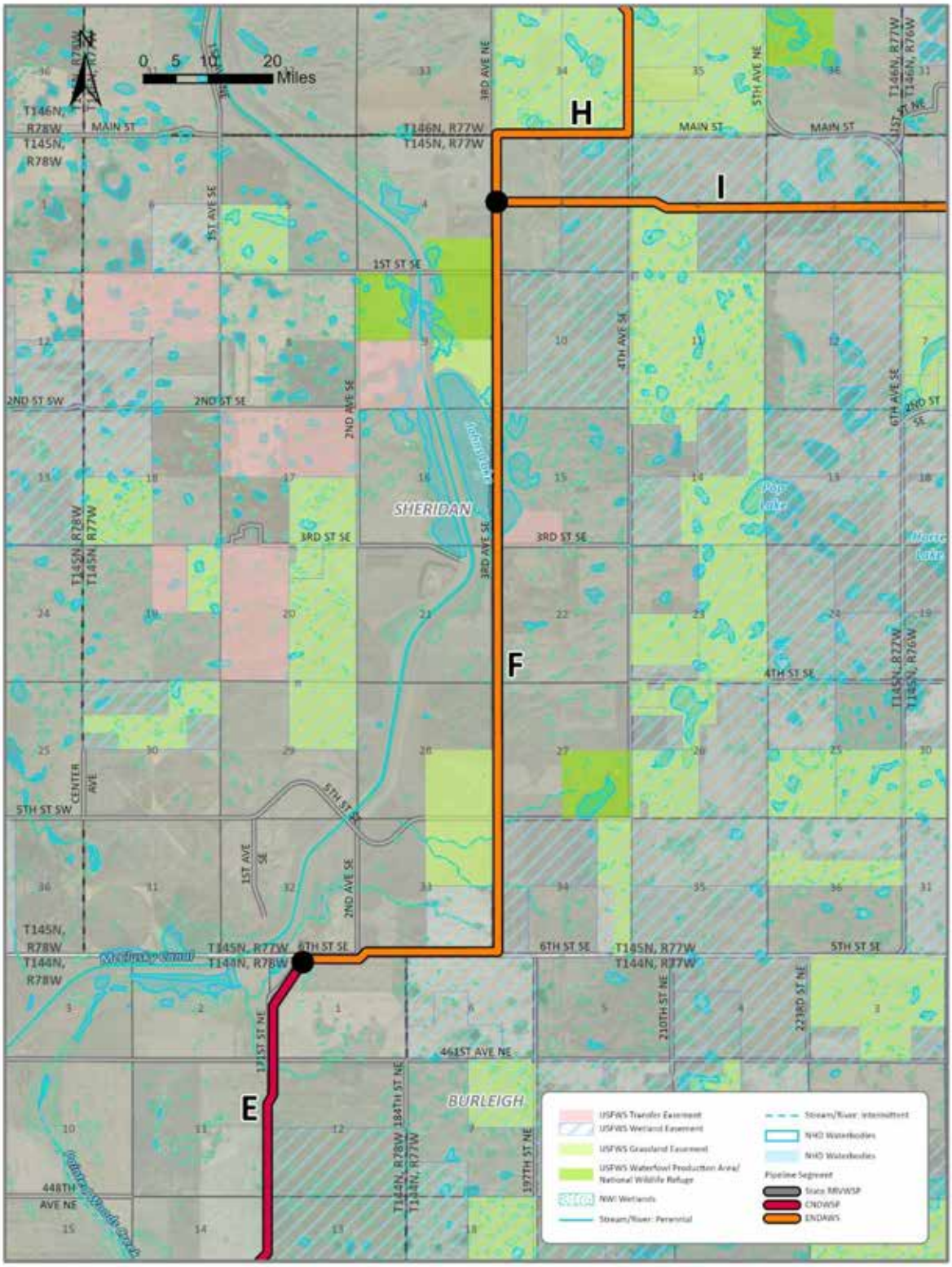


Figure 6-6 Pipeline Segment F: ENDAWS Route Options

6.10 PIPELINE SEGMENT G

Pipeline Segment G is part of some of the ENDAWS route options and is a 31.7-mile pipeline segment from the proposed BWTP, approximately 1.5 miles northwest of McCluskey, ND to the intersection with Segment D and Segment C near 33rd Avenue NE northwest of Chaseley, ND in Wells County. This segment runs through portions of three unincorporated townships, along with Denhoff and Goodrich Townships in Sheridan County. The segment continues through Bull Moose and Chaseley Townships in Wells County. Elevations range from a low near 1848 ft msl to a high near 2016 ft msl, with rolling terrain along the route. The route is a mix of cultivated land and pasture land with numerous potholes and sloughs. ND Highway 14 and ND Highway 3 are crossed within this segment, along with two paved county/township roads and 16 gravel township/county roads. An estimated 20 jurisdictional wetlands are traversed by the route. Figure 6-7 depicts the overall segment, and detailed alignment drawings are included in Attachment A

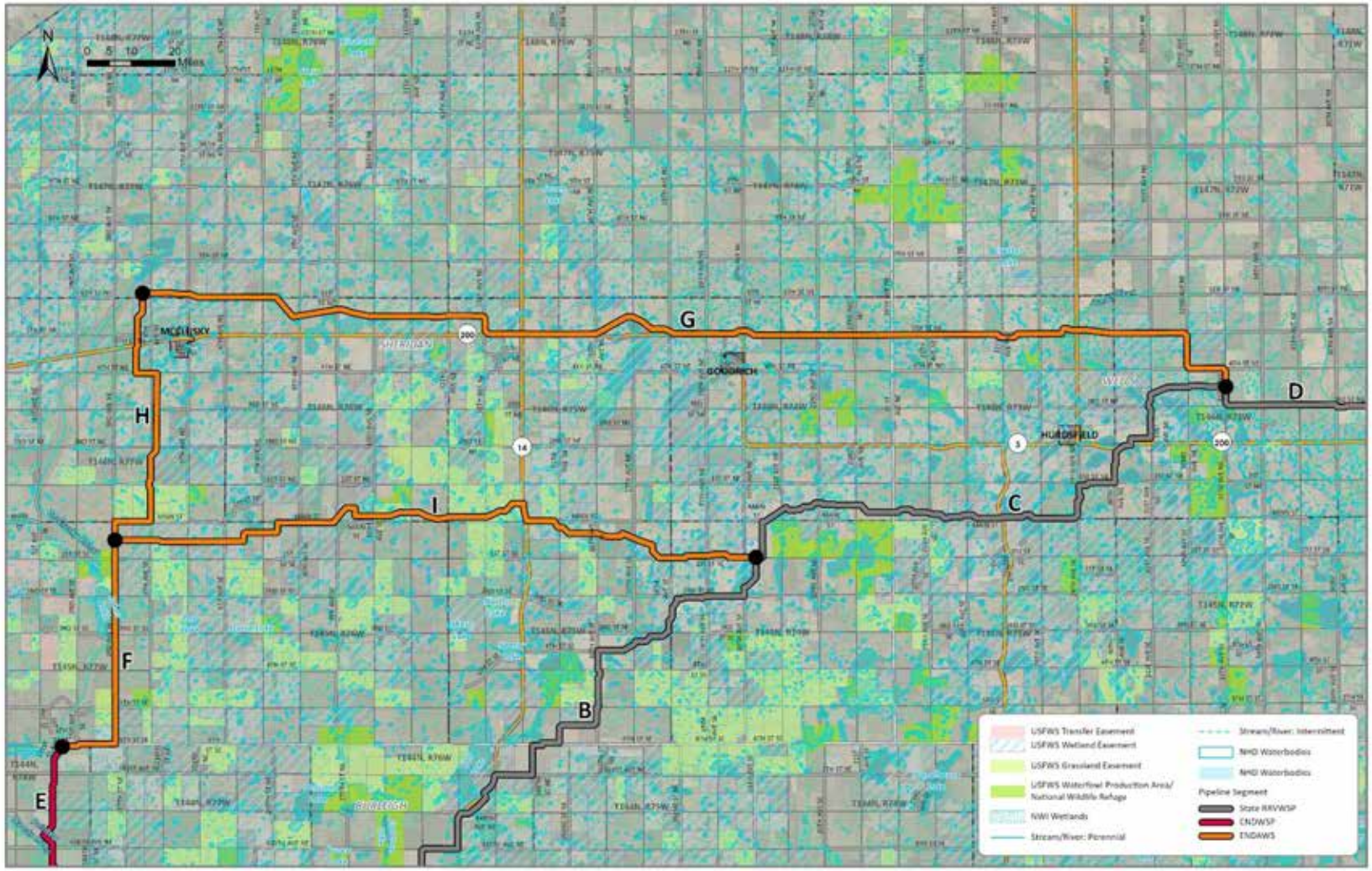


Figure 6-7 Pipeline Segment G: ENDAWS Route Options

6.11 PIPELINE SEGMENT H

Pipeline Segment H is part of some of the ENDAWS route options and is an 8.3-mile pipeline segment running north from approximately 0.5 miles north of 1St Street SE and 1 mile east of 3rd Avenue SE near MM 46 on the McClusky Canal to the proposed BWTP (approximately 1.5 miles northwest of McCluskey, ND near MM 57). The route runs through two unincorporated townships and McClusky Township in Sheridan County. Elevations range from a low near 1879 ft msl to a high near 1988 ft msl, with rolling terrain along the route. Land traversed along the route is a mix of cultivated land and pasture land with several sloughs and wetlands. Major crossings within this segment include ND Highway 200. Two gravel township/county roads are crossed within the segment. Three jurisdictional wetland crossings are also anticipated. Figure 6-8 depicts the overall segment; detailed alignment drawings are included in Attachment A.

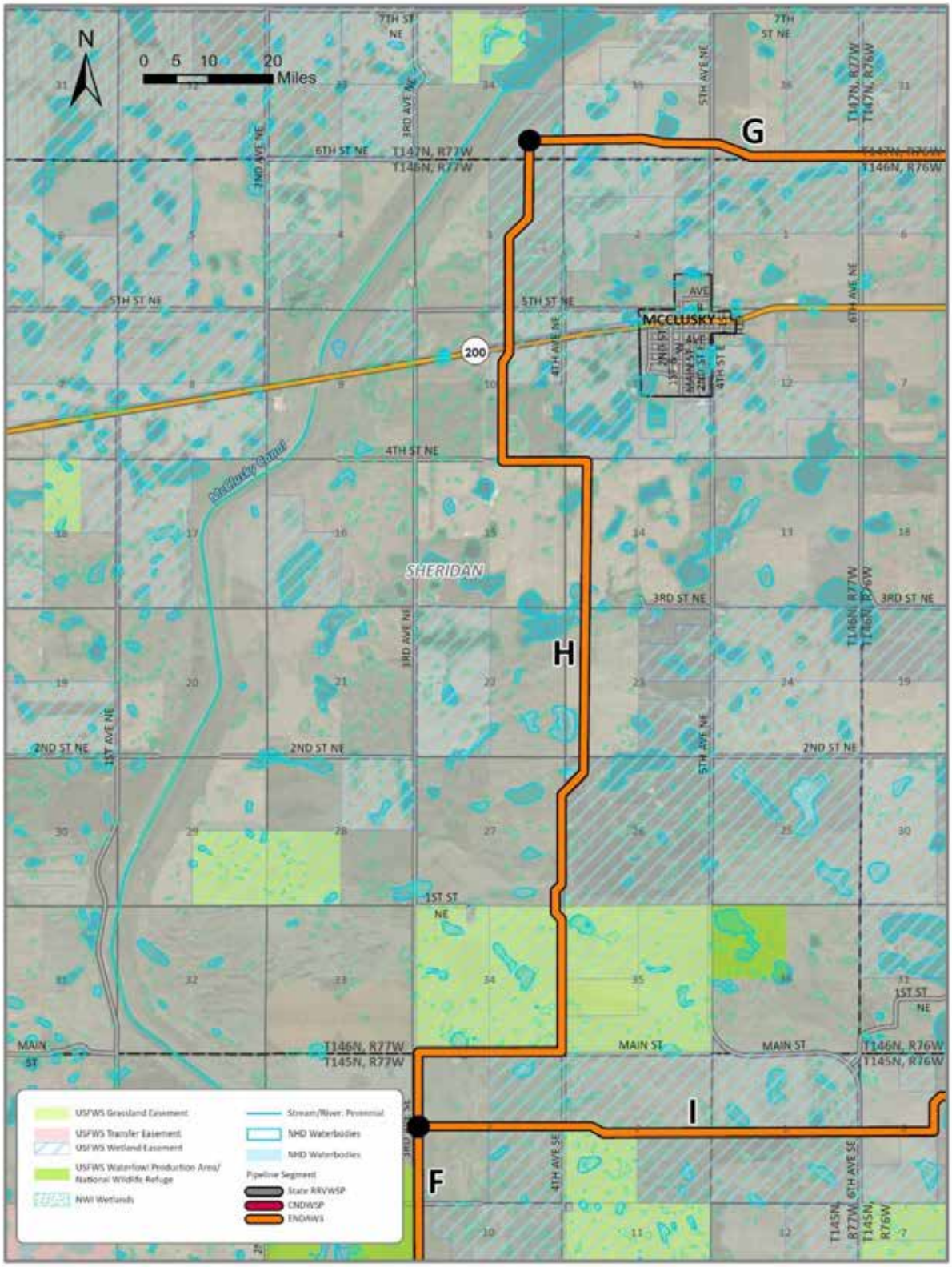


Figure 6-8 Pipeline Segment H: ENDAWS Route Options

6.12 PIPELINE SEGMENT I

Pipeline Segment I is part of some of the ENDAWS route options and is a 19.3-mile-long pipeline segment running east from 3rd Avenue SE near MM 46 on the McClusky Canal (approximately 0.5 miles north of 1st Street SE) to the intersection with Segment C near 1st Street SE (east of 20th Avenue SE) in Sheridan County, ND. Elevations range from a low near 1909 ft msl to a high near 2180 ft msl, with rugged terrain along the middle portion of the route. West of ND Highway 14, the land use is primarily pasture land due to the terrain. East of ND Highway 14, the land use is a mixture of cultivated land and pasture land with jogs around the numerous wetlands. The route runs through several parcels with USFWS Grassland Easements. Major crossings include ND Highway 14 in this segment. Nine gravel township/county roads are crossed by the segment. Seven jurisdictional wetlands are anticipated to be crossed within this segment. Much of this segment is cross-county and not near any roadways. The pipeline segment is a steel pipe with cement mortar lining in all Alternatives.

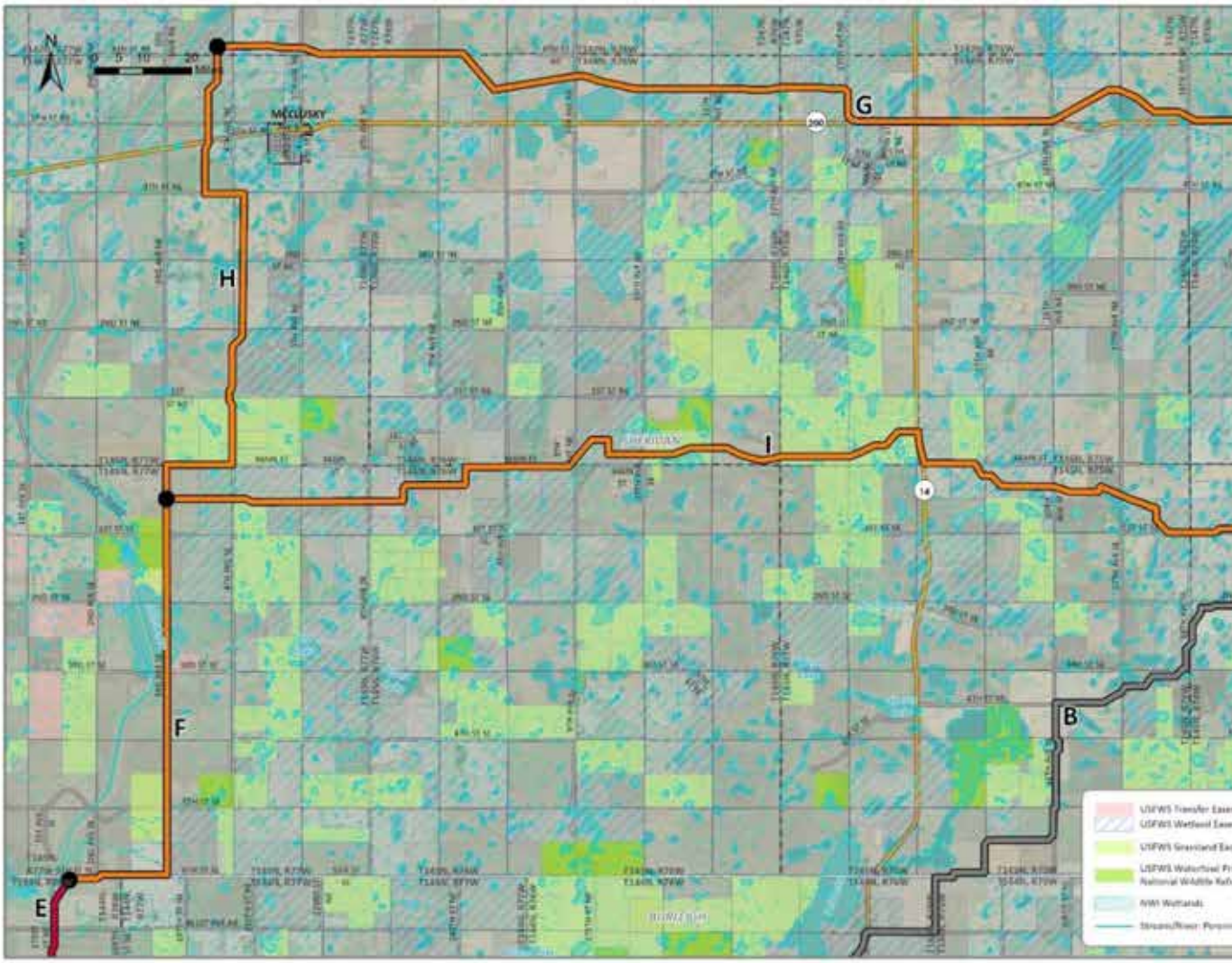


Figure 6-9 depicts the overall segment, and detailed alignment drawings are included in Attachment A.

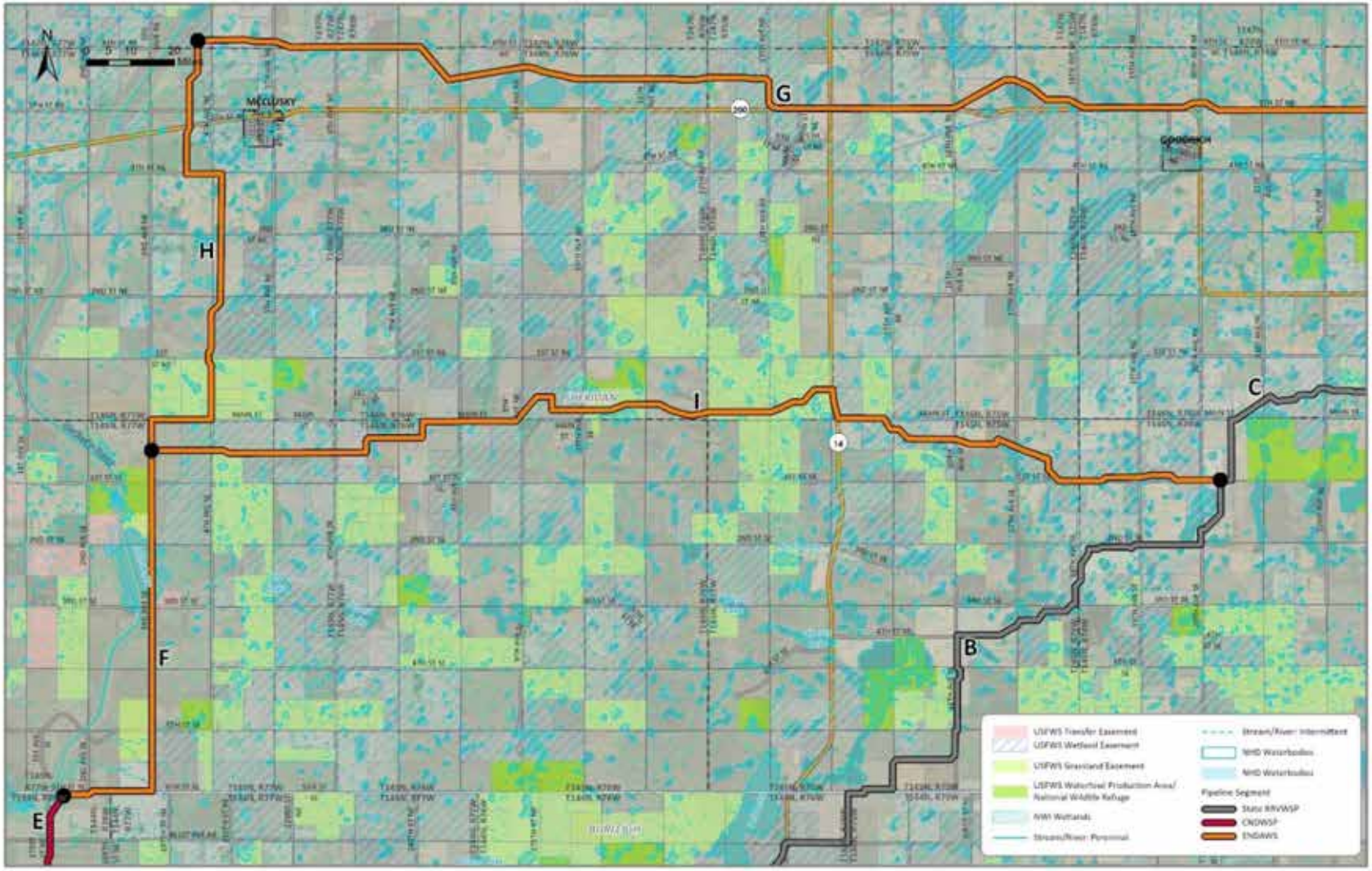


Figure 6-9 Pipeline Segment I: ENDAWS Route Options

6.13 MISSOURI RIVER INTAKE AND PUMPING STATION

The Missouri River Intake and Pumping Station is part of the State RRVWSP and includes the Intake Screen Structure or crib, the MRIPS, and the tunnel running from the crib to the MRIPS shown in Figure 6-10. Additional drawings are shown in Attachment B.

The proposed Intake Screen Structure will consist of eight screens on a concrete box structure set flush with the bottom of the river and supported by steel piling. The concrete box structure will be approximately 124 feet long by 27 feet wide, with an angled wall and debris deflector on the upstream edge. Each screen will be 66 inches in diameter and 20 feet long and will require a minimum of half the screen diameter clearance (33 inches) all the way around the screens. The screens will have 0.177-inch openings, a maximum approach velocity of 1/4 inch per second, and be a minimum of 33 inches off the bottom of the river (in compliance with USACE Nationwide Permit 12 conditions for North Dakota and with the manufacturer's clearance requirements).

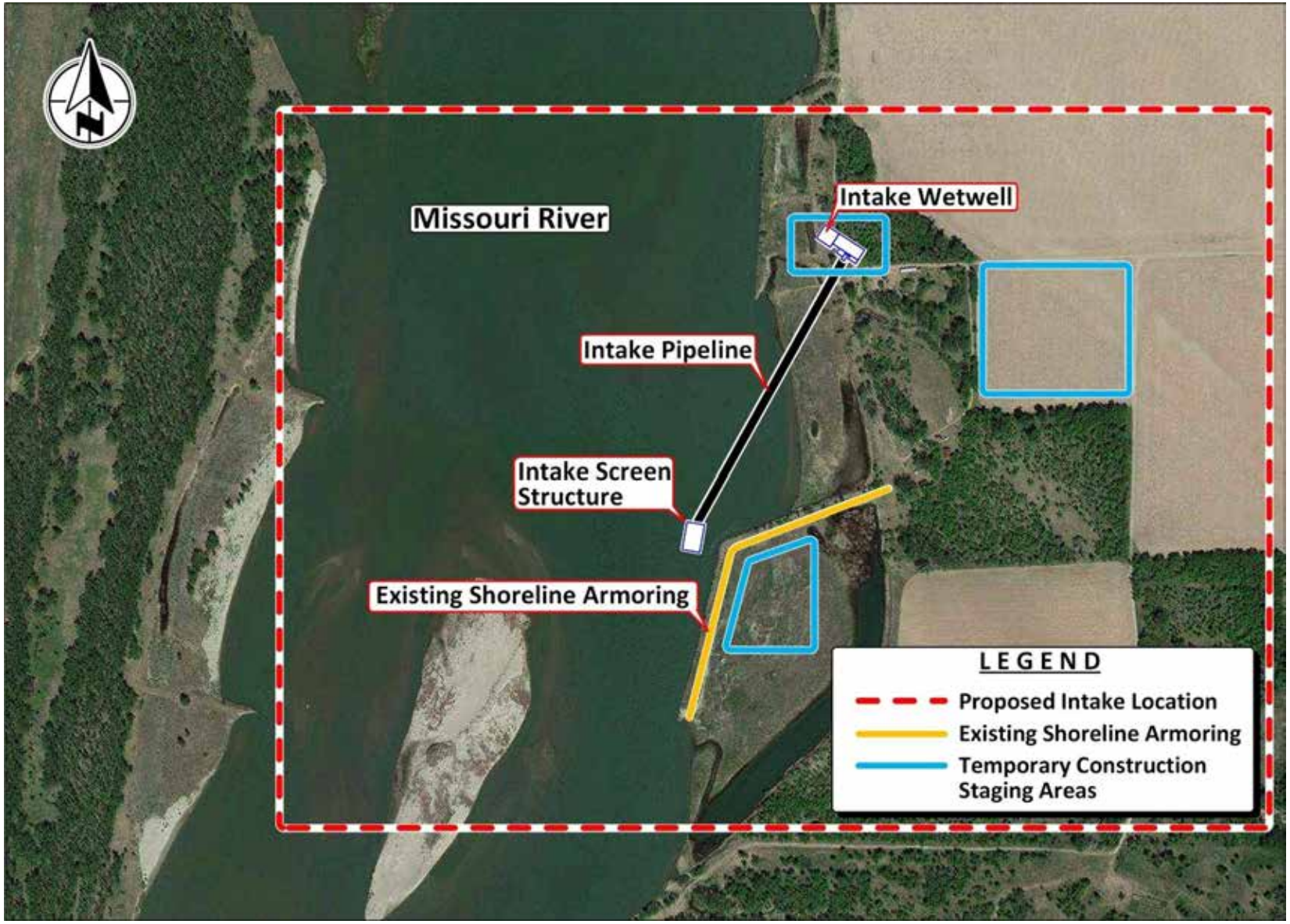


Figure 6-10 Screen Structure and Tunnel

As part of the State RRVWSP Preliminary Design Report, a HEC-RAS model, which was developed for this stretch of the Missouri River to characterize river flow and depth, predicted the water depth would be in excess of 18 feet at river flow rates as low as 10,000 cfs (98.5 percent exceedance between 1967 and 2016). In addition, the location is situated in an area of the Missouri River where the shoreline was previously armored with riprap, which has resulted in a shoreline that has historically remained stable. The armored area just upstream of the proposed intake location also appears to act as a jetty and prevents silt deposition at the proposed intake location. The design is such that construction would avoid disturbance of the armored portions of the shoreline and so does not require a permit from the USACE.

The 72-inch tunnel will be installed to transfer water from the Intake Screen Structure to the MRIPS wetwell. Eight eight-inch steel pipelines will also be installed for air scour to clean the screens individually. The raw water and air scour pipelines will extend to a wetwell that will be constructed outside the ordinary high-water mark. Isolation valves will facilitate maintenance of individual lines without having to take the intake completely out of service.

The wetwell design will allow for the flow to be segregated into two separate wetwells, defined as the low flow and high flow wetwells. Isolation gates will allow for the flow split between the two wetwells. Flow will split into each wetwell to facilitate cleaning and inspections, as well as isolation between the high and low flow ranges. The wetwells can operate together and have been designed for a collective 165-cfs peak flow rate. The wetwell will be approximately 65 feet deep at the MRIPS.

A pumping station will be constructed over the top of the wetwell and will be connected to a pipeline to convey water the State RRVWSP WTP or the SRP. The layout of the pump station for the MRIPS will be the same as the MPS described below so separate drawings and a description were not developed.

6.14 SEDIMENT REMOVAL PLANT

Conceptual drawings for the SRP are included in Attachment B. As shown in Attachment B and described in more detail in the State RRVWSP Preliminary Design Report, the SRP would be built in the same location as proposed for the State RRVWSP WTP. The functional objective of the SRP is to remove grit particles (sand, stone, grit, etc.) to protect downstream pumps and other mechanical equipment in the MPS and to prevent material from settling out into the pipeline. The process should remove 95 percent of all grit (specific gravity 2.1) and greater than or equal to 100 microns at peak flow, including some biota. This percentage equates to a 140-mesh removal at 165-cfs. Sand/grit removal as conceptualized consists of three process steps: (1) removing grit from the Missouri River water with six HeadCell grit concentrators, (2) washing and separating the settled grit from the HeadCell unit with three TeaCup grit removal washing and classification units, and (3) dewatering the concentrated grit slurry with Grit Snail dewatering unit.

The likely volume of solids that would be produced was evaluated on the basis of historical source water quality near the river intake. Based on currently available data, the annual volume of solids is anticipated to be roughly 7,800 cubic yards (CY). Assuming 95 percent removal, disposal volume would be 7,400 CY. The remaining balance of 400 CY of finer materials would pass through and into the pipeline.

Solids will need to be removed from the site and disposed. The sand/grit removal process uses no chemicals and produces clean low-organic slurry. Disposal options include hauling off grit to a nearby landfill in the MRB or storing it on-site. Typically, dewatered sand would be discharged into a bin and hauled off for disposal; however, grit solids may need to be stored on-site because of the

remote site location. During periods of more sediment load in the river such as during the spring runoff, more grit solids may accumulate than can practically be removed from the site.

A typical 10-yard roll-off container would be placed under the Grit Snail to collect the dewatered grit for off-site disposal when the system is operating under lower flow conditions. As a back-up, a drying bed would be able to handle the variability in flows and solids quantities that may be encountered. The grit slurry would be pumped directly from the HeadCell units to a drying bed. The sand drying bed would be located near the Grit Removal Building to store grit solids long term.

6.15 WATER TREATMENT PLANT

The 165-cfs WTP is part of the State RRVWSP and is designed to provide sand/grit removal and basic chlorine disinfection for 3-log *Giardia* and 4-log virus inactivation. The functional objective of sand/grit removal is to remove fine particles (silt, sand, etc.) to protect downstream pumps and other mechanical equipment and to prevent material from settling out into the pipeline. The process should remove 95 percent of all sand/grit (specific gravity 2.65) greater than or equal to 100 microns at peak flow. It is anticipated that removal of AIS similar in size and density as sand/grit will occur concurrently with sand/grit removal process.

Chlorine is used to achieve these disinfection goals. To be effective as a disinfectant in water, chlorine must have adequate contact time with the water. A post-contact chlorine residual of 3 mg/L was selected as the target residual at the end of the contactor. A water pH of 8.0 and a minimum water temperature of 0.5°C on the Missouri River were used for engineering calculations. Similarly, an initial chlorine dose of about 5 to 6 mg/L was anticipated based on typical Missouri River water quality characteristics. Missouri River water quality characteristics are described in more detail in the State RRVWSP Preliminary Design Report.

The contactor volume required to meet detention/contact time requirements varies depending on flow rate. A 4 cfs to 165-cfs flow range was evaluated, and disinfection will be achieved through a combination of sufficient chlorine dosage "c," and adequate contact time "T" (referred to as a cT value). The cT value for chlorine disinfection is driven by *Giardia* inactivation. If the cT for *Giardia* is achieved, the cT for viruses will be achieved as virus inactivation requires a lower cT value.

Based on guidance from the USEPA *Disinfection Profiling and Benchmarking Guidance Manual* (USEPA 2003) and utilizing the equations provided therein for pH, temperature, and chlorine residual, a 175-minute detention time is required for the Disinfection Contact Basin (DCB) to achieve a 3-log inactivation of *Giardia*. This detention time includes a 0.7 derating factor for the detention time in the DCB in consideration of a serpentine flow path.

The basin volume was evaluated over the project flow range. At 165-cfs, a 13-million-gallon (MG) basin would be required to provide the target inactivation of *Giardia*. Given the cost of such a basin, it was considered more cost effective to provide the required cT times in a combination of tankage (for low flows) and pipeline use (for high flows). A nominal 2-MG DCB was selected as a practical and affordable size for the State RRVWSP. This size basin will provide the necessary cT for plant flows at or below 25 cfs, with the rest of the treatment occurring in the pipeline. It was calculated that about seven miles of pipeline would provide the required cT.

6.16 CHLORINE RESIDUAL MONITORING

Multiple locations will be used for chlorine residual monitoring. All monitoring locations will be located downstream of the chlorine injection point. The chlorine residual concentrations will be monitored continuously with a minimum of two chlorine residual analyzers at each monitoring

location to provide complete redundancy. At select monitoring locations, there will be an option to add additional chlorine if the desired residual chlorine concentration is not met.

6.17 MAIN PUMPING STATION

The MPS is part of the State RRVWSP. Two different versions of the 165-cfs MPS are included in this document. MPS1 is part of the State RRVWSP and RRVWSP/CDNWSP. It is designed to pump to the HBT, approximately 60 miles east of the pumping station. MPS2 is part of the State RRVWSP when combined with ENDAWS Route Options that utilize both the McClusky Canal and the Missouri River. It would be a similar design and sized to pump to the BWTP at either MM 57 or MM 49. The conceptual drawings shown in Attachment B are representative of both pumping stations. The only difference would be the size of the pumps installed. MPS1 will have approximately 24,000 HP installed, while MPS2 will have approximately 18,000 HP installed. The following descriptions apply to MPS1 and MPS2.

The MPS Building will be designed to include eight pumps, piping, valves, and ancillary equipment, as well as provide access for operations staff to conduct equipment maintenance. The MPS will have a wetwell where water enters from the State RRVWSP WTP or SRP. The lower level will have the ability to be serviced by the overhead bridge crane to pull pumps, valves, and piping from the lower level, and then move them to the workshop area or load them onto a large truck through the double overhead doors provided. Two exterior rooms will be provided to enclose the Variable Frequency Drives (VFDs) for each of the pumps. The MPS building overall footprint, including open areas for mechanical cooling, will be approximately 200 feet by 75 feet.

The MPS will include four large and four smaller vertical turbine pumps. The pumps will consist of wetwell mounted pumps where the column and inlet are inside the wetwell. The pump discharge will be in the lower level of the MPS, and the motor will be mounted on top at the operating level of the MPS. The pumps will operate on a variable frequency drives to accommodate the wide range of head and flow conditions required for the project.

Because of the potential for considerable hydraulic transients, a surge control system will be part of the MPS. The surge control system will consist of a series of hydro-pneumatic steel tanks to allow for an air-over-water combination to reduce high pressure spikes during a transient event. The piping associated with the surge system will be steel pipe for both the inlet and outlet to the surge tank connected to the pipeline. Each surge tank inlet and outlet pipe will be equipped with a valve for isolation purposes. A series of air compressors will be required to supply the compressed air to the surge tanks. A series of air receiver tanks will be provided to allow for backup air and to manifold the compressors to operate in lead/lag modes for the surge tanks. Attachment B shows representative drawings for the MPS and associated surge control system.

6.18 CENTRAL NORTH DAKOTA INTAKE AND PUMPING STATION

The CNDIPS is part of the CNDWSP and is a 20-cfs intake facility with screens, wetwell, pumps, and switchgear. The facility is to provide water to in-basin users located within central North Dakota. The CNDIPS would be located near MM 42.5 on the McClusky Canal in Sheridan County. The facility will utilize dual submerged tee screens (sized 4 feet, 6 inches by 3 feet, 6 inchs) to supply a concrete wetwell located adjacent to the canal maintenance road. The pumping station will be constructed on top of the wetwell. The 600-square foot pumping station building will be constructed of concrete walls and inverted tee beams supporting precast double tee roof members. Heating and cooling will be provided for the pumping station. Electrical controls and switchgear will be housed within the building. The CNDIPS will convey a design flow of 20 cfs. It is anticipated that 3 700-HP vertical turbine pumps will be installed to provide firm capacity. Each of the pumps will be equipped with a VFD. The discharge pipeline from the CNDIPS will be approximately 0.3 miles of 2-foot, 6-inch

ductile iron pipe to reach Pipeline Segment E described above. A preliminary site plan and layout for the facility is included in Attachment B.

6.19 MCCLUSKY CANAL INTAKE AND PUMPING STATION

The MCIPS is part of the ENDAWS route options and is a 165-cfs intake facility with screens, wetwell, pumps, and switchgear. The facility would be located adjacent to the McClusky Canal to lift water from the Canal to the BWTP. MCIPS1 is the proposed intake pumping station at McClusky Canal MM 57 near the town of McClusky. MCIPS2 is the proposed intake pumping station at MM 49 south of McClusky. The facilities, MCIPS1 and MCIPS2, are identical except for horsepower of the installed pumps and the length of discharge pipe required to reach the BWTP.

The intake facility will utilize concrete anchor pads supporting dual 54-inch steel inlet pipes and conventional cylindrical intake screens mounted on the inlet pipes. The intake will consist of eight screens - 66 inches in diameter and 20 feet long - and require a minimum of half the screen diameter clearance (33 inches) all the way around the screens. The dual 54-inch inlet pipes will supply a conventional concrete wetwell, approximately 40 feet in diameter and 30 ft deep. The MCIPS will be constructed above the wetwell and is designed to be housed in a two-story building with approximate dimensions of 221 feet by 85 feet.

The MCIPS will have eight pumps and provide a flow range from 4 to 165-cfs, depending on demands. During low flow conditions, or flows up to 36 cfs, up to three pumps will operate and one pump will be in standby mode. During high flow conditions between 30 and 165-cfs, one to three pumps will operate as required and one pump will remain in standby mode, providing firm capacity at 165-cfs. MCIPS1 will have approximately 2,400 installed horsepower, while MCIPS2 will have approximately 3,600 HP installed.

The discharge manifold and piping will exit the structure below grade and connect to a 72-inch diameter steel water pipeline. The pipeline will extend between 0.3 miles (at MM 57) and 0.9 miles (at MM 49) to connect to the BWTP.

An electrical/control room will be constructed in the pumping station. This electrical/control room will be equipped with heating and cooling capabilities to maintain proper temperature for the electrical equipment.

A preliminary site plan, floor plan, and piping plan for MCIPS1 at MM57 is included in Attachment B. A piping plan for the MM49 facility is also included in Attachment B. The site plan and floor plan for the MM49 facility would be identical to the MM57 facility.

6.20 BIOTA WATER TREATMENT PLANT

A 165-cfs BWTP is required under the ENDAWS route options. The proposed BWTP will be located adjacent to the McClusky Canal near MM 57, or near MM 49 (depending on the route option). The specifics of the proposed biota water treatment options are discussed in detail in Chapter 5.

6.21 MCCLUSKY CANAL MAIN PUMPING STATION

The 165-cfs McClusky Canal Main Pumping Station (McMPS) will transfer treated water from the BWTP to the HBT as part of the ENDAWS route options. The design/layout is assumed to be similar to the MPS described above; however, the pump sizes will vary as shown on Table 6-1. It is assumed that the adjacent BWTP will provide three-phase power to the McMPS regardless of location. Attachment B presents site plan drawings to show the pumping stations orientation in relation to the Canal. McClusky Canal Main Pumping Station 1 (McMPS1) is located at MM 57 and

will have approximately 9,000 HP installed. McMPS2 is located at MM 49 and will have approximately 11,000 HP installed.

6.22 HYDRAULIC BREAK TANKS

The HBT serve as a hydraulic control point separating the pipeline hydraulic grade line between the west side (pumped) and the east side (gravity). The HBT site consists of two 5 MG circular pre-stressed concrete tanks along with control valve vaults and a flowmeter vault. Downstream of the HBT, the pipeline will be designed to flow by gravity to the Sheyenne River and other end users along the alignment.

Three potential locations exist depending upon the selected project or route option. These locations are presented in the following chapter with the project or route option descriptions; however, the actual HBT design and layout will be similar for all three locations, and drawings representative of all three hydraulic break tank layouts are shown in Attachment B.

The tanks will be positioned on-site to minimize yard piping between the structures. The pressurized segment of the pipeline will enter the site as a 72-inch steel pipe and be reduced to 60 inches before entering the inlet valve vault. The valve vault will accommodate a bifurcation in the pipeline, resulting in 2 60-inch pipes (each serving one of the 5 MG tanks). Each pipe will be equipped with an isolation butterfly valve with electric actuators. Similarly, the tank outlet pipes at 60 inches will converge to an outlet valve vault equipped with isolation butterfly valves with electric actuators. This design allows the ability to operate under low and high flow conditions, as well as for each tank to be isolated for maintenance and inspection as needed. The pipe will then continue and enter the 48-inch flowmeter vault. The meter vault will be equipped with an electromagnetic flowmeter and isolation butterfly valve with electric actuator similar to those in the outlet valve vault.

No buildings will be present at this site.

The HBT will be circular, pre-stressed concrete tanks. These tanks are pre-engineered structures designed by a tank manufacturer to meet AWWA D110. Preliminary design parameters are as follows:

- 5 million gallon tanks.
- Tank diameter = 180+/- feet.
- Tank height = 28 feet.
- High water level = 24 feet.
- Low water level = 2 feet.
- Roof, pre-cast dome with interior supports.
- Air vent, single top.
- 60-inch intake pipe.
- 48-inch outfall/discharge piping with sump structure.
- 36-inch overflow pipe to energy dissipation structure.
- Roof hatch with sidewall mounted access ladder (multiple locations for ease of access).

6.23 CONTROL VALVE STRUCTURE AND DISCHARGE STRUCTURE

The discharge at the Sheyenne River is part of the State RRVWSP and includes the CVS and the DS. As described in the State RRVWSP Preliminary Design Report, multiple discharge locations along the Sheyenne River were evaluated according to the following criteria:

- Orientation to the Sheyenne River.
- Proximity to the pipeline.
- Ease of access from the nearest road.
- Floodplain and environmental constraints.
- Ease of constructability.

The site that best met those criteria is located in Griggs County, southeast of Cooperstown, North Dakota, on a 2-acre parcel at the intersection of 3rd Street Southeast and 117th Avenue Southeast (Figure 6-11). The site access will be from 117th Avenue Southeast.

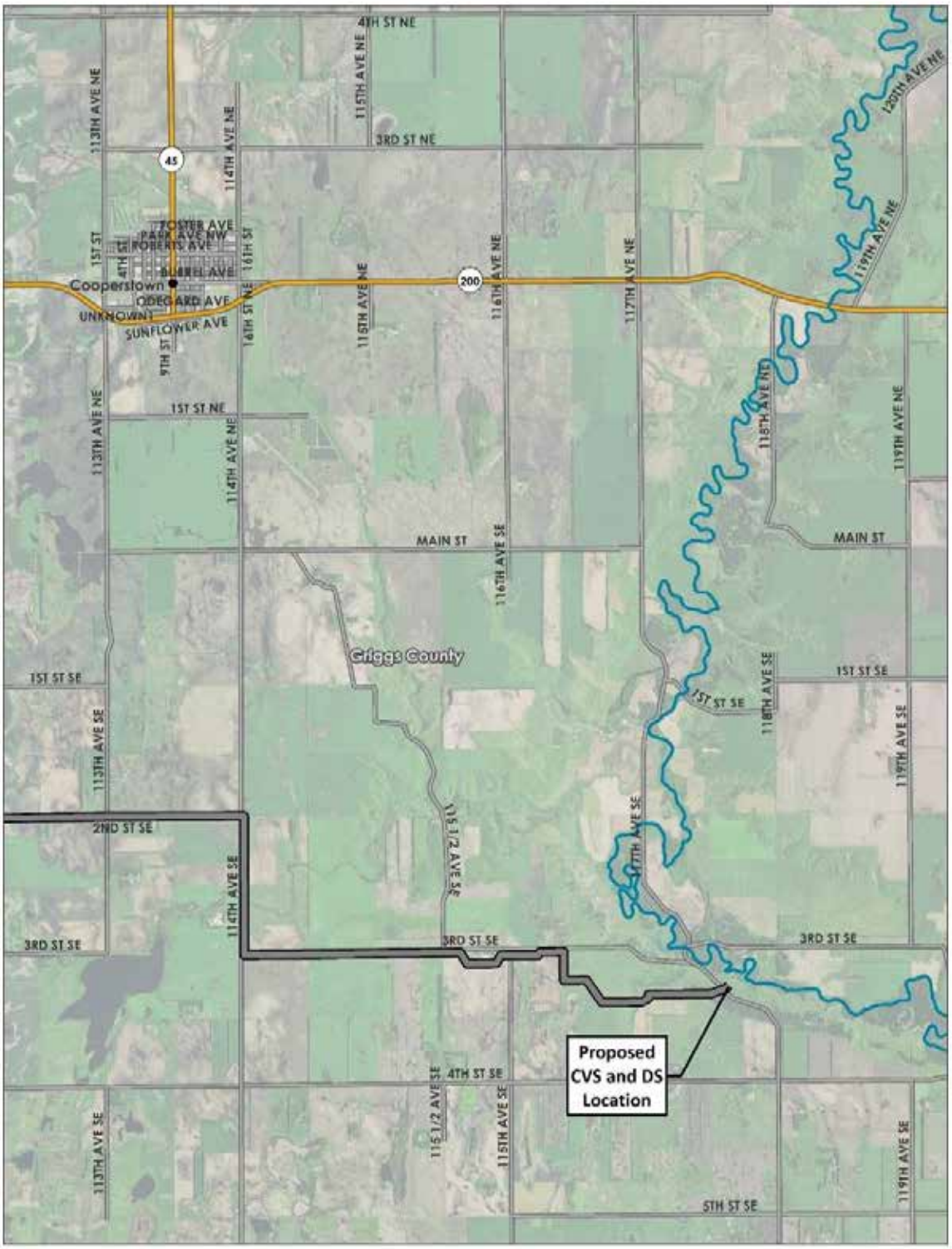


Figure 6-11 Proposed CVS and DS

The site will contain the CVS, as well as propane tank storage for heating, electrical pad, potential dechlorination tanks and systems, septic system, and associated leach field. The need for dechlorination tanks and systems will be determined after detailed design of the water treatment facilities has been completed.

The CVS is part of the State RRVWSP and will function as a pressure reducing station to allow full pipe gravity flow from the HBT and allow for a reduced pressure discharge to the Sheyenne River. Further discharge control will be achieved by a downstream discharge structure near the Sheyenne River.

The process mechanical design for the CVS will include sleeve valves to reduce flow pressure before discharge to the Sheyenne River. The CVS will be required to control flows coming from the upstream HBT and further reduce the pressure to less than 10 psi. Two different sizes of sleeve valves will be provided to accommodate flow conditions from 4 cfs to 140 cfs. At the 72-inch inlet header, the pipes will branch into 2 18-inch pipes for small sleeve valves and 3 36-inch pipes for the large sleeve valves. CVS drawings are included in Attachment B.

The DS is designed to dissipate remaining energy in the water before discharge and spread the discharged water over approximately 100-feet of weir. The DS was located adjacent to the Sheyenne River but outside the ordinary high-water mark and flood easements owned by the USACE. Additional drawings for the DS are included in Attachment B.

7.0 Projects and Route Options Summary and Estimate Costs

This chapter provides a description of the four ENDAWS route options and their estimated costs. For comparison purposes, descriptions and estimated costs of the State RRVWSP and State RRVWSP/CNDWSP are included as well. Route options were developed by combining the individual components described in Chapter 6. Graphics showing the layout for each route option are presented in Chapter 2. Components included in each project or route option are shown Table 7-1.

Opinions of probable construction and O&M costs were developed as part of this report. Construction costs include labor, equipment, materials, incidentals, and appurtenances required to comply with typical Reclamation construction specifications. The construction costs summarized below also include mobilization, unlisted costs, contract costs, contingencies, and non-contract costs. O&M costs consist of power and chemicals, which are the majority of the O&M costs. Labor and maintenance are not included but those costs are expected to be similar for all options. Power costs for the State RRVWSP and State RRVWSP/CNDWSP are based on expected power rates for large industrial users. Power costs for the rest of the ENDAWS route options assume that the cost of power is based on rates from the Western Authority Power Authority preferred rates per the requirements of the Dakota Water Resource Act Section 6. Attachment C provides the detailed cost estimates.

In addition, the ENDAWS Biota Water Treatment Plant Report presented a range of biota water treatment plant options and costs as shown below. The annual O&M costs are based on the plant running at its maximum capacity for a year.

Option	Construction Cost	Annual O&M
1	$56M	$3,500,000
2	$70M	$4,100,000
3	$220M	$8,400,000
4	$240M	$9,400,000

Table 7-1 Summary of Components Included in Each Project or Route Option

Major Components	Abbrev.	Estimated Size	Alterantive/Route Option					
			CNDWSP	RRVWSP	Canal Only North	Canal Only South	Canal & River North	Canal & River South
Pipeline Segment A	Seg A	23.0 miles/72-inch	•	•			•	•
Pipeline Segment B	Seg B	31.9 miles/72-inch	•	•				
Pipeline Segment C	Seg C	17.5 miles/72-inch	•	•		•		•
Pipeline Segment D	Seg D	93.2 miles/72-inch	•	•	•	•	•	•
Pipeline Segment E	Seg E	6.0 miles/30-inch	•					
Pipeline Segment E	Seg E	6.0 miles72-inch					♦	♦
Pipeline Segment F	Seg F	7.0 miles/72-inch					♦	♦
Pipeline Segment G	Seg G	31.7 miles/72-inch			♦		♦	
Pipeline Segment H	Seg H	8.3 miles72-inch					♦	
Pipeline Segment I	Seg I	19.3 miles/72-inch				♦		♦
Missouri River Intake and Pumping Station	MRIPS	165 cfs	•	•			•	•
Water Treatment Plant (State)	WTP	165 cfs	•	•				
Sedimentation Treatment Plant (State)	SRP	165 cfs					•	•
Main Pumping Station *(to Break Tanks)*	MPS1	165 cfs	•	•				
Main Pumping Station *(to BWTP)*	MPS2	165 cfs					•	•
Central North Dakota Intake & Pump Station	CNDIPS	20 cfs	•					
McClusky Canal Intake Pumping Station (MM 57)	McIPS1	165 cfs			♦		♦	
McClusky Canal Intake Pumping Station (MM 49)	McIPS2	165 cfs				♦		♦
Biota Water Treatment Plant (federal)	BWTP	165 cfs			♦	♦	♦	♦
McClusky Canal Main Pumping Station (MM 57)	McMPS1	165 cfs			♦		♦	
McClusky Canal Main Pumping Station (MM 49)	McMPS2	165 cfs				♦		♦
Hydraulic Break Tanks	HBT	Two 5 MG Tanks	•	•	•	•	•	•
Control Valve Structure and Discharge Structure	CVS	145 cfs	•	•	•	•	•	•

• - Included in "No Action" Alternative
♦ - ENDAWS Route Option Component

7.1 RED RIVER VALLEY WATER SUPPLY PROJECT

7.1.1 Overview

As described in Chapter 2, this represents the State RRVWSP. Under this project, 165-cfs is pumped from the Missouri River near Washburn to the State RRVWSP WTP. The water from the Missouri River is treated to comply with the North Dakota Pollutant Discharge Elimination System (NDPDES) permit (Permit No. ND0026964) issued by the North Dakota Department of Environmental Quality (NDDEQ) as a draft permit. The water is then pumped by the MPS to the HBT, then flows via gravity to the discharge structure on the Sheyenne River southeast of Cooperstown, ND. As noted previously, 20 cfs is used within the Missouri River Basin and 5 cfs is used by pipeline users after the continental divide between the MRB and HBB so only 145 cfs crosses the continental divide and only 140 cfs reaches the Sheyenne River. A hydraulic profile of the State RRVWSP project is shown in Figure 7-1.

7.1.2 Pipeline Summary

The pipeline system for this project includes Segments A, B, C, and D as 72-inch steel pipe. Approximately 165.6 miles of pipeline are included in this project. The estimated capital costs are shown on Table 7-2.

Table 7-2 State RRVWSP Estimated Cost Summary

	Size	Capital Cost
State Components		
MRIPS	165 cfs/2,000 HP	$57,773,000
WTP (state)	165 cfs	$38,555,000
MPS1	165 cfs/20,000 HP	$36,908,000
HBT	10 MG	$16,507,000
CVS & DS	140 cfs	$9,963,000
Pipeline Seg. A	72-inch	$130,210,000
Pipeline Seg. B	72-inch	$168,213,000
Pipeline Seg. C	72-inch	$91,939,000
Pipeline Seg. D	72-inch	$544,020,000
Totals		**$1,094,000,000**

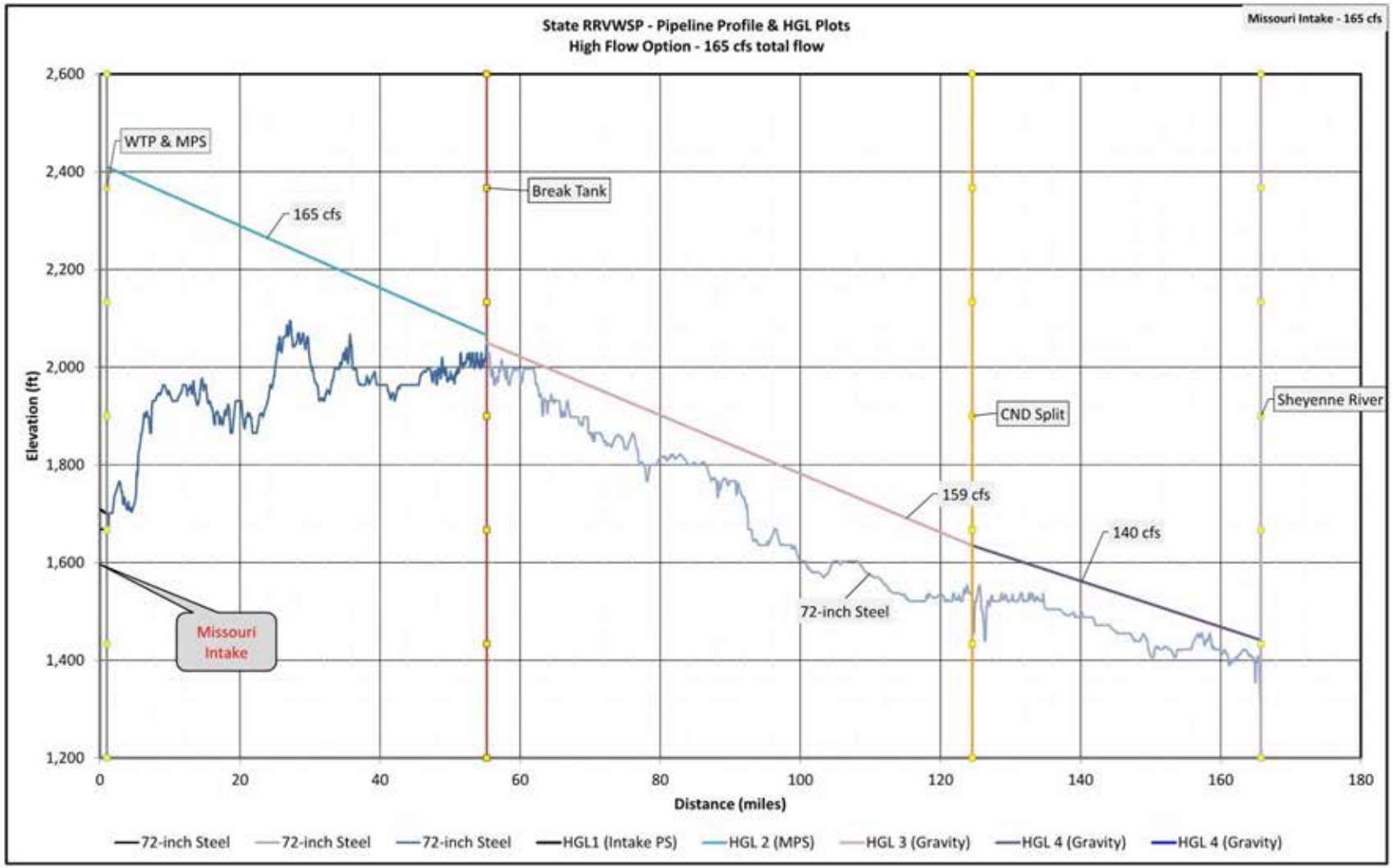


Figure 7-1 State RRVWSP Missouri River Source Water Hydraulic Profile

7.2 CENTRAL NORTH DAKOTA WATER SUPPLY PROJECT WITH STATE RED RIVER VALLEY WATER SUPPLY PROJECT

7.2.1 Overview

As described in Chapter 2, this represents the No Action alternative. Under this project, 145 cfs or 165 cfs is pumped from the Missouri River near Washburn to the State RRVWSP WTP. The water from the Missouri River is treated to comply with the same requirements of the NDPDES draft permit issued by the NDDEQ for the State RRVWSP. The water is then pumped by the MPS to the HBT, then flows via gravity to the discharge structure on the Sheyenne River southeast of Cooperstown, ND. An additional 20 cfs of untreated water for in-basin use from the CNDWSP is also withdrawn from the McClusky Canal near MM 42.5 and pumped to the main pipeline at the beginning of Segment B. During periods of in-basin use only, the water will be pumped directly to the main pipeline without treatment. During periods of full flow, the pipeline will be flushed prior to crossing the continental divide and water from the Canal will be treated in a similar fashion prior to entering the main pipeline. A hydraulic profile of the State RRVWSP/CNDWSP Alternative is shown in Figure 7-2 (from the Missouri River).

7.2.2 Pipeline Summary

The pipeline system for this project includes Segments A, B, C, and D as 72-inch steel pipe and Segment E as 30-inch pipe. Approximately 171.7 miles of pipeline are included in this alternative. Table 7-3 presents the estimated capital costs.

Table 7-3 State RRVWSP/CNDWSP Estimated Cost Summary

	Size	Capital Cost
State Components		
MRIPS	145 cfs/2,000 HP	$57,773,000
WTP (state)	165 cfs	$38,555,000
MPS1	145 cfs/20,000 HP	$36,908,000
HBT	10 MG	$16,507,000
CVS & DS	140 cfs	$9,963,000
Pipeline Seg. A	72-inch	$130,210,000
Pipeline Seg. B	72-inch	$168,213,000
Pipeline Seg. C	72-inch	$91,939,000
Pipeline Seg. D	72-inch	$544,020,000
Subtotal		**$1,094,088,000**
CNDWSP Components		
CNDIPS	20 cfs/2,100 HP	$8,662,000
Pipeline Seg. E	30-inch	$15,506,000
Subtotal		**$24,168,000**
Totals		**$1,118,000,000**

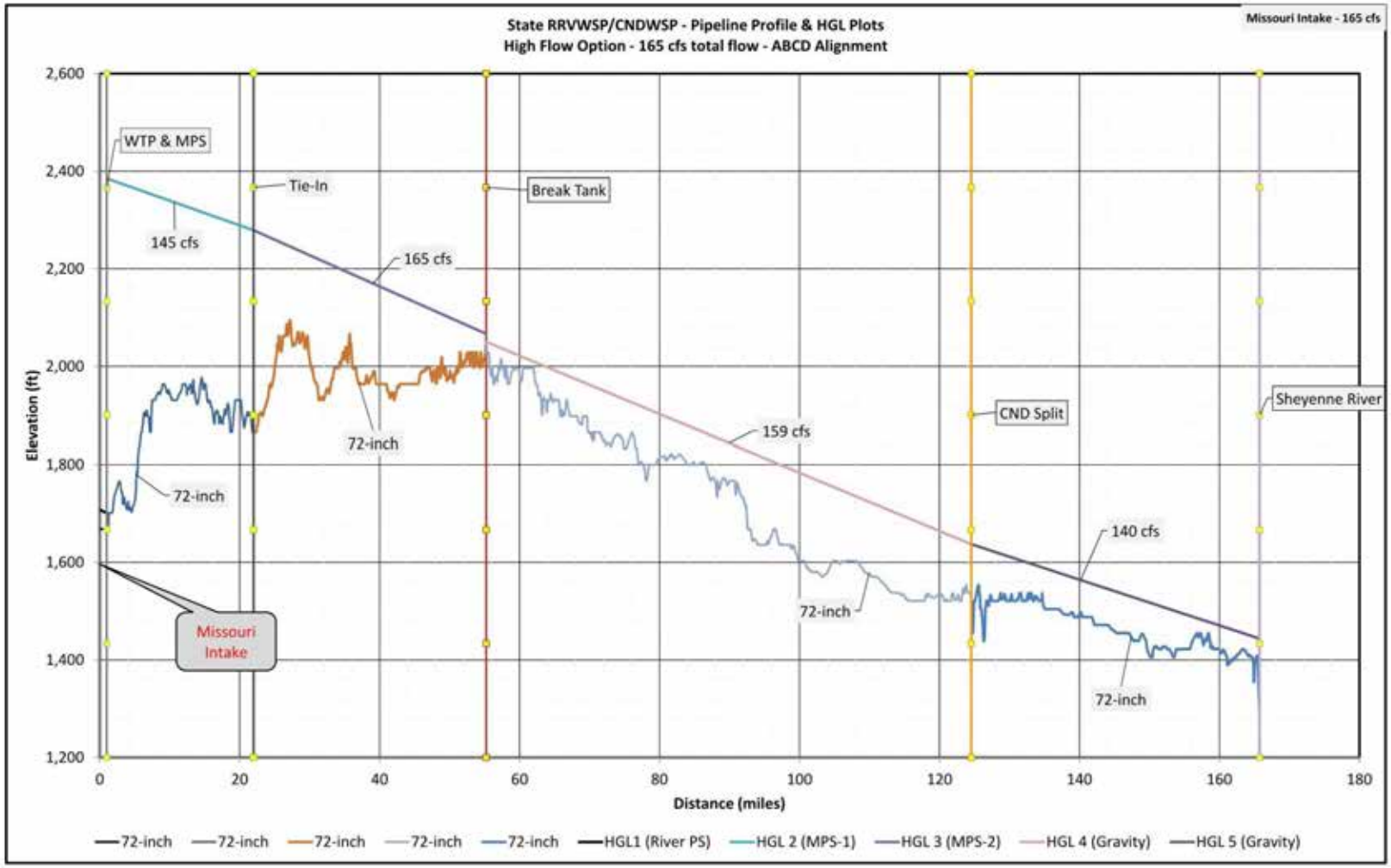


Figure 7-2 State RRVWSP/CNDWSP Missouri River Source Water Hydraulic Profile

7.3 ENDAWS ROUTE OPTION MCCLUSKY CANAL NORTH

The rest of this section describes the four route options associated with the ENDAWS. To facilitate comparison between the ENDAWS route options, the RRVWSP, and the State RRVWSP/CNDWSP, the ENDAWS route options include costs for portions of the RRVWSP or State RRVWSP/CNDWSP that are required to make a complete water delivery system.

7.3.1 Overview

This route option as described in Chapter 2, represents the proposed withdrawal of 165-cfs of water from the McClusky Canal near MM 57. Under this route option, 165-cfs is pumped from the McClusky Canal by MCIPS1 to the adjacent BWTP. The treated water is then pumped by the McMPS1 along a more northern route to the HBT, then flows via gravity to the intersection with the State RRVWSP and associated discharge structure on the Sheyenne River southeast of Cooperstown, ND. A hydraulic profile of the route option is shown in Figure 7-3.

7.3.2 Pipeline Summary

The pipeline system for this route option will utilize Segment G of the ENDAWS route options and Segment D of the State RRVWSP as 72-inch steel pipe. Approximately 124.9 miles of pipeline are included in this route option. Table 7-4 shows the estimated capital costs.

Table 7-4 ENDAWS Route Option McClusky Canal North Estimated Cost Summary

	Size	Capital Cost
Route Components		
McIPS1	165 cfs/2,000 HP	$28,246,000
McMPS1	165 cfs/20,000 HP	$34,545,000
Pipeline Seg. G	72-inch	$189,735,000
Subtotal		**$252,526,000**
Common Components		
HBT	10 MG	$16,461,000
CVS & Discharge Structure	140 cfs	$9,963,000
Pipeline Seg. D	72-inch	$544,020,000
Subtotal		**$570,444,000**
Totals(1)		**$823,000,000**

(1) Route Option Total does not include BWTP capital cost. Route Option Total increases to $879M with BWTP Option #1; $893M with BWTP Option #2; $1,043M with BWTP Option #3; and $1,063M with BWTP Option #4.

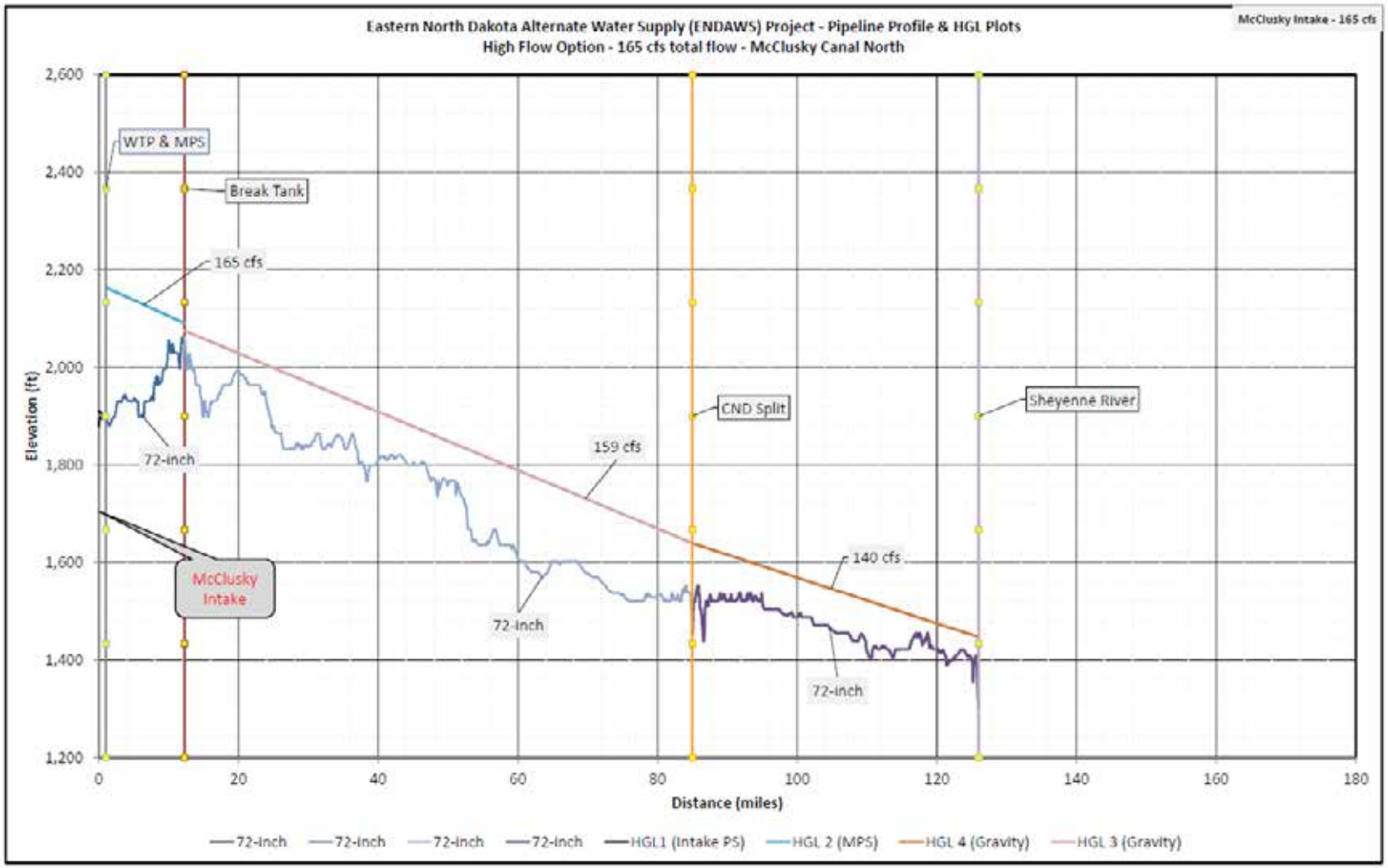


Figure 7-3 ENDAWS Route Option McClusky Canal North Hydraulic Profile

7.4 ENDAWS ROUTE OPTION MCCLUSKY CANAL SOUTH

7.4.1 Overview

This route option, as described in Chapter 2, represents the proposed withdrawal of 165-cfs of water from the McClusky Canal near MM 49. Under this route option, 165-cfs is pumped from the McClusky Canal by MCIPS2 to an adjacent BWTP. The treated water is then pumped by the McMPS2 along a more southerly route to the HBT, then flows via gravity to the intersection with the State RRVWSP and the associated discharge structure on the Sheyenne River southeast of Cooperstown, ND. A hydraulic profile of the route option is shown in Figure 7-4.

7.4.2 Pipeline Summary

The pipeline system for this route option will utilize Segment I of ENDAWS and Segments C and D of the State RRVWSP as 72-inch diameter steel pipe. Approximately 130.0 miles of pipeline are included in this route option. Table 7-5 shows the estimated capital costs.

Table 7-5 ENDAWS Route Option McClusky Canal South Estimated Cost Summary

	Size	Capital Cost
Route Components		
McIPS2	165 cfs/2,000 HP	$31,953,000
McMPS2	165 cfs/20,000 HP	$35,258,000
Pipeline Seg. I	72-inch	$103,307,000
Subtotal		**$170,518,000**
Common Components		
HBT	10 MG	$16,778,000
CVS & DS	140 cfs	$9,963,000
Pipeline Seg. C	72-inch	$91,939,000
Pipeline Seg. D	72-inch	$544,020,000
Subtotal		**$662,700,000**
Totals(1)		**$833,000,000**

(1) Route Option Total does not include BWTP capital costs. Route Option Total increases to $889M with BWTP Option #1; $903M with BWTP Option #2; $1,053M with BWTP Option #3; and $1,073M with BWTP Option #4.

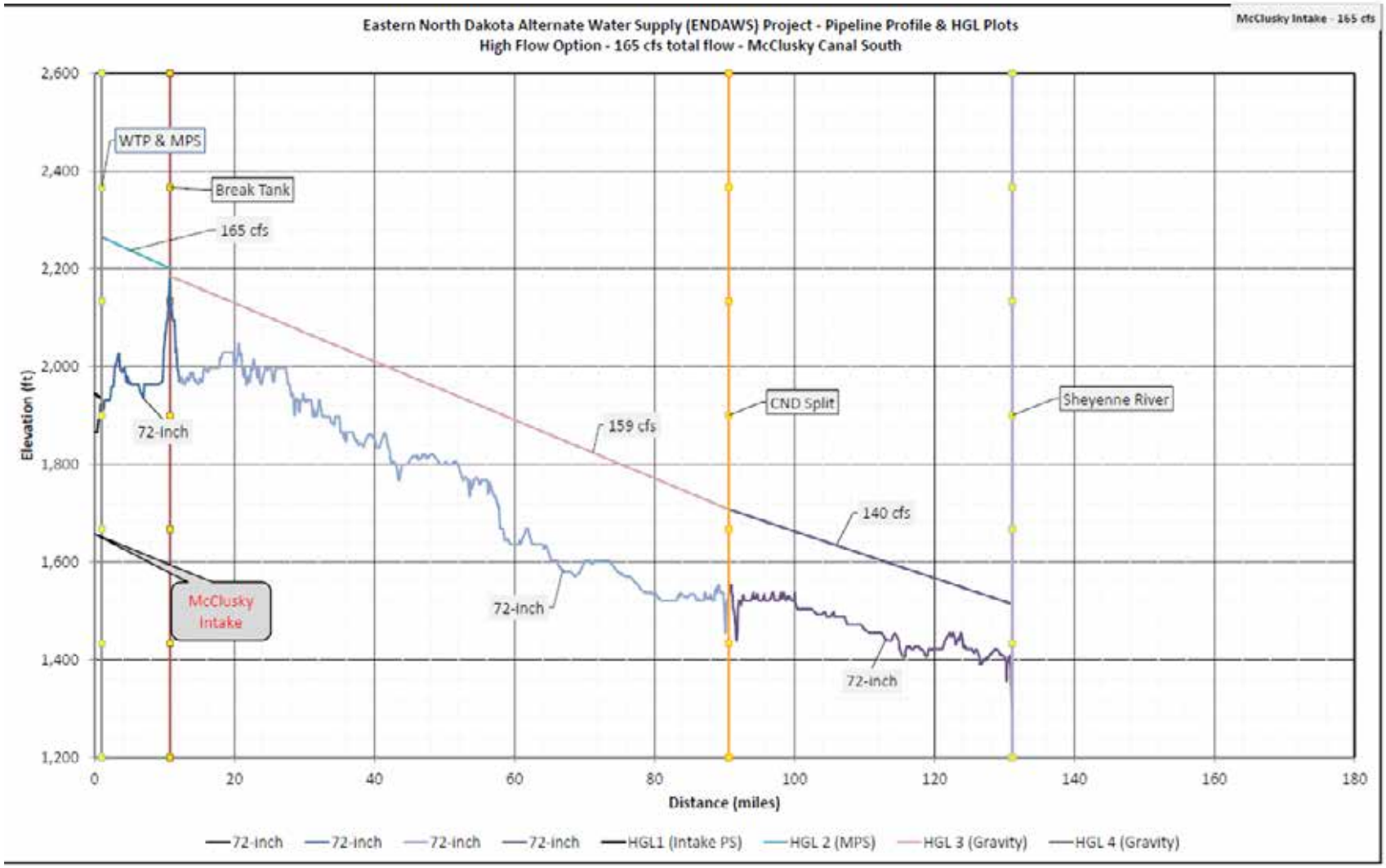


Figure 7-4 ENDAWS Route Option McClusky Canal South Hydraulic Profile

7.5 ENDAWS ROUTE OPTION MCCLUSKY CANAL AND MISSOURI RIVER NORTH

7.5.1 Overview

This route option, as described in Chapter 2, represents a fully redundant system that allows for either the withdrawal of 165-cfs of water from the McClusky Canal near MM 57 or the Missouri River near Washburn. Under this route option the 165-cfs is pumped from the McClusky Canal to an adjacent BWTP. Any water withdrawn from the Missouri River must undergo sand/grit removal in the SRP at the proposed site for the State RRVWSP WTP prior to pumping to the ENDAWS BWTP to prevent sediment buildup within the pipeline. The water from the BWTP is then pumped by the McMPS along the northerly route to the HBT and then flows via gravity to the intersection with the State RRVWSP and the associated discharge structure on the Sheyenne River southeast of Cooperstown, ND. A hydraulic profile of this route option when utilizing the Missouri River as the source is shown in Figure 7-5.

7.5.2 Pipeline Summary

The pipeline system for this route option will utilize Segments A and D of the State RRVWSP, Segment E of the CNDWSP, and Segments F, H, and G of ENDAWS as 72-inch steel pipe. Approximately 169.3 miles of pipeline are included in this route option. Table 7-6 shows the estimated capital and operational costs for this option. The estimated costs are broken out by the phases described in Chapter 2.

Table 7-6 ENDAWS Route Alternative McClusky Canal and Missouri River North Estimated Cost Summary

	Size	Capital Cost
Phase 1		
ENDAWS Route Option Components		
McIPS1	165 cfs/2,000 HP	$28,246,000
McMPS1	165 cfs/20,000 HP	$34,545,000
Pipeline Seg. G	72-inch	$189,735,000
Subtotal		**$252,526,000**
State RRVWSP Components		
HBT	10 MG	$16,461,000
CVS & DS	140 cfs	$9,963,000
Pipeline Seg. D	72-inch	$544,020,000
Subtotal		**$570,444,000**
Phase 1 Subtotals		**$823,000,000**
Phase 2		
ENDAWS Route Option Components		
Pipeline Seg. E	72-inch	$43,971,000
Pipeline Seg. F	72-inch	$35,673,000
Pipeline Seg. H	72-inch	$51,702,000
Subtotal		**$131,346,000**
State RRVWSP Components		
MRIPS	165 cfs	$57,773,000
SRP	165 cfs	$12,976,000
MPS2	165 cfs	$36,114,000
Pipeline Seg. A	72-inch	$130,210,000
Subtotal		**$237,073,000**
Phase 2 Subtotals		**$368,419,000**
Totals(1)		**$1,191,000,000**

(1) Route Option Total does not include BWTP capital costs. Route Option Total increases to $1,247M with BWTP Option #1; $1,261M with BWTP Option #2; $1,411M with BWTP Option #3; and $1,431M with BWTP Option #4.

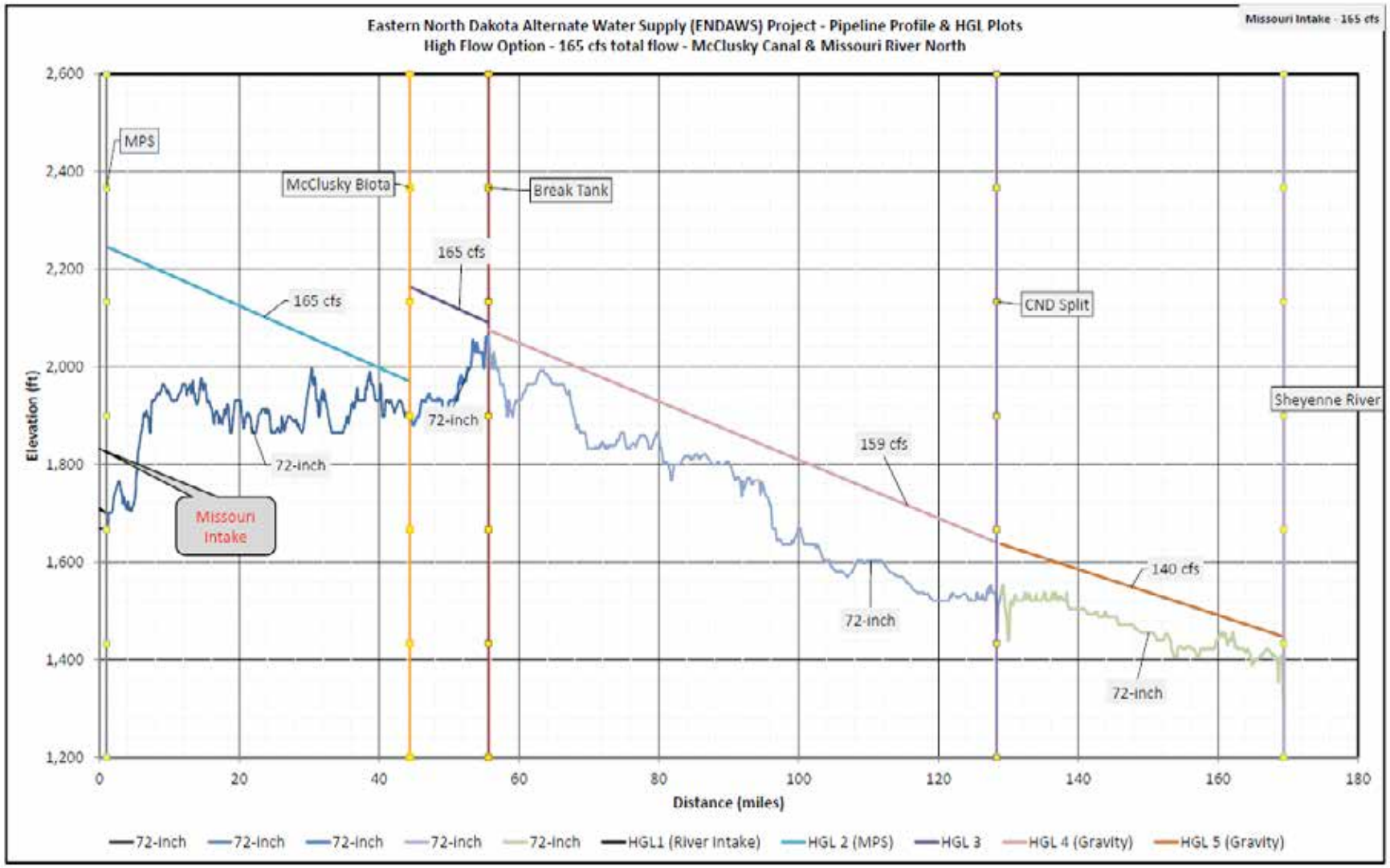


Figure 7-5 ENDAWS Route Option McClusky Canal and Missouri River North Hydraulic Profile

7.6 ENDAWS ROUTE OPTION MCCLUSKY CANAL AND MISSOURI RIVER SOUTH

7.6.1 Overview

This route option, as described in Chapter 2, represents a fully redundant system that allows for either the withdrawal of 165-cfs of water from the McClusky Canal near MM 49 or the Missouri River near Washburn. Under this route option, the 165-cfs from the McClusky Canal is pumped to an adjacent BWTP. Any water withdrawn from the Missouri River must undergo sediment removal in the SRP at the same location proposed for the State RRVWSP WTP prior to pumping to the ENDAWS BWTP to prevent sediment buildup within the pipeline. The water from the BWTP is then pumped by the McMPS2 along the southerly route to the intersection with the State RRVWSP and the HBT before flowing by gravity to the associated discharge structure on the Sheyenne River southeast of Cooperstown, ND. A hydraulic profile of this route option when utilizing the Missouri River as the source is shown in Figure 7-6. Pipeline Summary

The pipeline system for this route option will utilize Segments A, C, and D of the State RRVWSP, Segment E of CNDWSP, and Segments F and I of ENDAWS as a 72-inch steel pipe. Approximately 166.0 miles of pipeline are included in this route option. Table 7-7 shows the estimated capital costs for this option. The costs are broken out by the phases described in Chapter 2.

Table 7-7 ENDAWS Route Option McClusky Canal and Missouri River South Estimated Cost Summary

	Size	Capital Cost
Phase 1		
ENDAWS Route Option Components		
McIPS2	165 cfs/2,000 HP	$31,953,000
McMPS2	165 cfs/20,000 HP	$35,258,000
Pipeline Seg. I	72-inch	$103,307,000
Subtotal		**$170,518,000**
State RRVWSP Components		
HBT	10 MG	$16,778,000
CVS & DS	140 cfs	$9,963,000
Pipeline Seg. C	72-inch	$91,939,000
Pipeline Seg. D	72-inch	$544,020,000
Subtotal		**$662,700,000**
Phase 1 Subtotals		**$833,218,000**
Phase 2		
ENDAWS Route Option Components		
Pipeline Seg. E	72-inch	$43,971,000
Pipeline Seg. F	72-inch	$35,673,000
Subtotal		**$79,644,000**
State RRVWSP Components		
MRIPS	165 cfs	$57,773,000
SRP	165 cfs	$12,976,000
MPS2	165 cfs	$36,114,000
Pipeline Seg. A	72-inch	$130,210,000
Subtotal		**$237,073,000**
Phase 2 Subtotals		**$316,717,000**
Totals(1)		**$1,150,000,000**

(1) Route Option Total does not include BWTP capital costs. Route Option Total increases to $1,206M with BWTP Option #1; $1,220M with BWTP Option #2; $1,370M with BWTP Option #3; and $1,390M with BWTP Option #4.

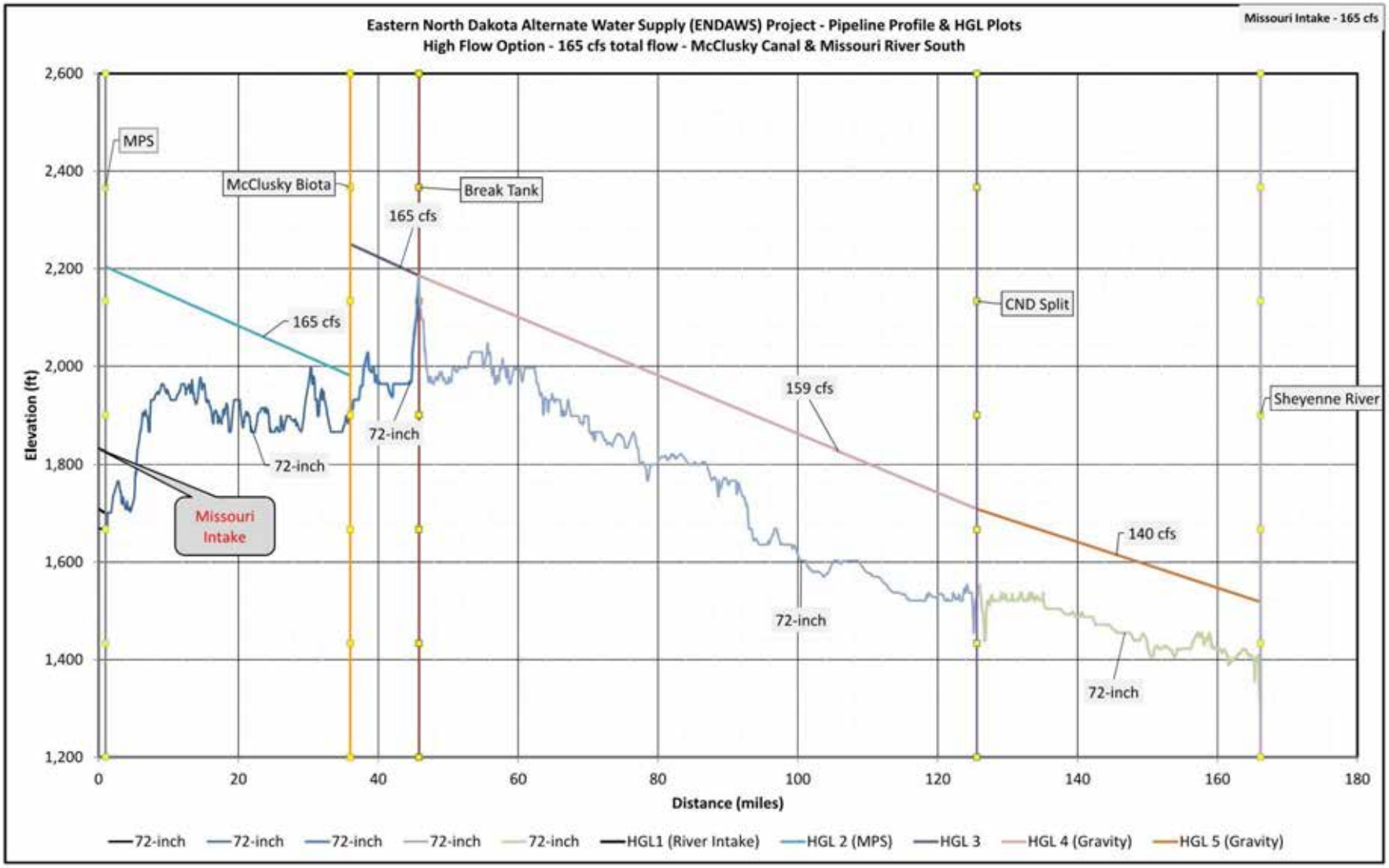


Figure 7-6 ENDAWS Route Option McClusky Canal and Missouri River South Hydraulic Profile

7.7 ANTICIPATED O&M COSTS

7.7.1 Overview

The route options have a wide range of anticipated O&M costs depending upon the water source, the facilities utilized by the route, the hydraulic profile of the route, and the selected treatment option. The ability to utilize WAPA power also has a significant impact on the annual O&M costs. The costs listed in Table 7-8 represent the total annual O&M cost for the route while operating at full flow capacity. The route options for McClusky Canal and River North and McClusky Canal and River South have the ability to operate with a range of flows coming from either the McClusky Canal or the Missouri River. The O&M costs showing 90% of the flow coming from the McClusky Canal and 10% of the flow coming from the Missouri River are the O&M costs most representative of expected long-term operations.

Table 7-8 Annual O&M Summary for Routes

Route Option	Total O&M	Total O&M with BWTP			
		Option 1	Option 2	Option 3	Option 4
Red River Valley Water Supply Project	$14,710,000	-	-	-	-
Central North Dakota Water Supply Project	$13,550,000	-	-	-	-
ENDAWS Alternate Route Option - McClusky Canal North	-	$6,540,000	$7,140,000	$11,440,000	$12,440,000
ENDAWS Alternate Route Option - McClusky Canal South	-	$7,440,000	$8,040,000	$12,340,000	$13,340,000
ENDAWS Alternate Route Option - McClusky Canal and River North					
With Source from Missouri River	-	$15,970,000	$16,570,000	$20,870,000	$21,870,000
With Source from McClusky Canal	-	$6,540,000	$7,140,000	$11,440,000	$12,440,000
Blended Source Water (90% McClusky Canal; 10% Missouri River)	-	$7,640,000	$8,240,000	$12,540,000	$13,540,000
ENDAWS Alternate Route Option - McClusky Canal and River South					
With Source from Missouri River	-	$15,880,000	$16,480,000	$20,780,000	$21,780,000
With Source from McClusky Canal	-	$7,440,000	$8,040,000	$12,340,000	$13,340,000
Blended Source Water (90% McClusky Canal; 10% Missouri River)	-	$8,440,000	$9,040,000	$13,340,000	$14,340,000

8.0 References

Final Environmental Impact Study, December 2007; U.S Bureau of Reclamation

Historic and Naturalized Monthly Streamflow for Selected Sites in the Red River of the North Basin in North Dakota, Minnesota, and South Dakota, 1931-2001; 2005; U.S. Geologic Survey

Red River Valley Water Supply Project Preliminary Design Report, April 2018; Black & Veatch

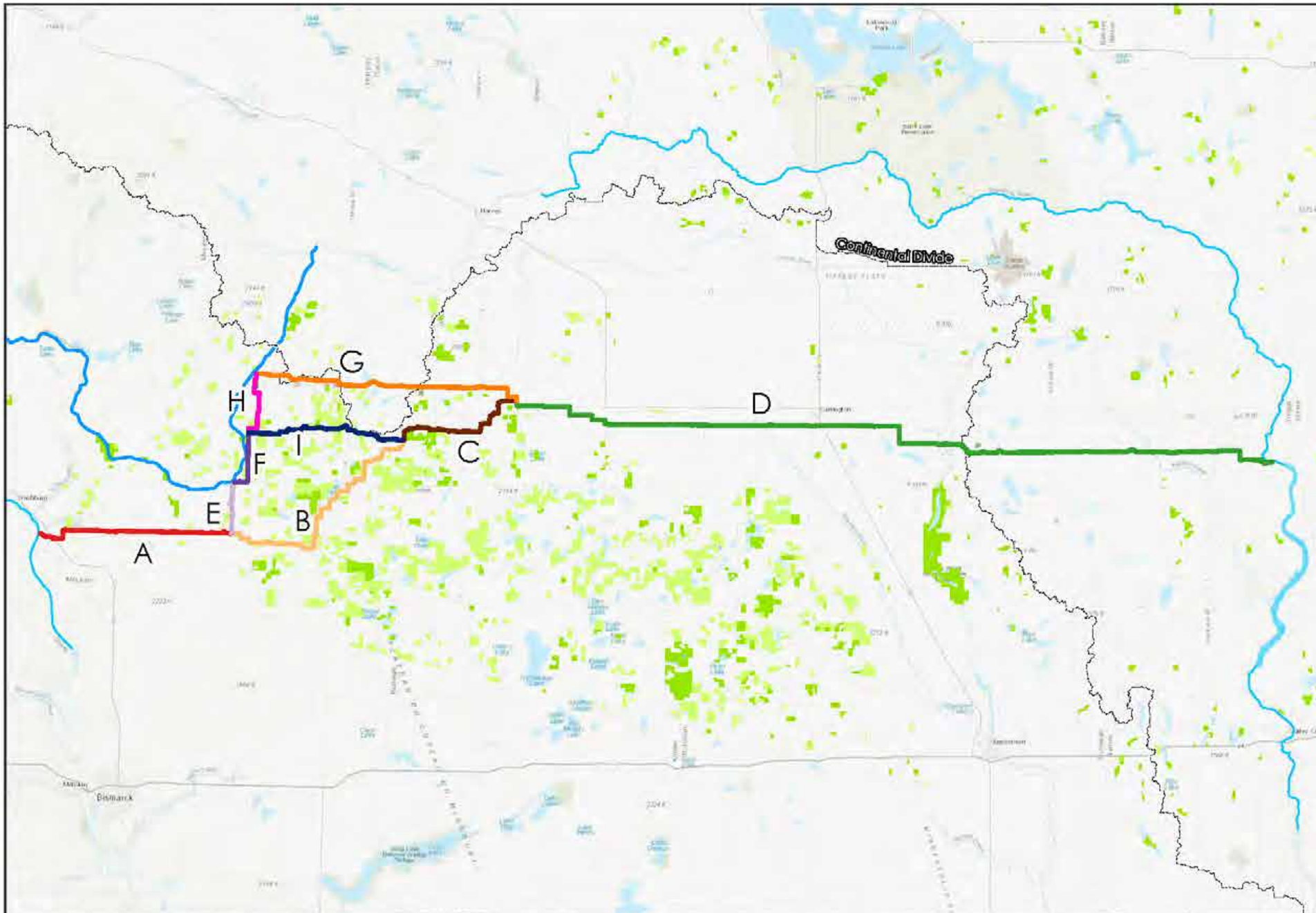
Snake Creek Dam and Lake Audubon Reservoir Water Control Manual; US Army Corps of Engineers. Revised 2019

Technical Memorandum – McClusky Canal Operations Hydraulic Model, December 5, 2018; AE2S

Water Control Manual Baldhill Dam and Lake Ashtabula; US Army Corps of Engineers. Revised March 2007

Attachment A Pipeline Alignment Maps

Segment	Grid	County	Mileposts	
			Begin	End
A	A1-A8	McLean	0	22.98
B	B1-B14	Burleigh, Sheridan	0	31.94
C	C1-C7	Sheridan, Wells	0	17.46
D	D1-D30	Wells, Foster, Griggs	0	93.21
E	E1-E6	Burleigh	0	6.02
F	F1-F5	Burleigh, Sheridan	0	6.96
G	G1-G10	Sheridan, Wells	0	31.73
H	H1-H6	Sheridan	0	8.33
I	I1-I6	Sheridan	0	19.33



Pipeline Segments

Date: 11/25/2019

Service Layer Credits: World Topographic Map: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase

N

0 5 10 20 Miles

GARRISON DIVERSION

BLACK & VEATCH

AE2S

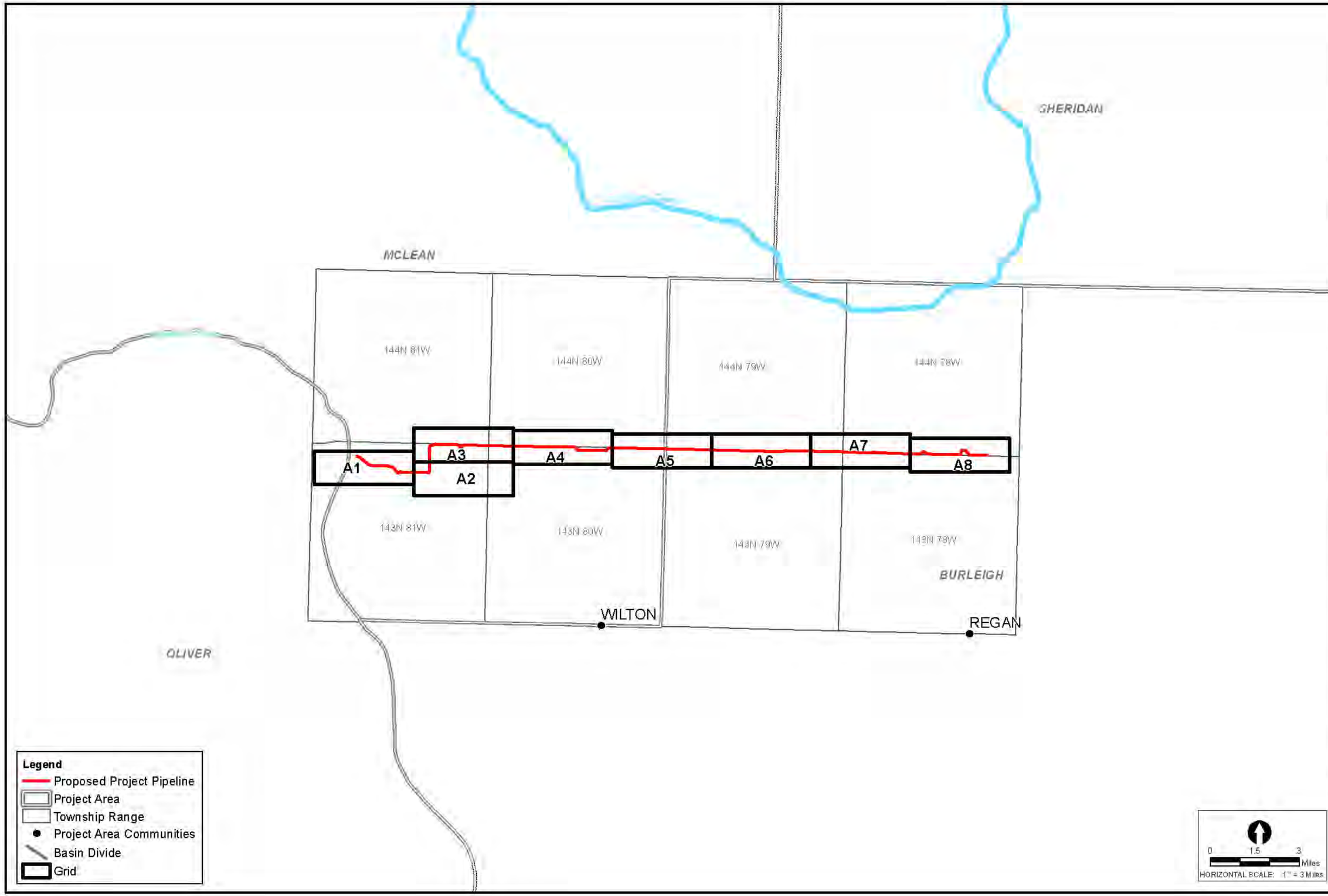
Edited by: dlee
Imagery 2010 NAIP and 2016-10 QSI
Coordinate System: UTM Zone 14N
C:\Data\Projects\WAFS\B\Black & Veatch\00200-2019-017\GIS\RRVWSP Route Alternates.aprx

Segments

- A
- B
- C
- D
- E
- F
- G
- H
- I

- Continental Divide
- McClusky Canal
- USFWS Grassland Easement
- USFWS Waterfowl Production Area/ National Wildlife Refuge
- USFWS Waterfowl Production Area Easement (New)

Segment	A	B	C	D	E	F	G	H	I
Miles	22.98	31.94	17.46	93.21	6.02	6.96	31.73	8.33	19.33



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INDEX SHEET- SEGMENT A

Eastern North Dakota Alternate Water Supply Project

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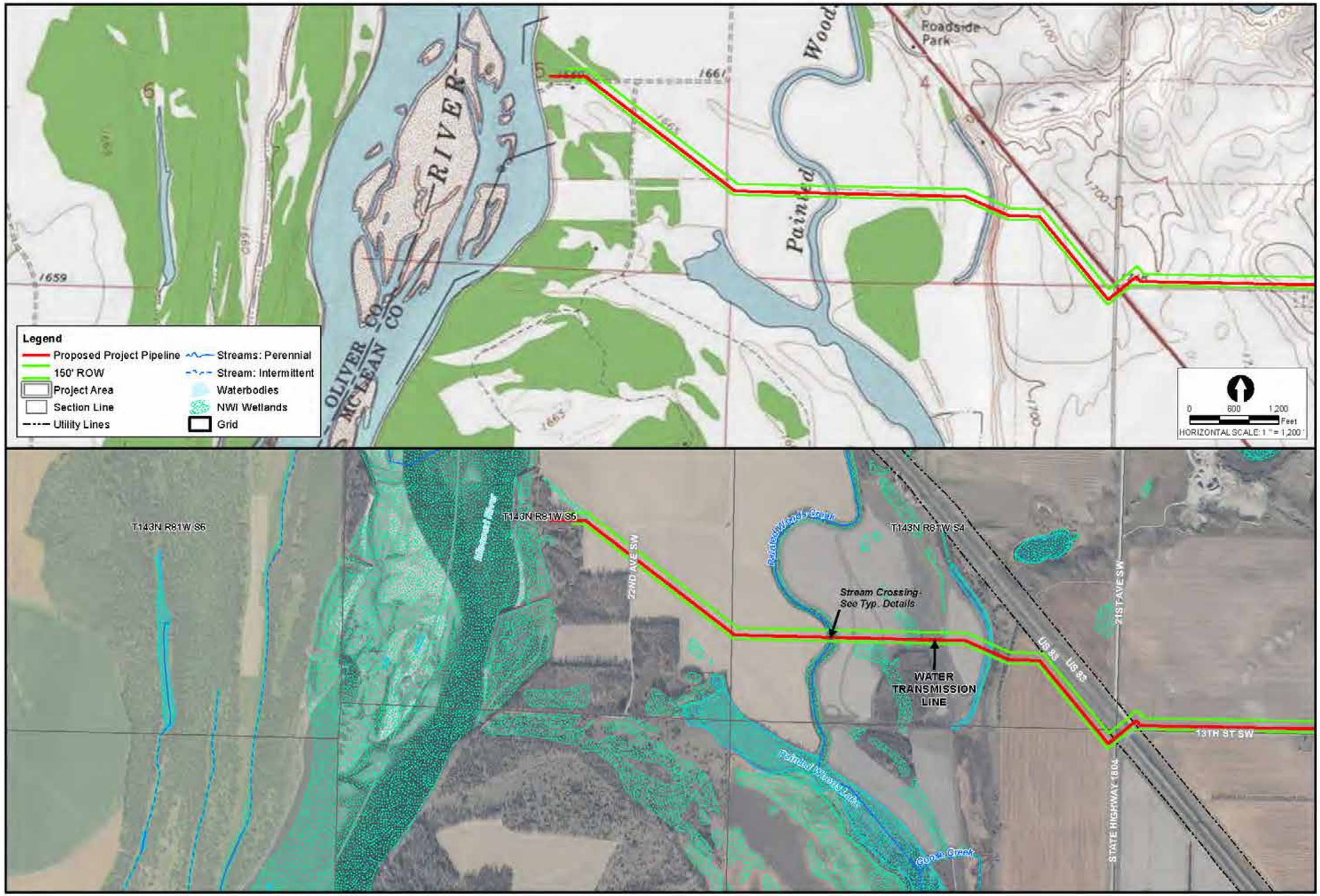
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. 01



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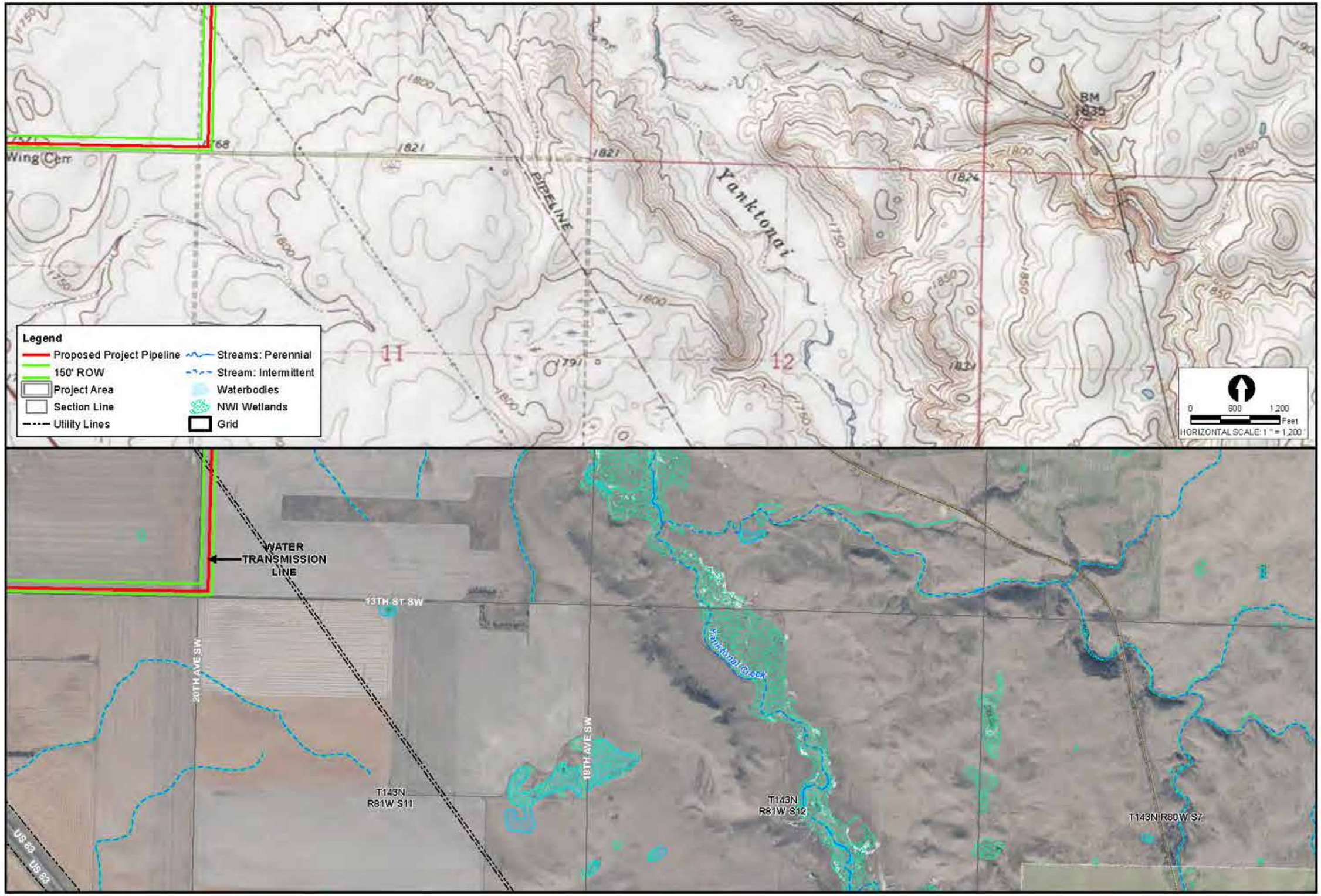

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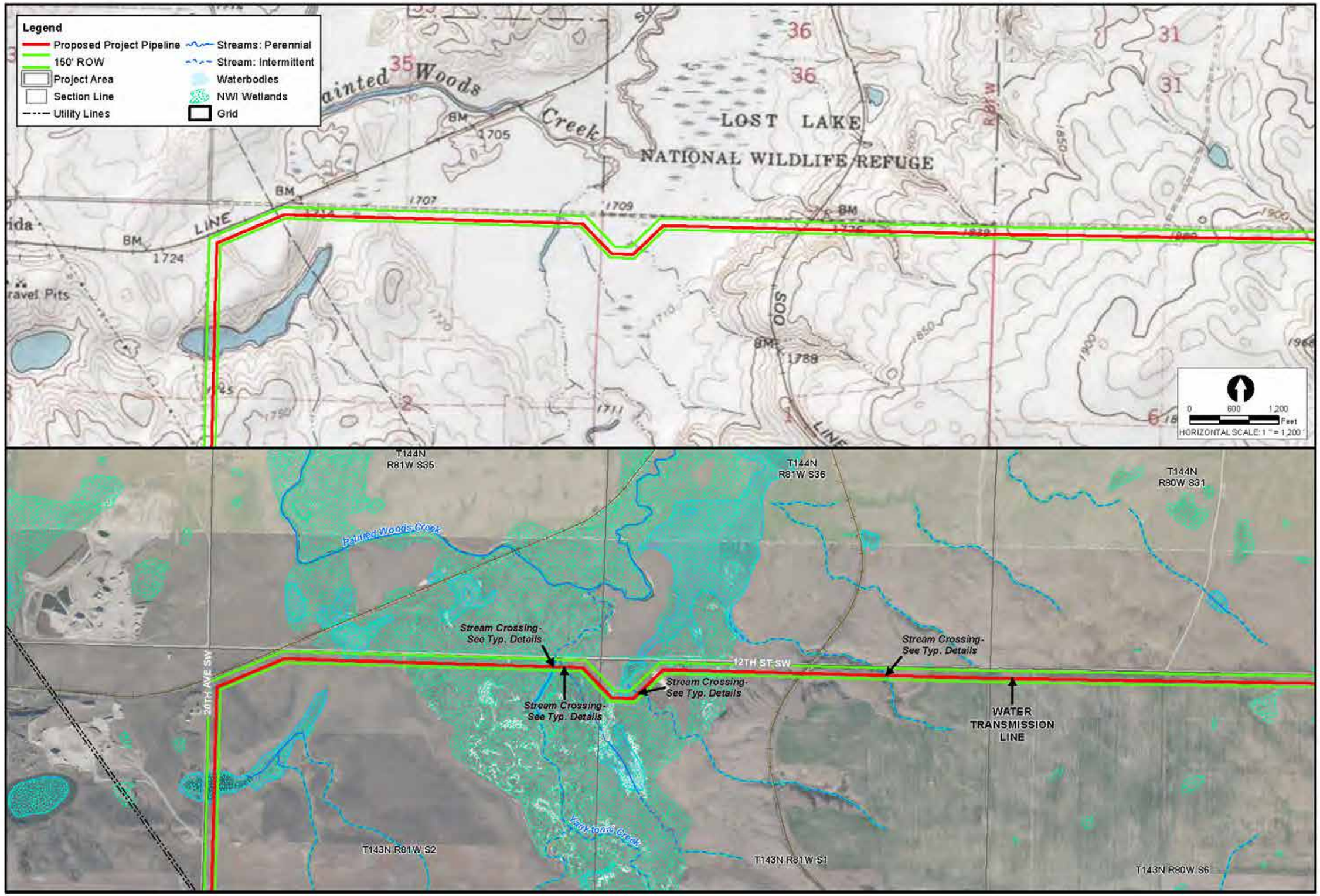

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FIGURE NO. A4

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Eastern North Dakota Alternate Water Supply Project

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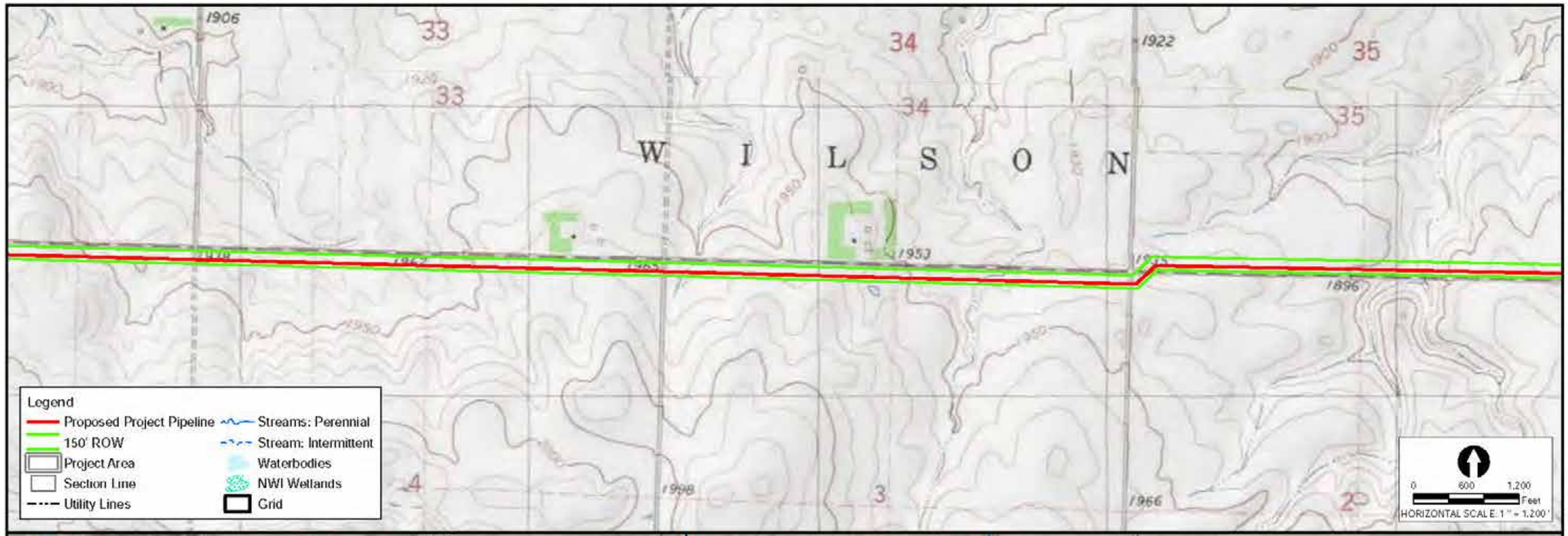

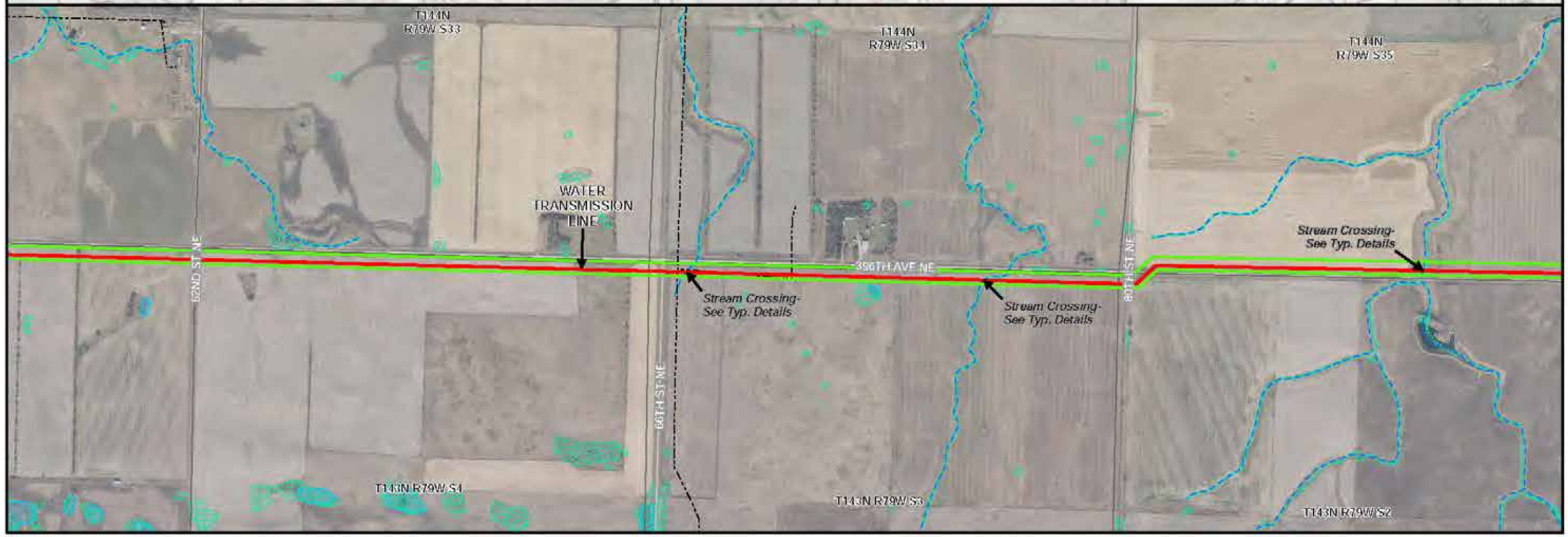

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Eastern North Dakota Alternate Water Supply Project

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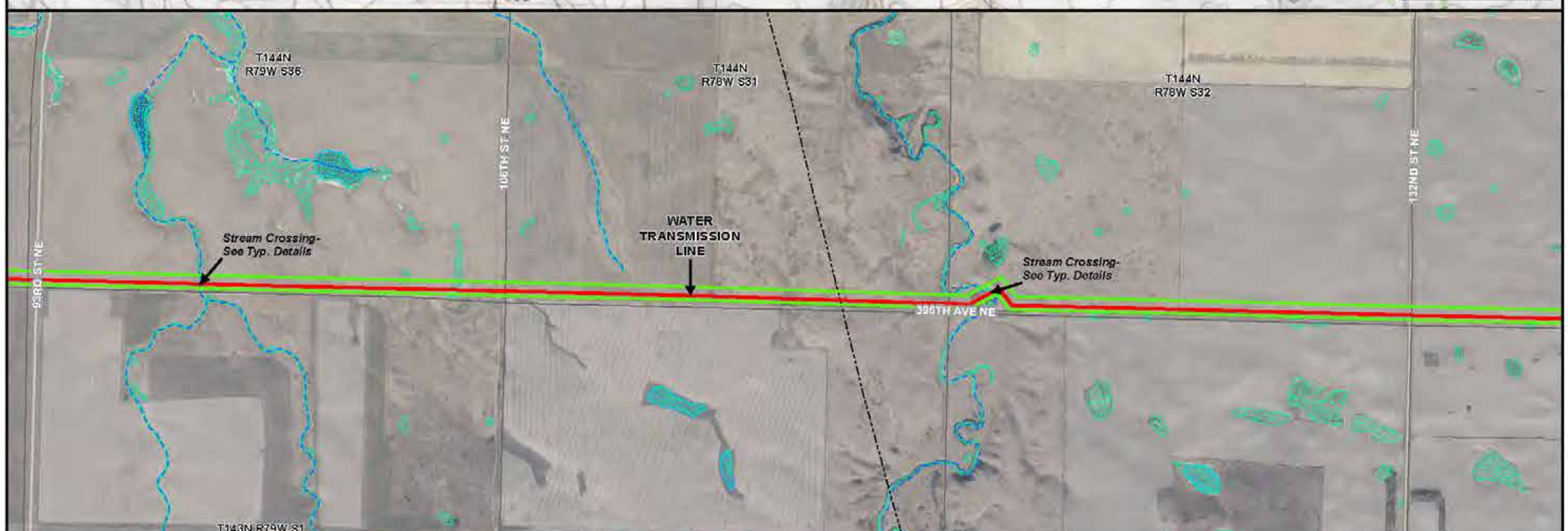
JOB NO. 00200-2019-017
FIGURE NO. A6



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PLAN SHEET- SEGMENT A

Eastern North Dakota Alternate Water Supply Project

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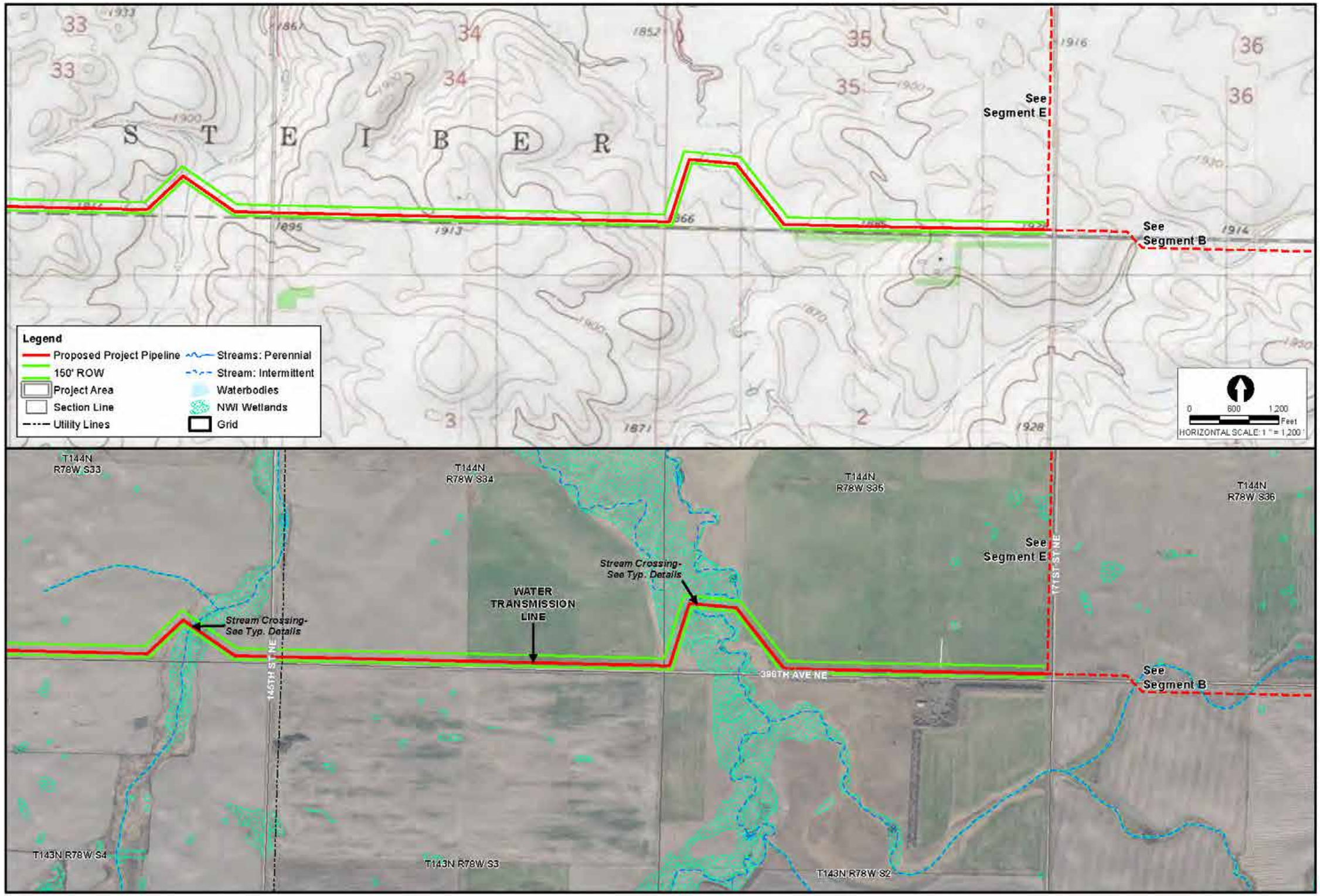
CHECKED BY: LR & SC
SCALE: AS SHOWN
JOB NO: 00200-2019-017
FIGURE NO. A7



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PLAN SHEET- SEGMENT A

Eastern North Dakota Alternate Water Supply Project

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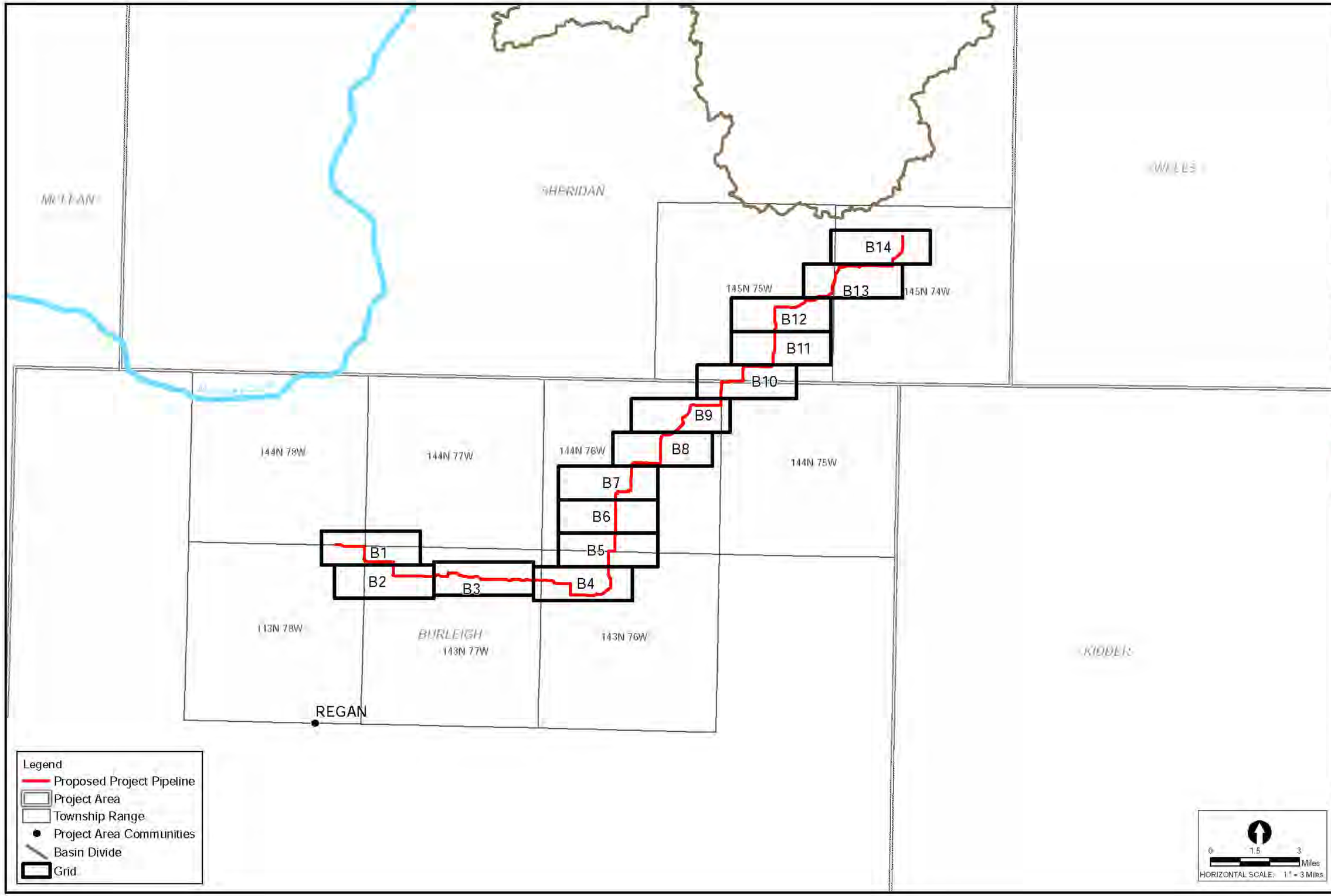
SCALE: AS SHOWN
JOB NO: 00200-2019-017
FIGURE NO. A8



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INDEX SHEET- SEGMENT B

Eastern North Dakota Alternate Water Supply Project

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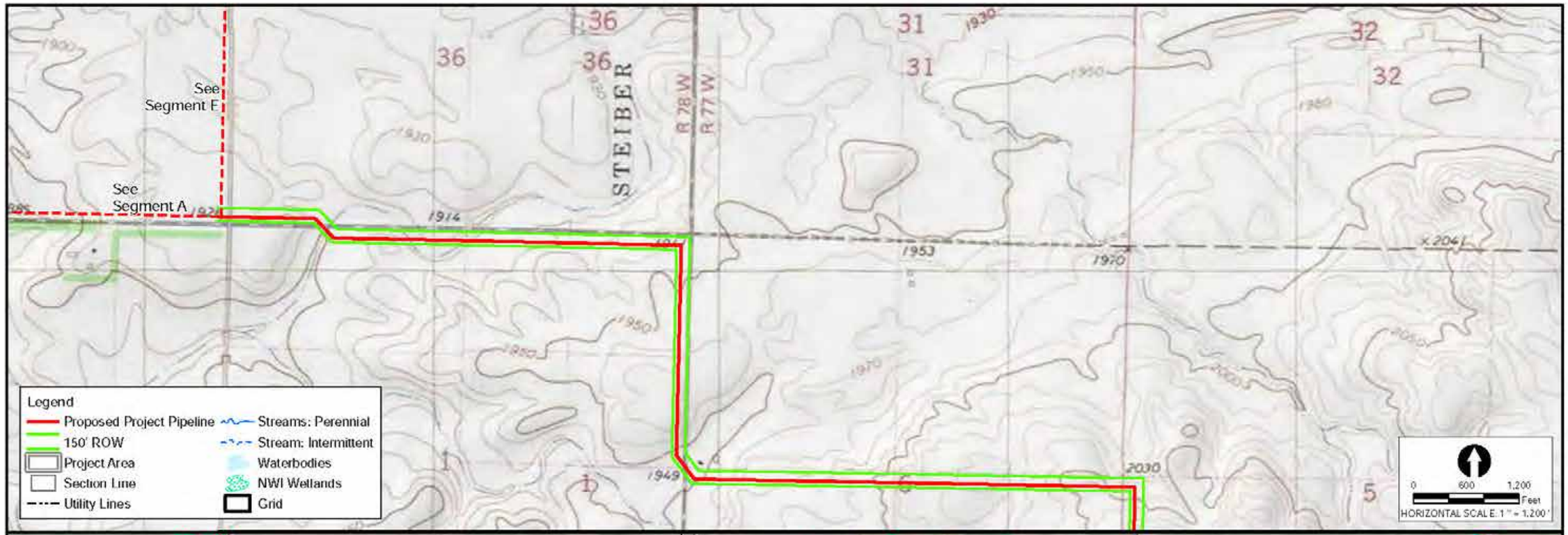
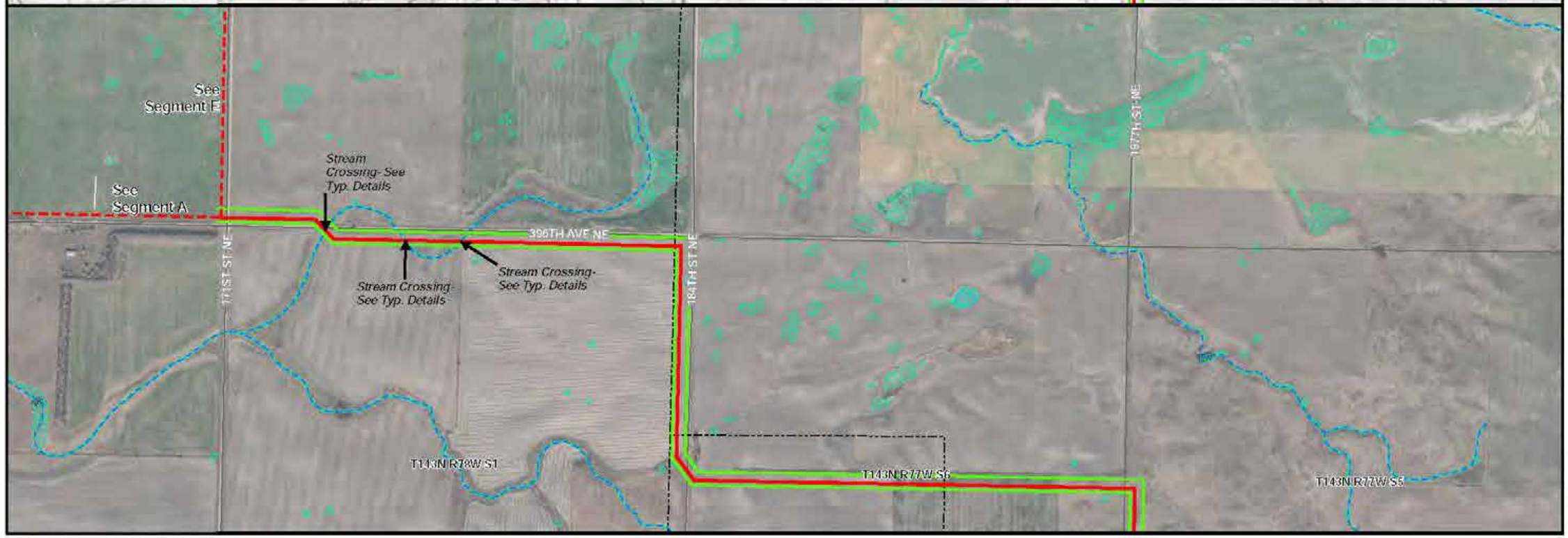
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. 01





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JOB NO. 00200-2019-017
FIGURE NO. B1

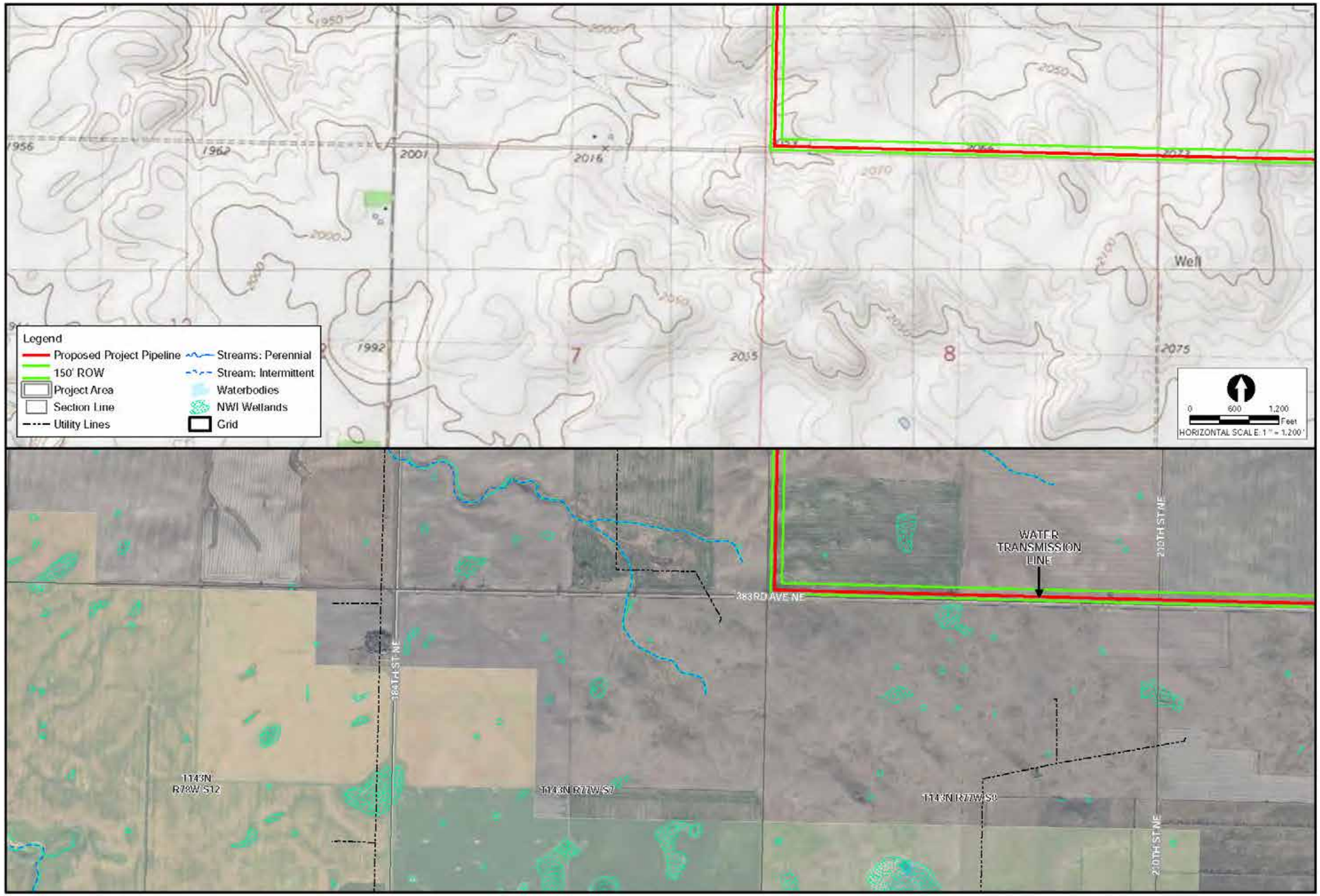

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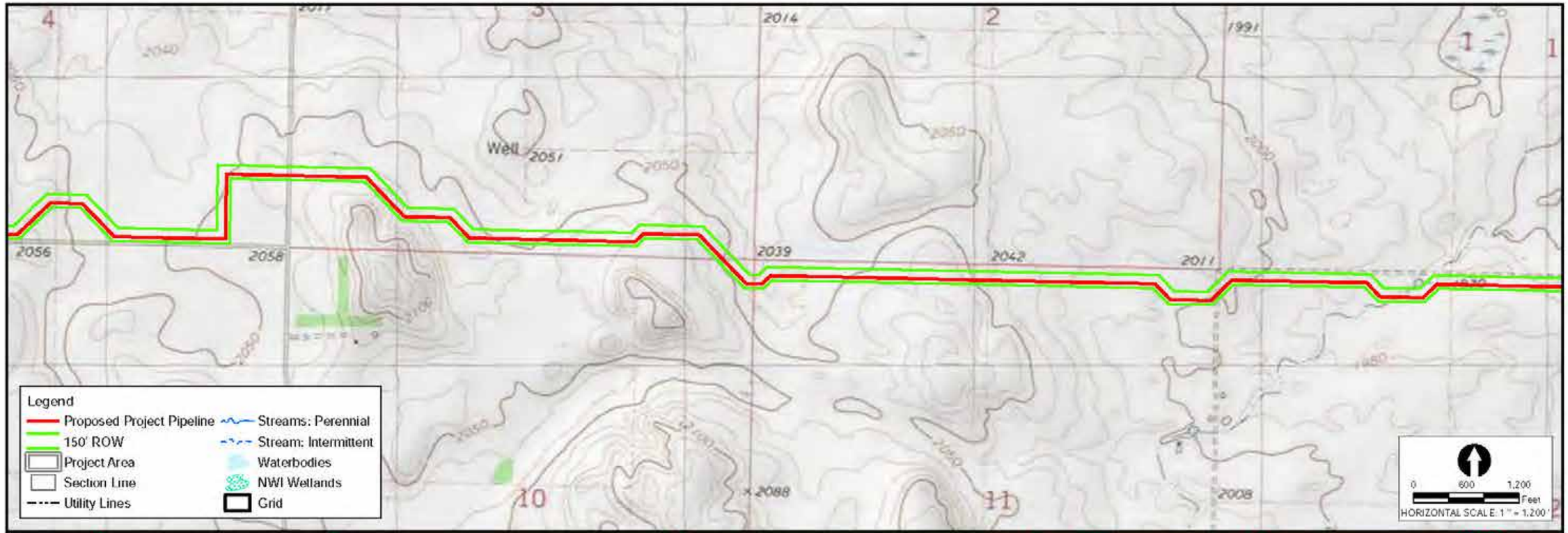
FIGURE NO. B2



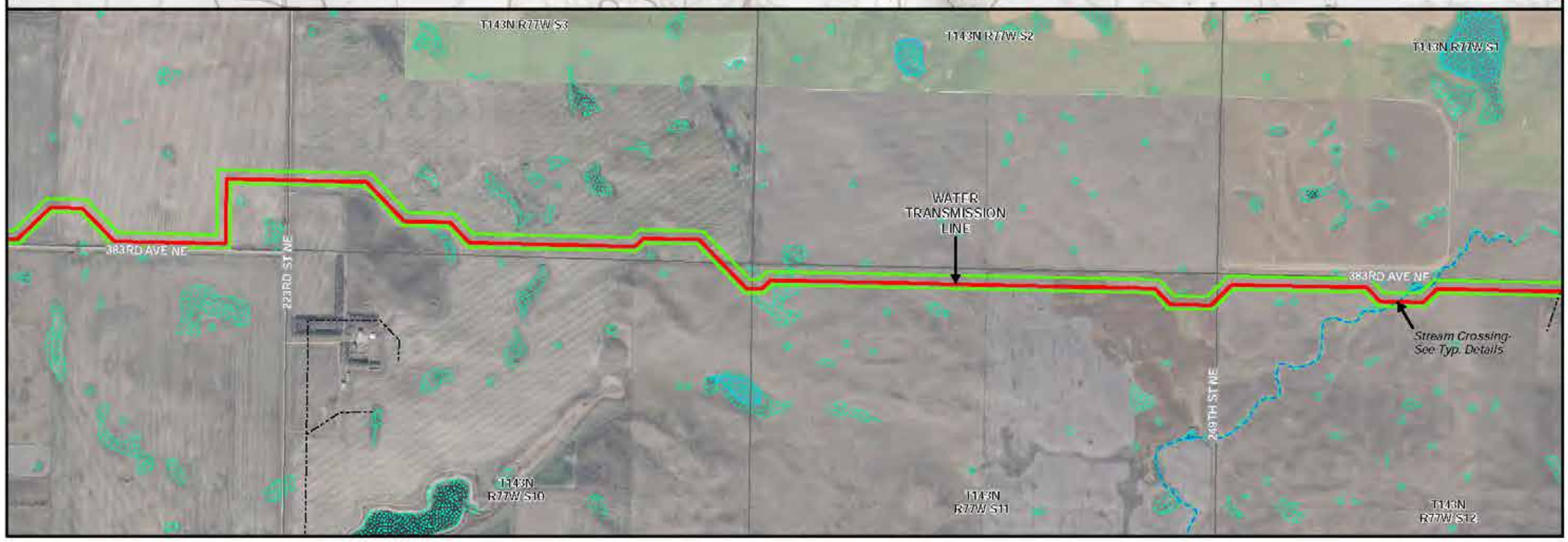


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FIGURE NO. B3

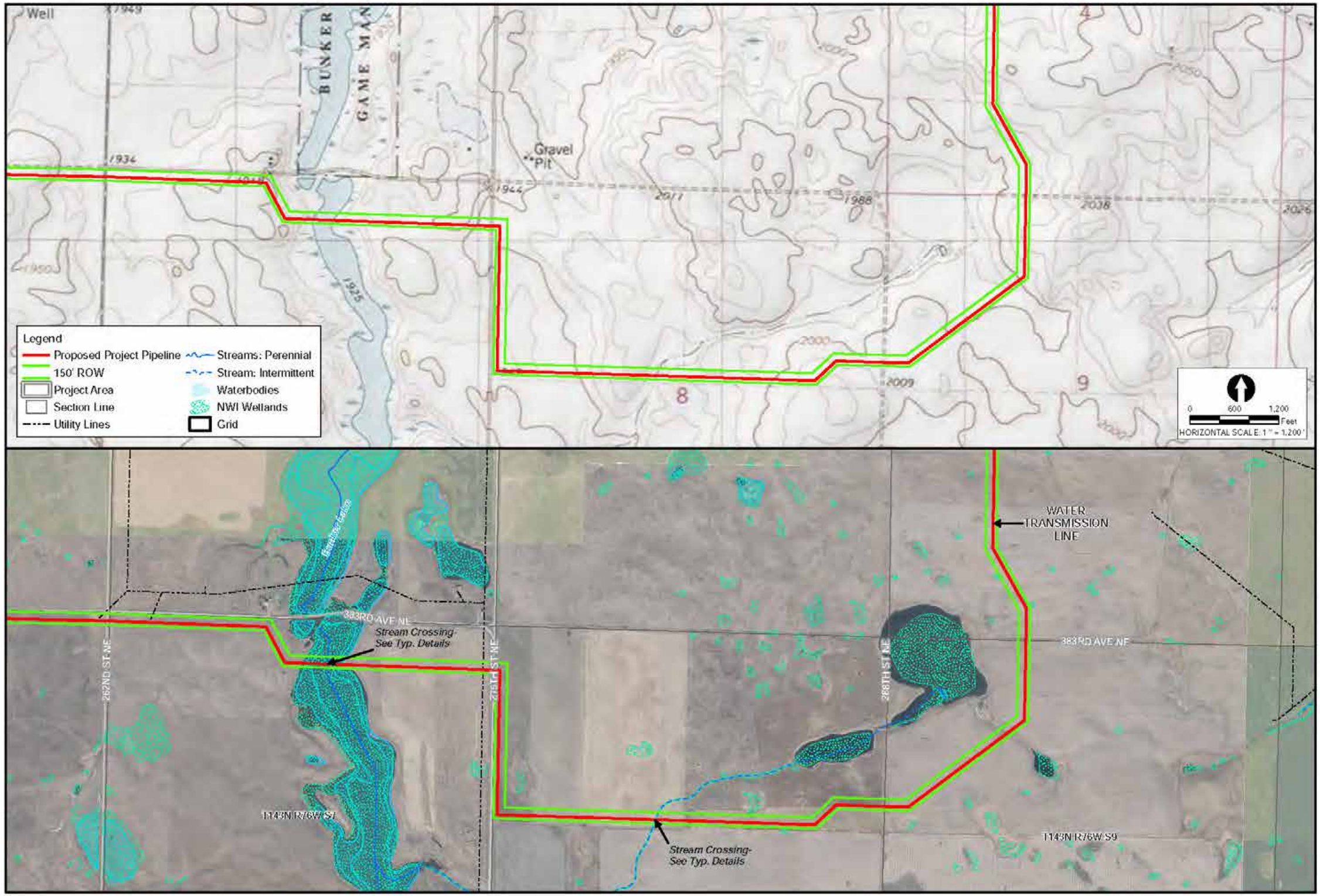

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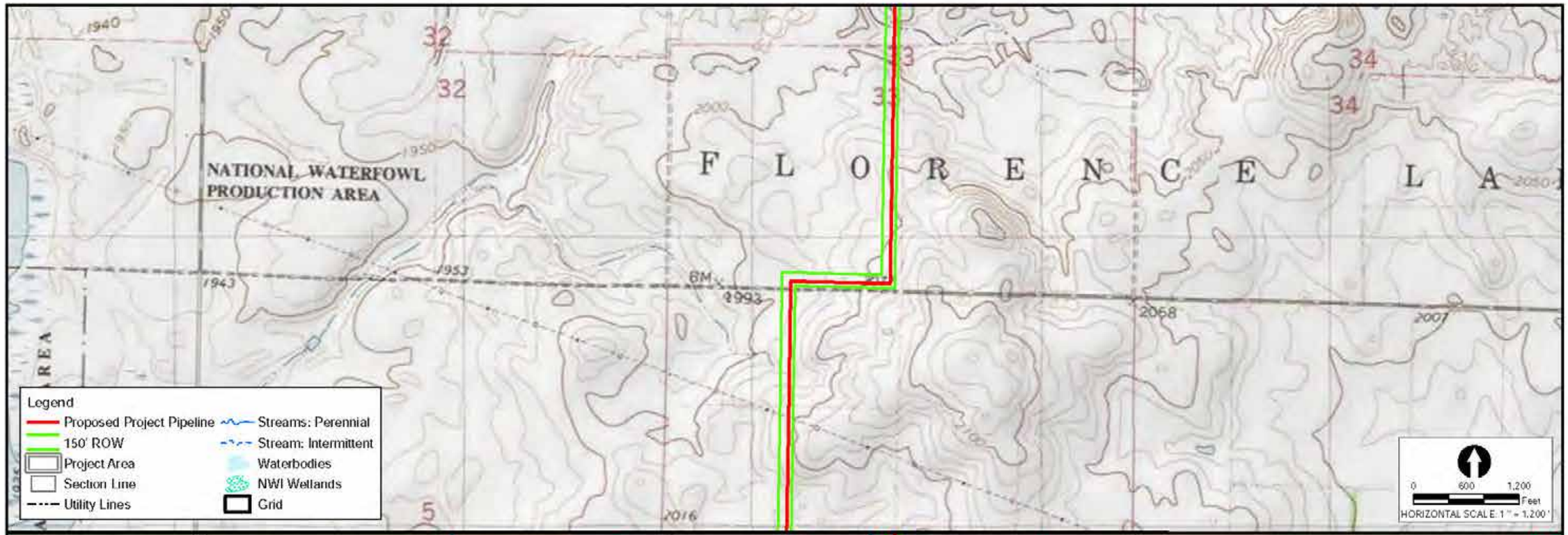
FIGURE NO. B4



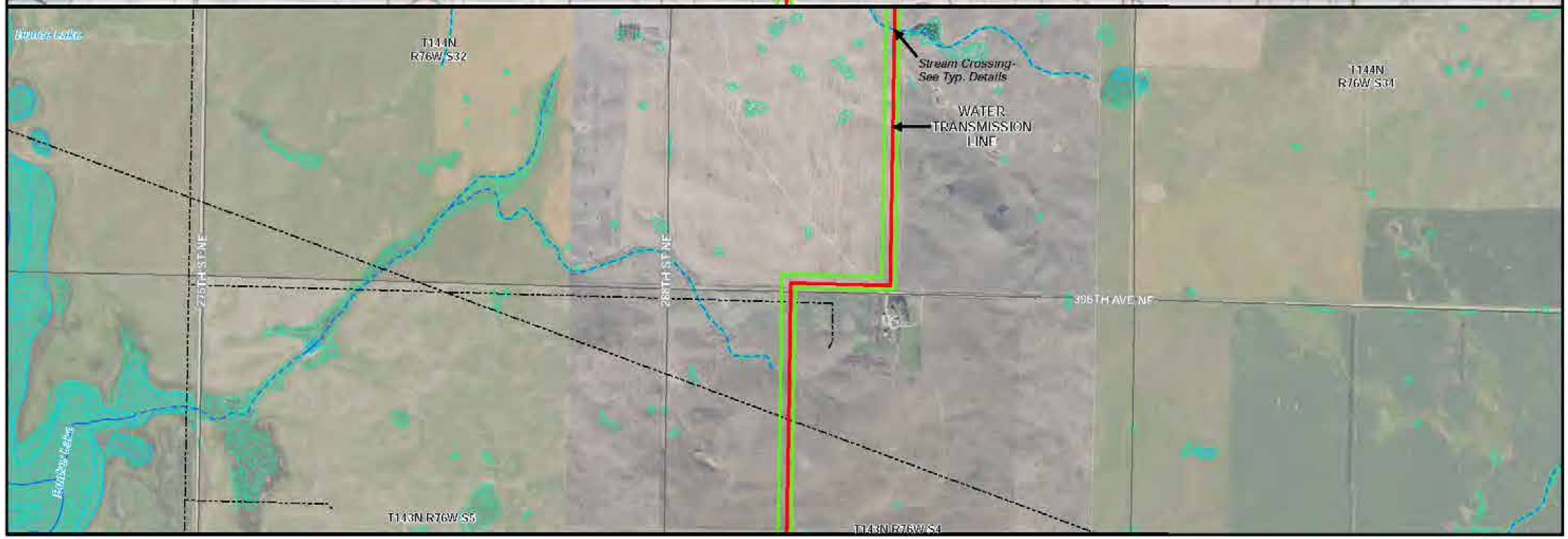


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FIGURE NO. B5

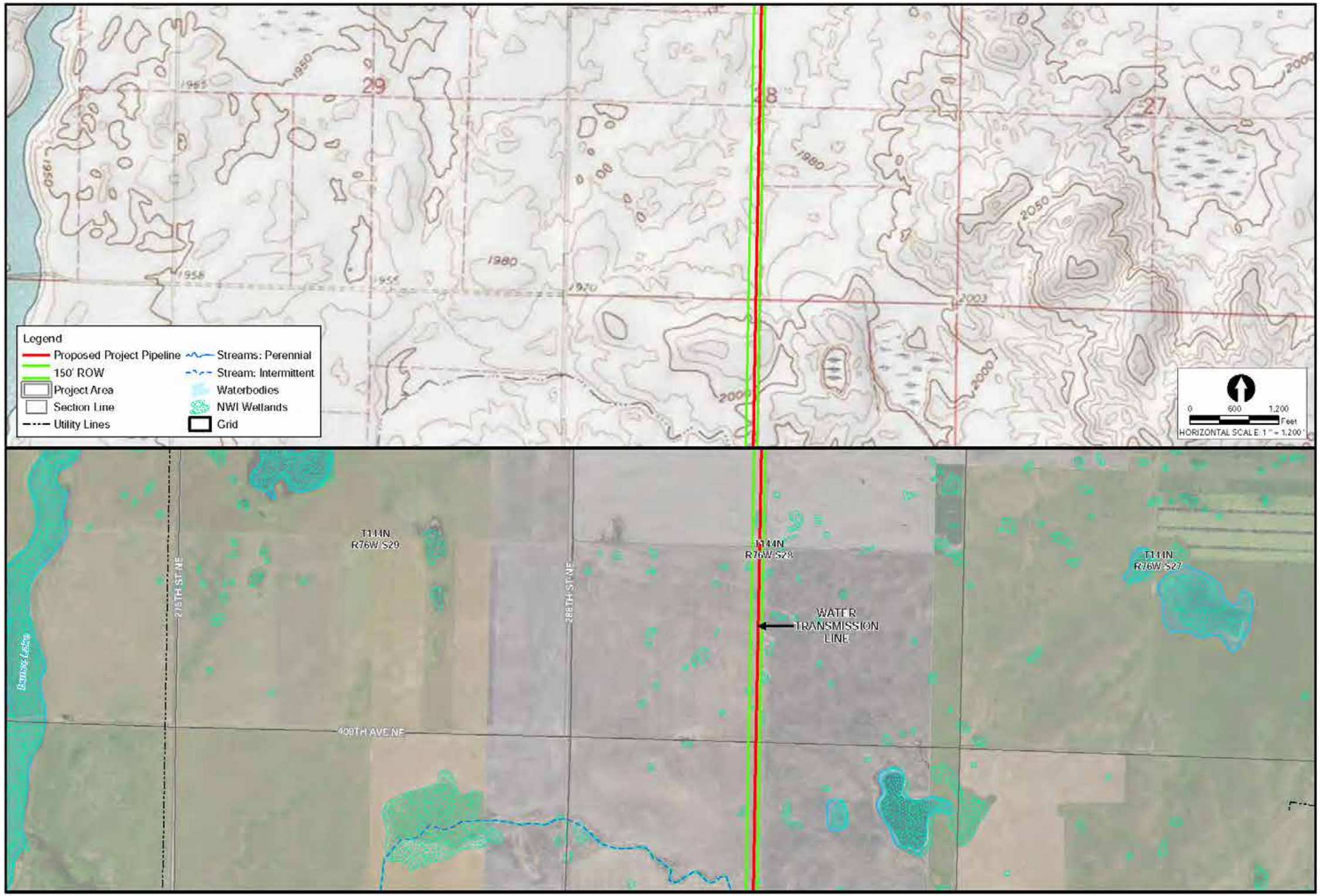

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FIGURE NO. B6

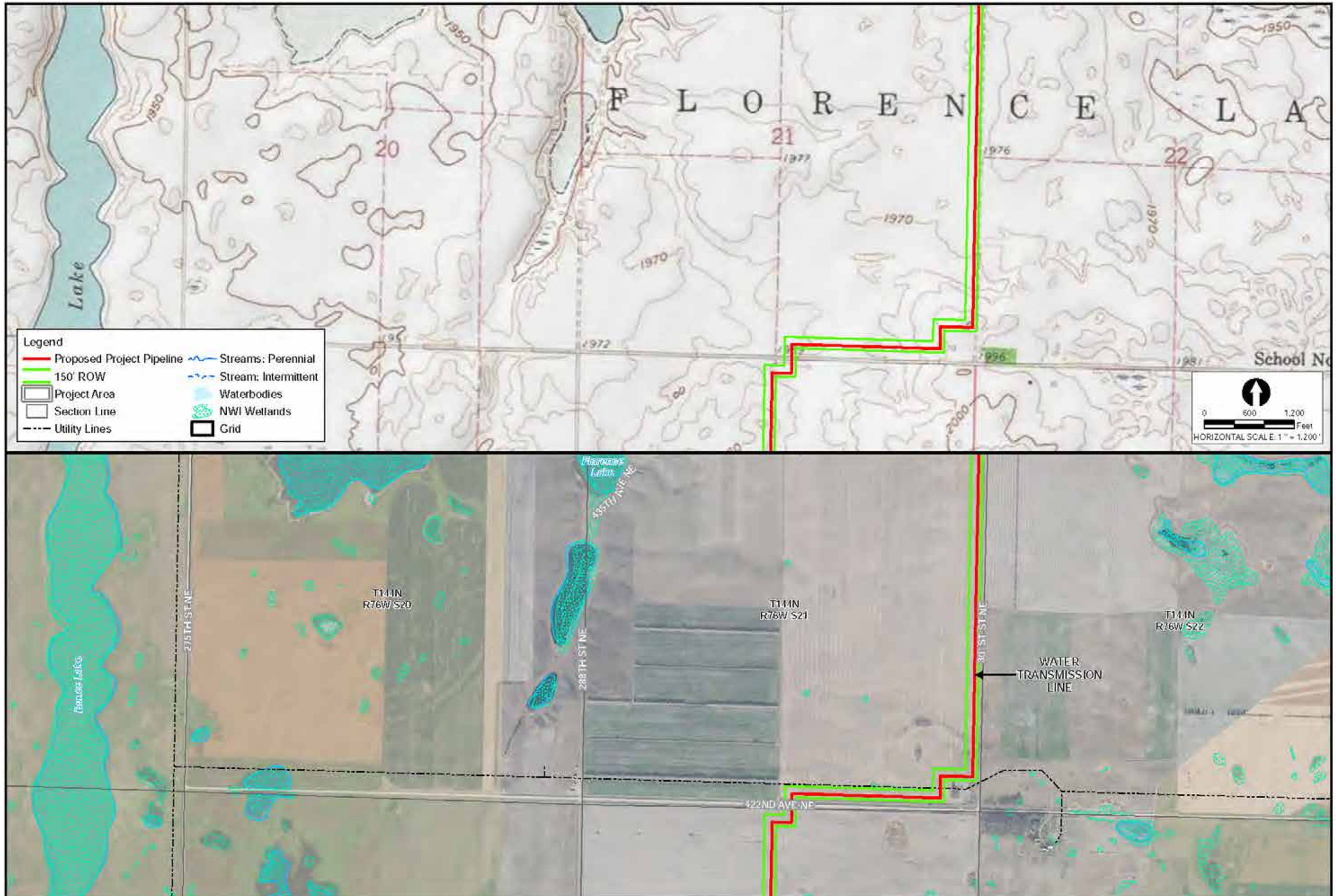

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FIGURE NO. B7

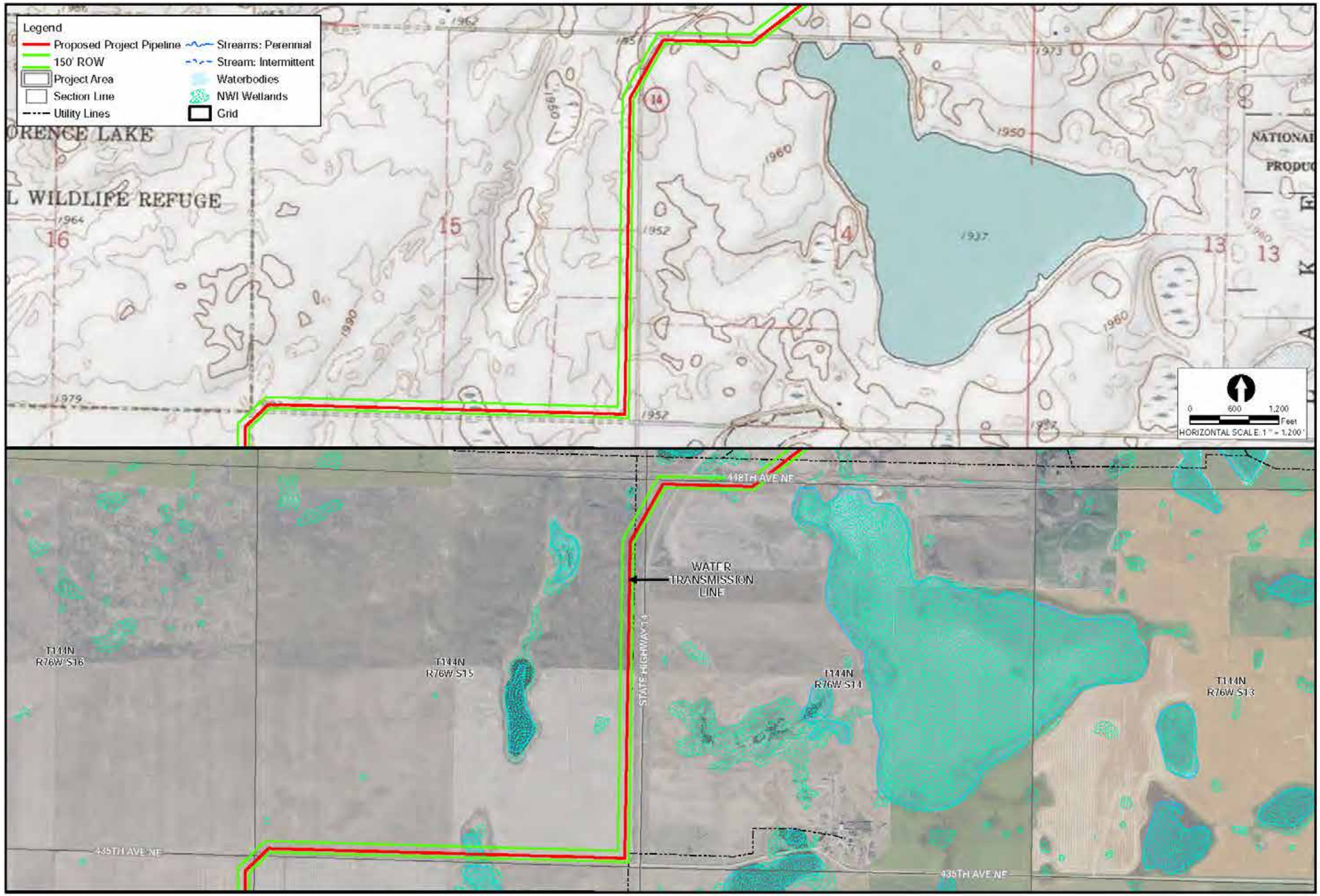

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FIGURE NO. B8

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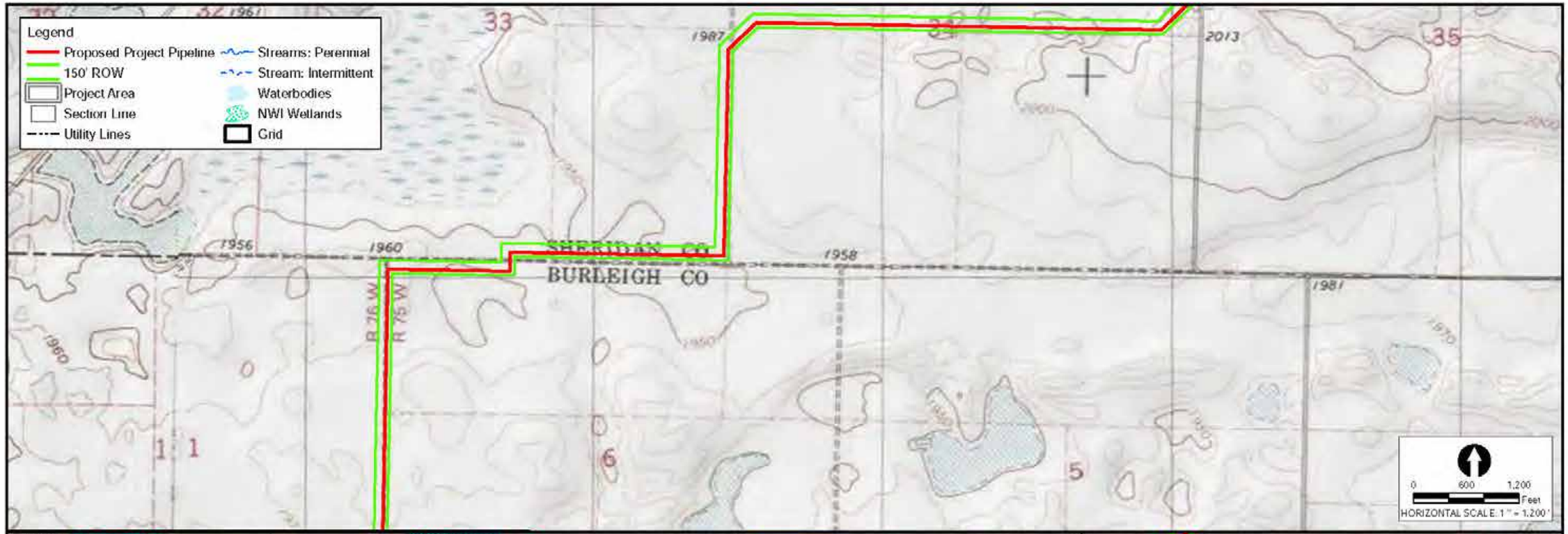
FIGURE NO. B9



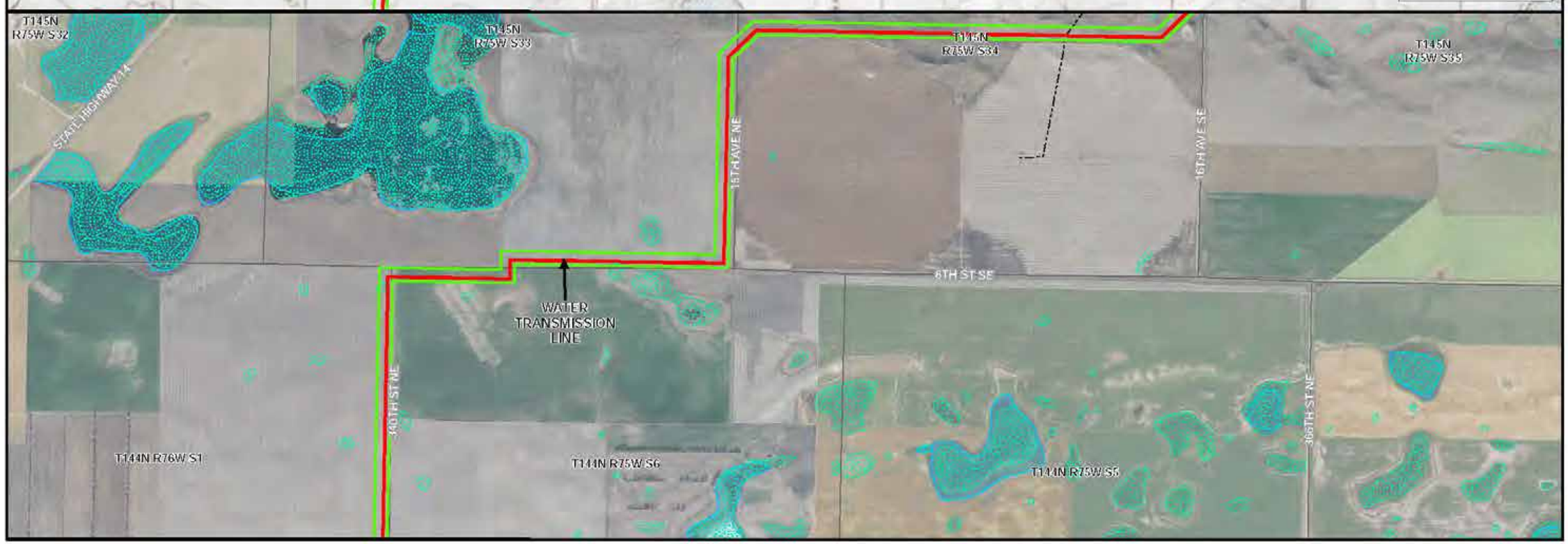


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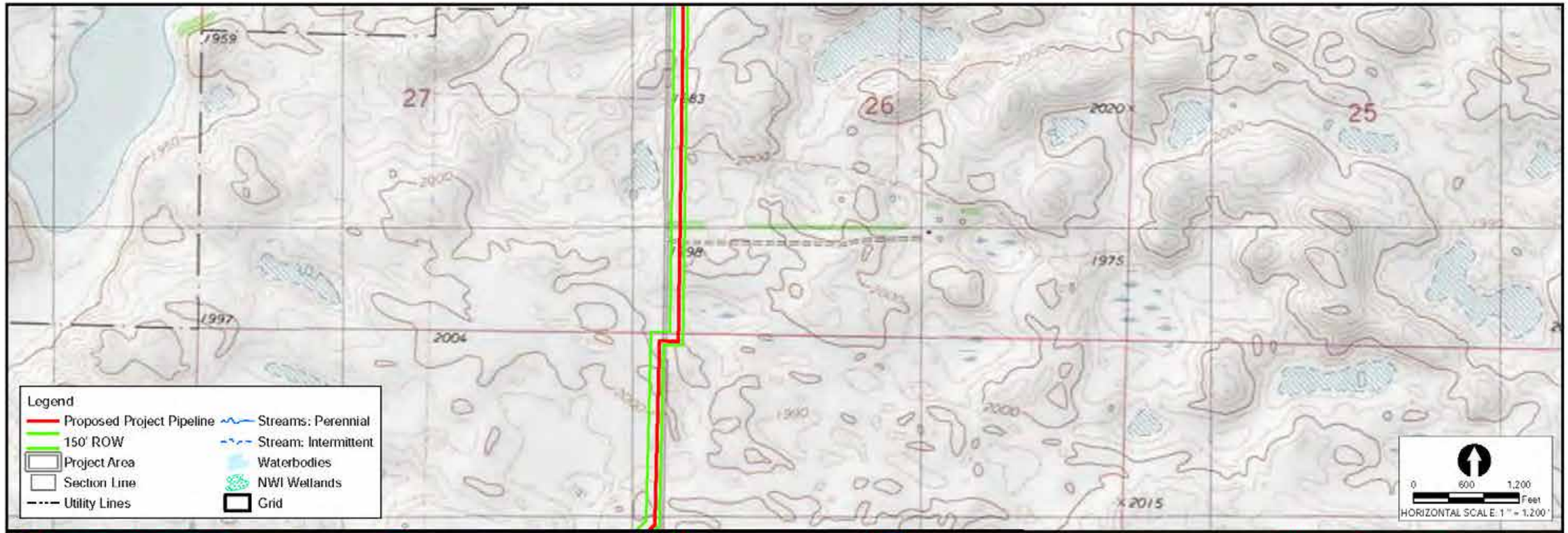
FIGURE NO. B10



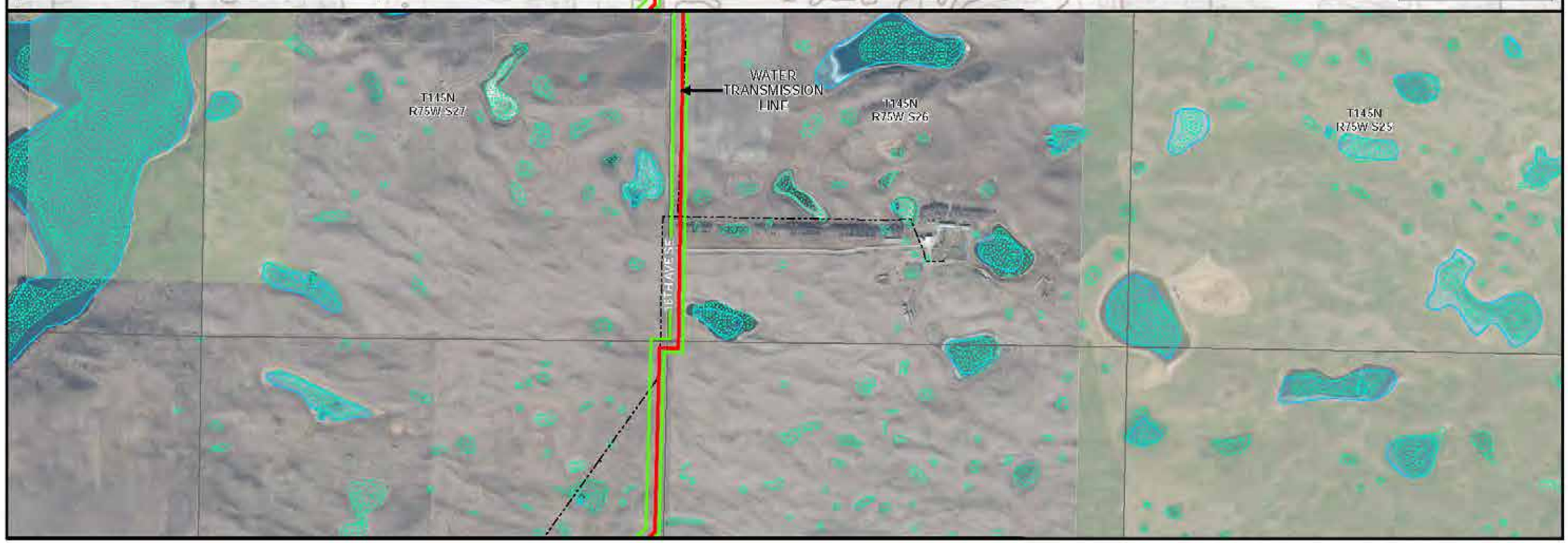


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FIGURE NO. B11

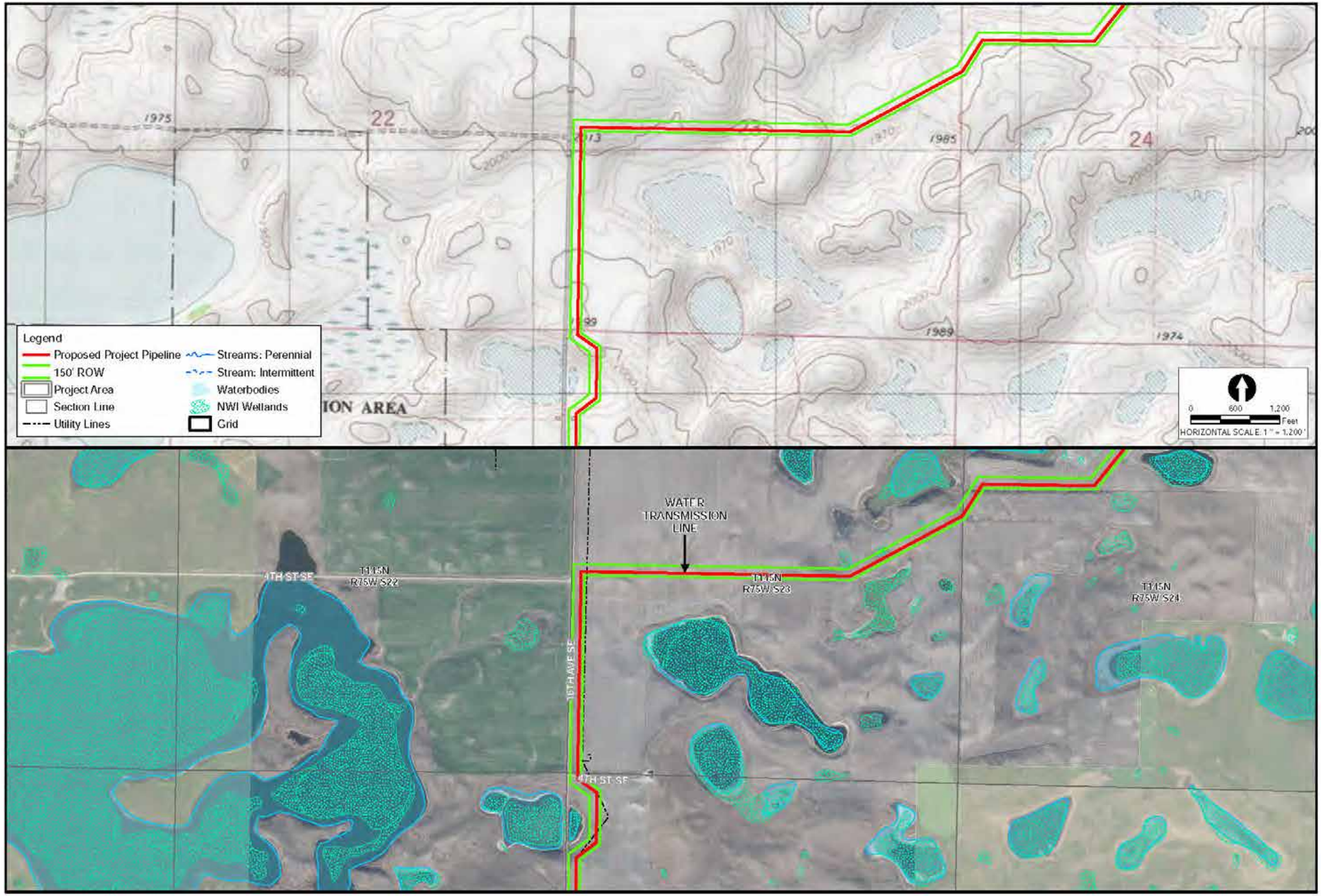

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FIGURE NO. B12

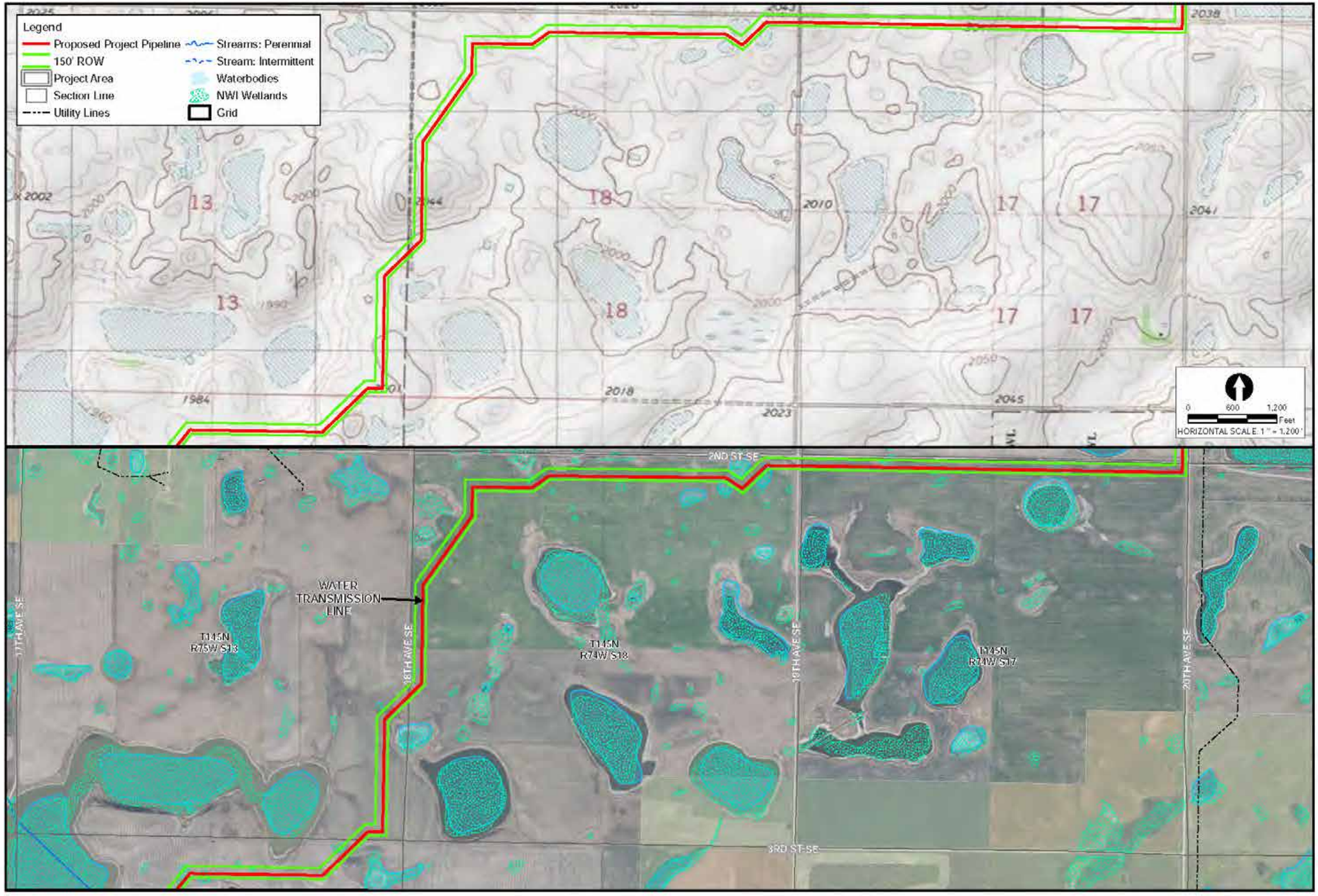

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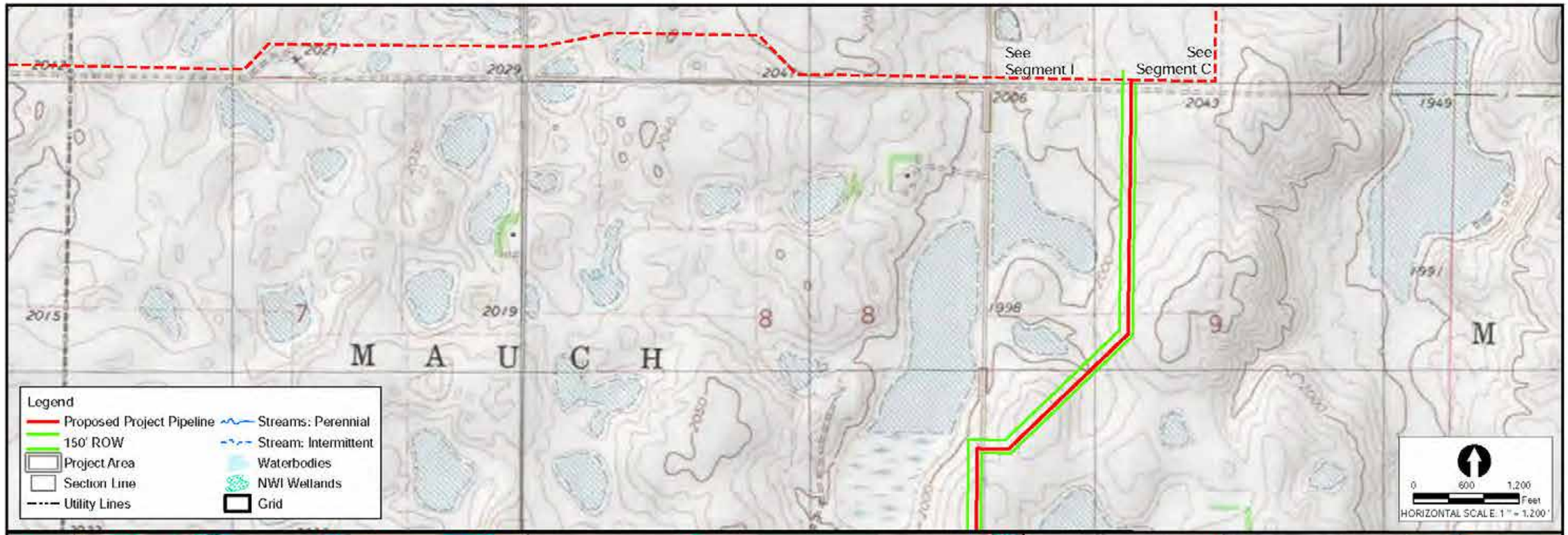
FIGURE NO. B13



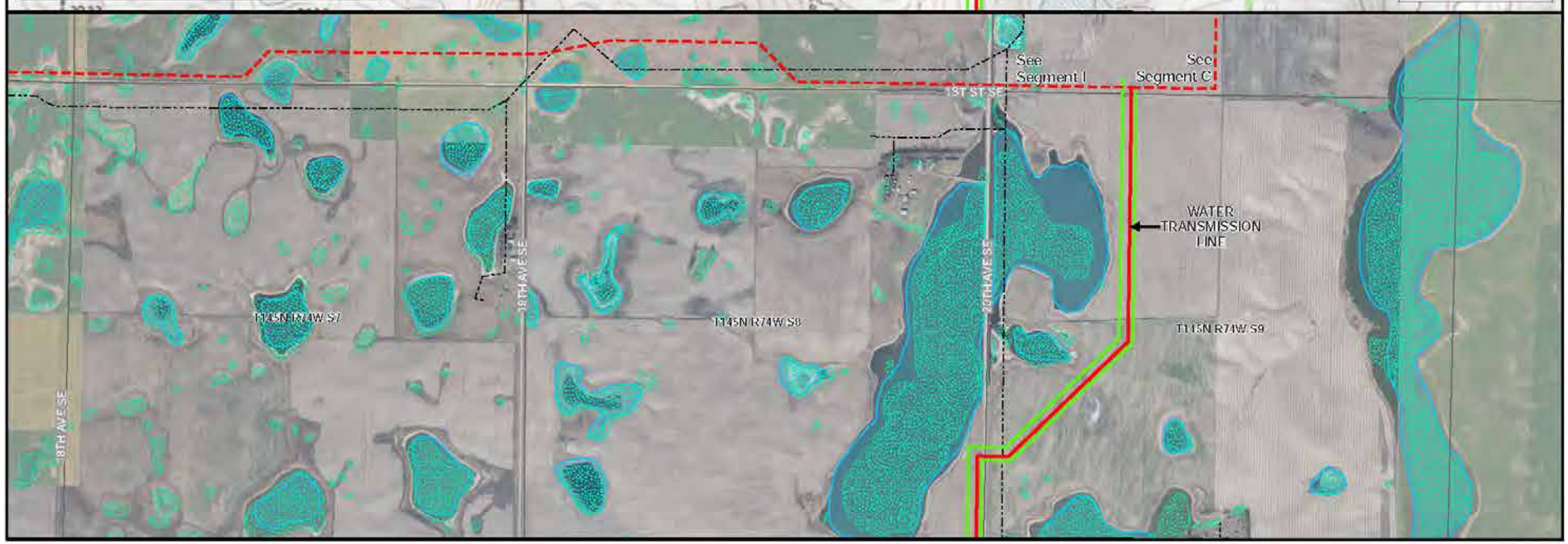


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FIGURE NO. B14

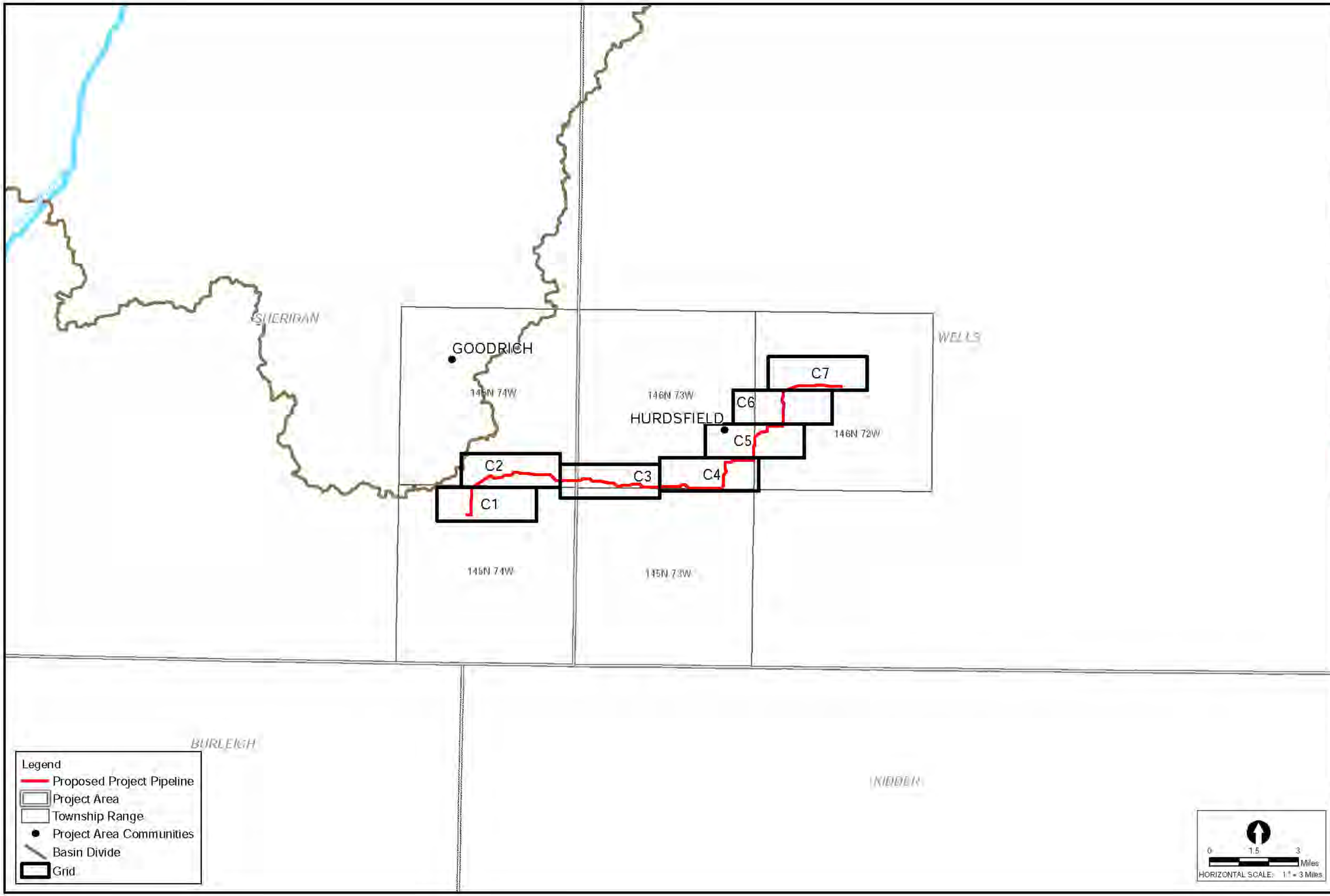

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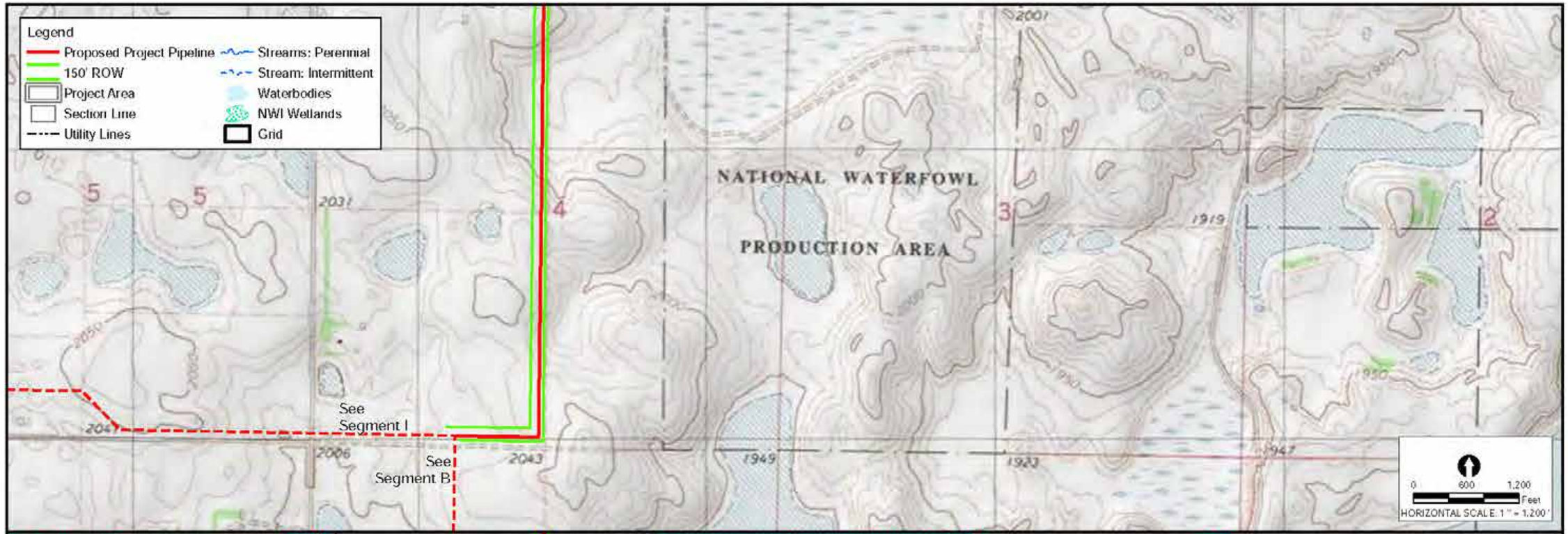
FIGURE NO. 01



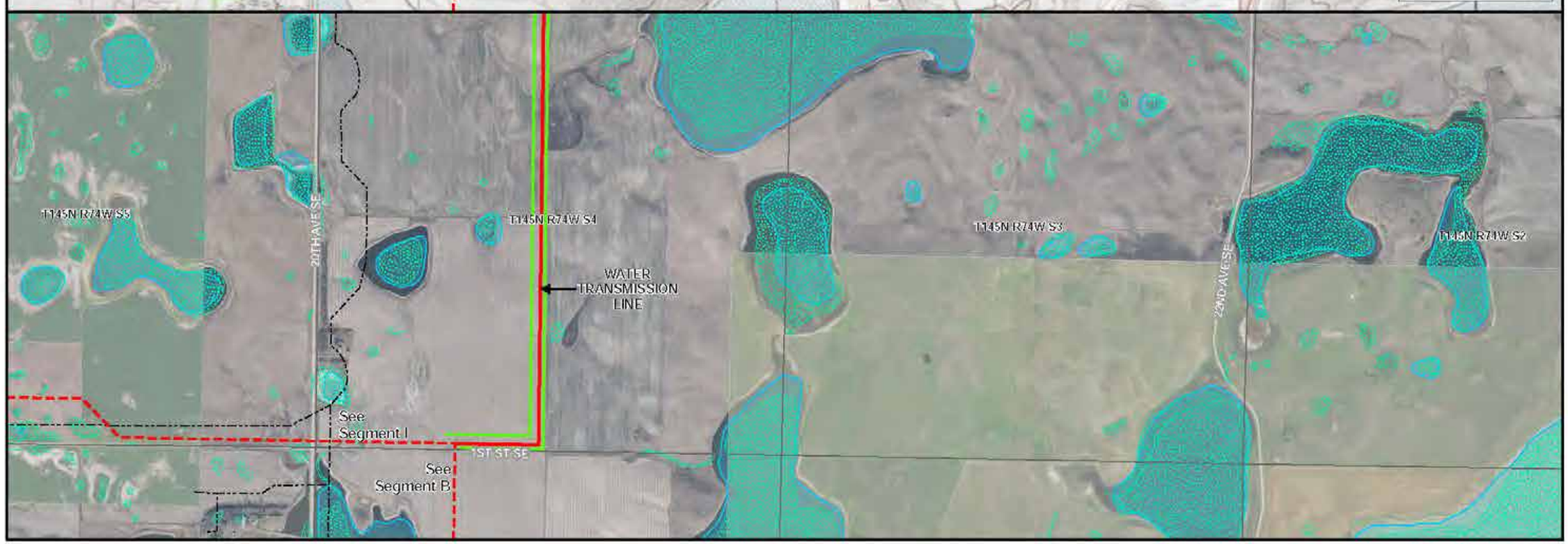


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FIGURE NO. C1

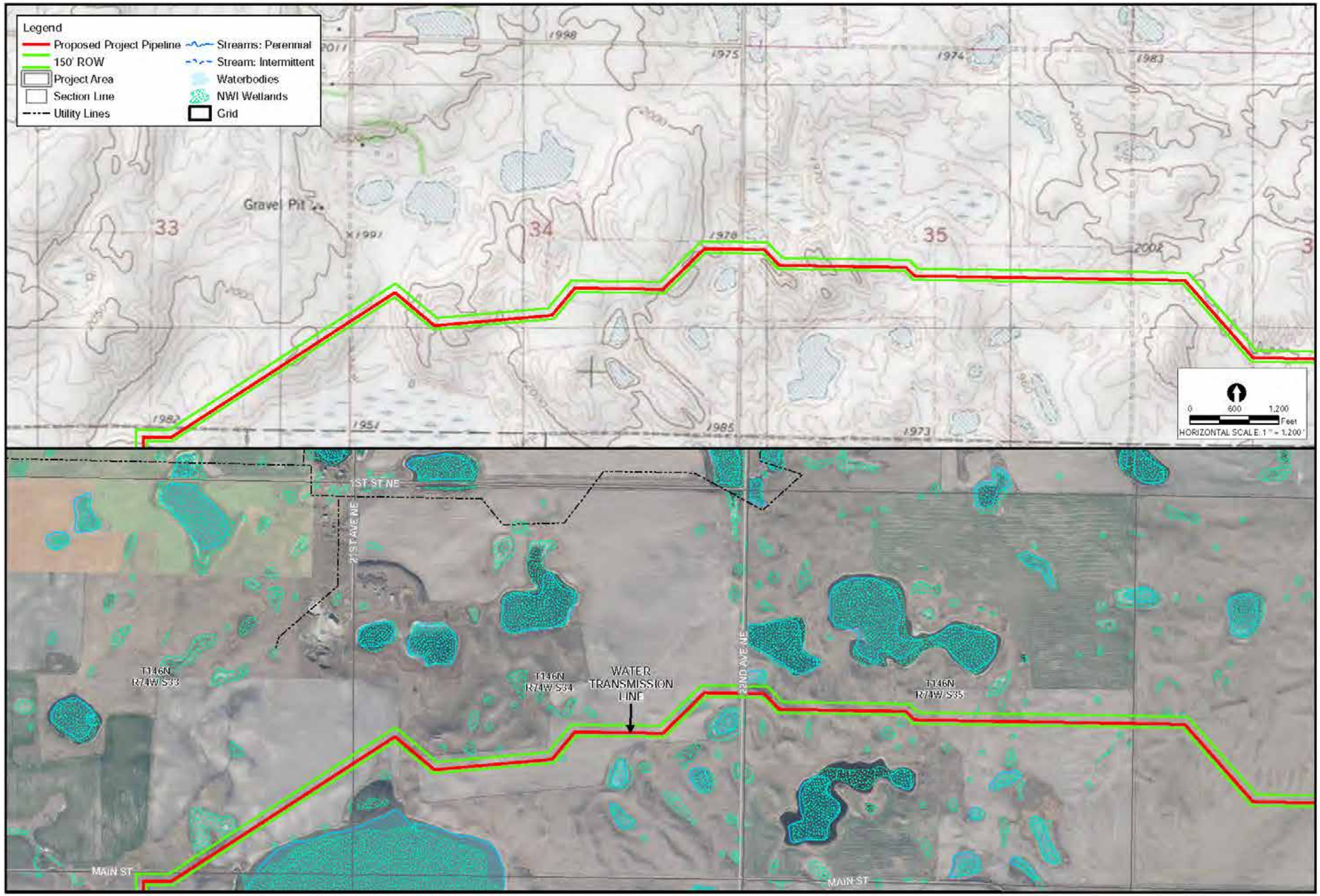

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FIGURE NO. C2

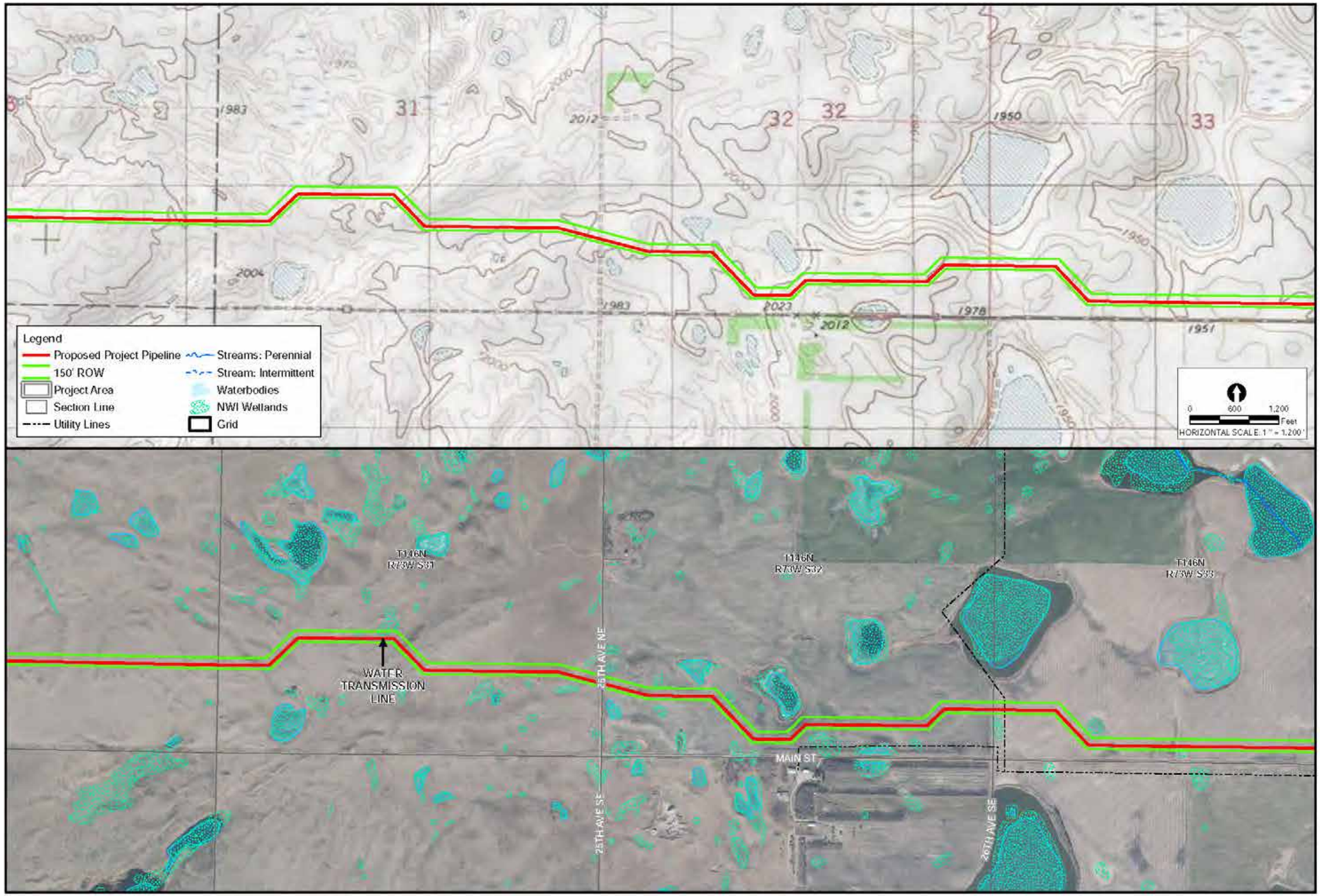

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FIGURE NO. C3

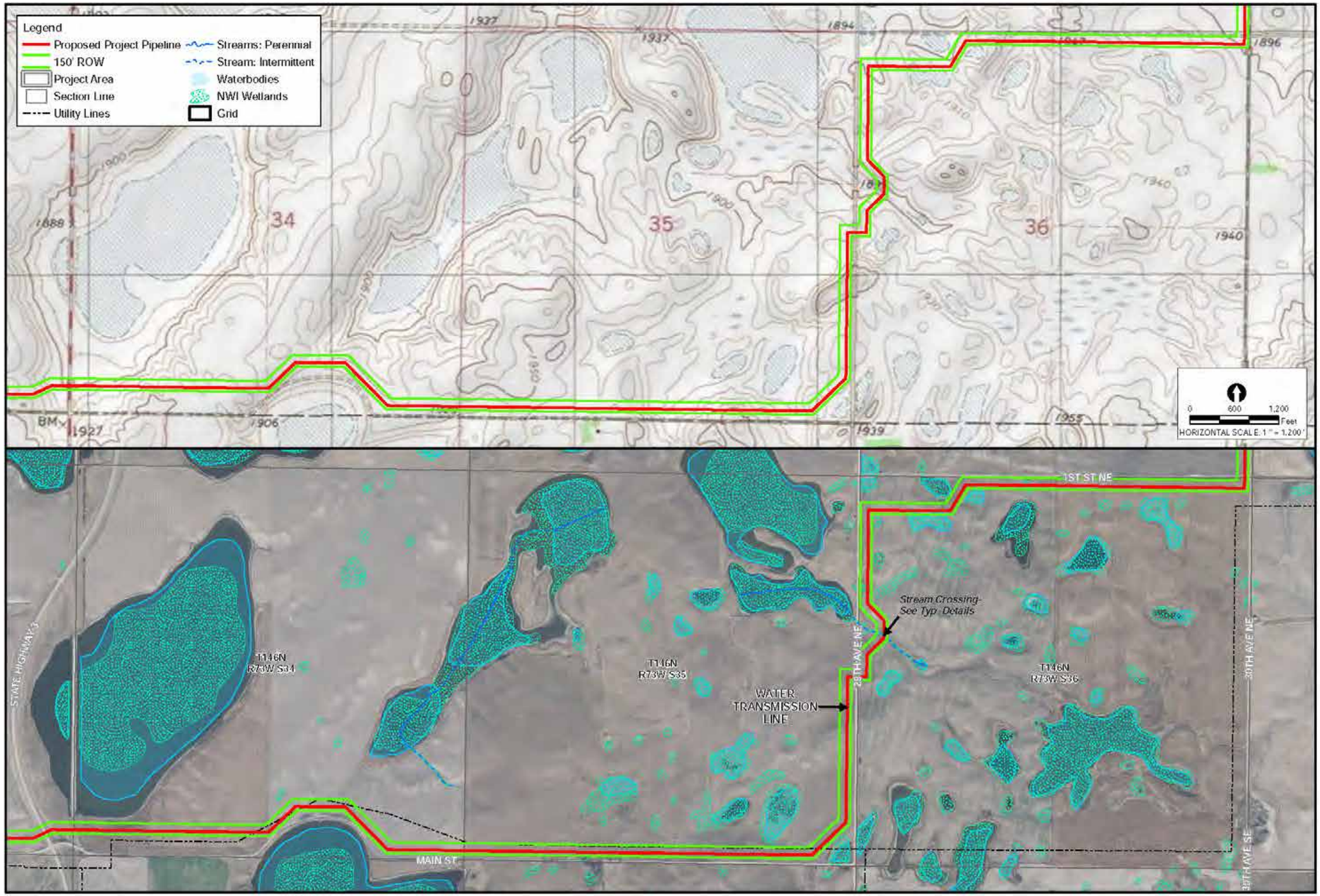

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FIGURE NO. C4

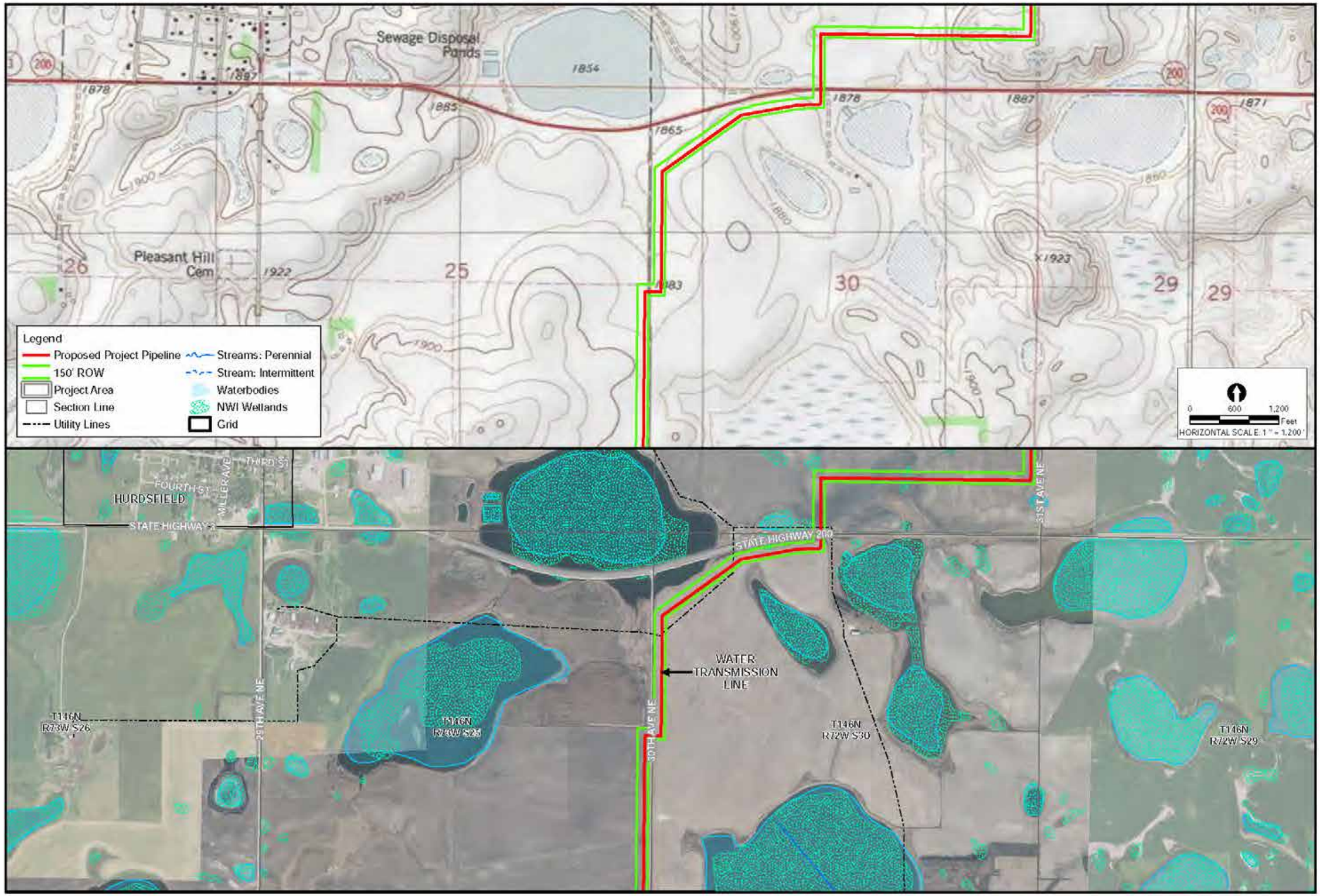

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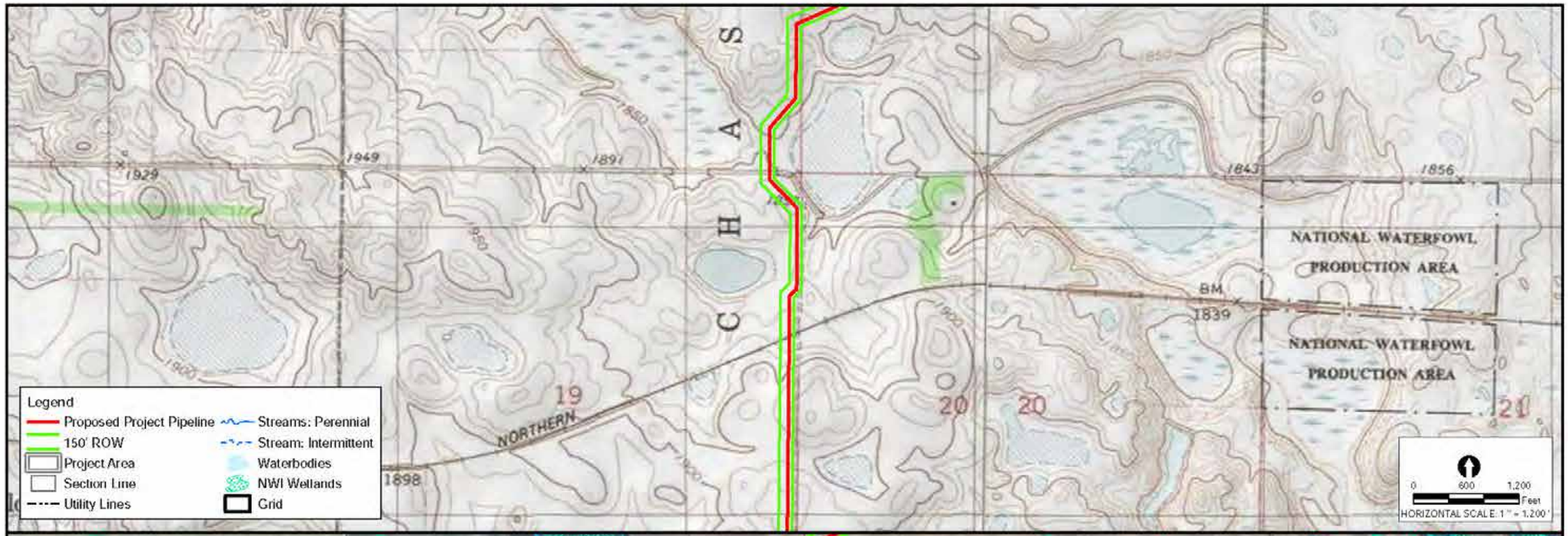
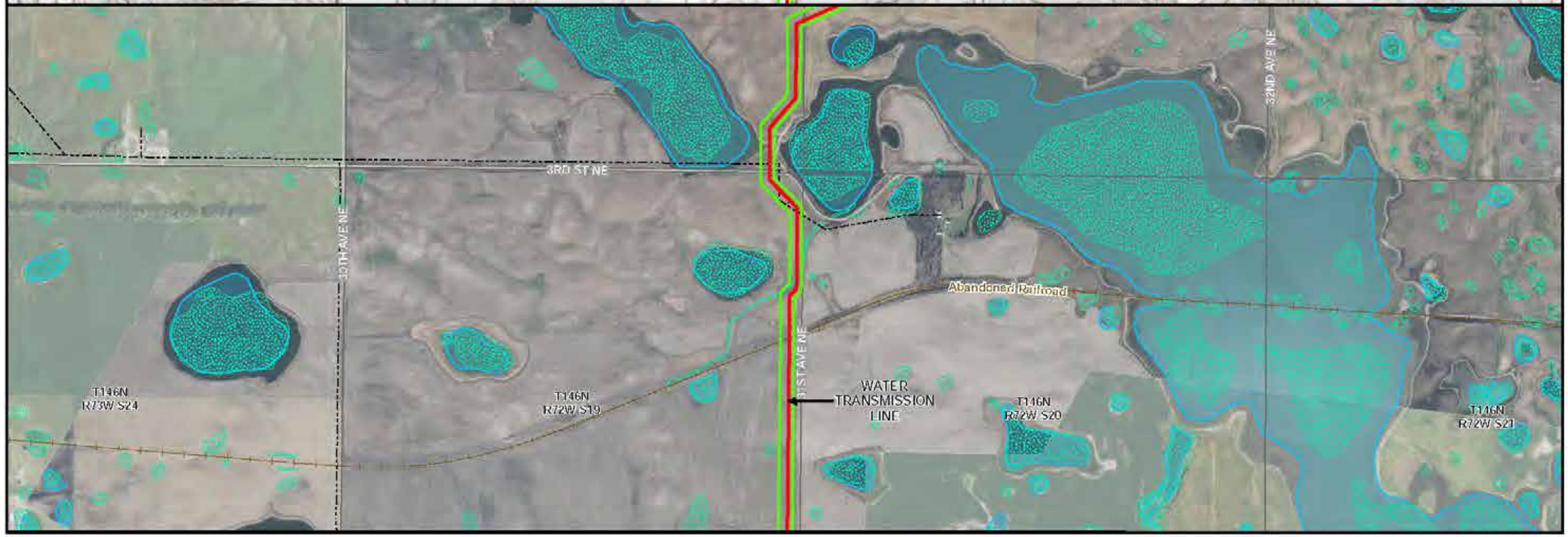
FIGURE NO. C5





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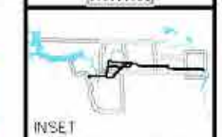

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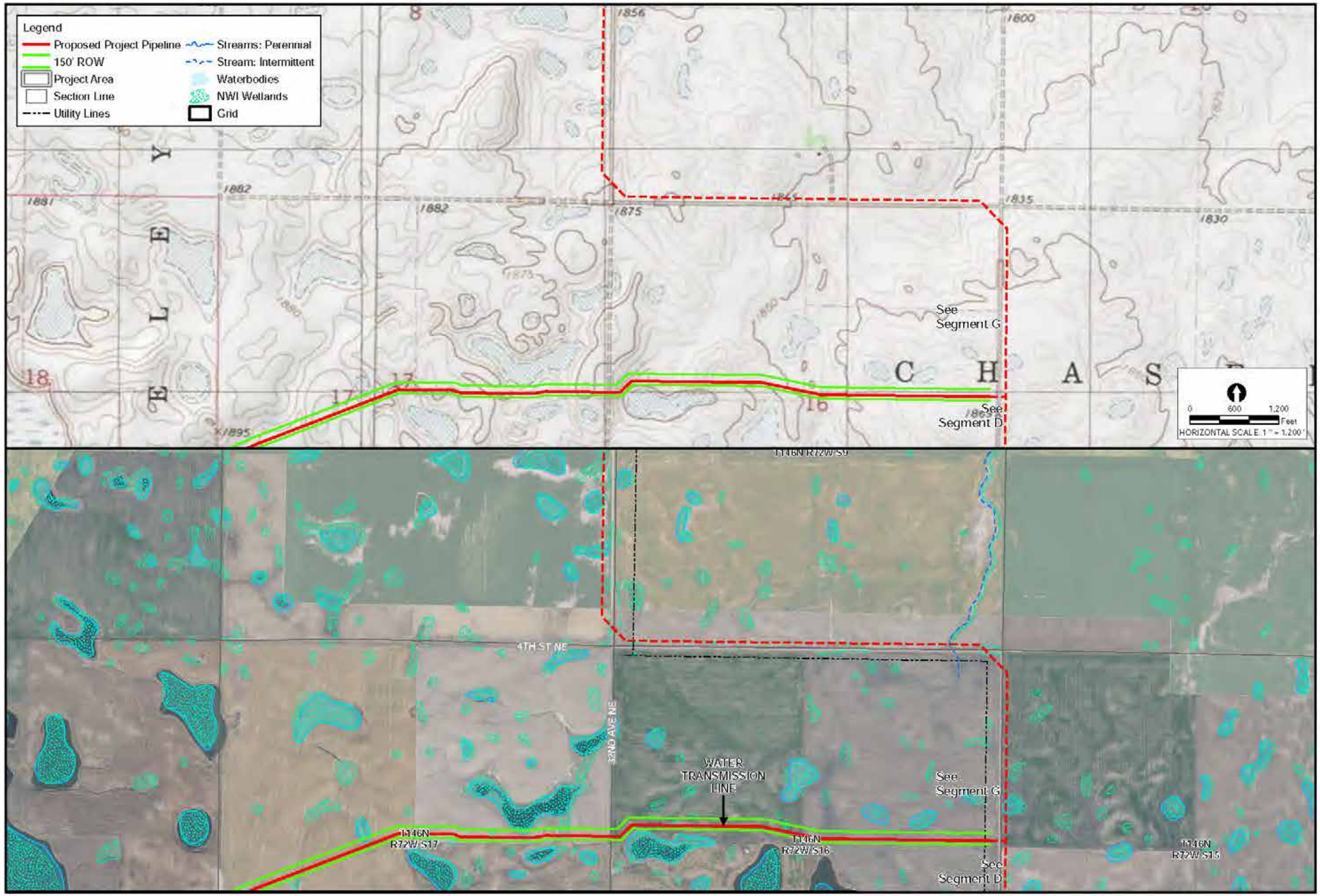

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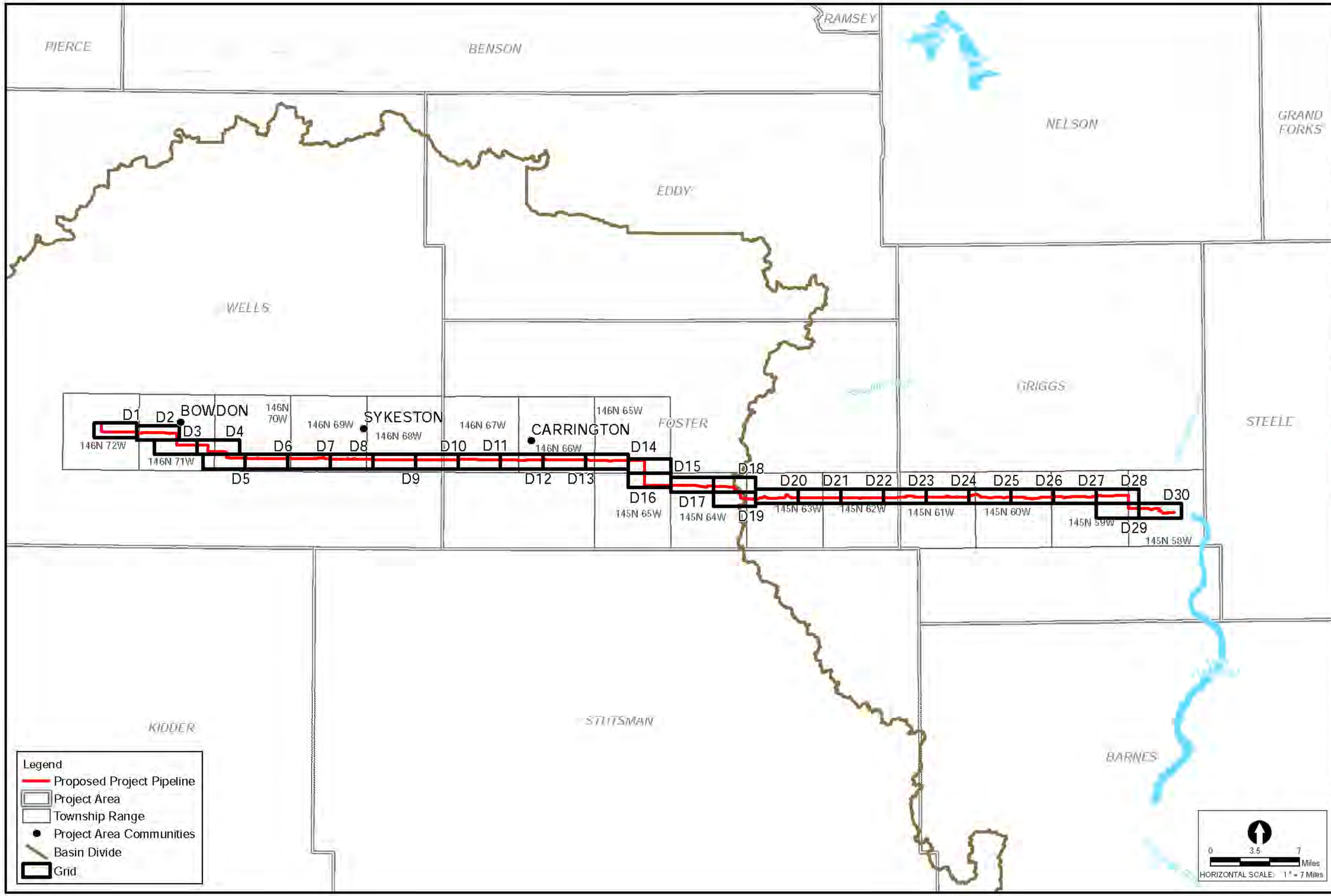
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. C7



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SCALE: AS SHOWN
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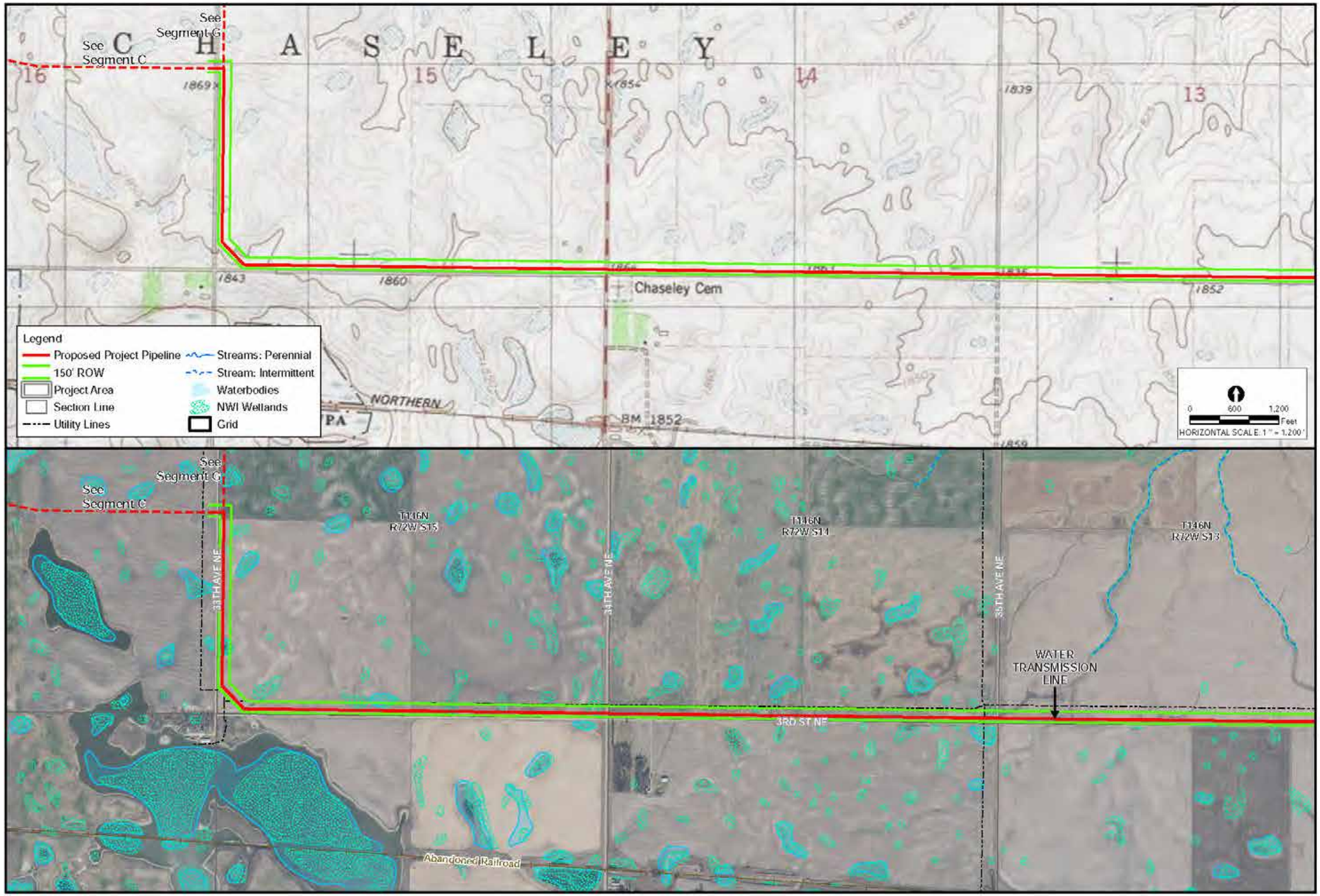
FIGURE NO. 01



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JOB NO. 00200-2019-017
FIGURE NO. D1

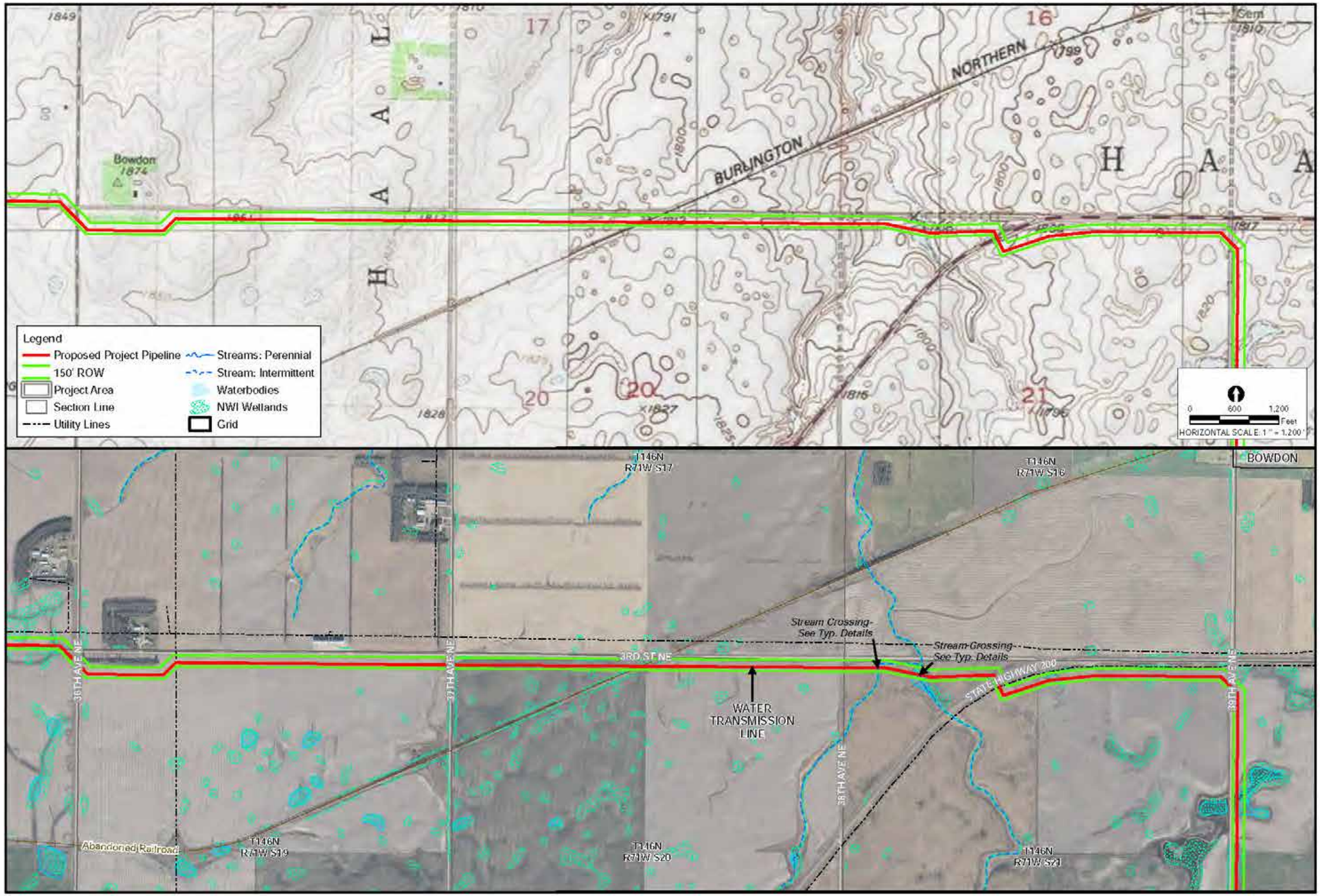

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FIGURE NO. D2

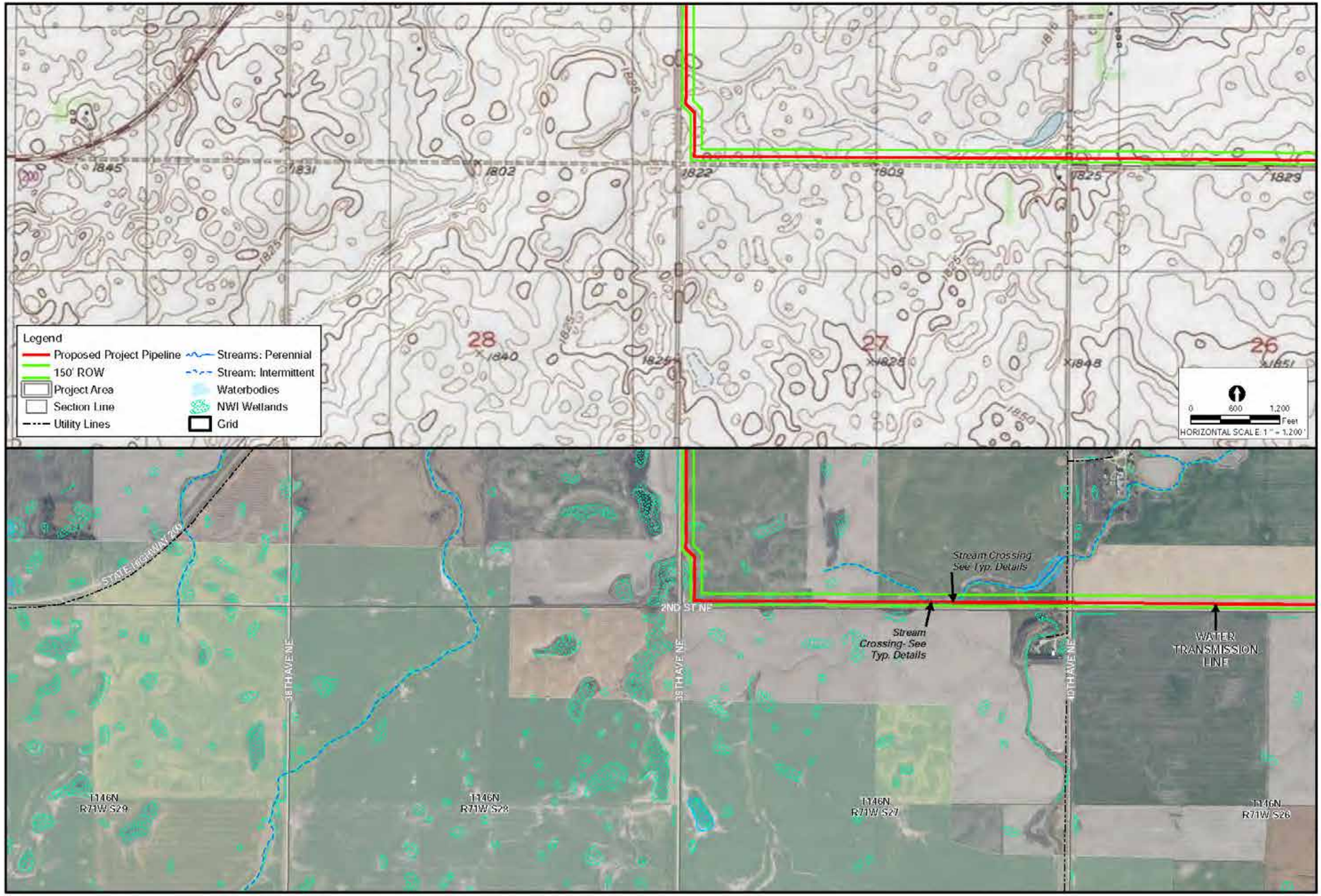

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FIGURE NO. D3

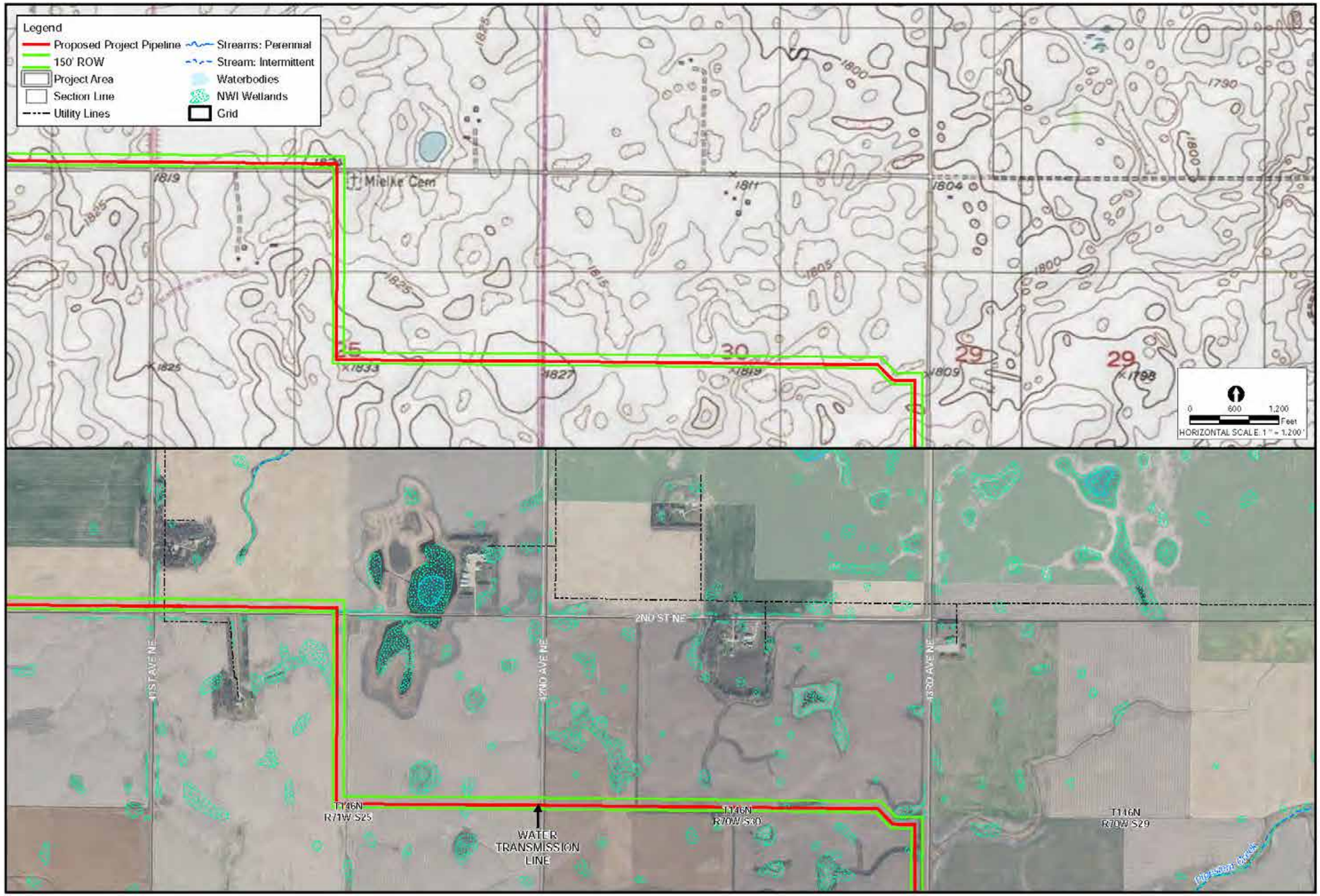

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FIGURE NO: D4

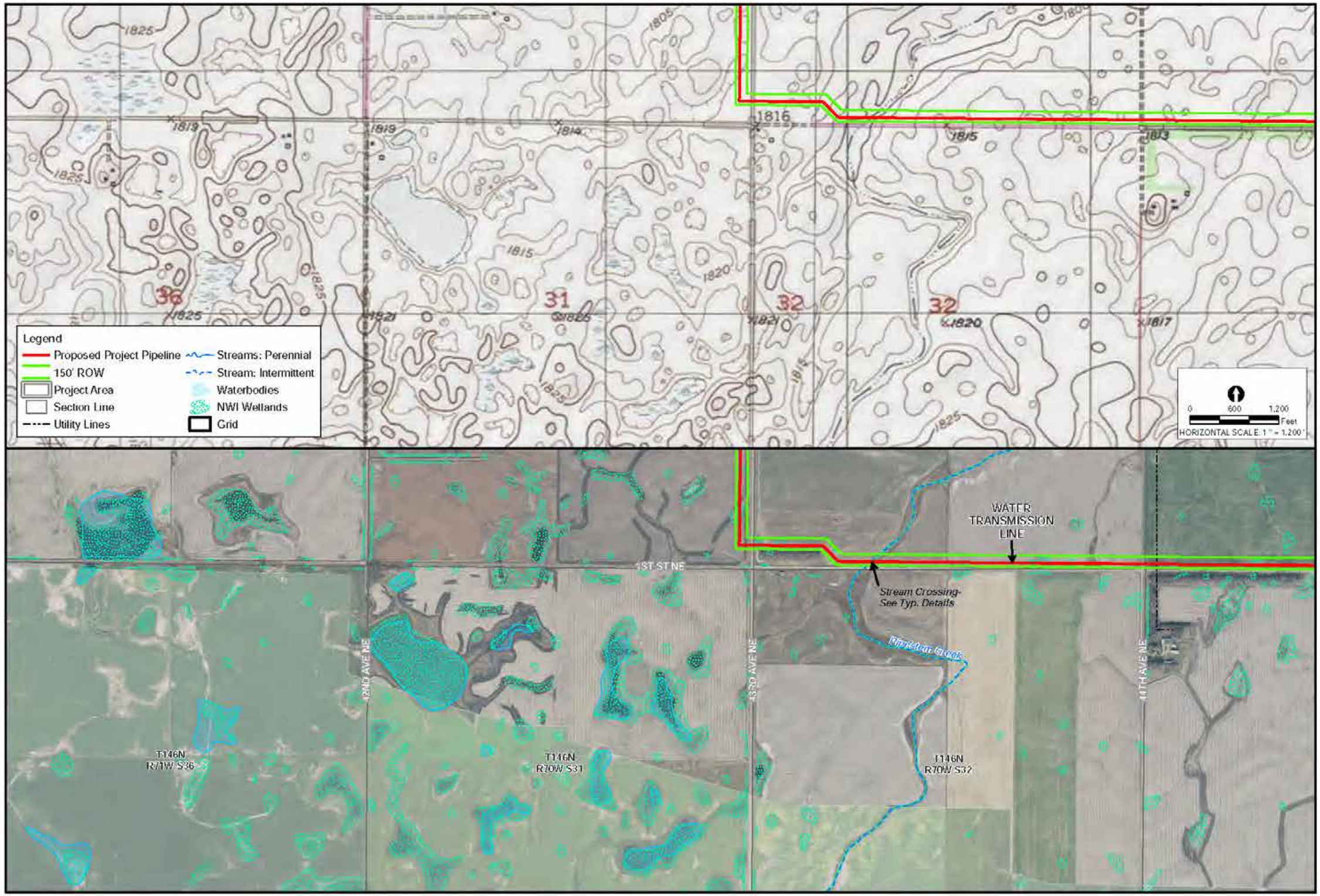

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FIGURE NO. D5

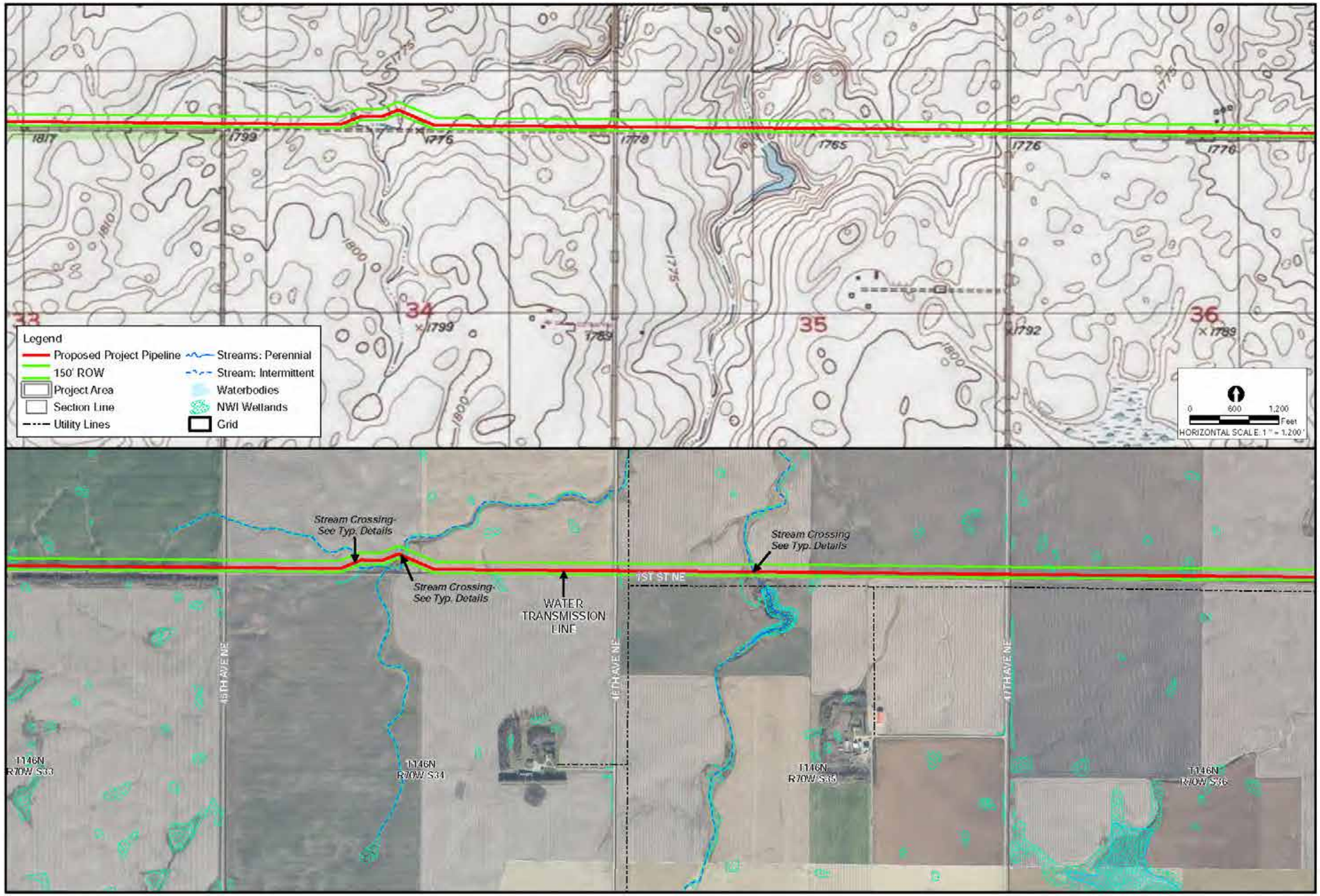

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FIGURE NO. D6

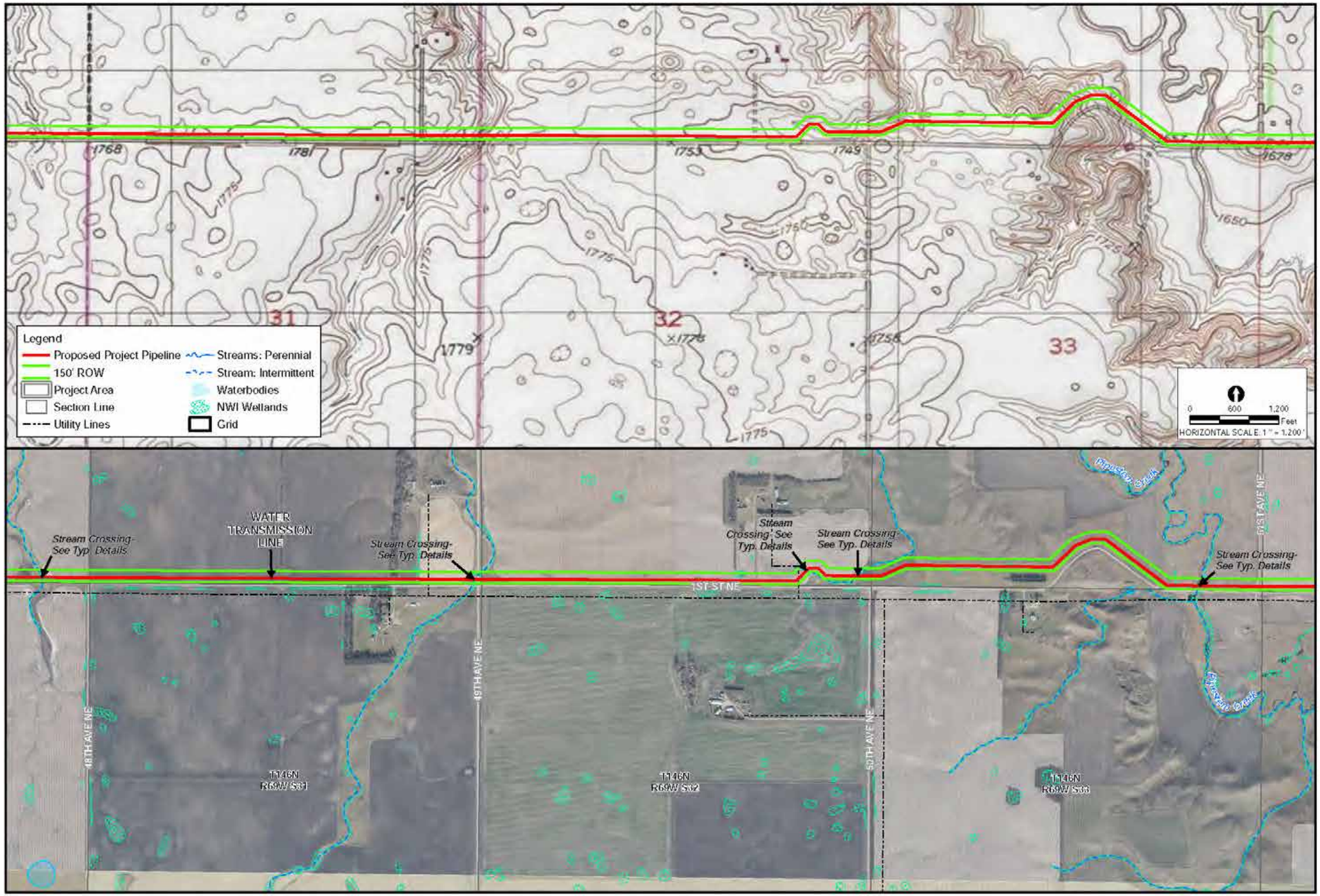

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FIGURE NO. D7

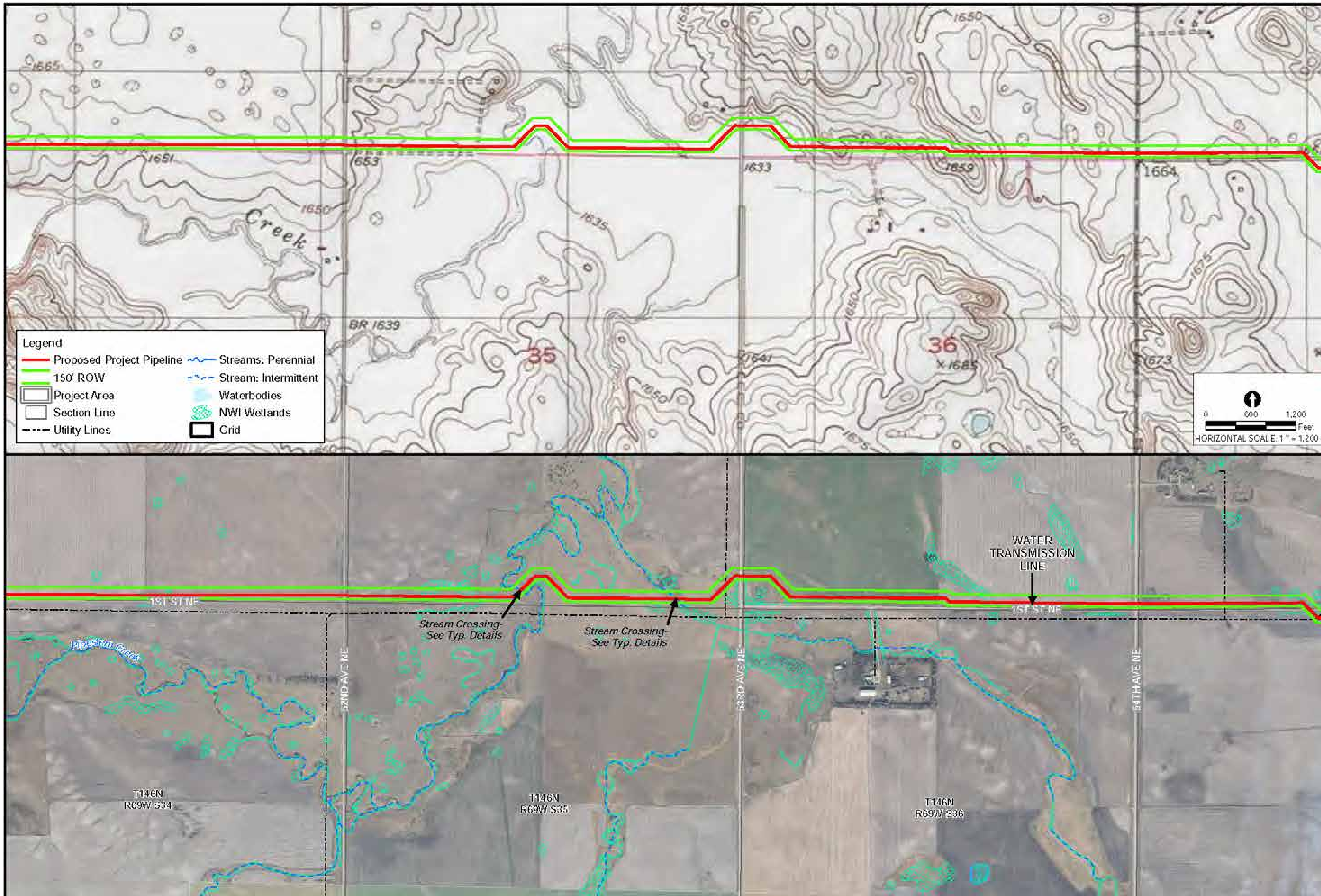

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FIGURE NO. D8

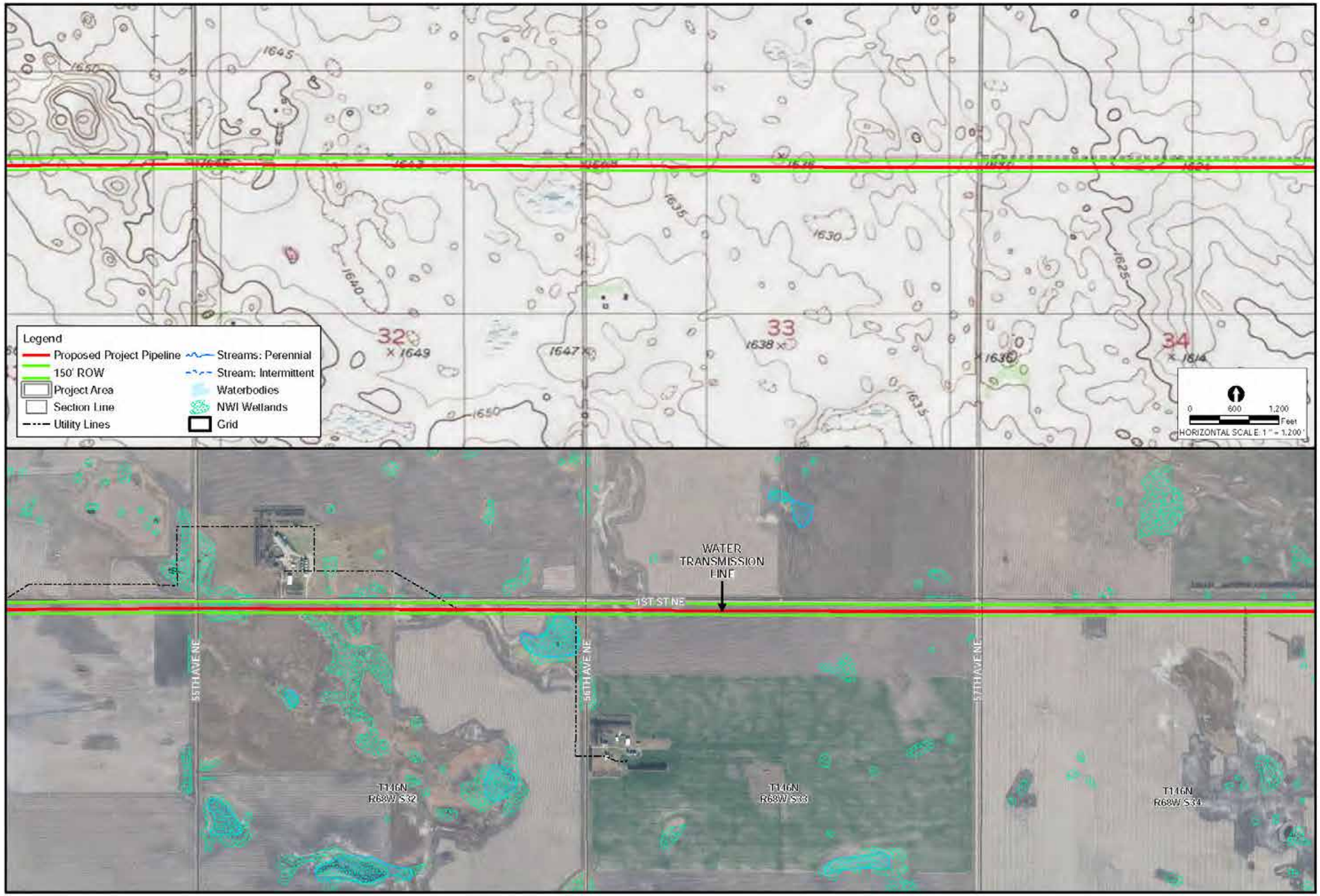

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FIGURE NO. D9

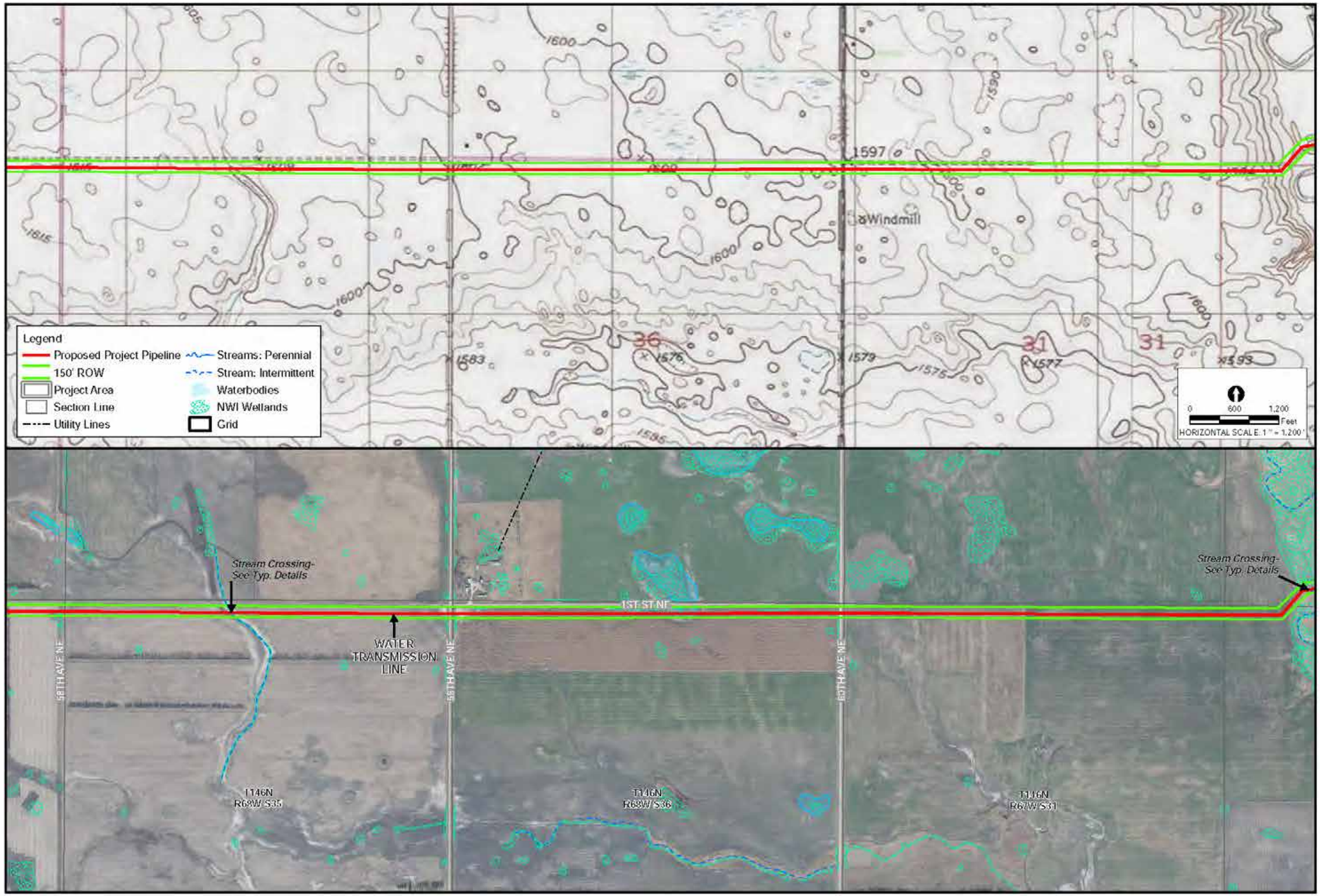

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FIGURE NO. D10

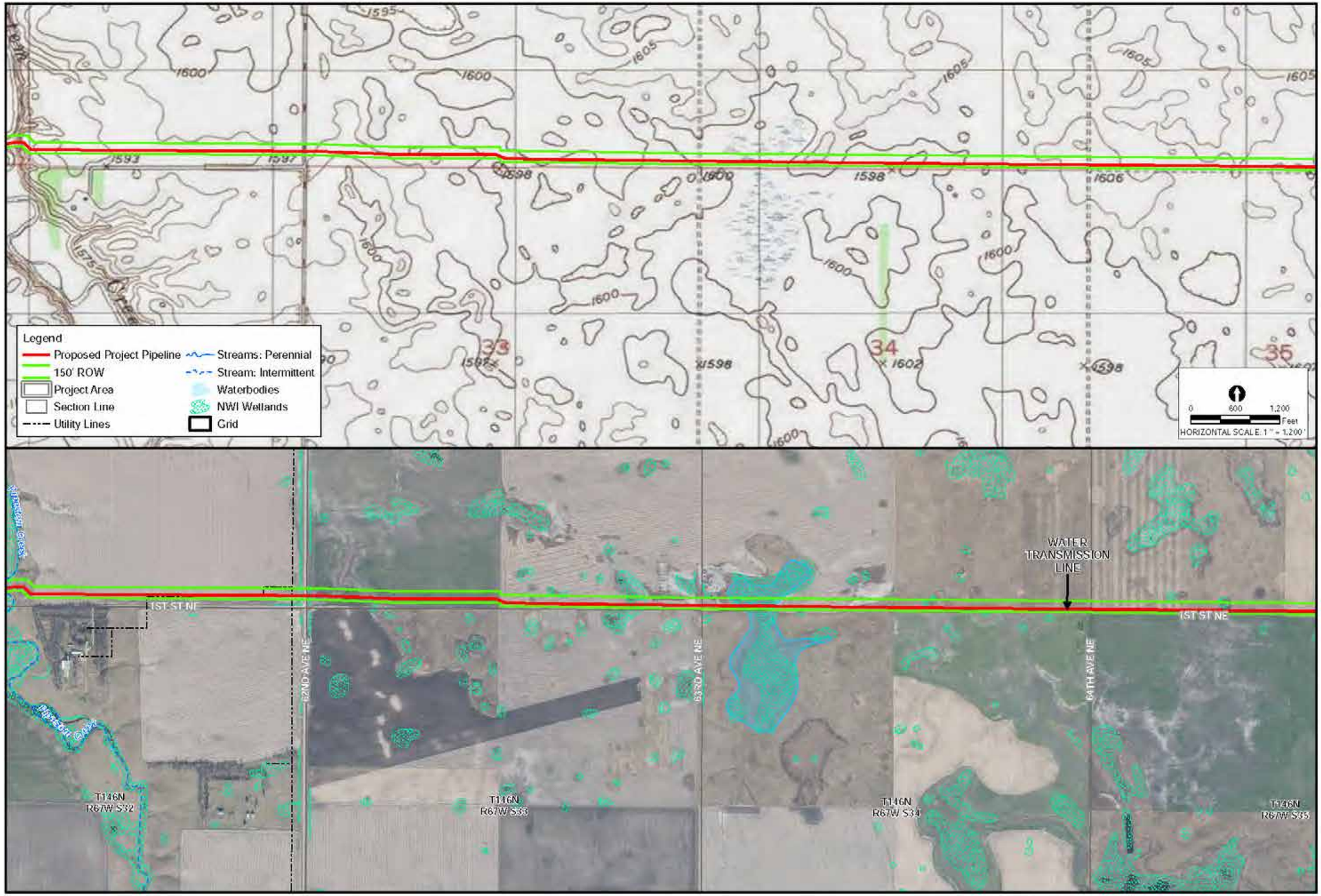

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FIGURE NO. D11

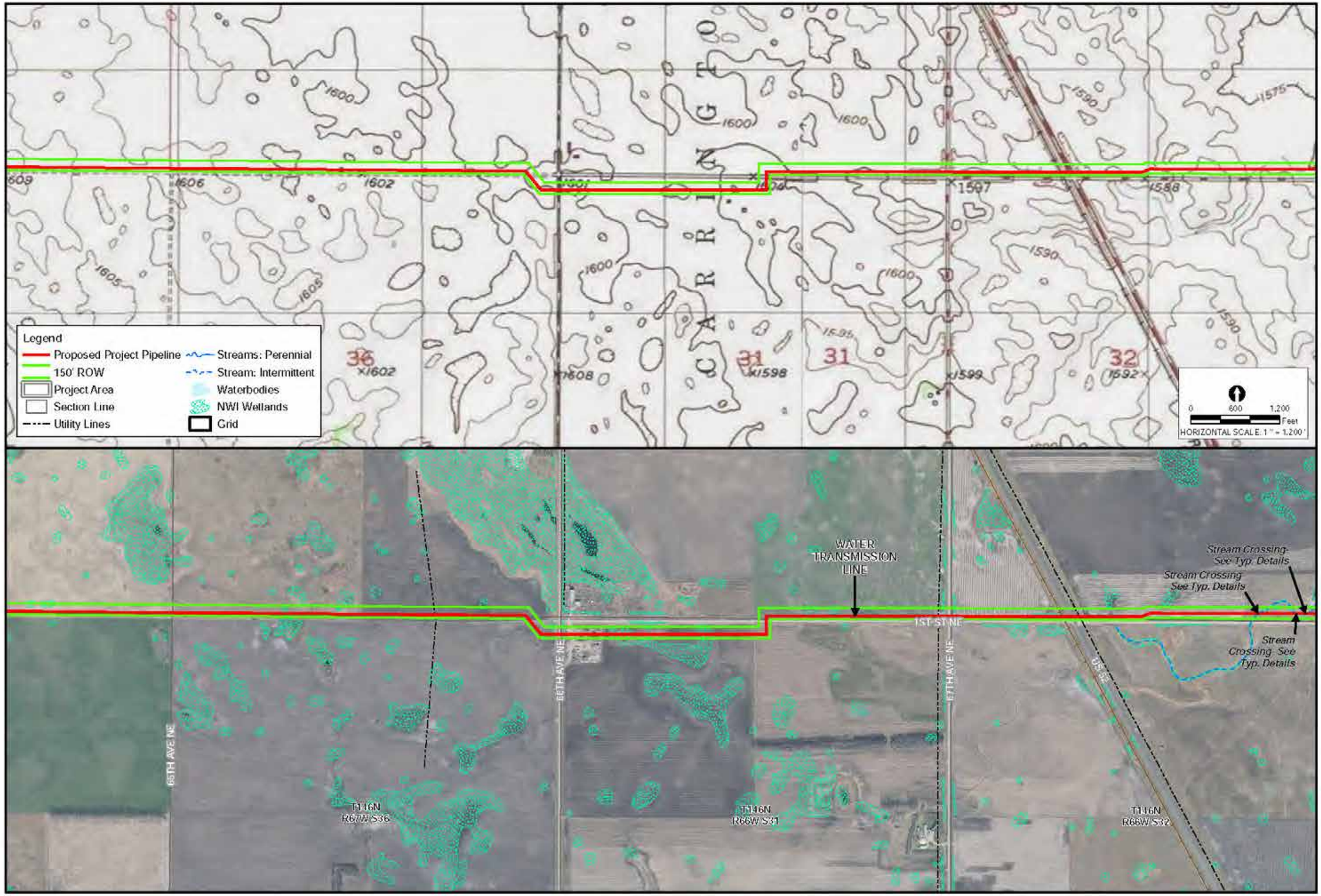

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FIGURE NO. D12

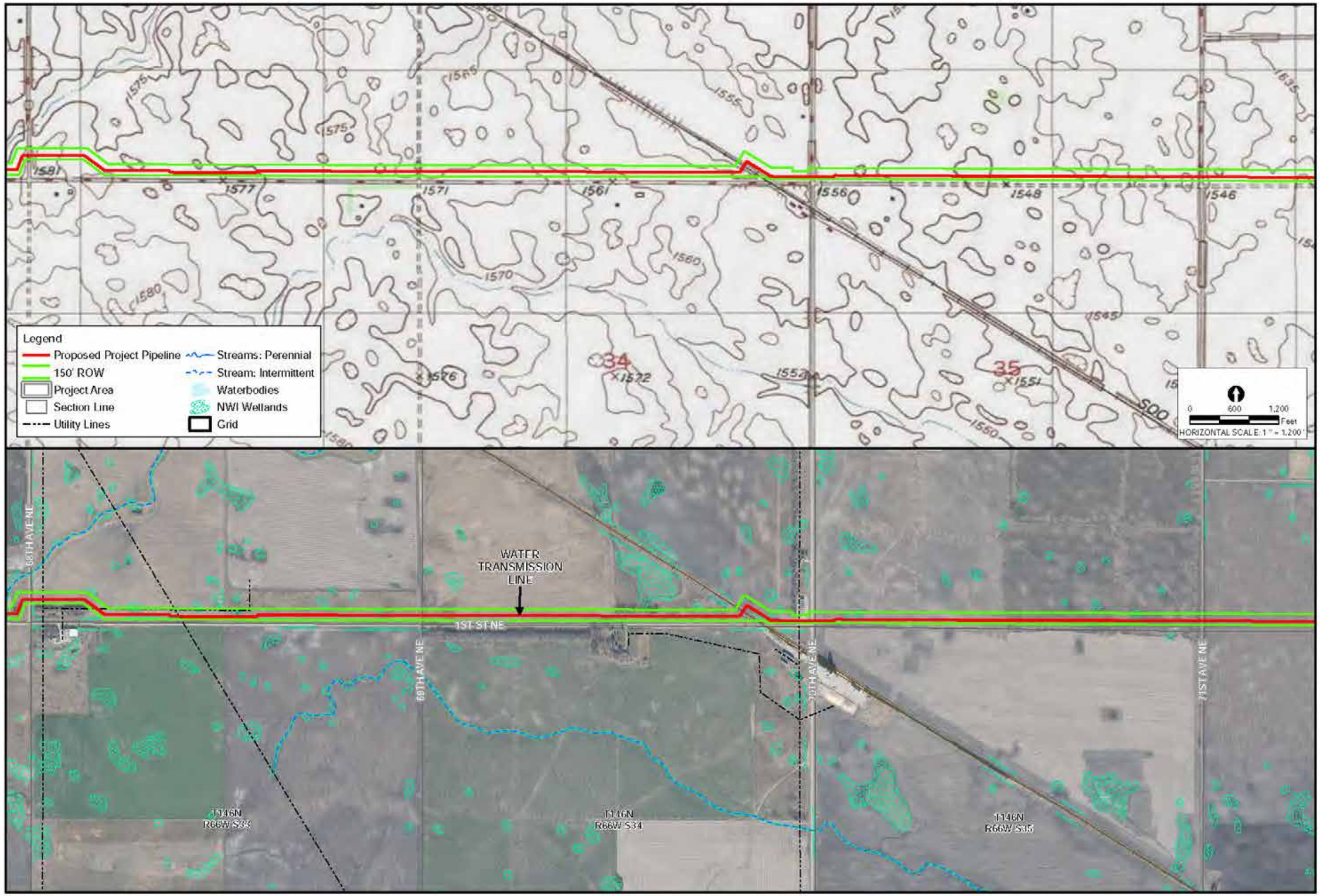

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FIGURE NO. D13

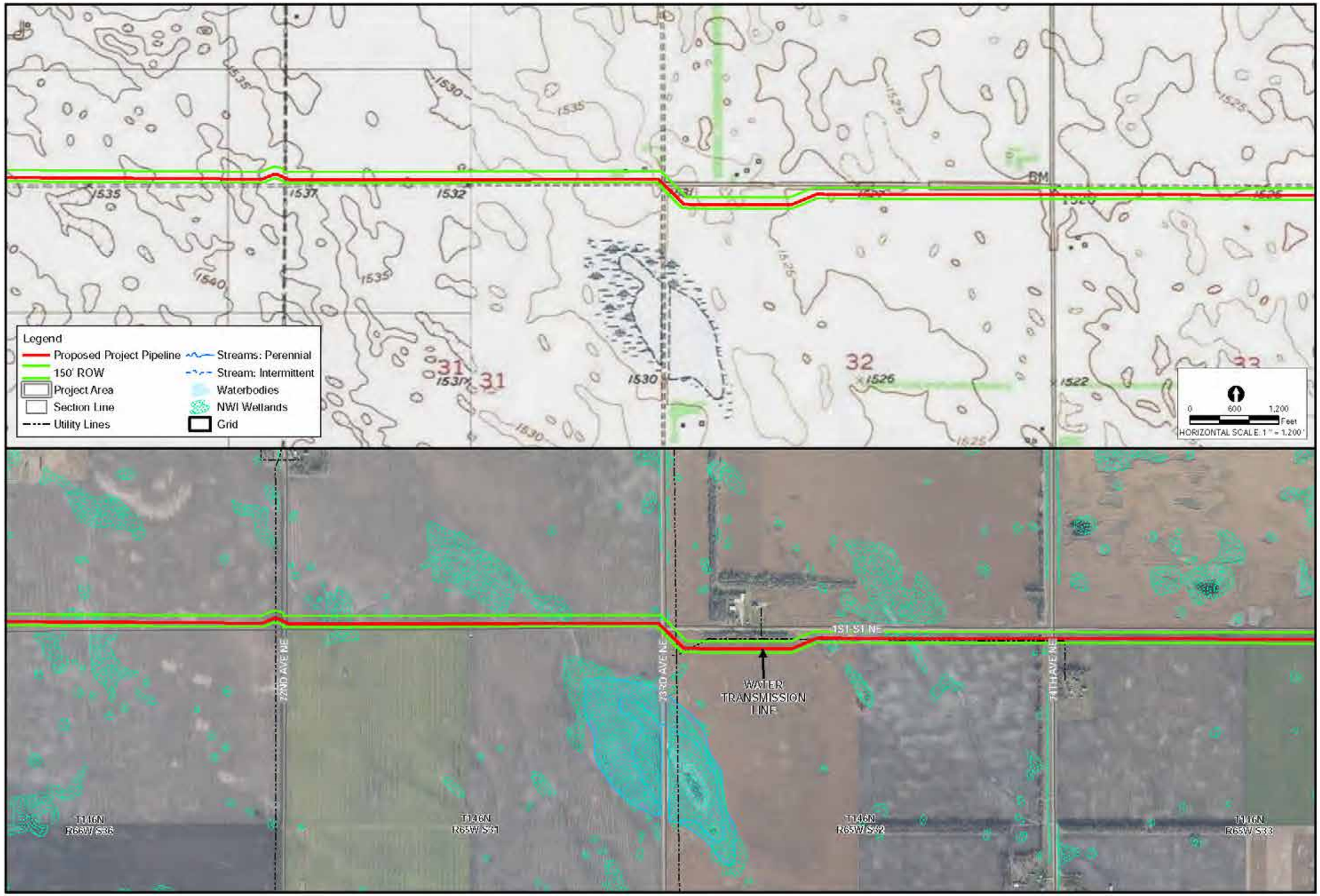

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FIGURE NO. D14

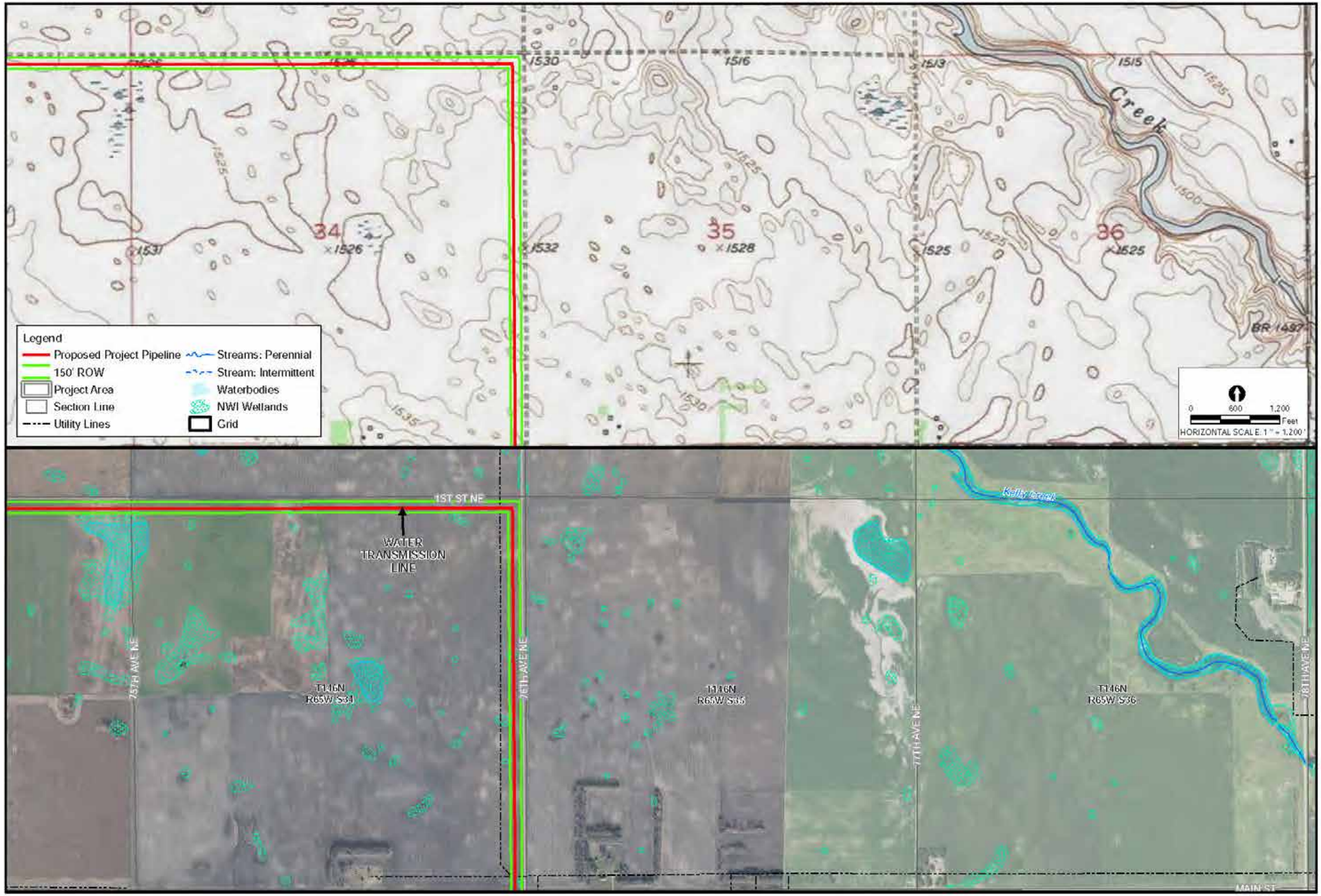

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FIGURE NO. D15

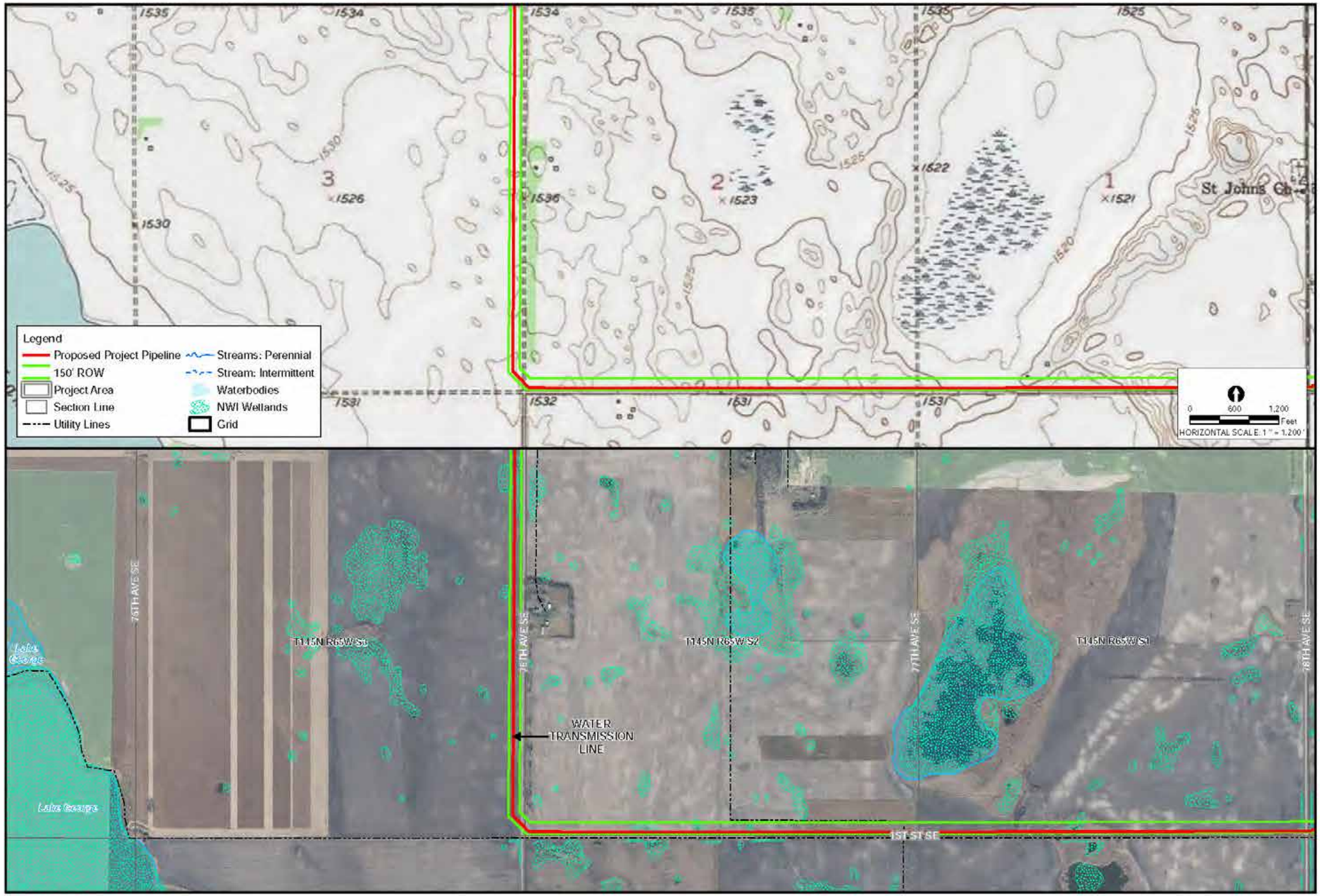

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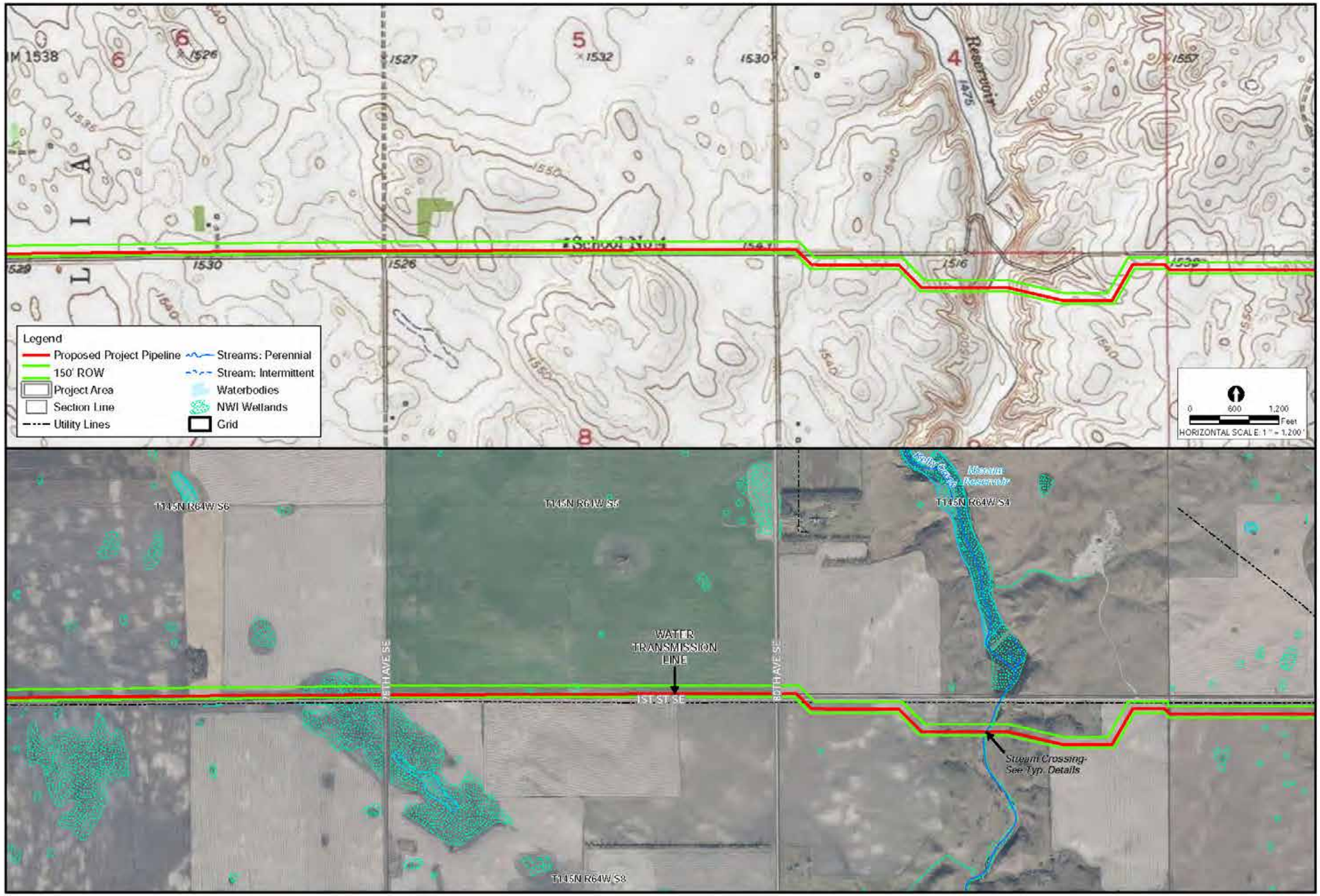
FIGURE NO. D16



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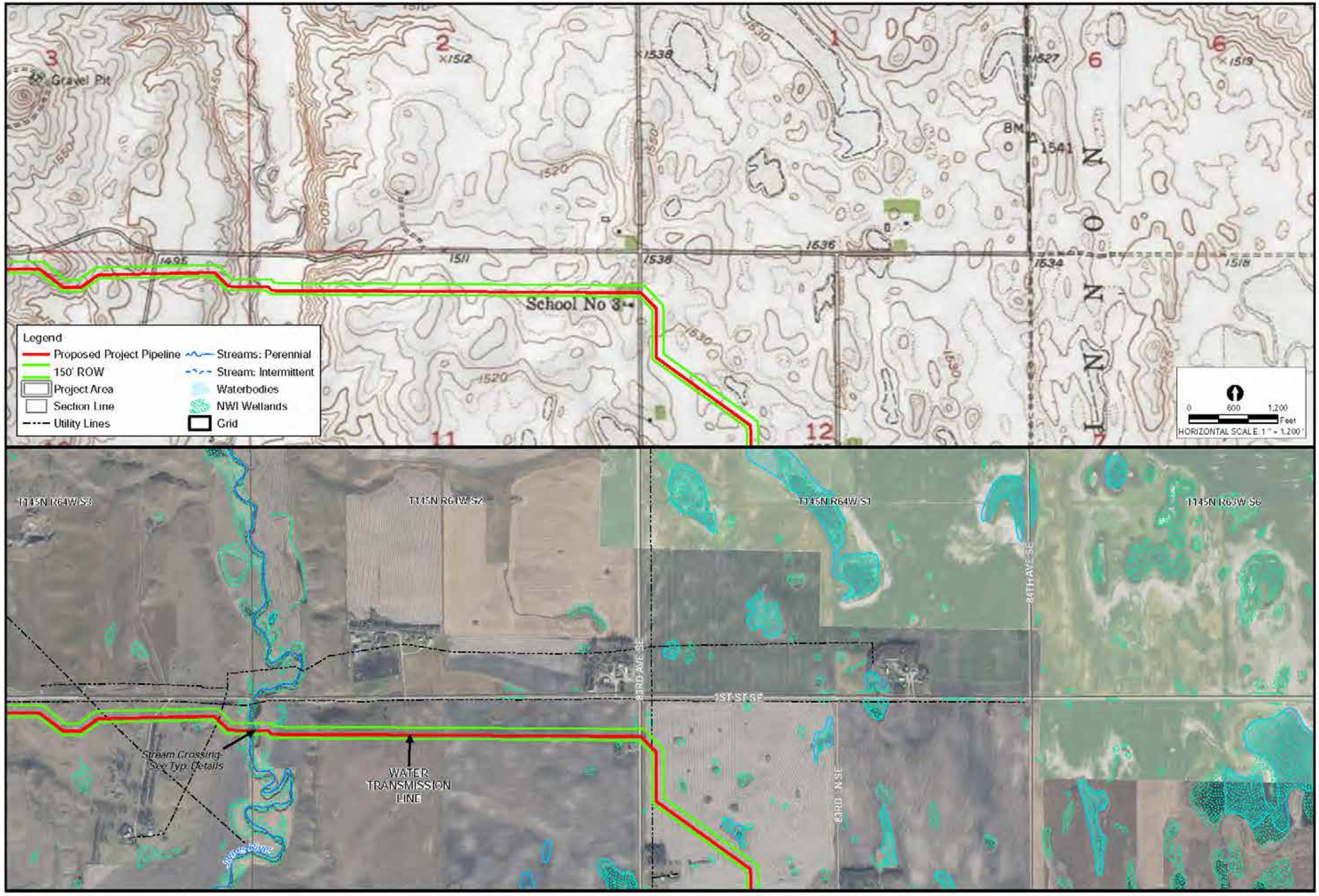

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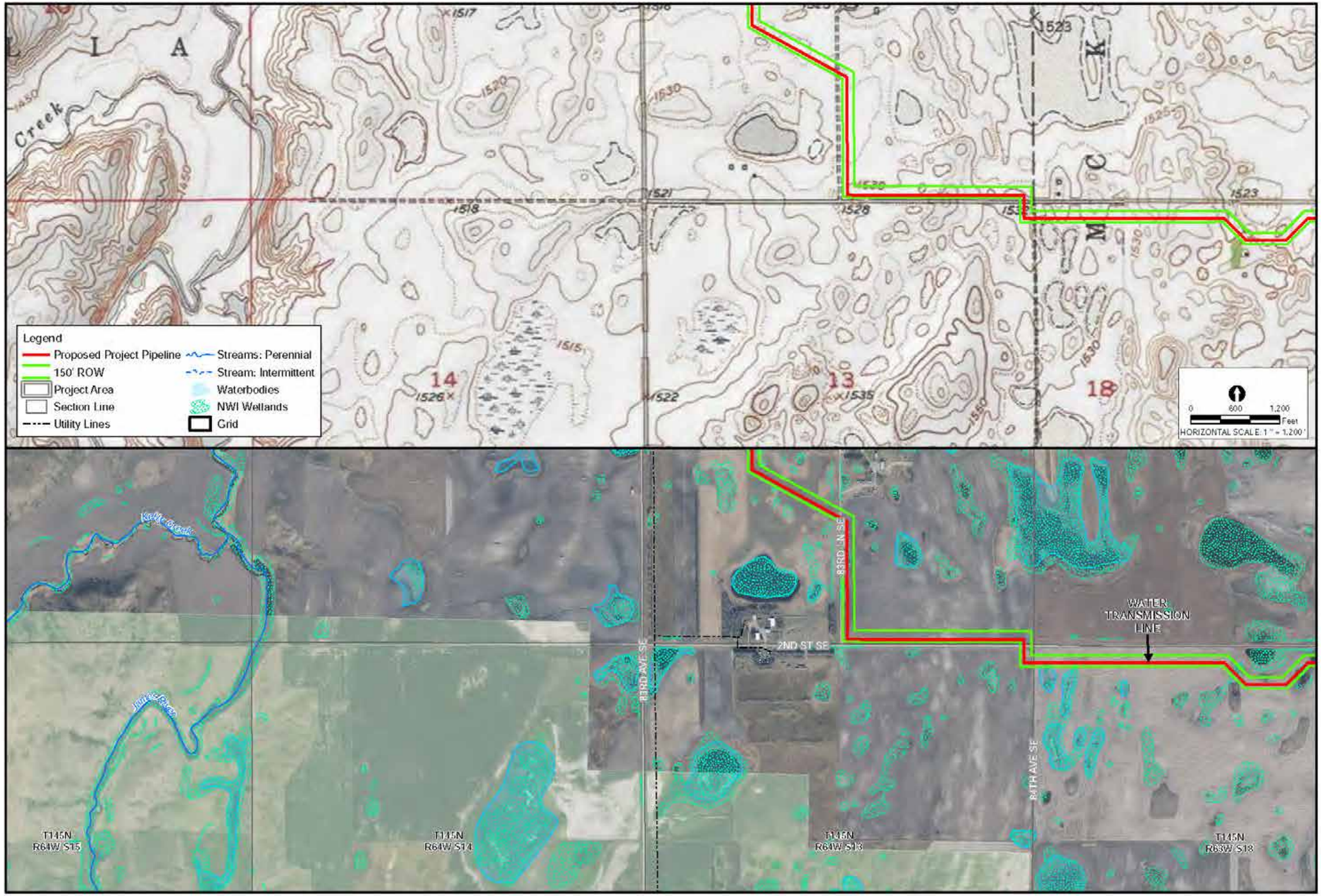

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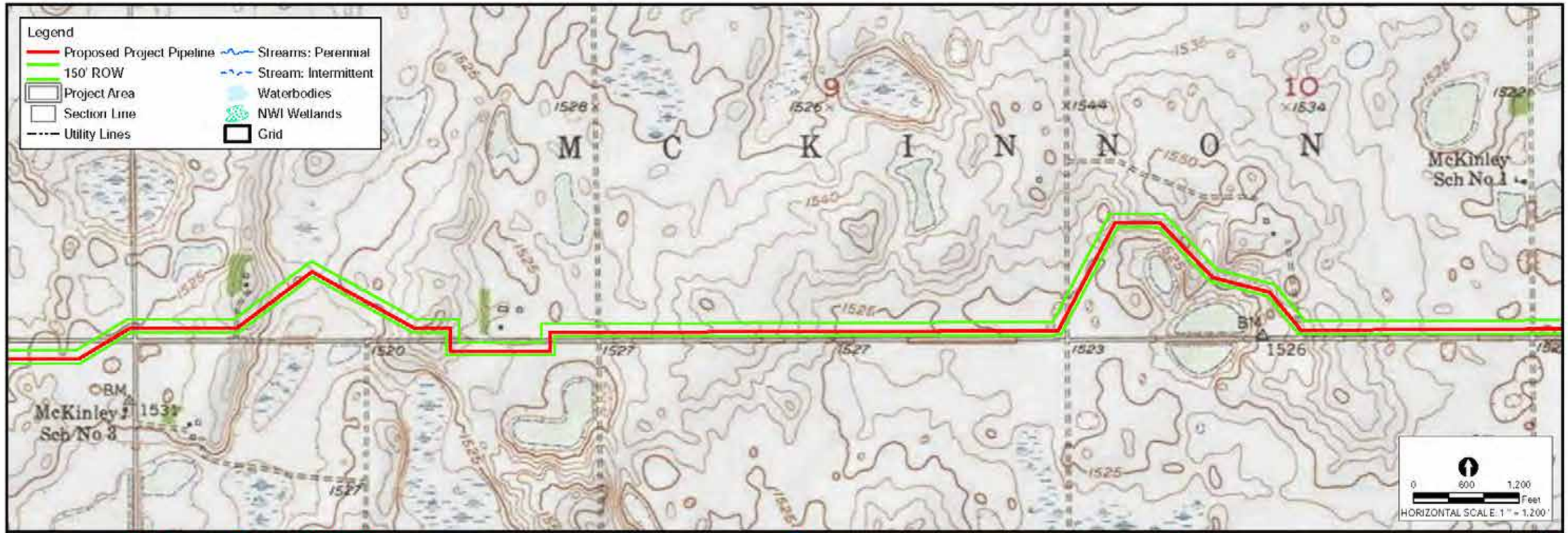
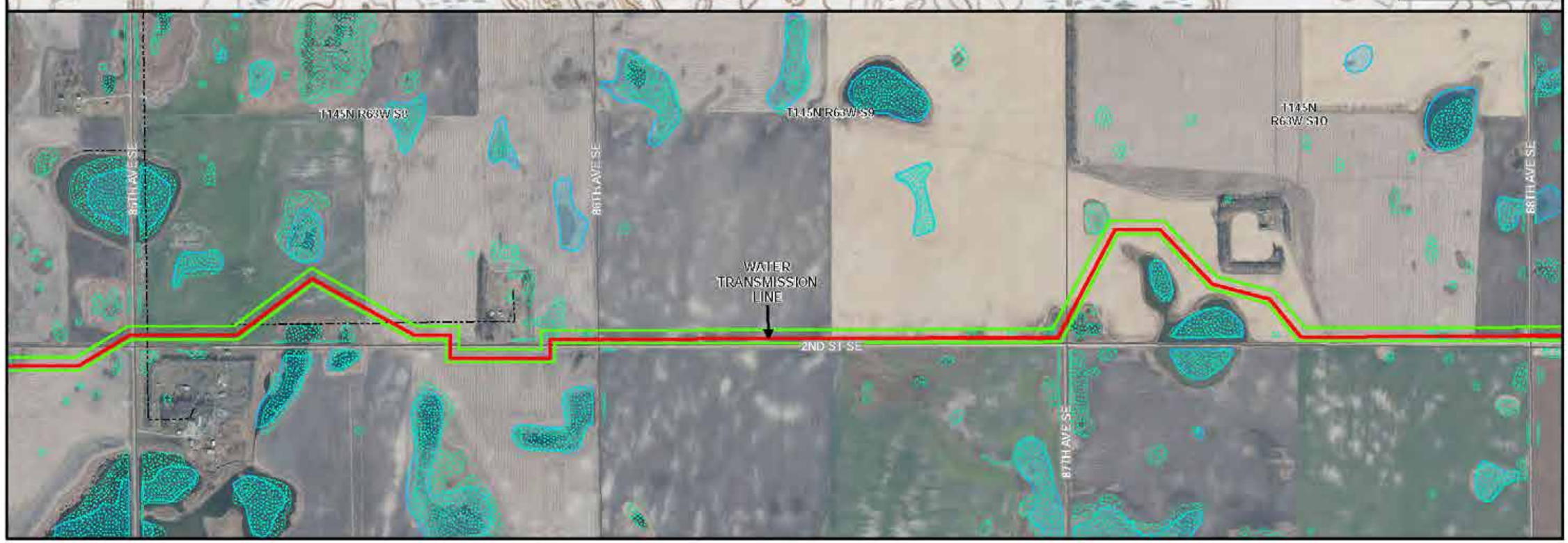
FIGURE NO. D19





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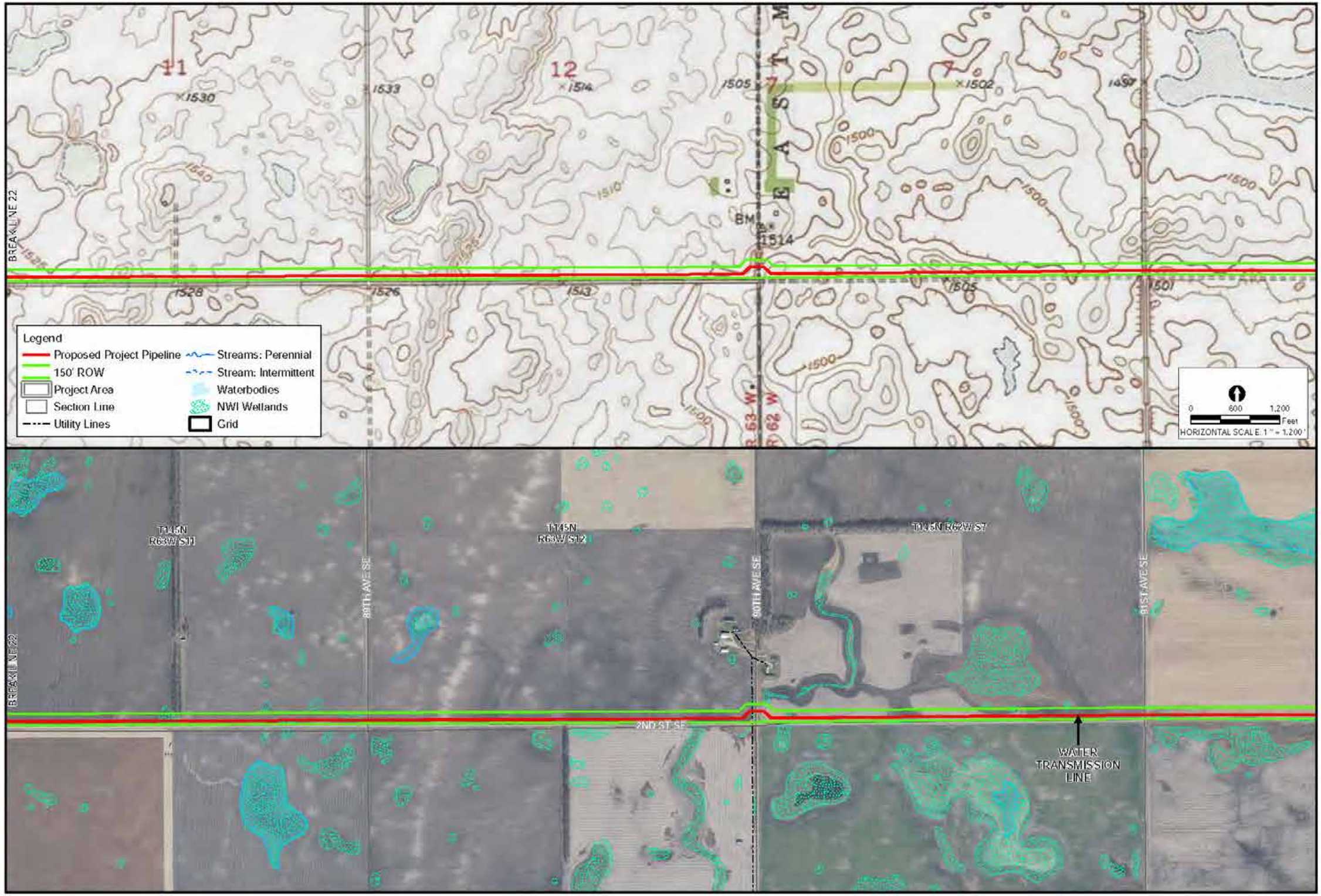

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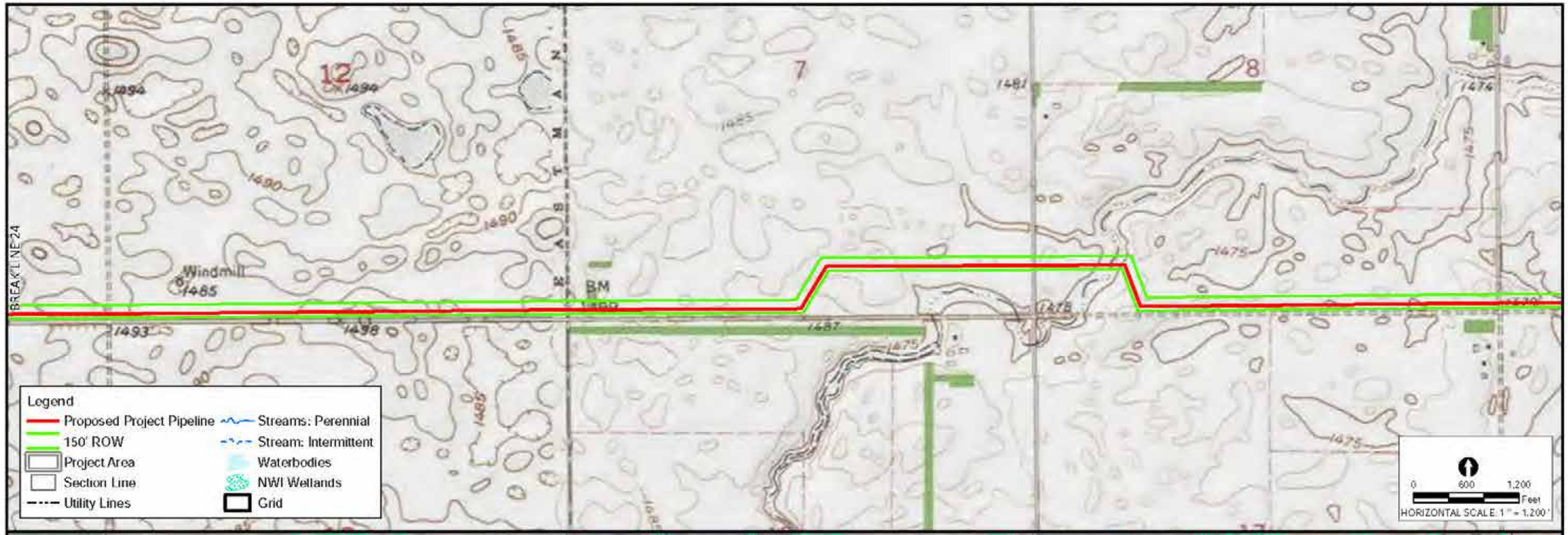

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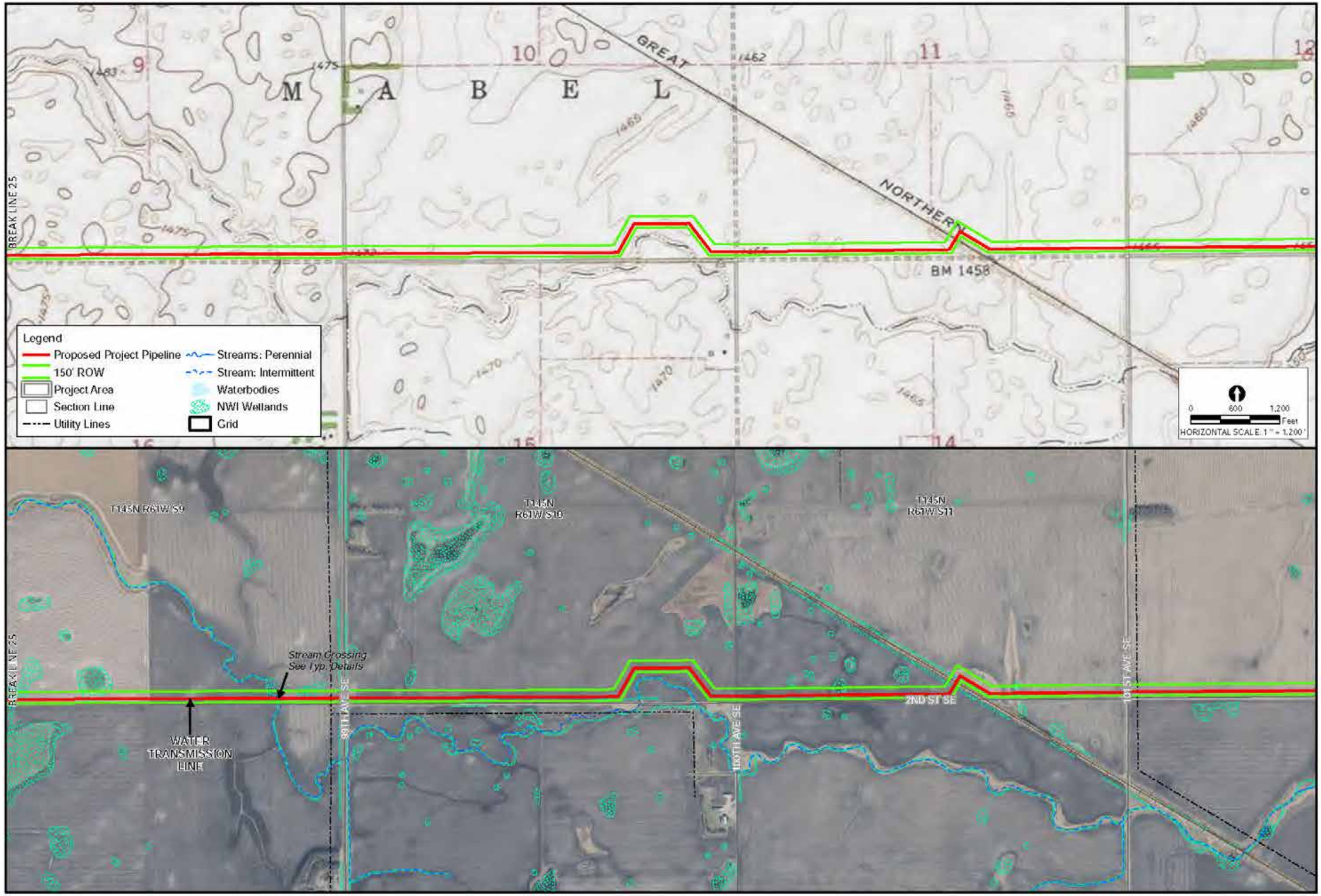

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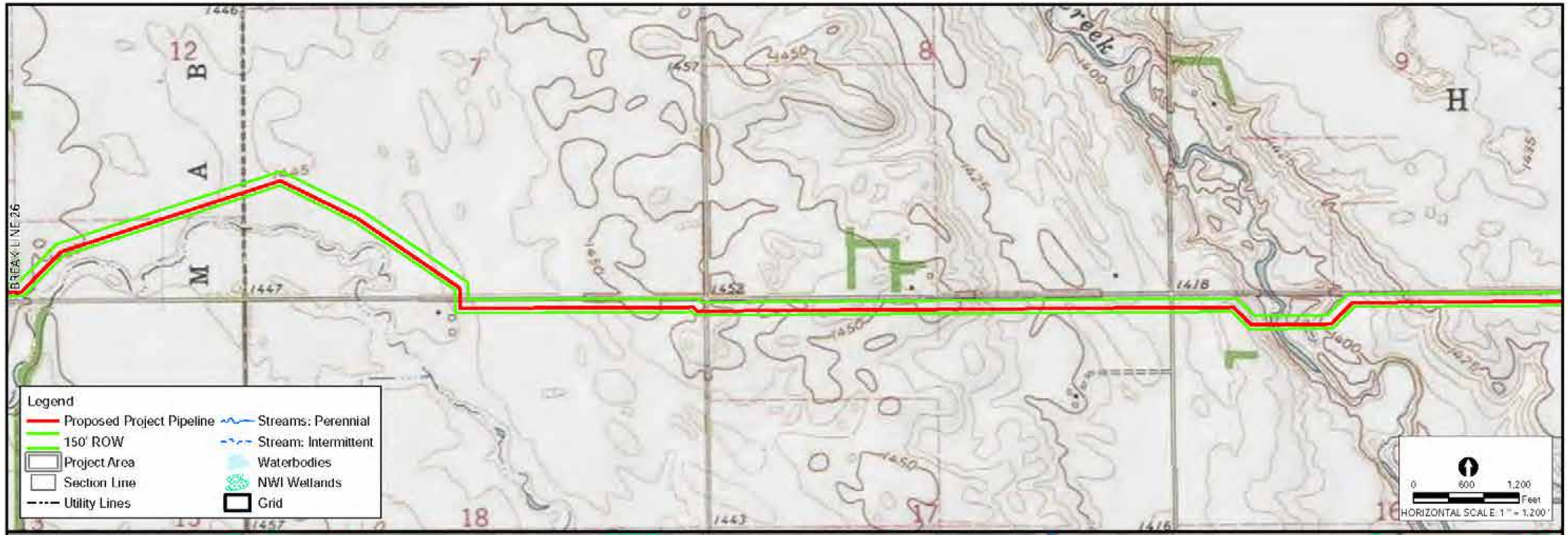

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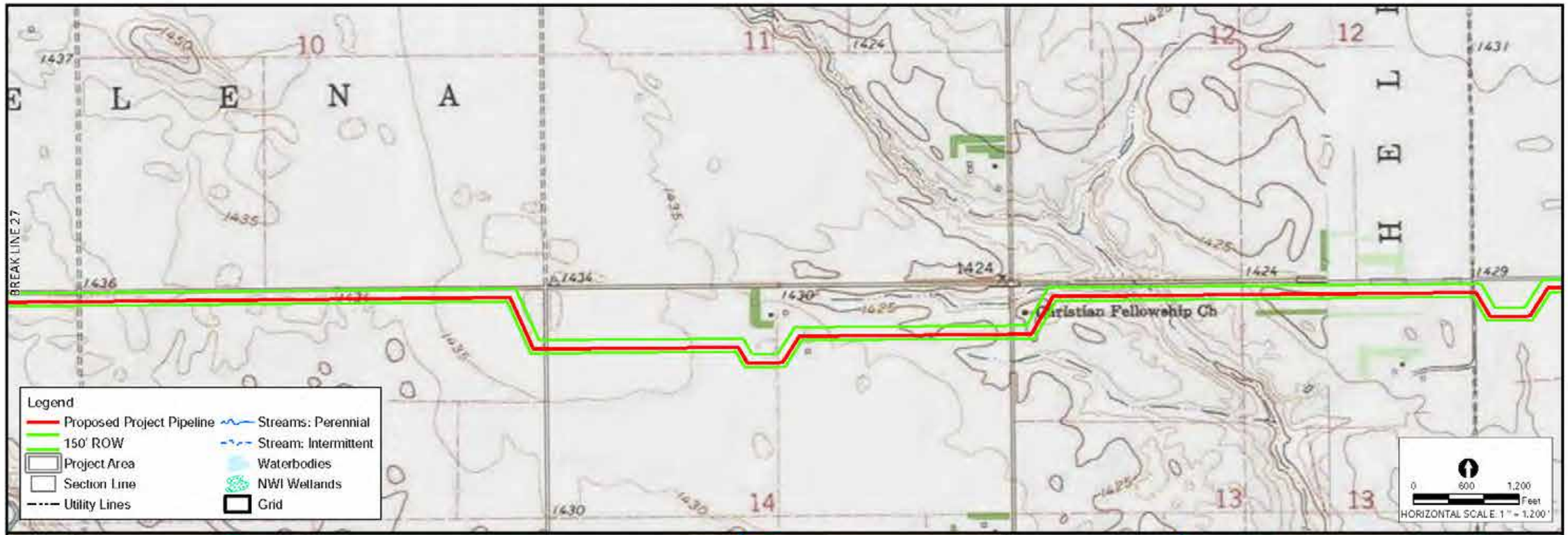
FIGURE NO. D25



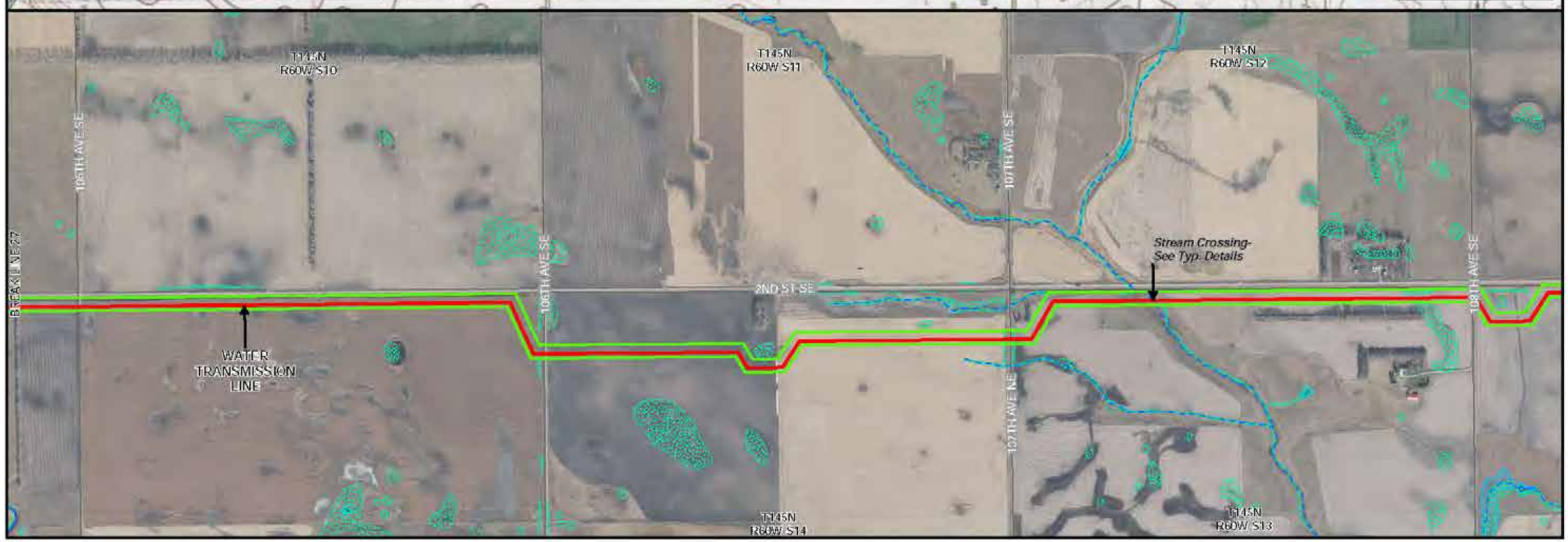


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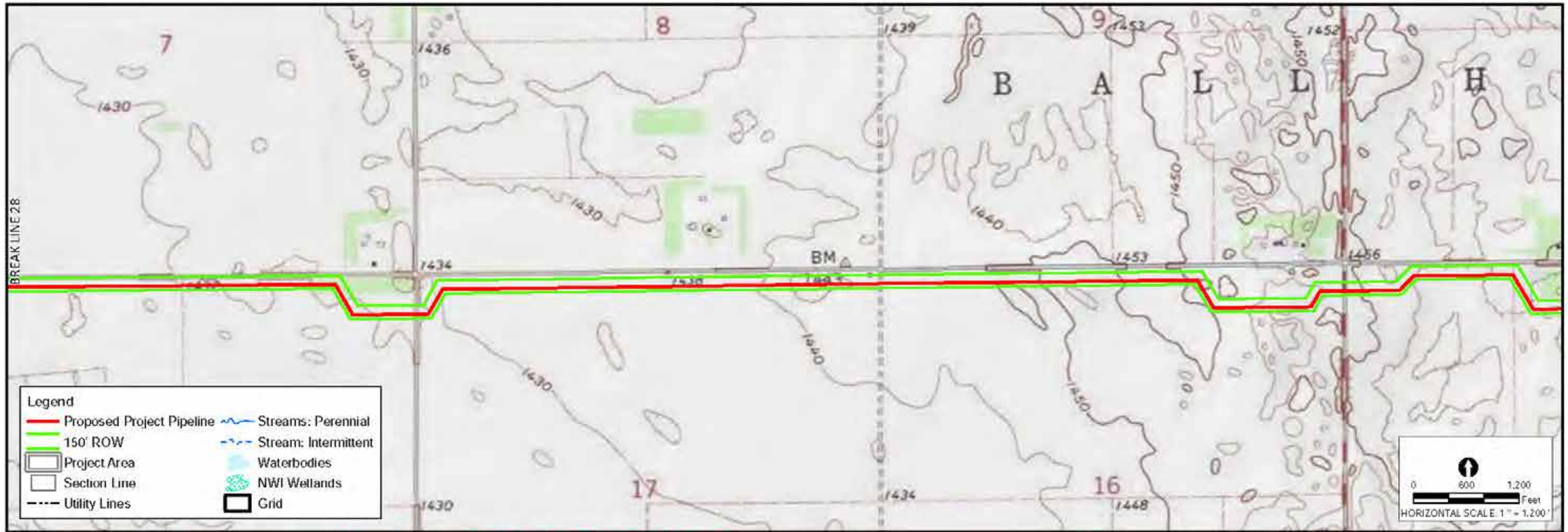
FIGURE NO. D26



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PLAN SHEET- SEGMENT D

Eastern North Dakota Alternate Water Supply Project

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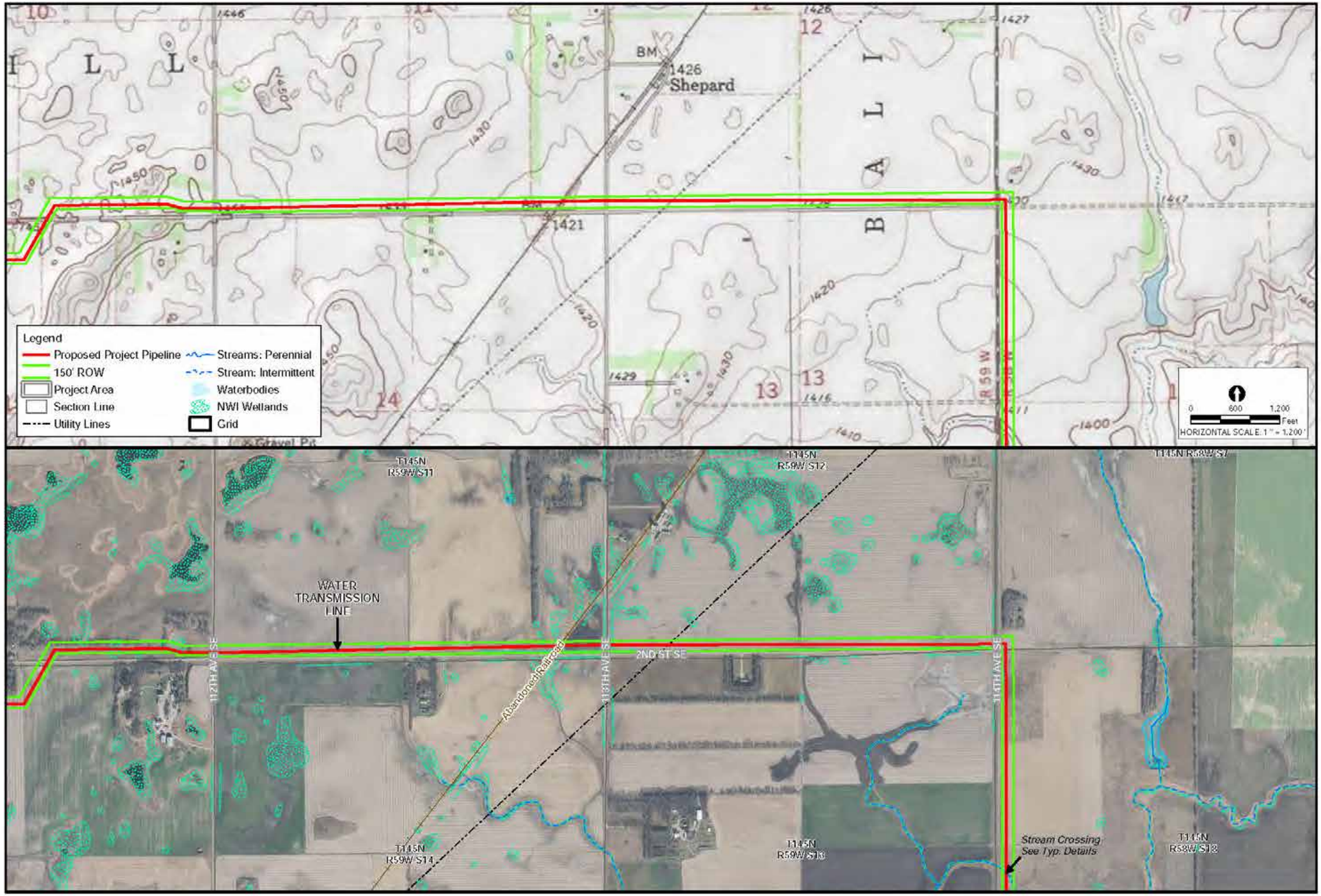
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. D27



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PLAN SHEET- SEGMENT D

Eastern North Dakota Alternate Water Supply Project

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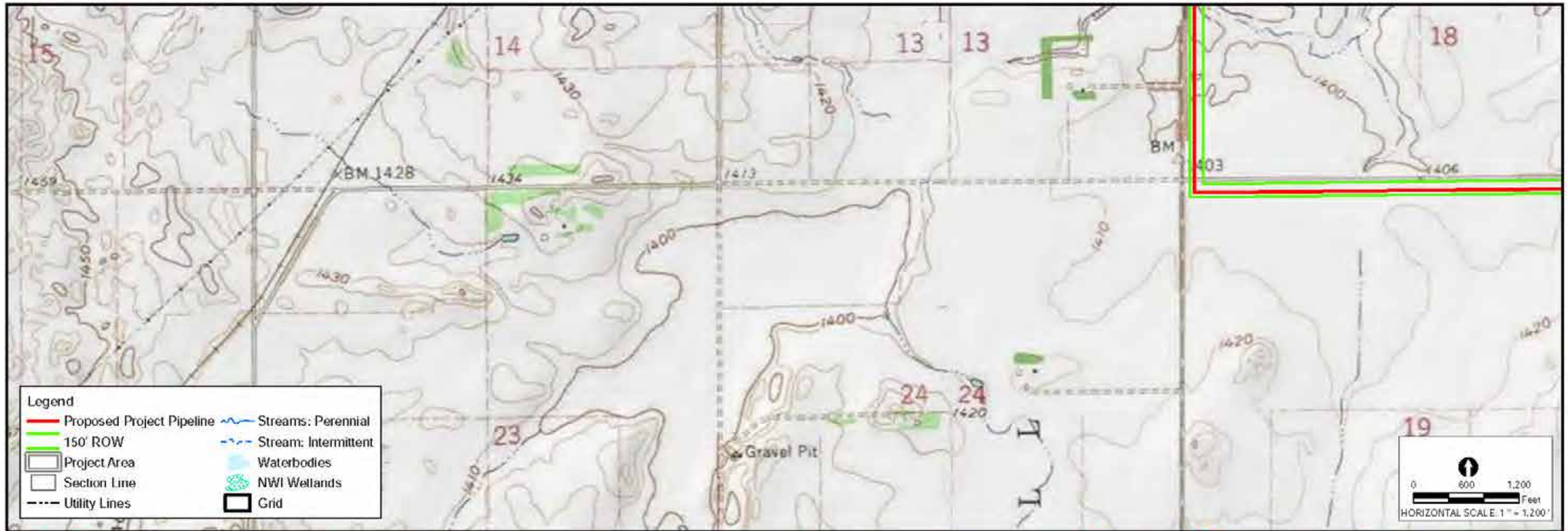
SCALE: AS SHOWN
JOB NO. 00700-2019-017
FIGURE NO. D28



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PLAN SHEET- SEGMENT D

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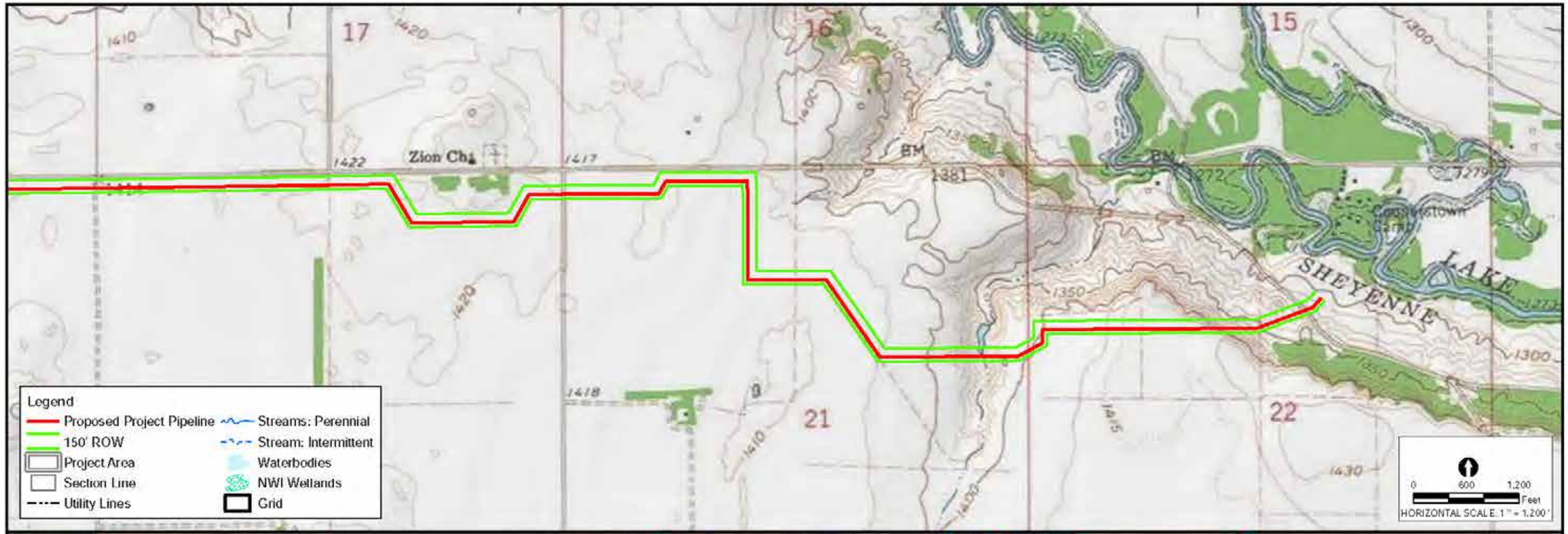
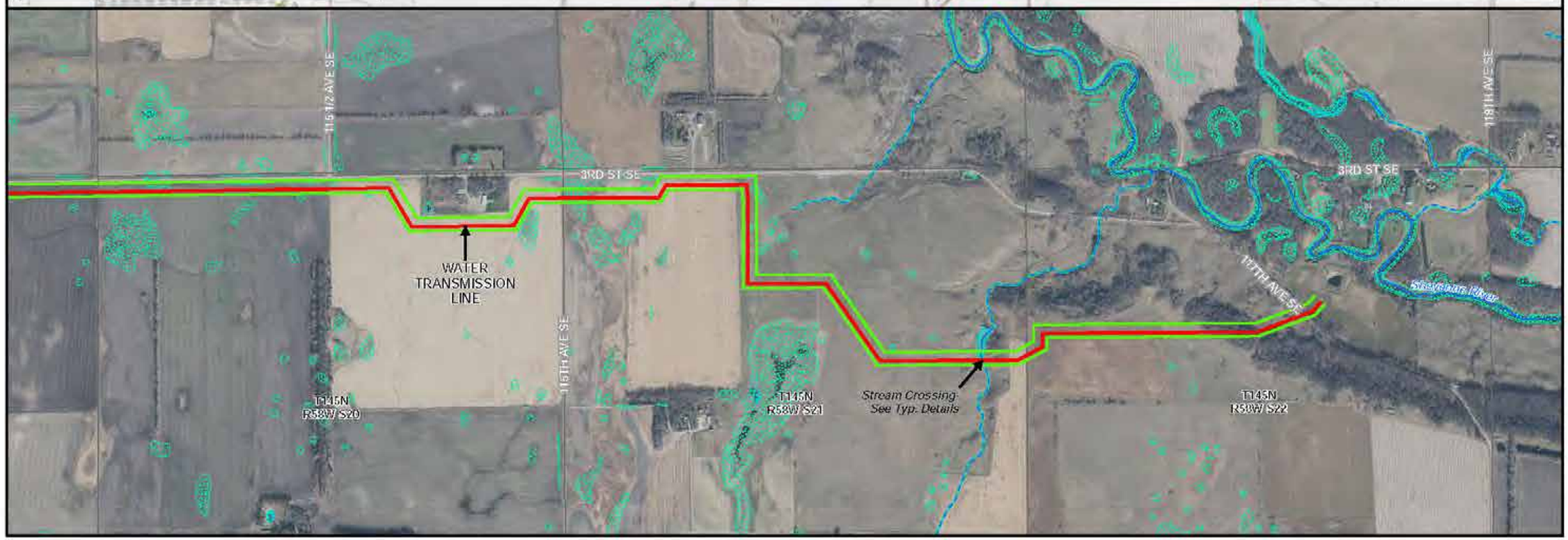
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. D29





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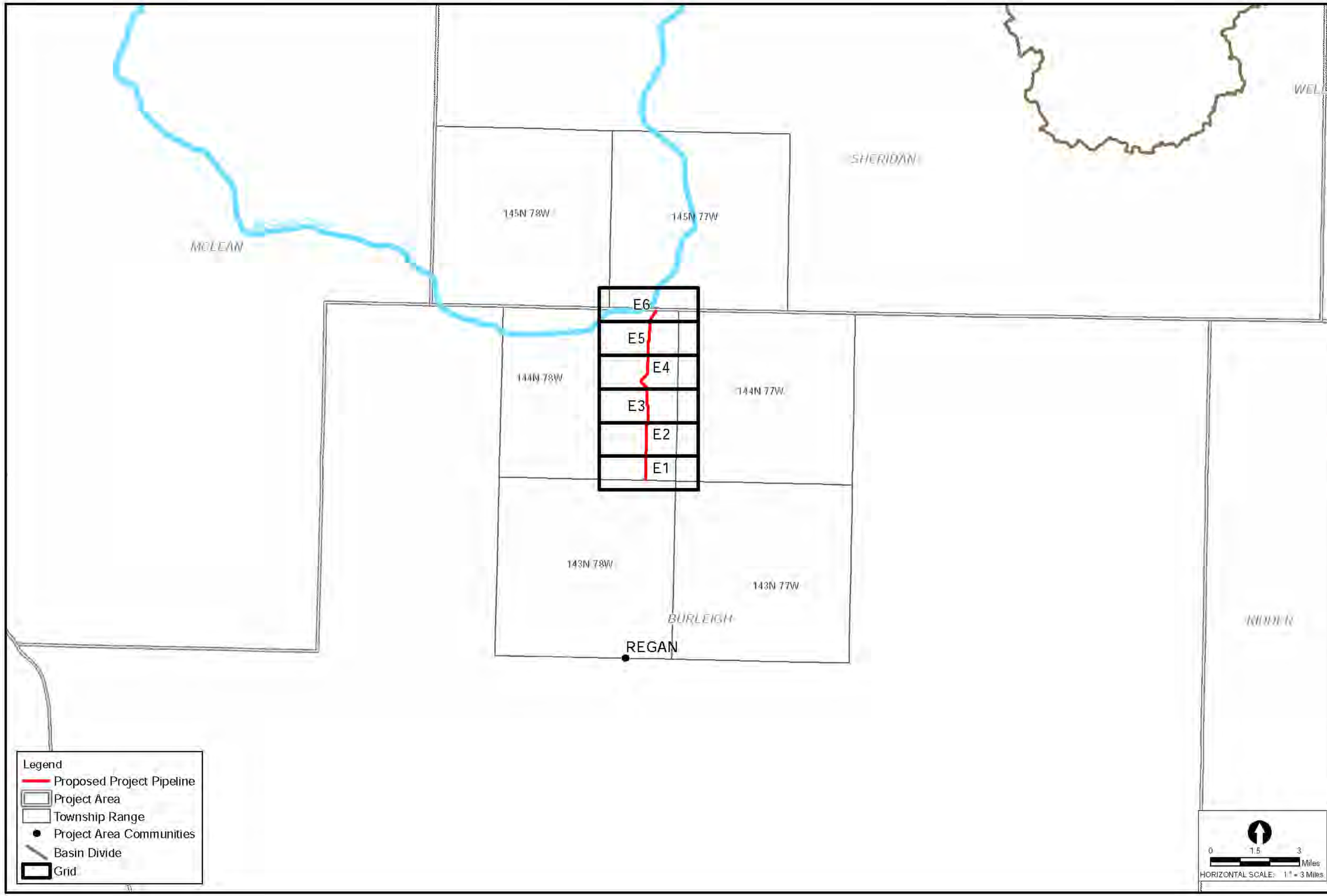
JOB NO. 00200-2019-017
FIGURE NO. D30



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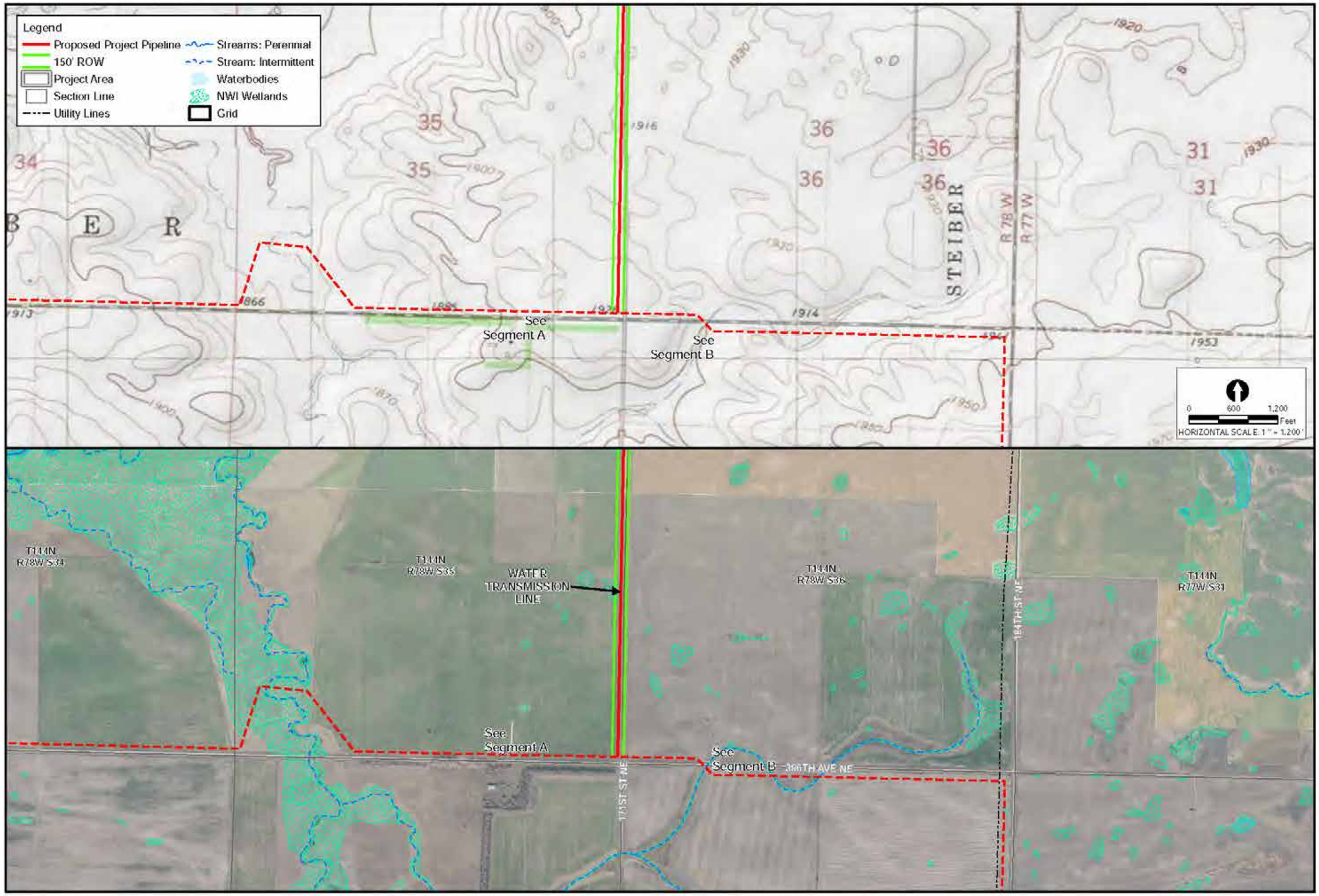
JOB NO. 00200-2019-017
FIGURE NO. 01



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Eastern North Dakota Alternate Water Supply Project

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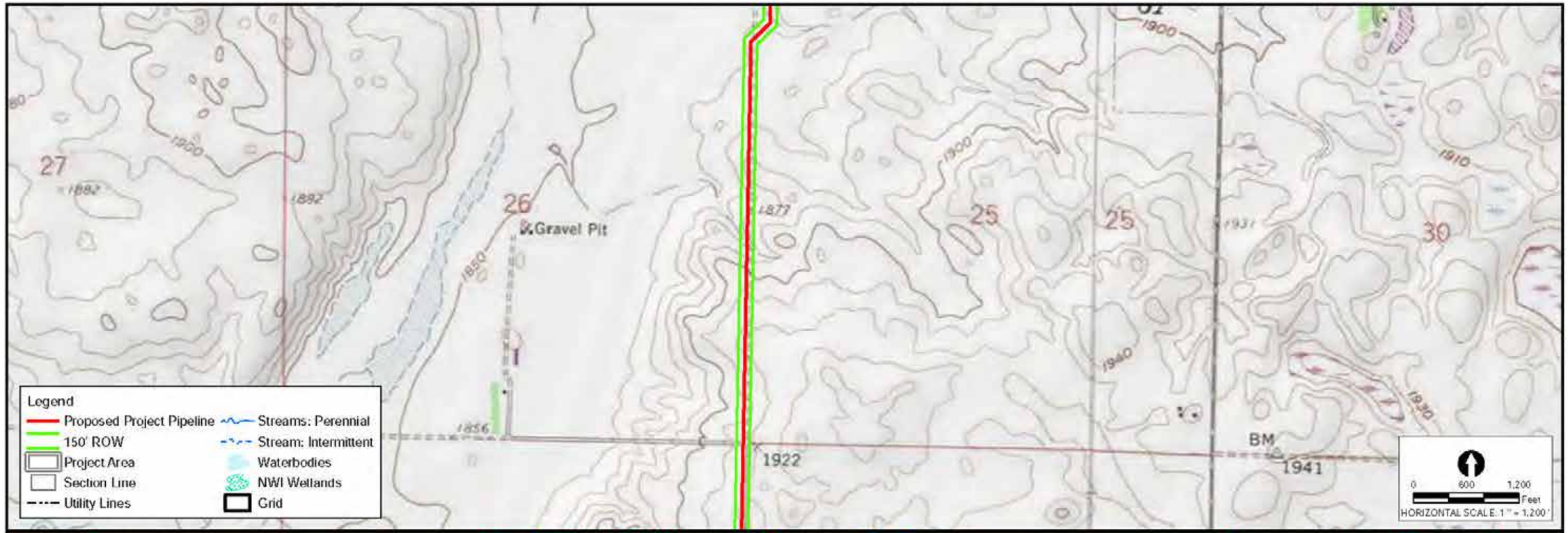
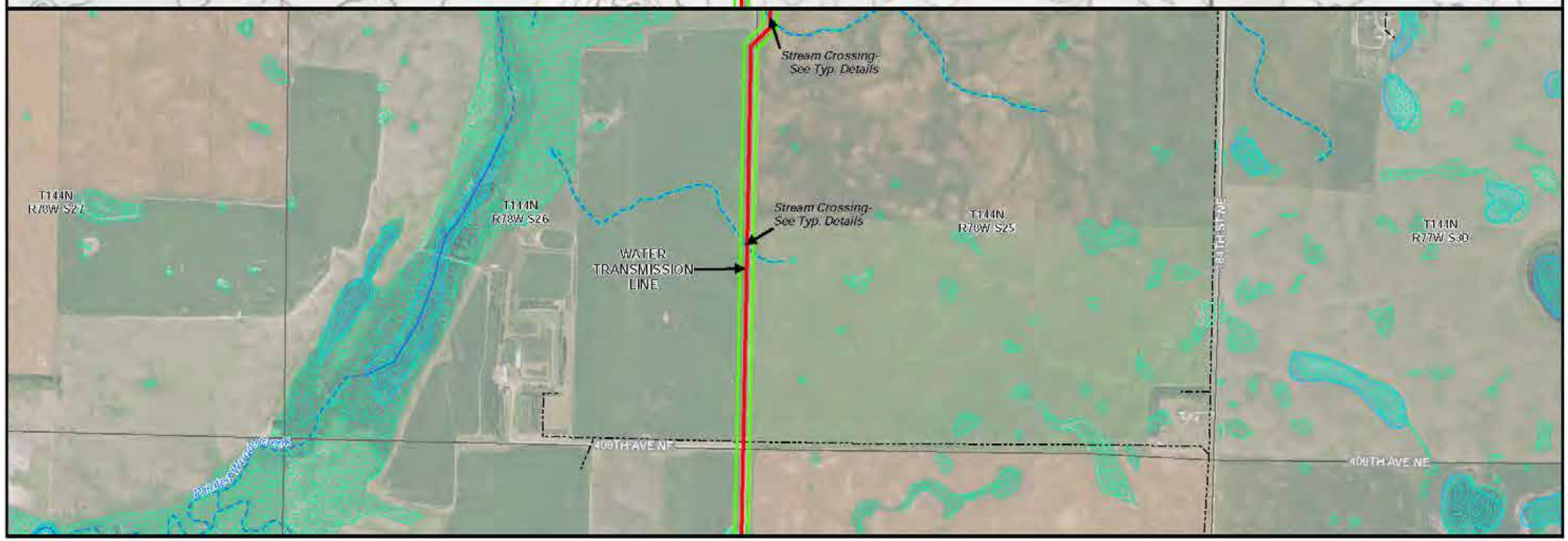
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. E1





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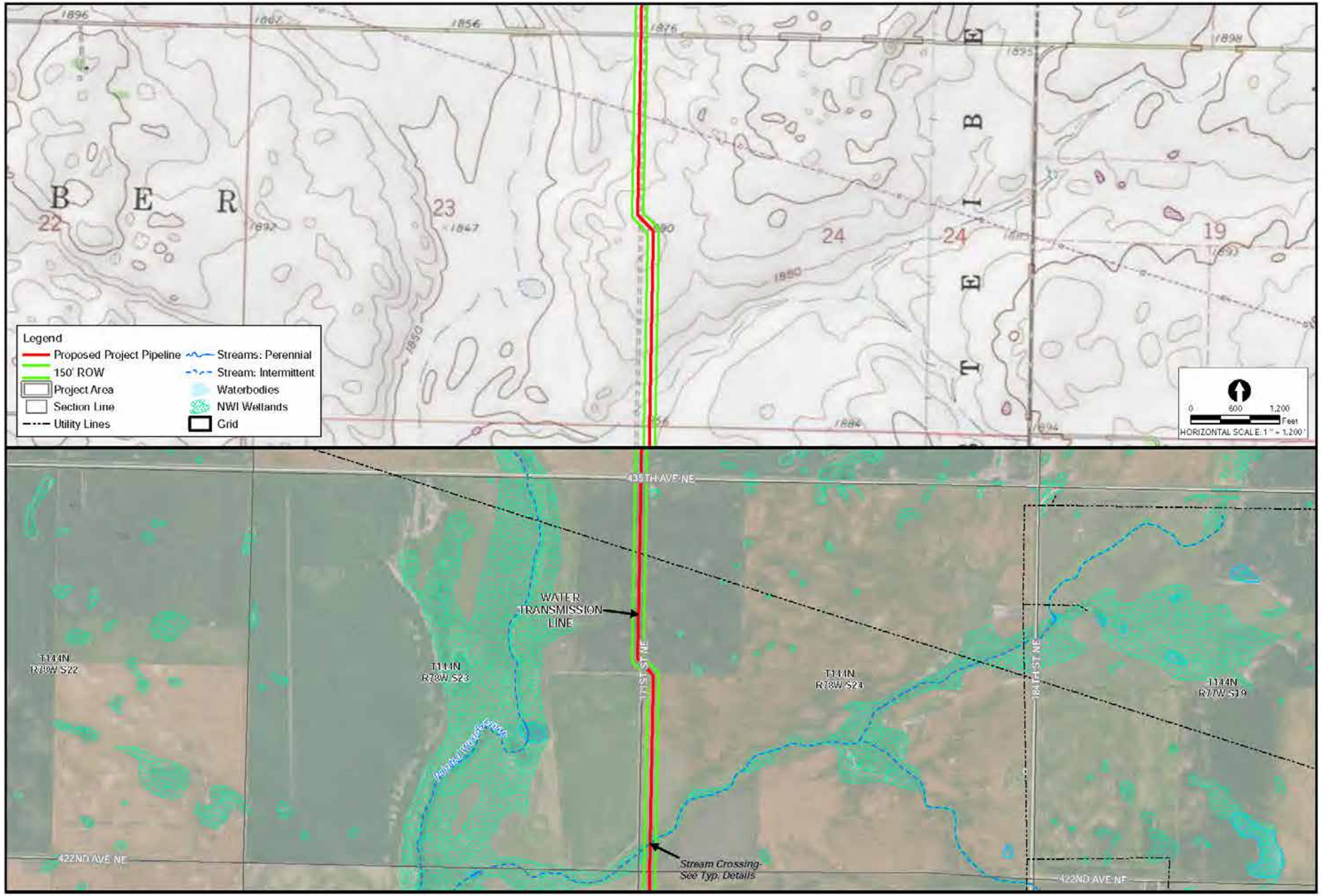
JOB NO. 00200-2019-017
FIGURE NO. E2



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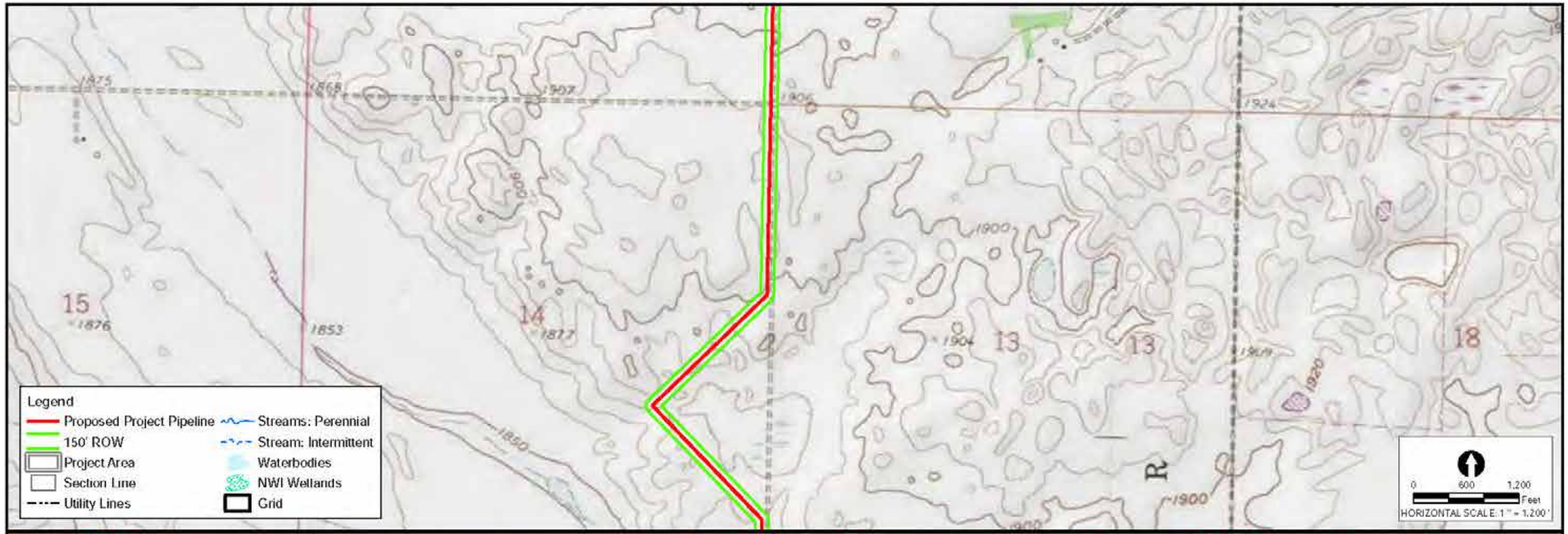
JOB NO. 00200-2019-017
FIGURE NO. E3



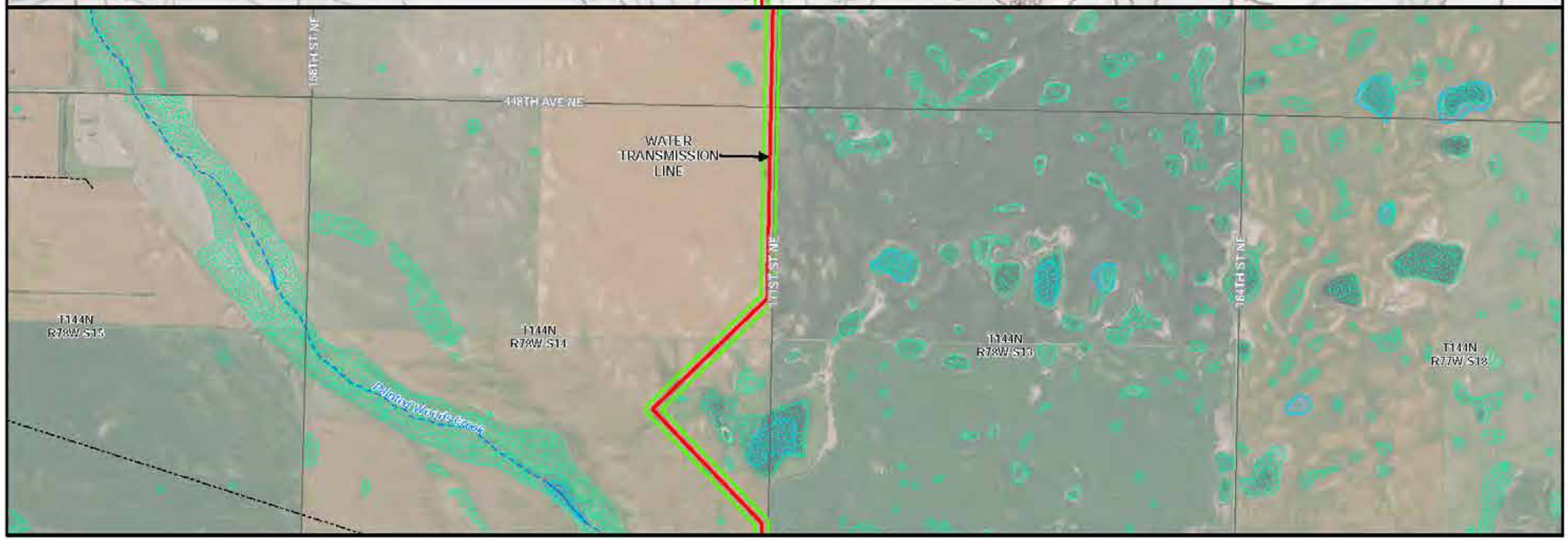


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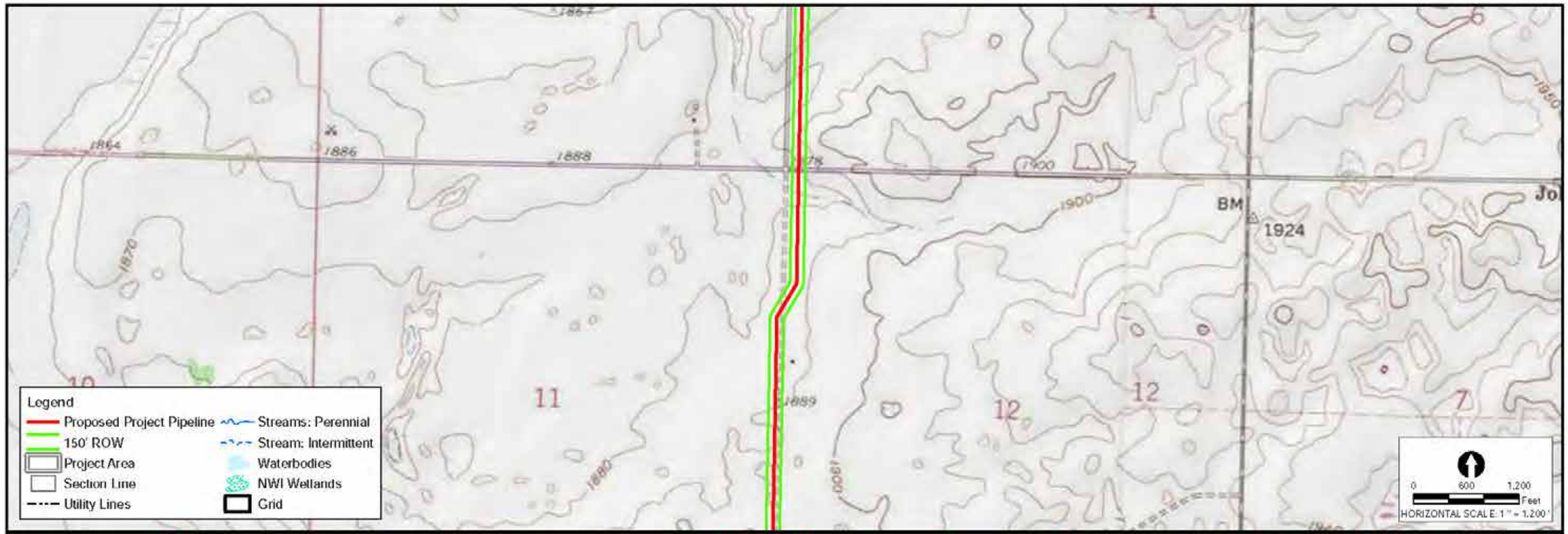
FIGURE NO. E4



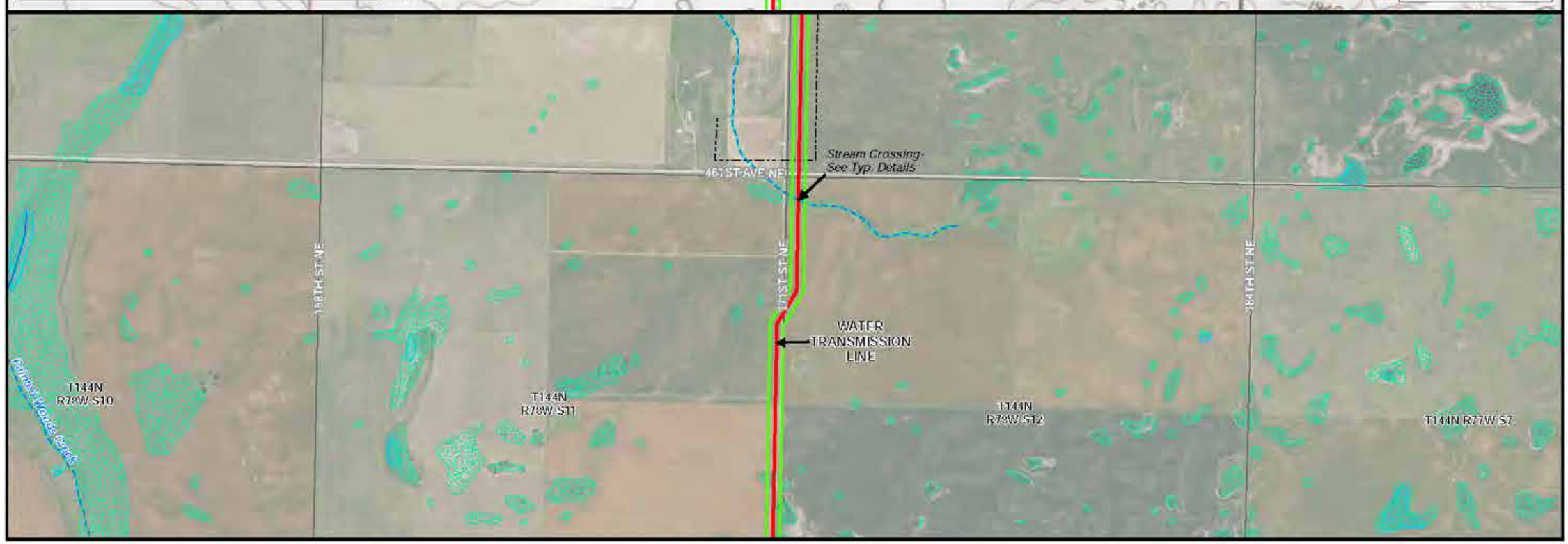


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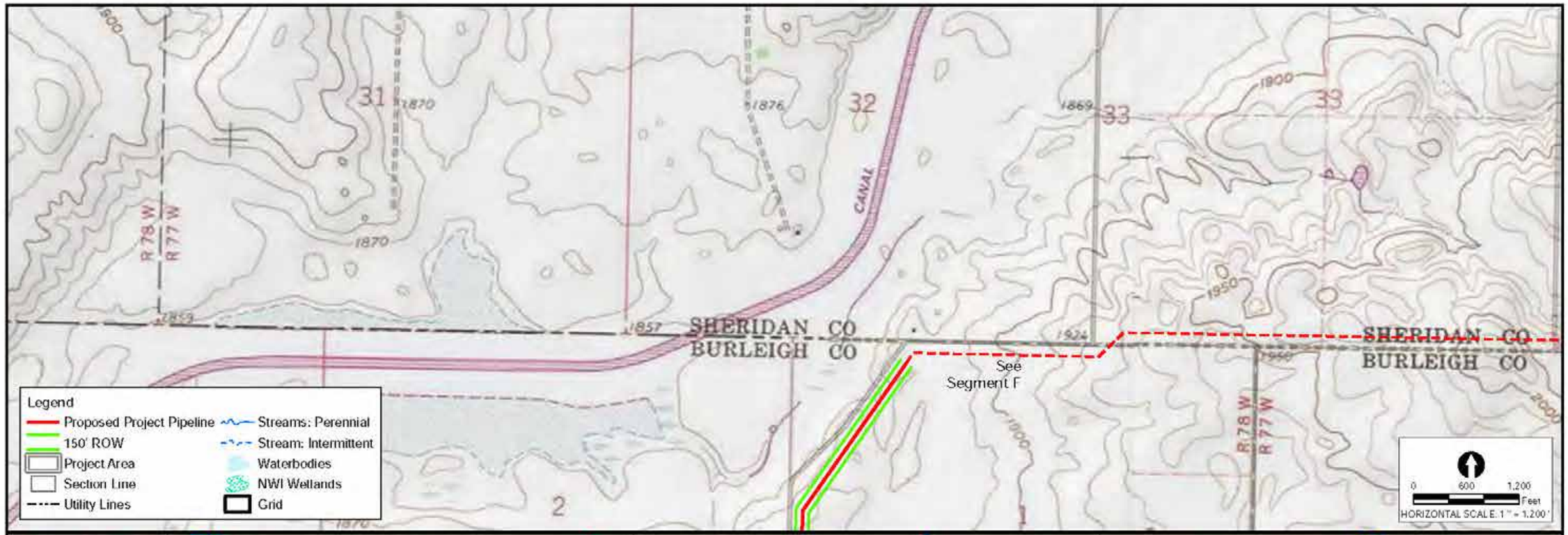
FIGURE NO. E5



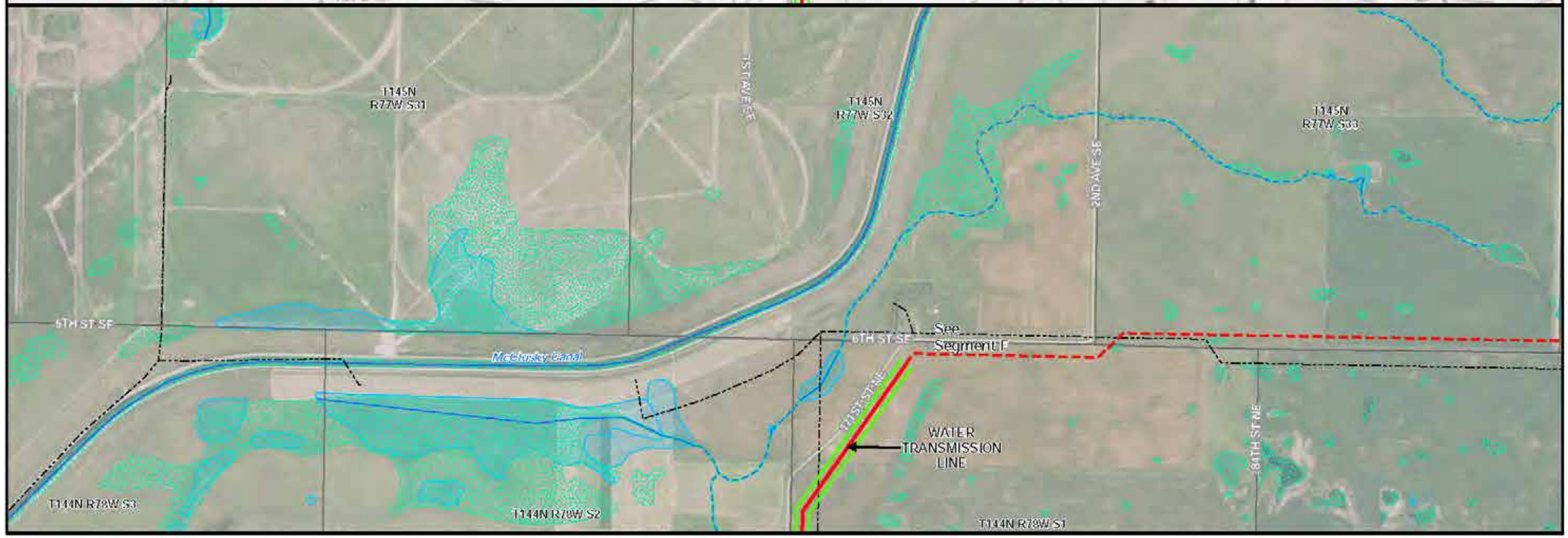


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FIGURE NO. E6

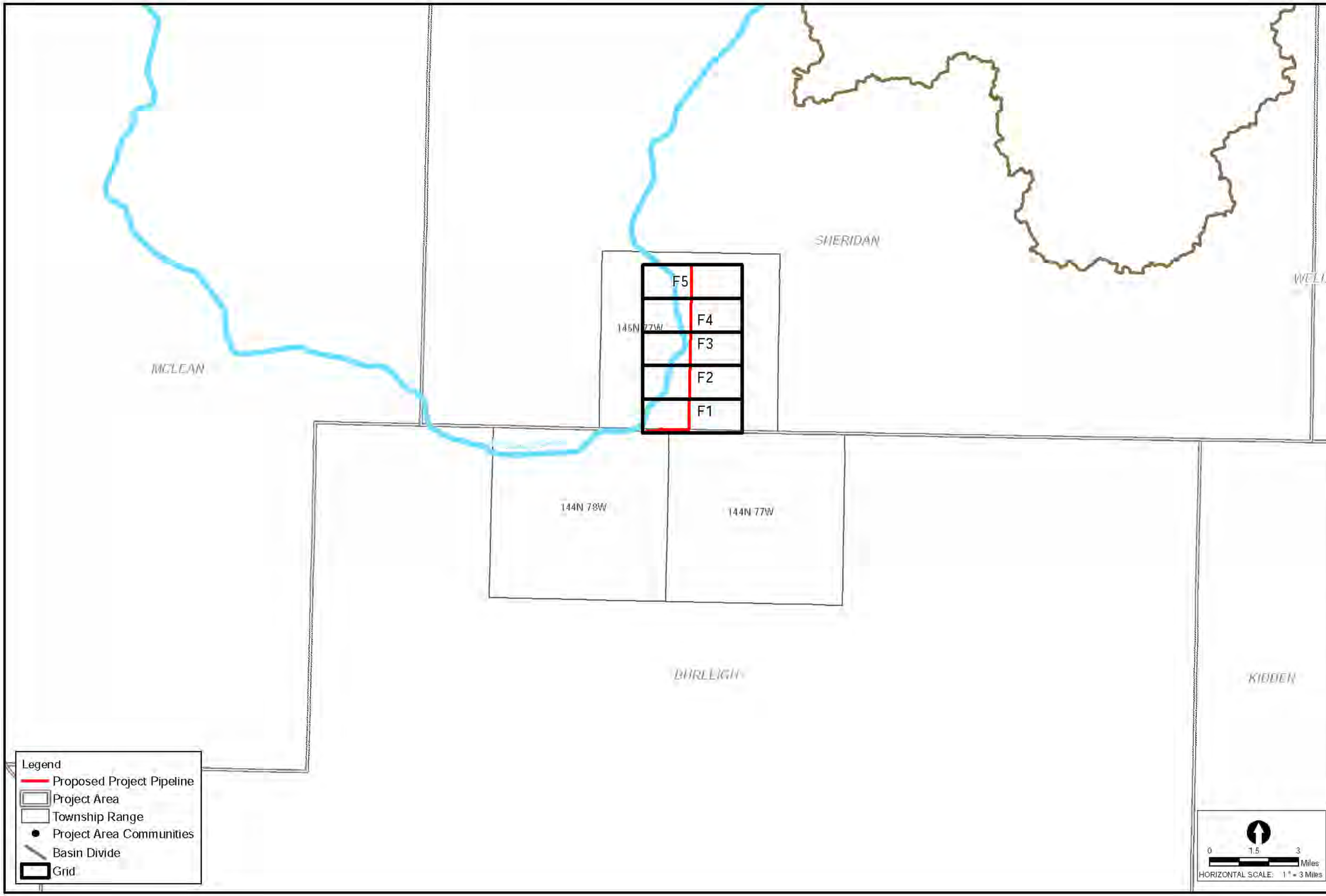

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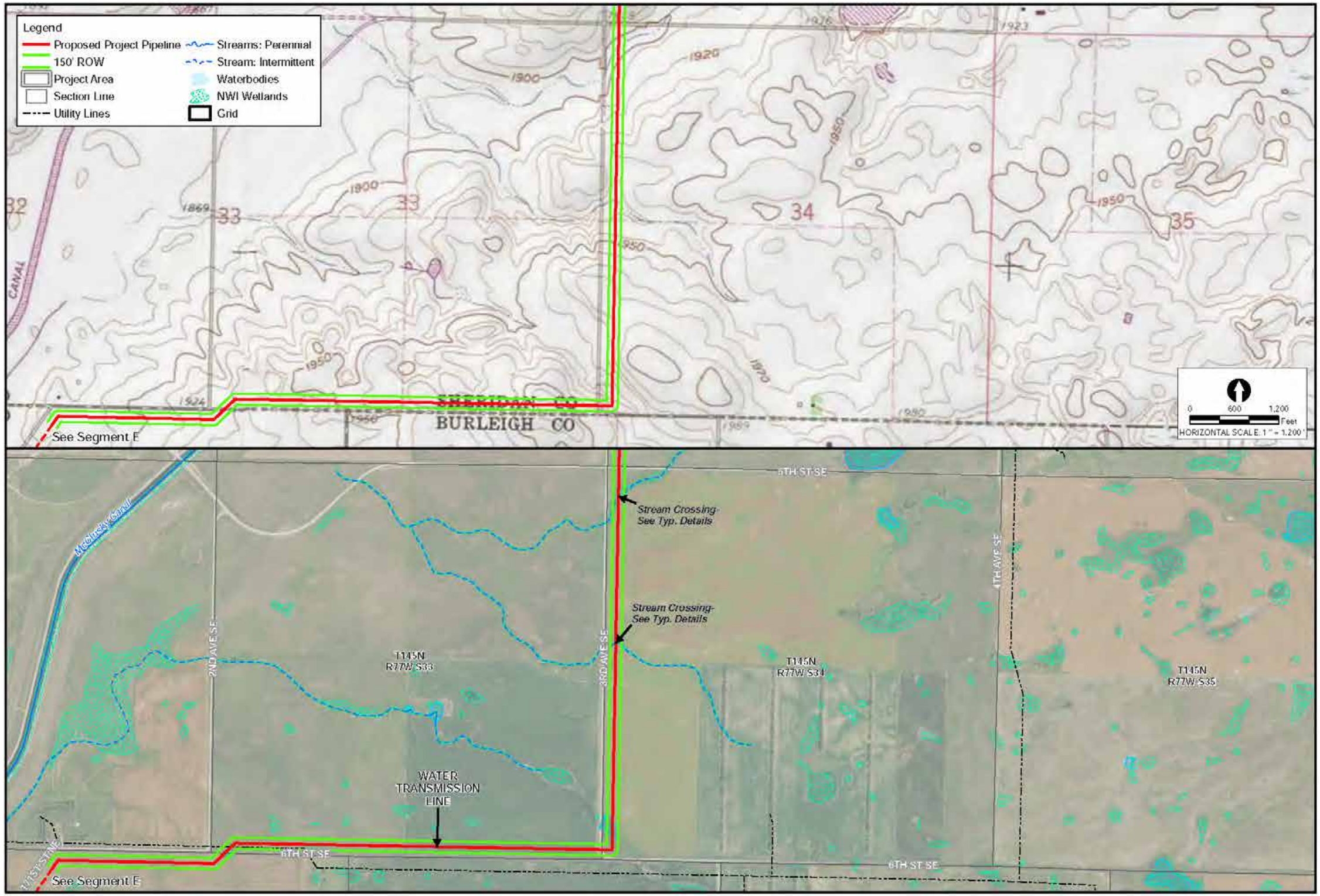
FIGURE NO. 01



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Eastern North Dakota Alternate Water Supply Project

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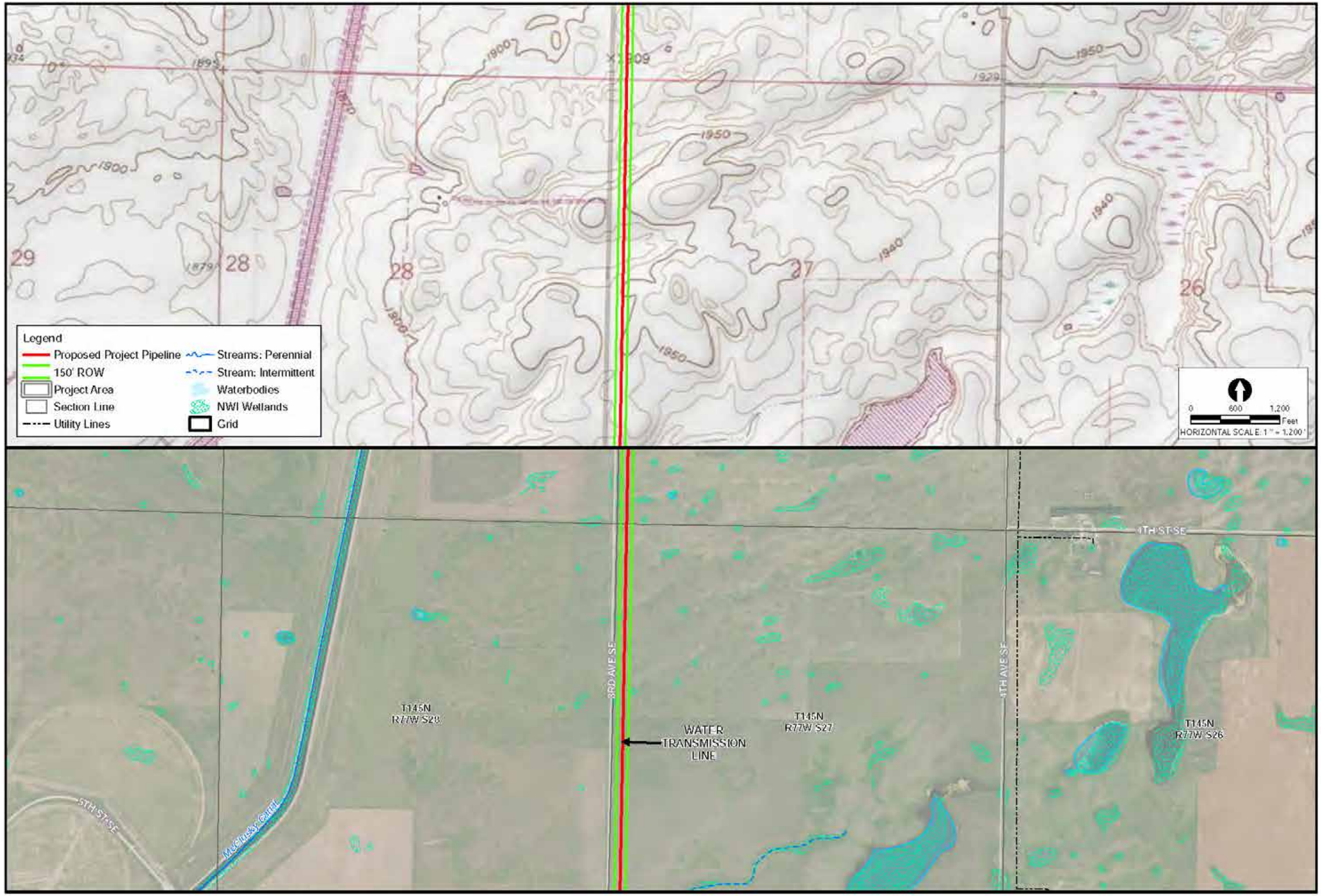
JOB NO. 00200-2019-017
FIGURE NO. F1



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Eastern North Dakota Alternate Water Supply Project

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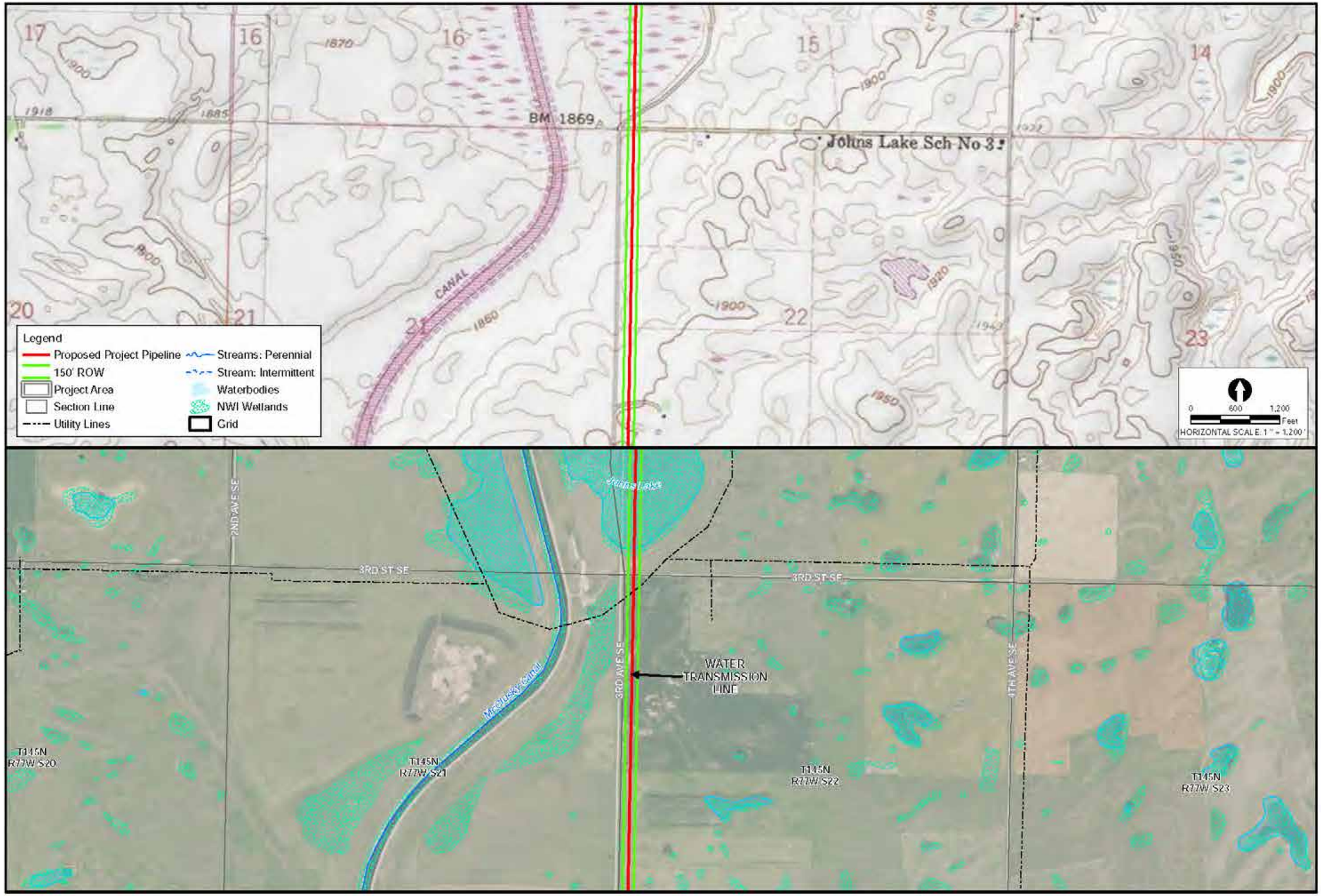
JOB NO. 00700-2019-017
FIGURE NO. F2



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Eastern North Dakota Alternate Water Supply Project

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JOB NO. 00200-2019-017
FIGURE NO. F3

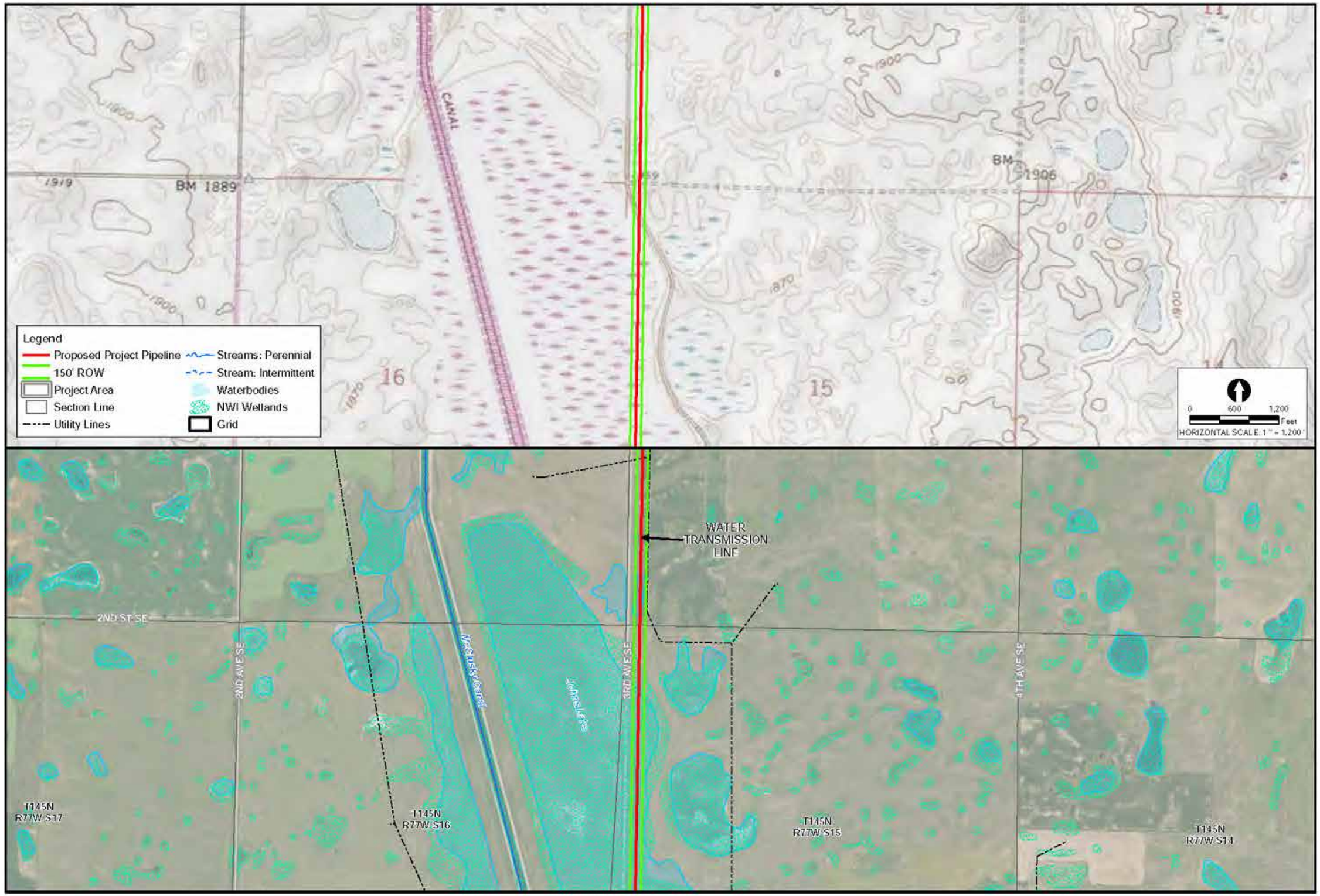

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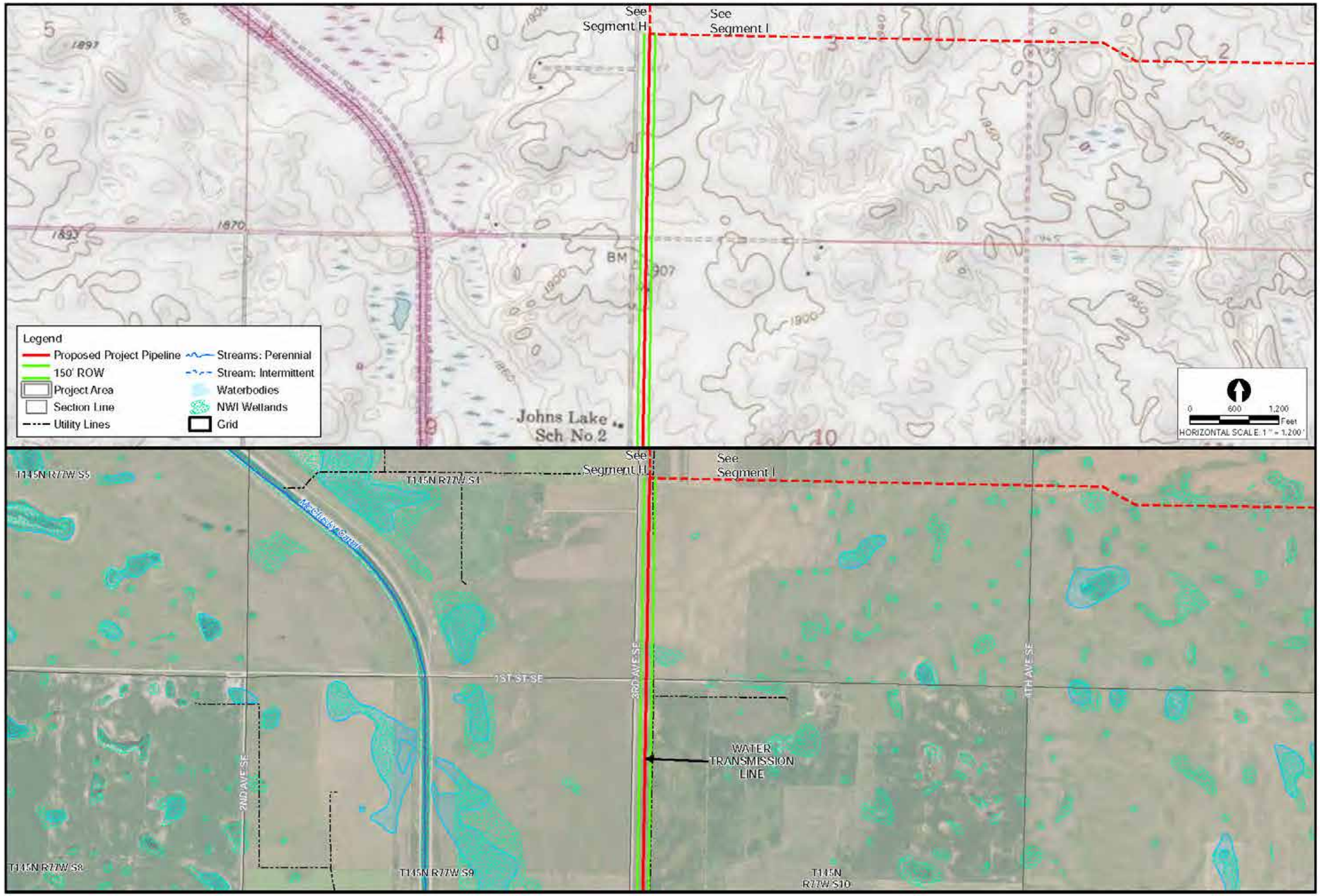
FIGURE NO. F4



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JOB NO. 00200-2019-017
FIGURE NO. F5

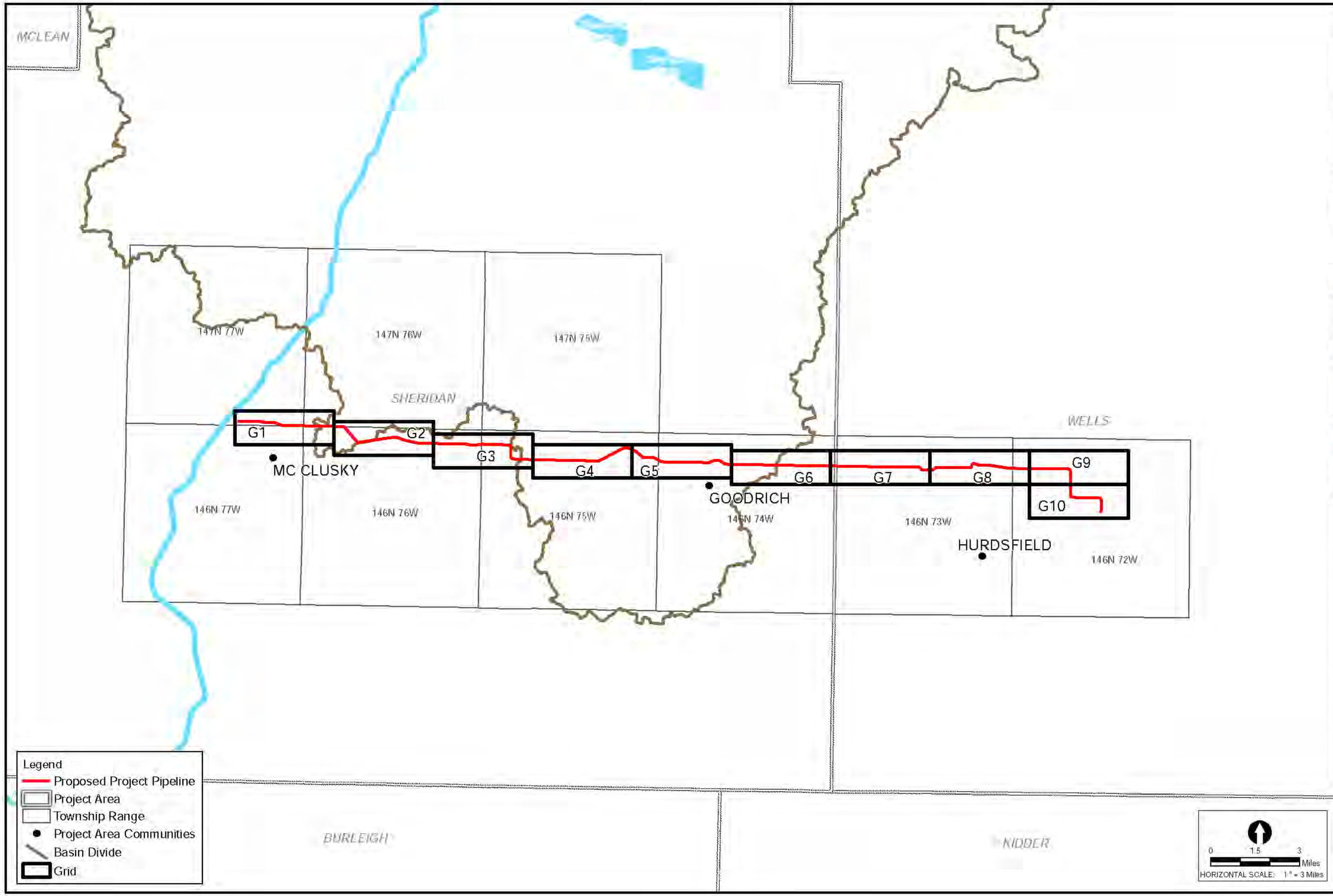

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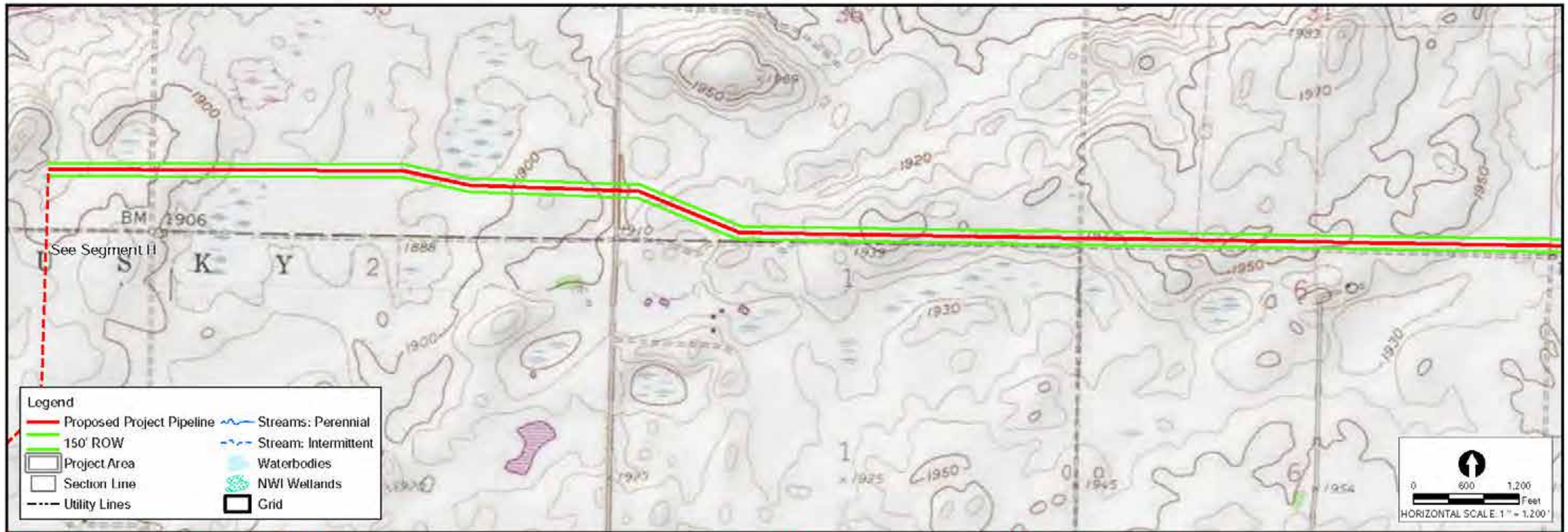
FIGURE NO. 01



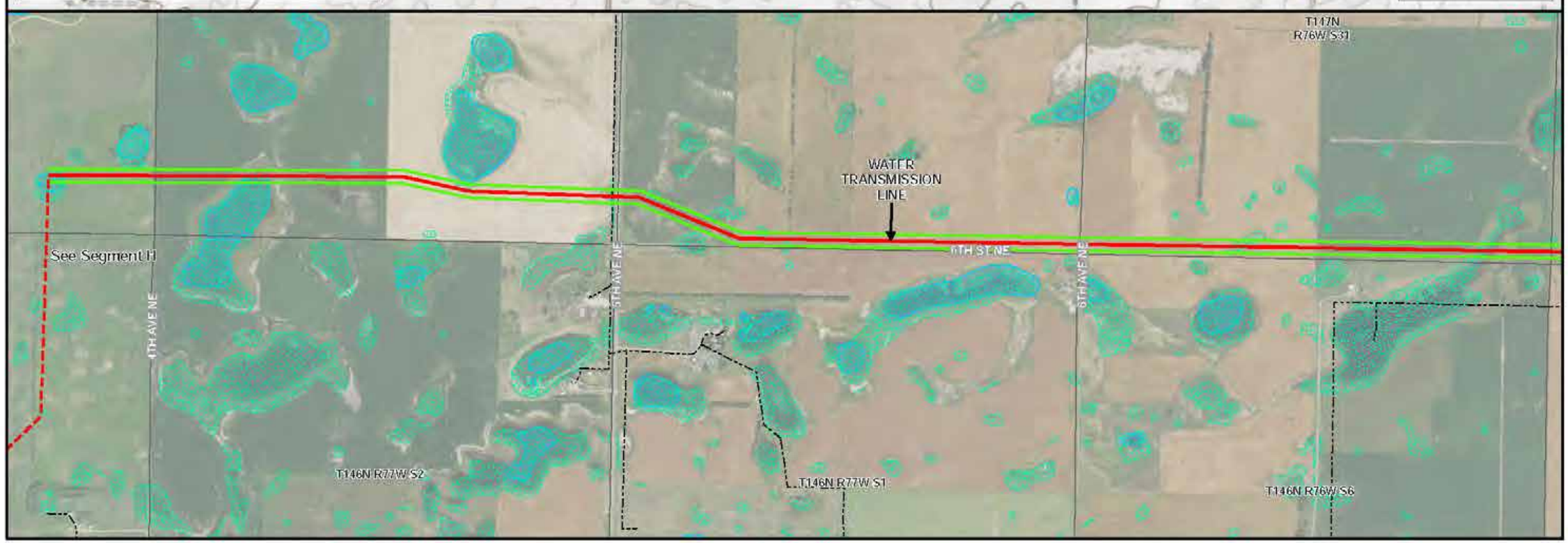


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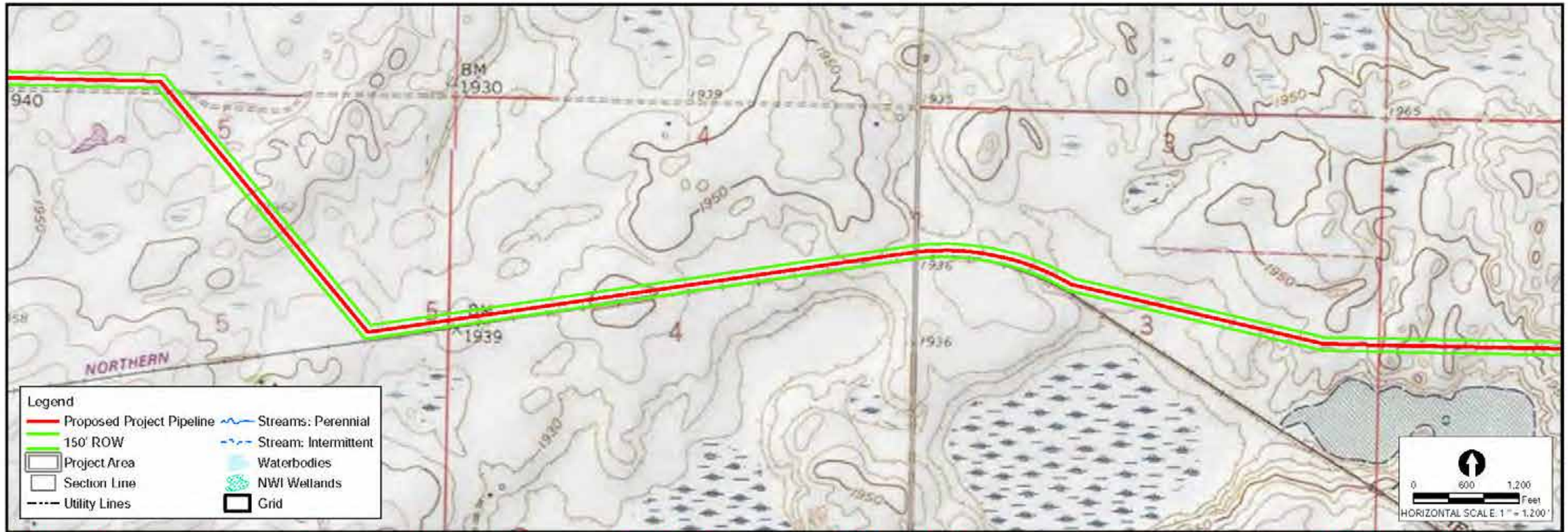
FIGURE NO. G1



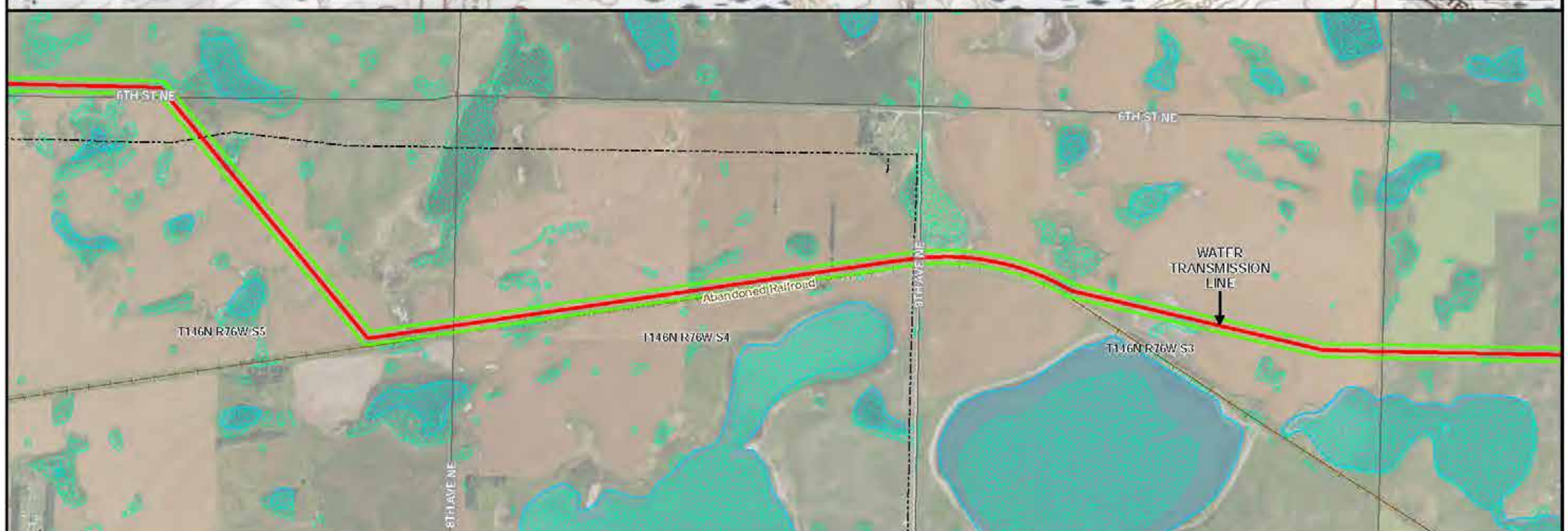


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FIGURE NO. G2

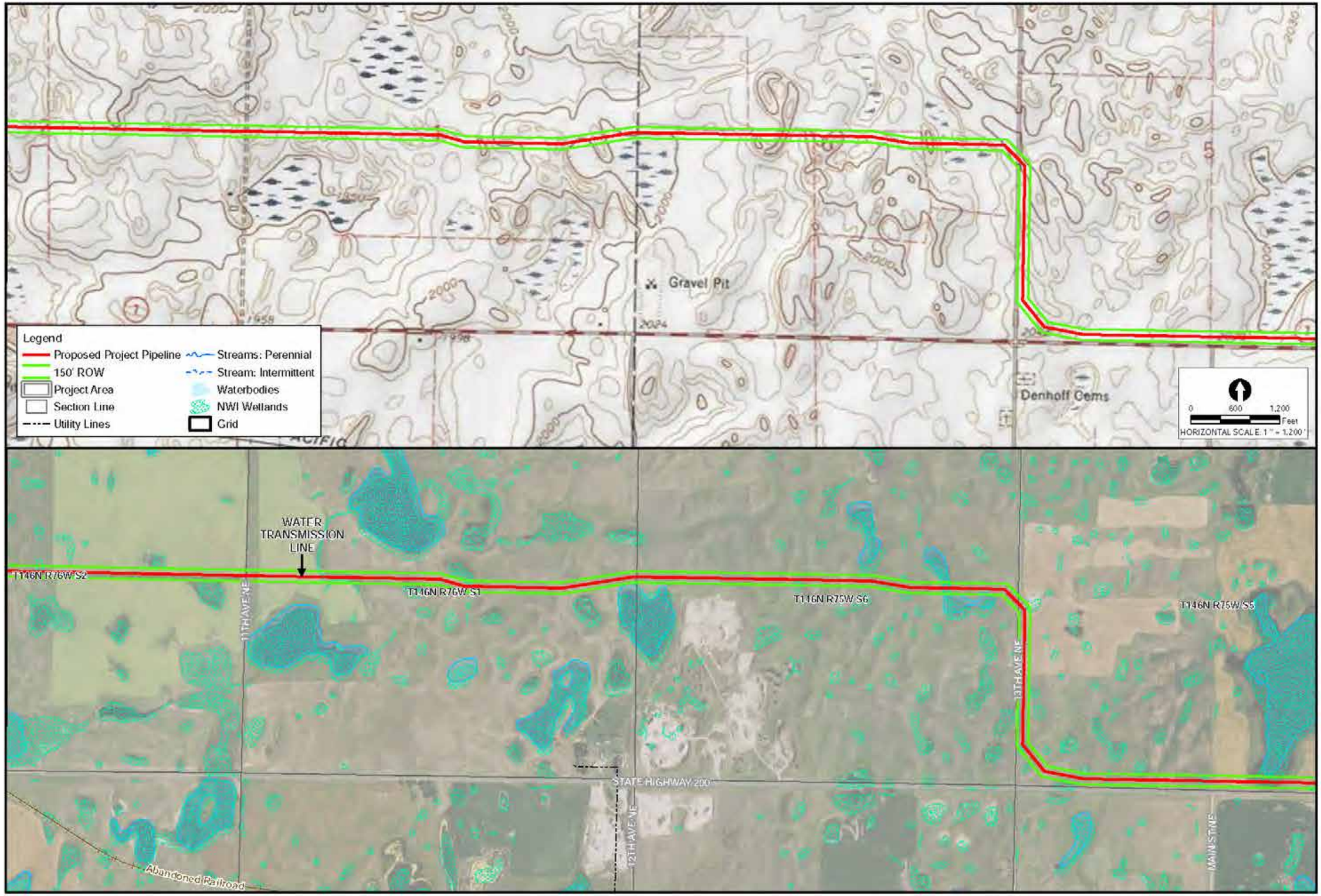

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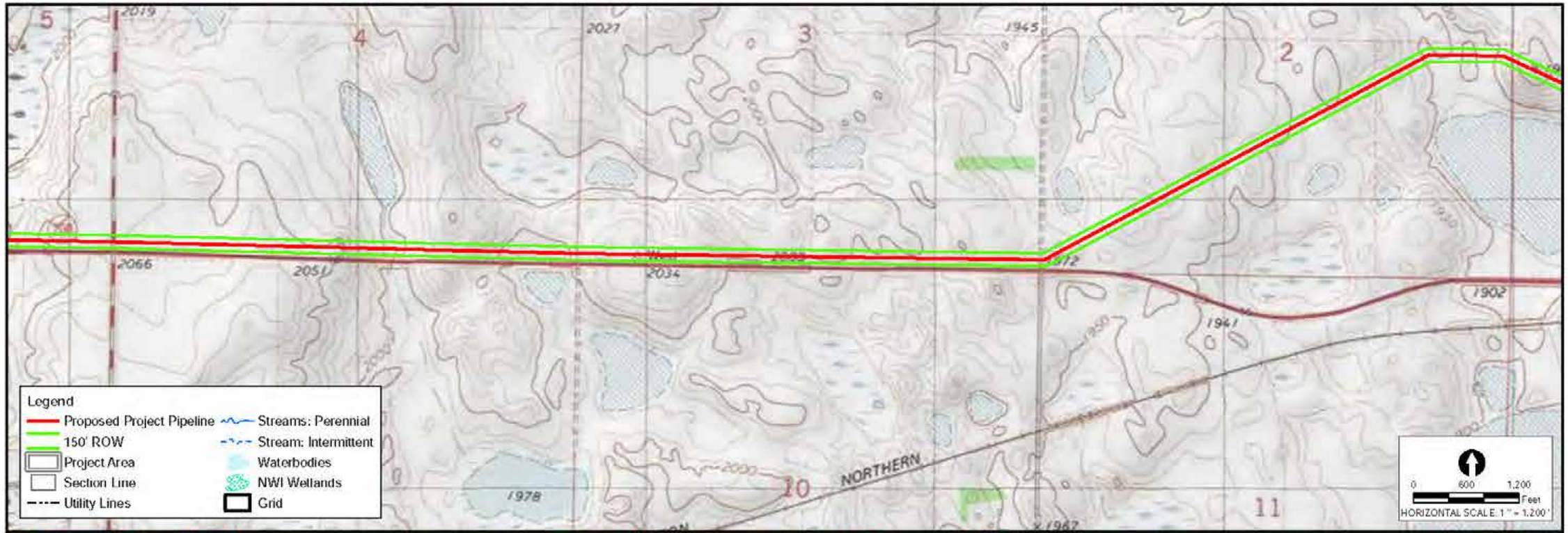
FIGURE NO. G3



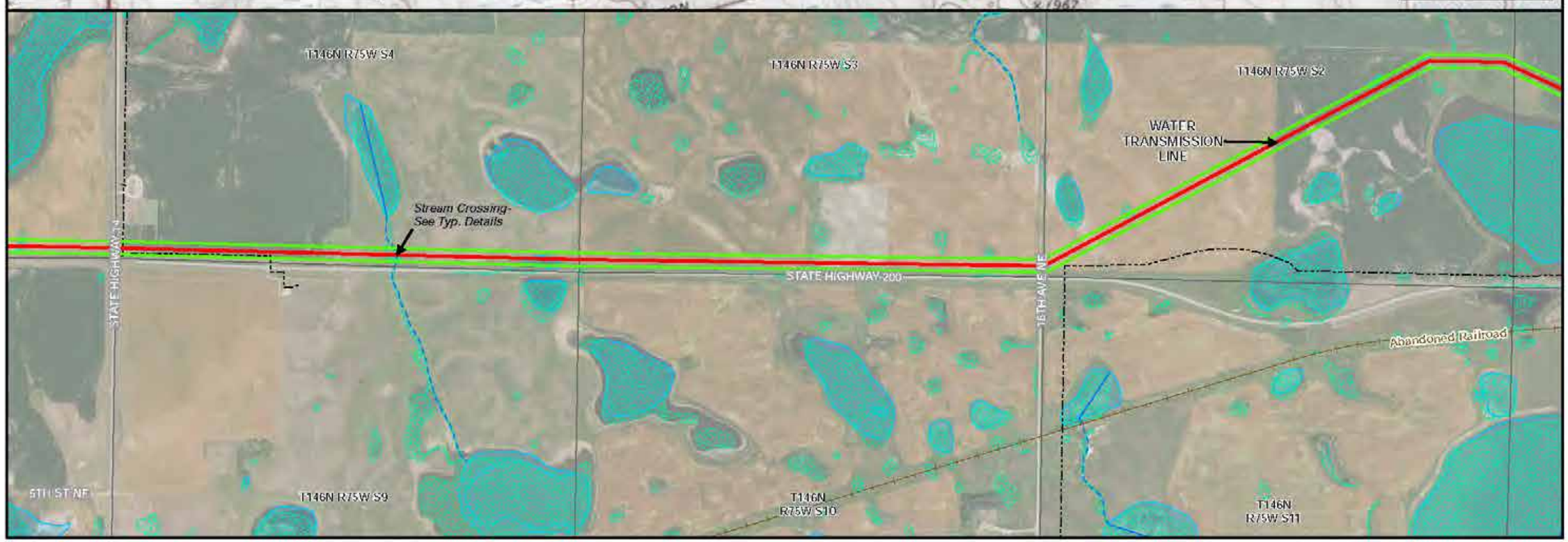


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FIGURE NO. G4

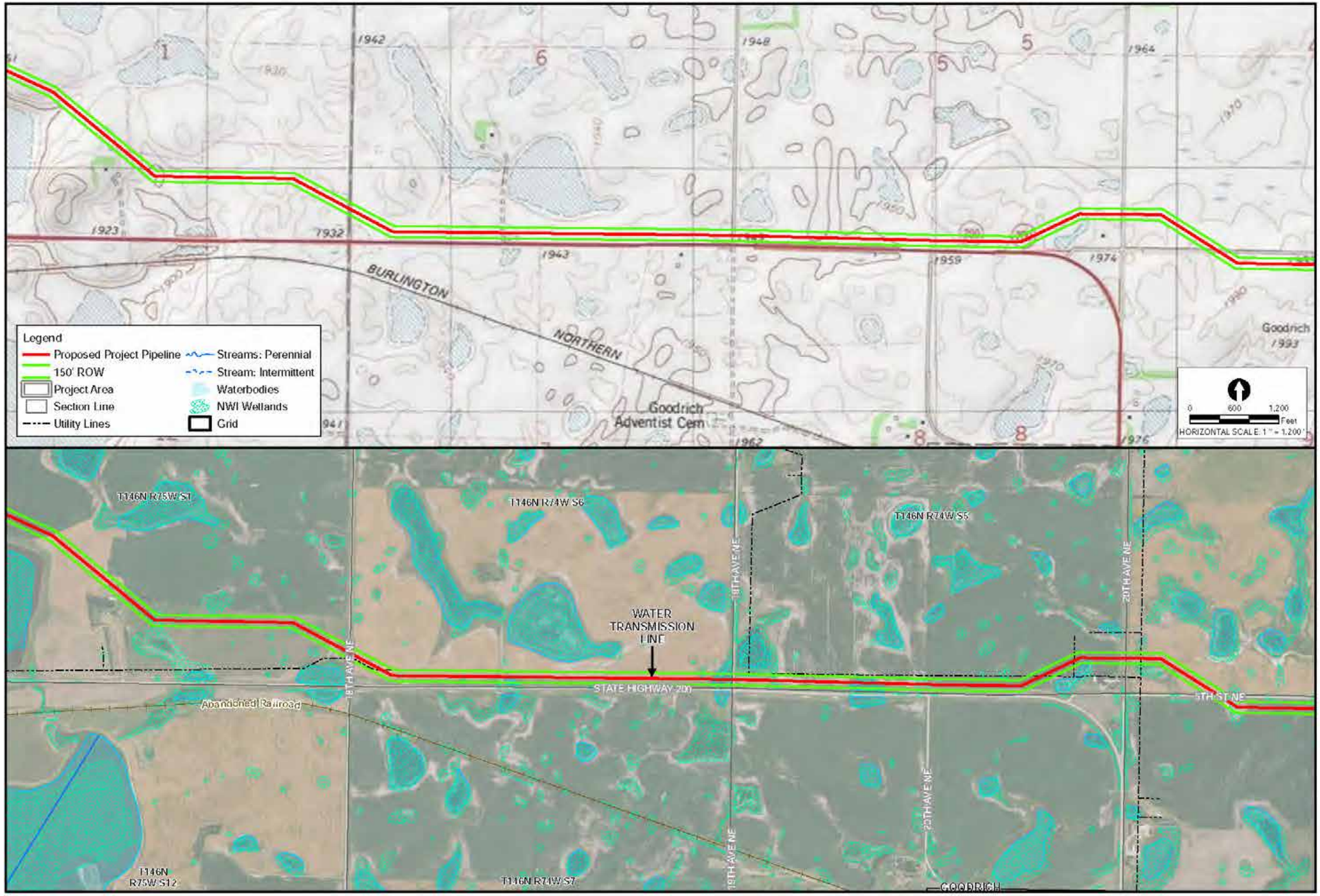

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FIGURE NO. G5

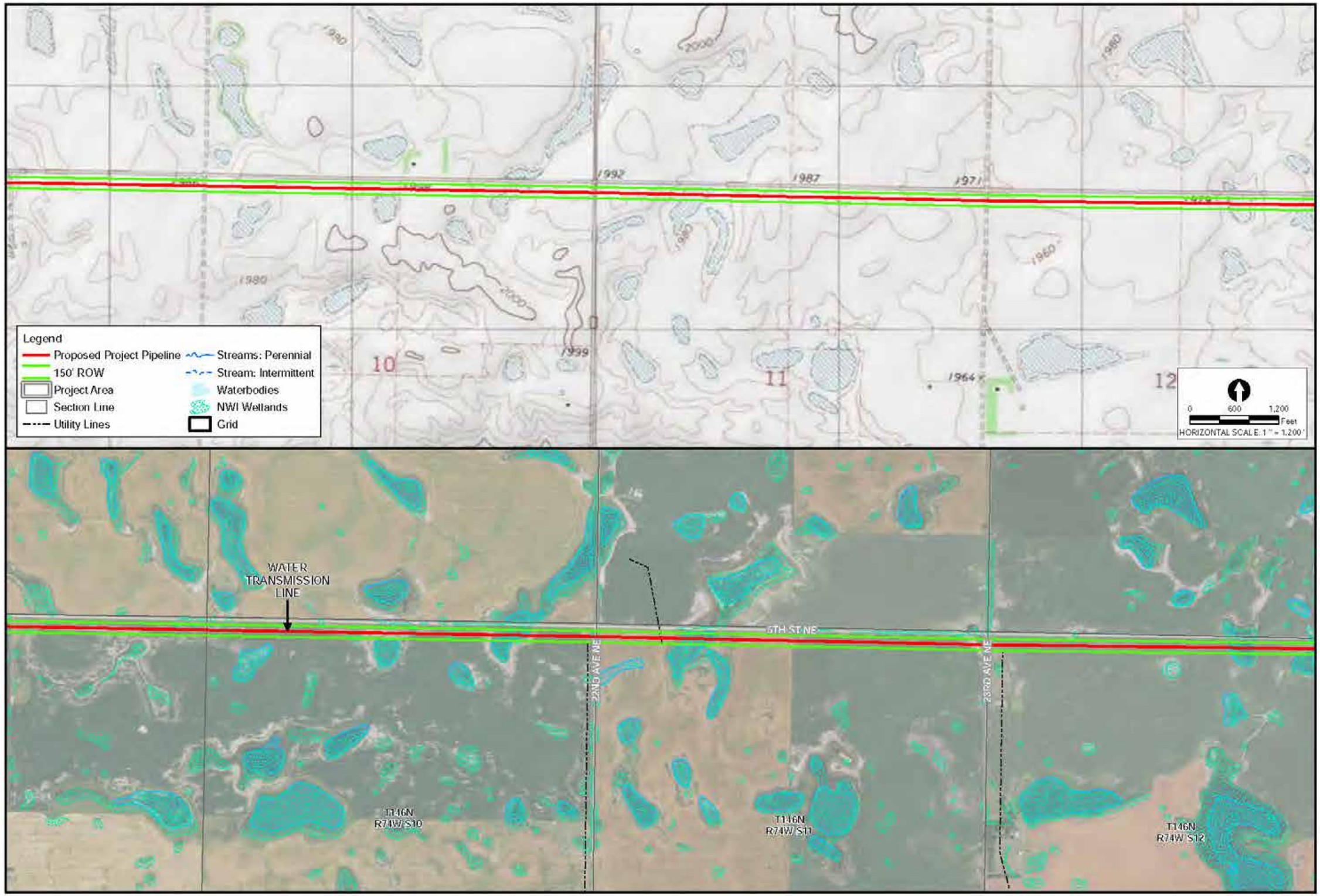

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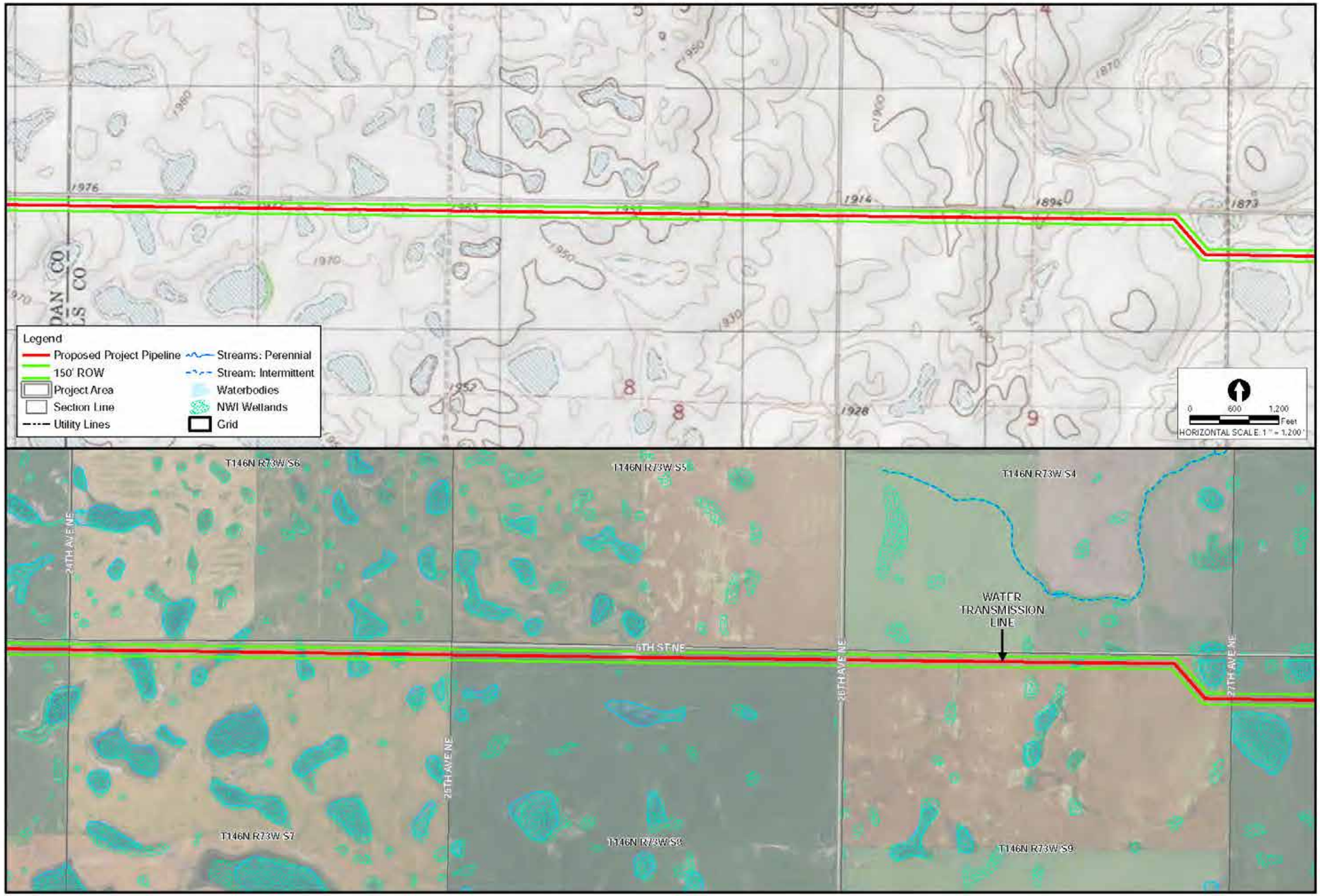
FIGURE NO. G6



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GARRISON DIVERSION

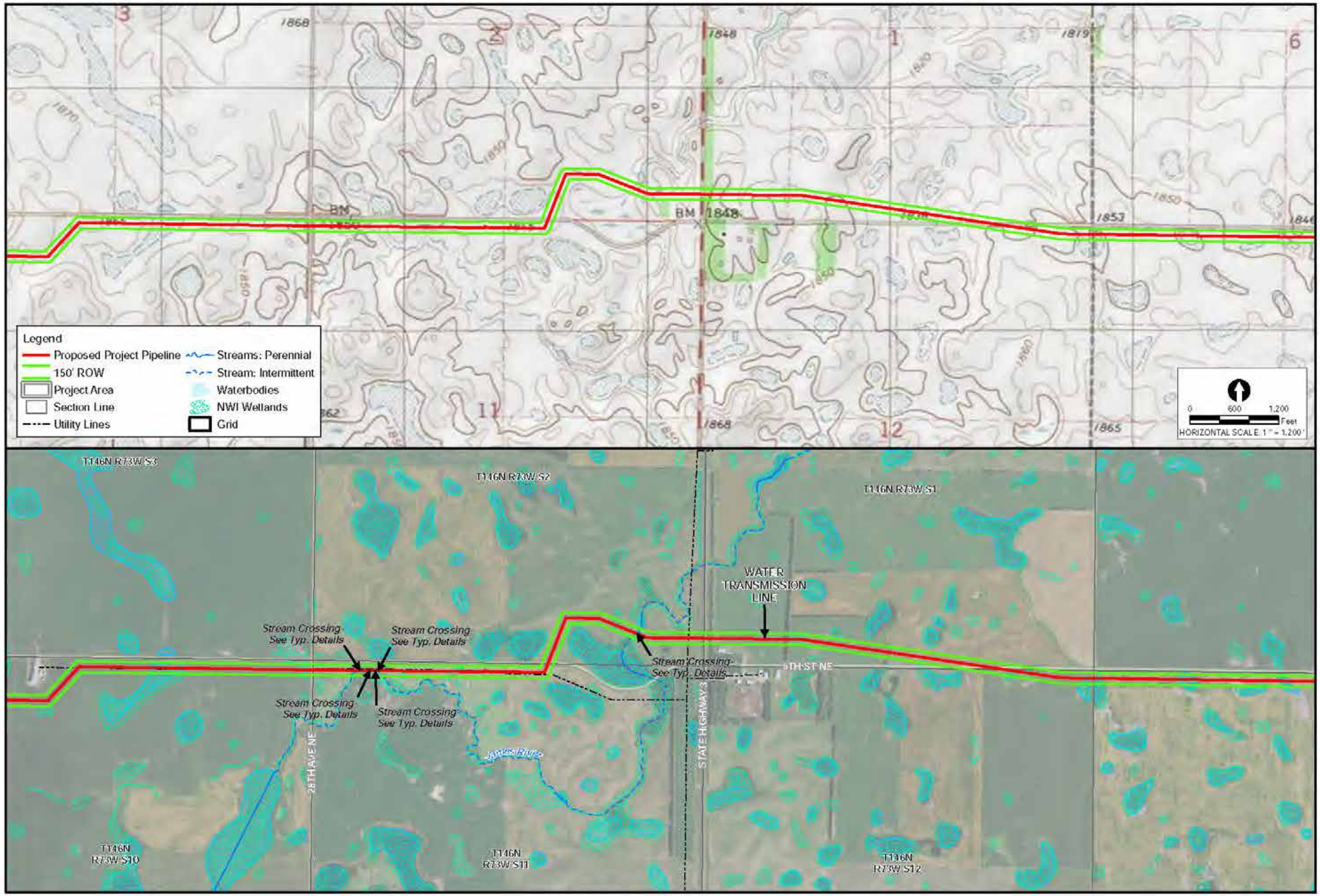
INSET

WATER TRANSMISSION PIPELINE

PLAN SHEET- SEGMENT G

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
DRAWN BY: DLEE
CHECKED BY: LR & SC
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. G7



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PLAN SHEET- SEGMENT G

Eastern North Dakota Alternate Water Supply Project

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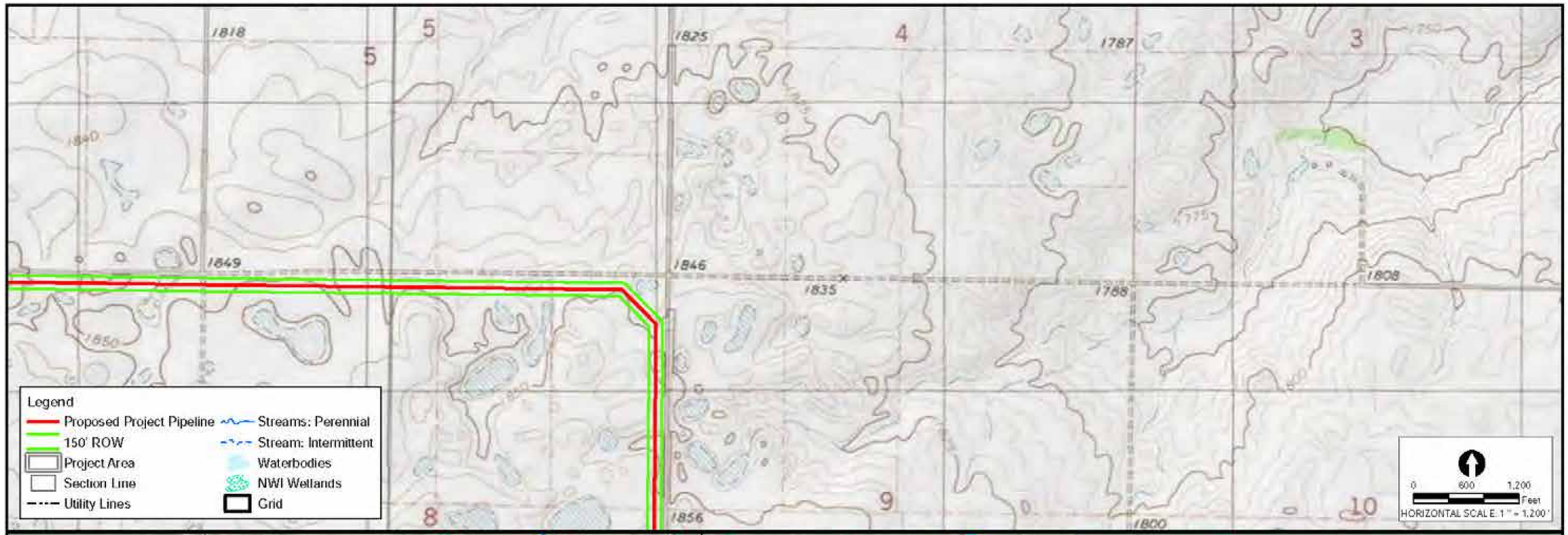
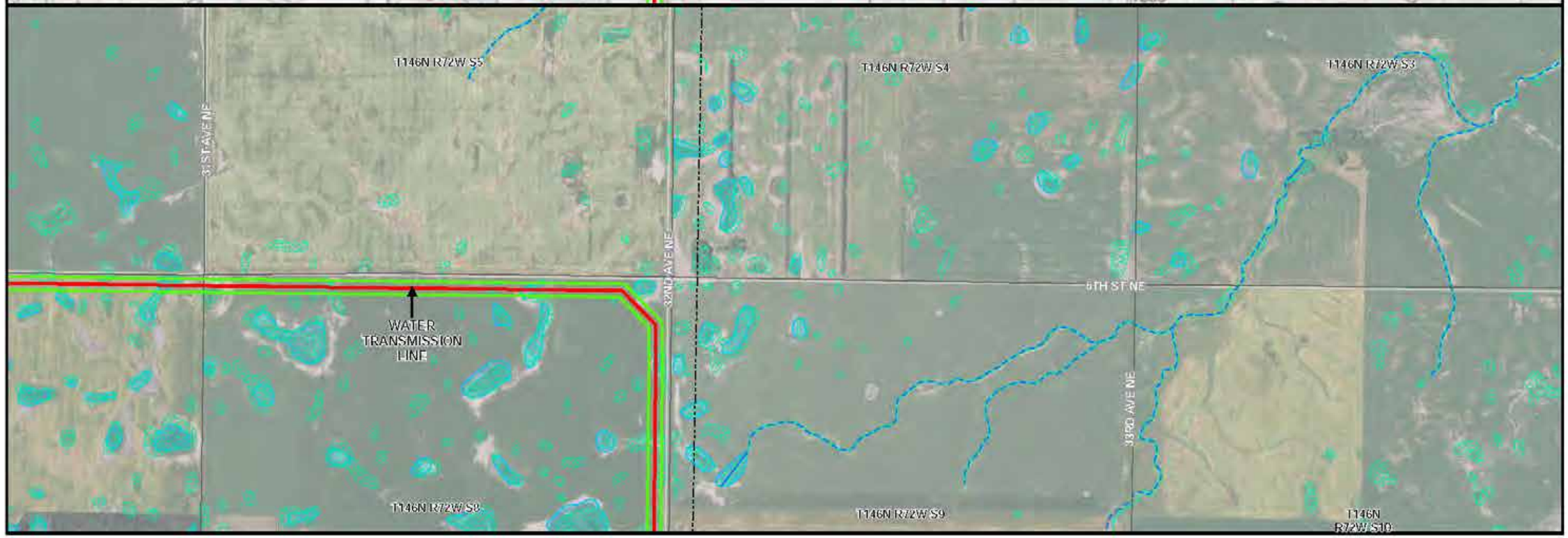
SCALE: AS SHOWN
JOB NO. 00700-2019-017
FIGURE NO. G8





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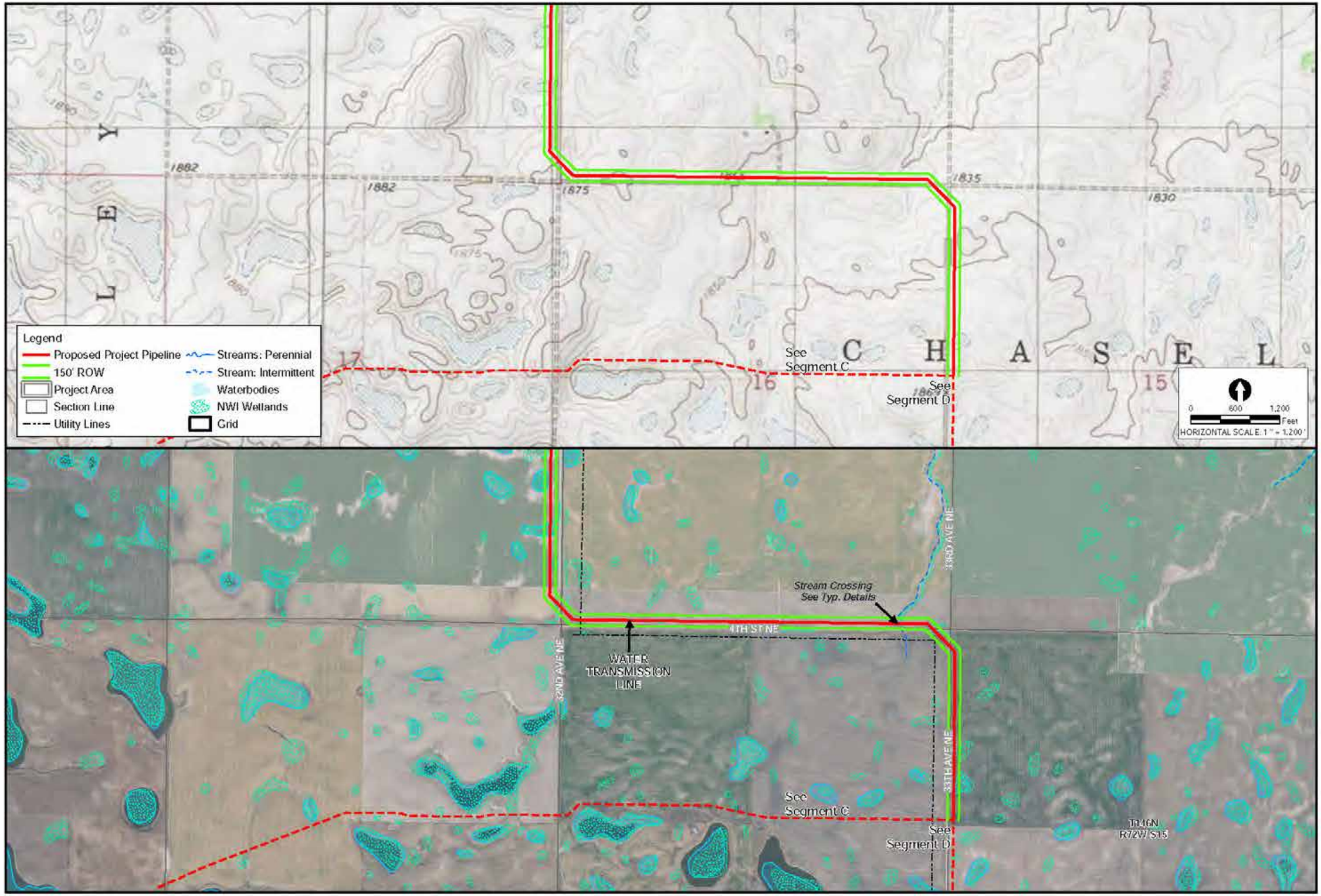
PLAN SHEET- SEGMENT G

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
DRAWN BY: DLEE
CHECKED BY: LR & SC
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. G9



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PLAN SHEET- SEGMENT G

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
DRAWN BY: DLEE
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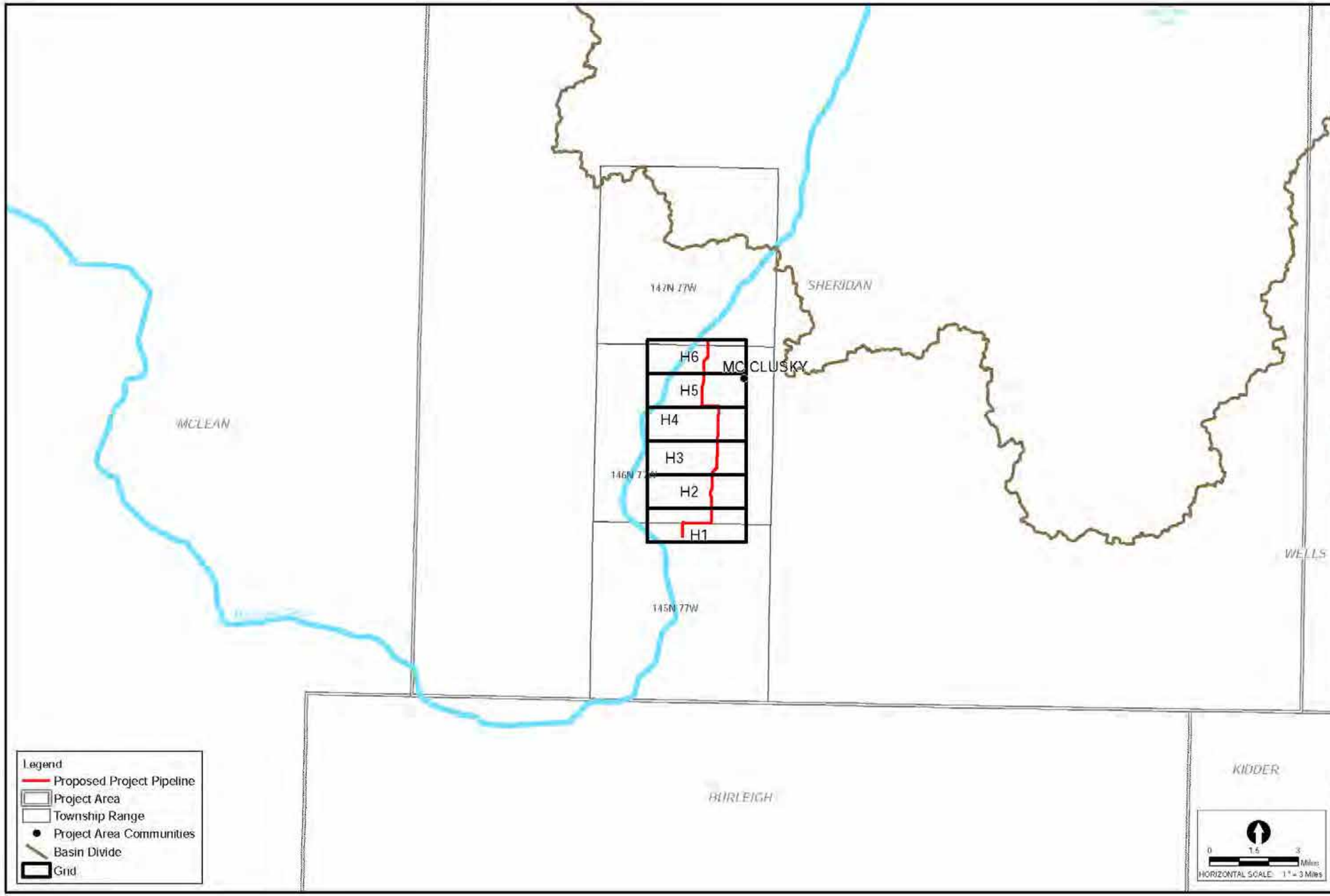
SCALE: AS SHOWN
JOB NO: 00700-2019-017
FIGURE NO. G10



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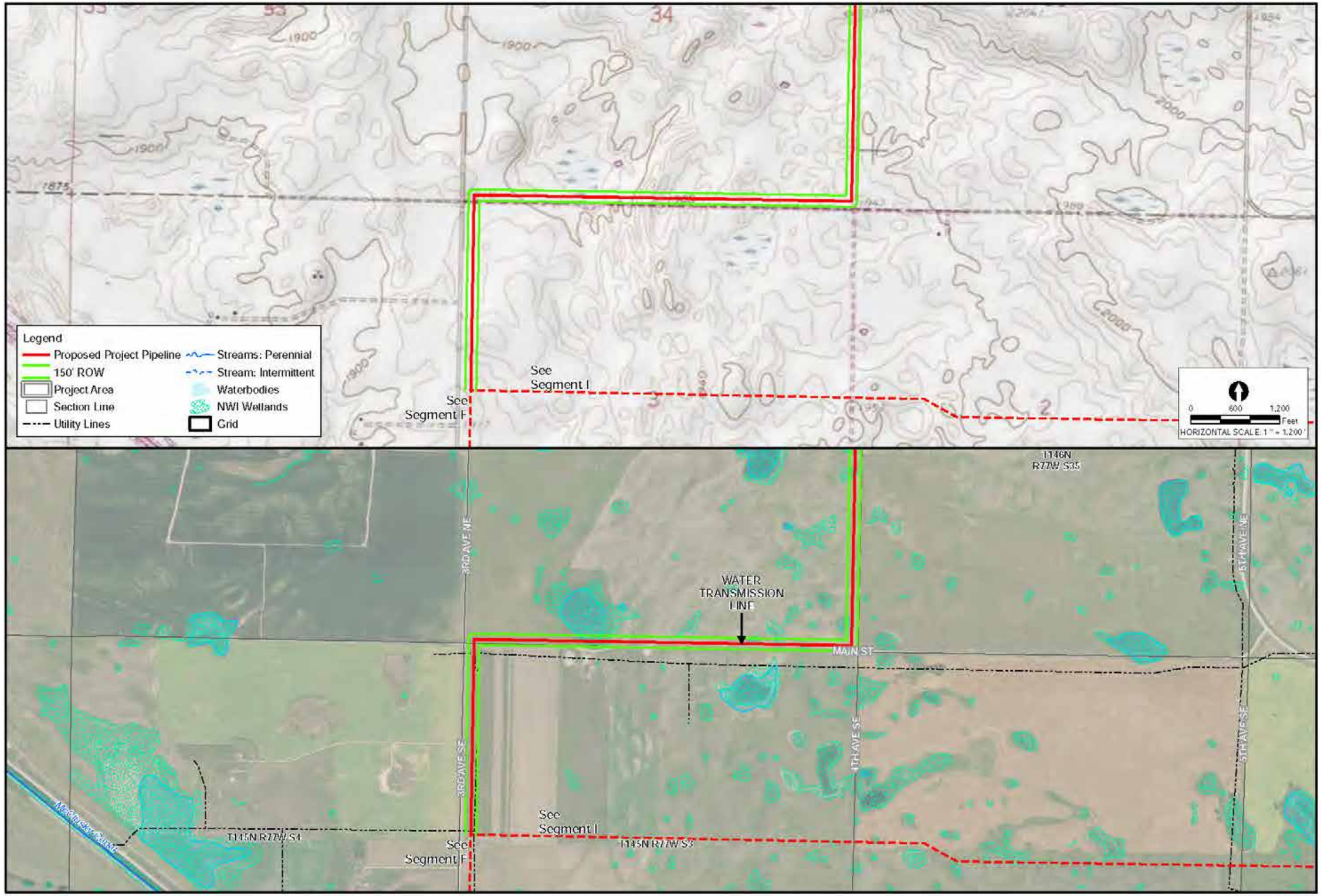
WATER TRANSMISSION PIPELINE

INDEX SHEET- SEGMENT H

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
DRAWN BY: DLEE
CHECKED BY: LR & SC
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. 01



DATE	REVISIONS	NO

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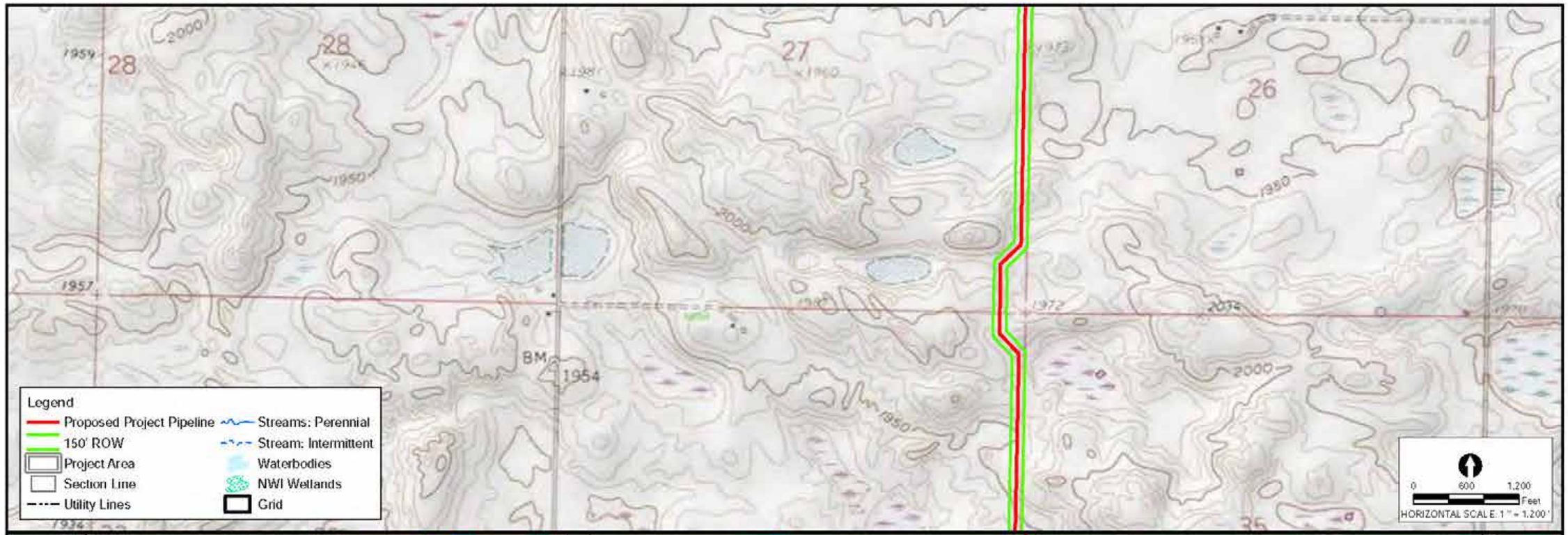
INSET

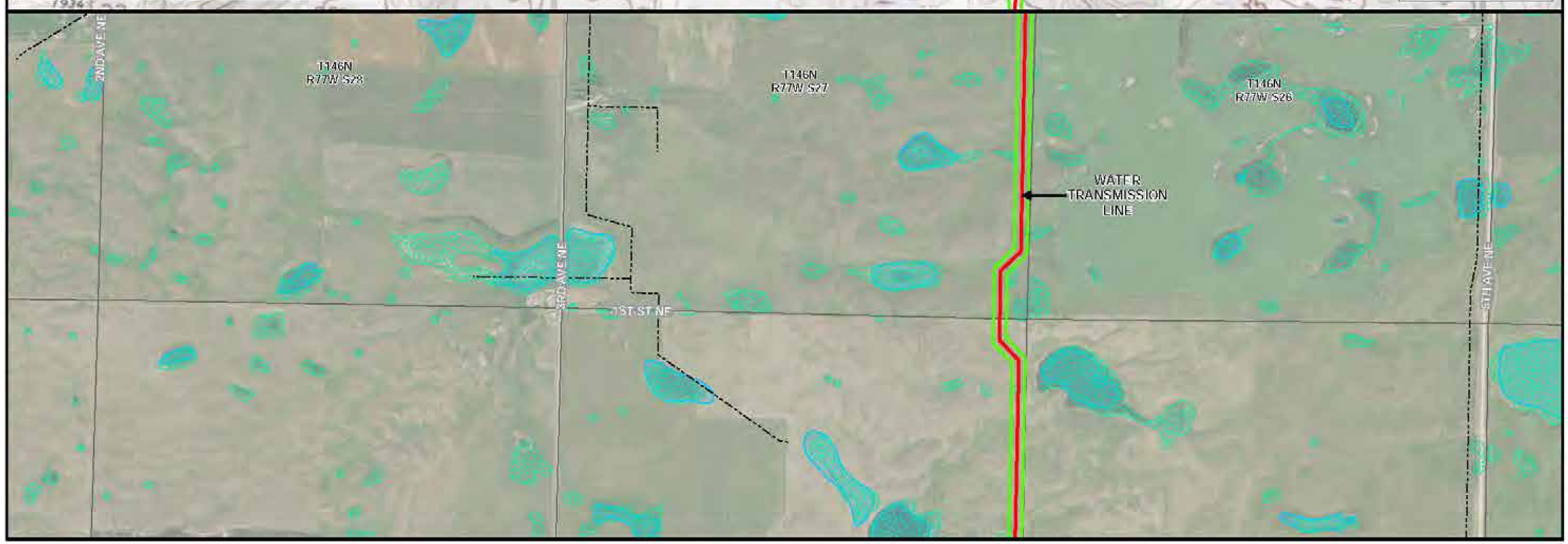
WATER TRANSMISSION PIPELINE

PLAN SHEET- SEGMENT H

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
DRAWN BY: DLEE
CHECKED BY: LR & SC
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. H1





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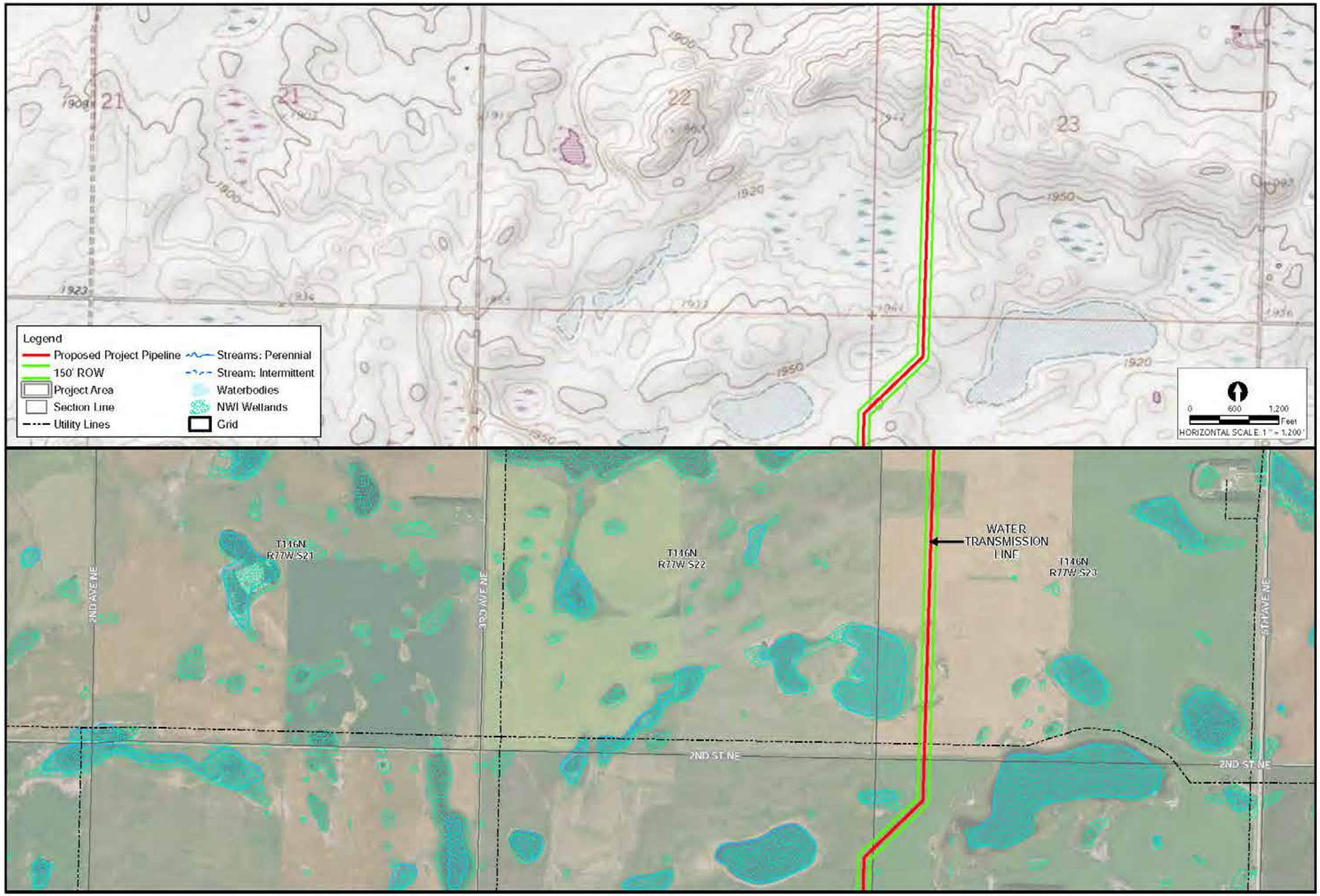
WATER TRANSMISSION PIPELINE

PLAN SHEET- SEGMENT H

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
DRAWN BY: DLEE
CHECKED BY: LR & SC
SCALE: AS SHOWN
JOB NO. 00700-2019-017
FIGURE NO. H2



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PLAN SHEET- SEGMENT H

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
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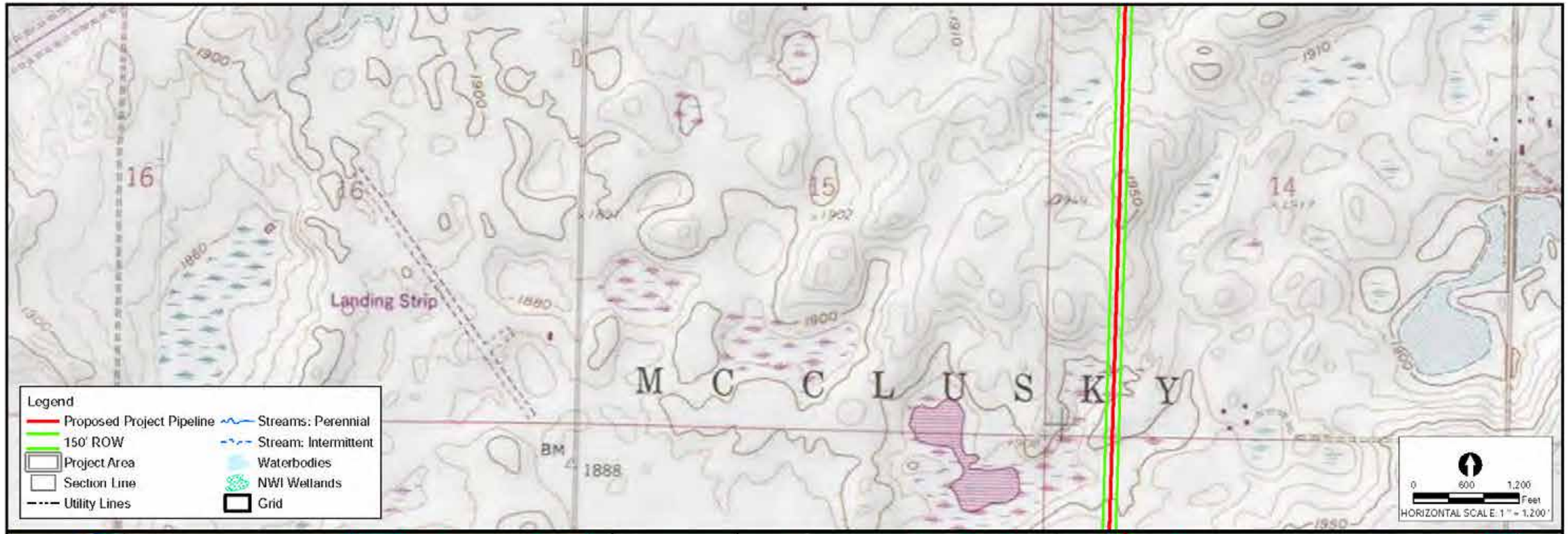
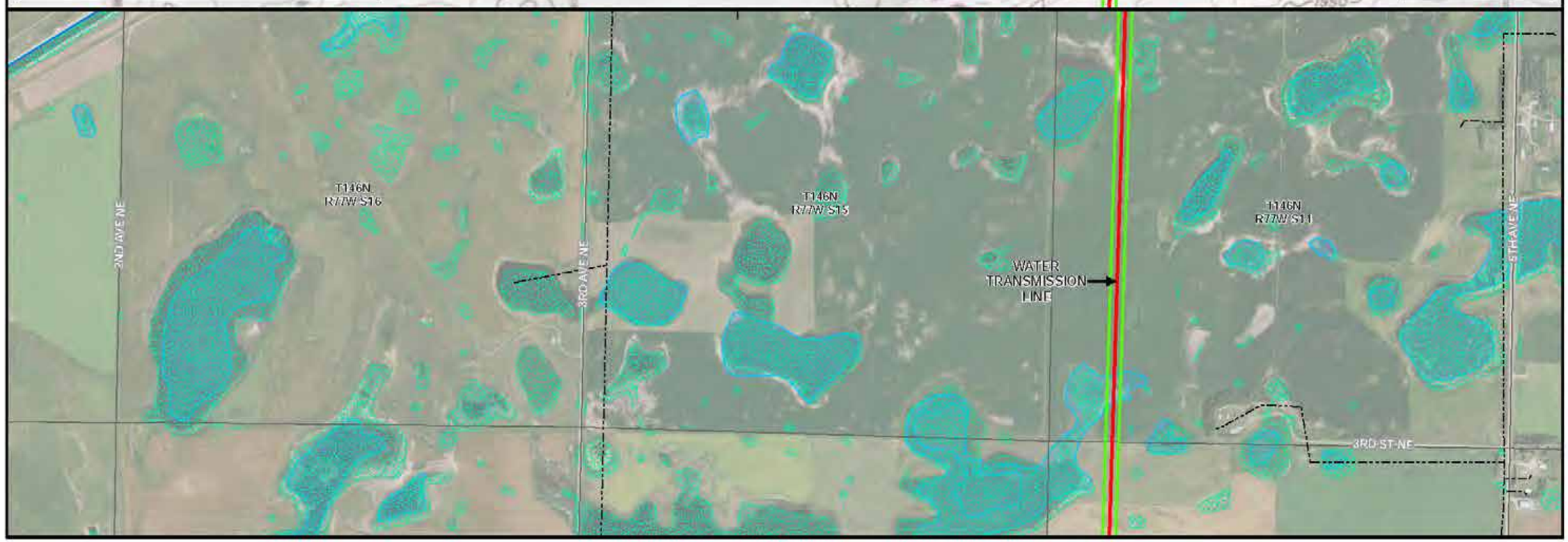
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. H3





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PLAN SHEET- SEGMENT H

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
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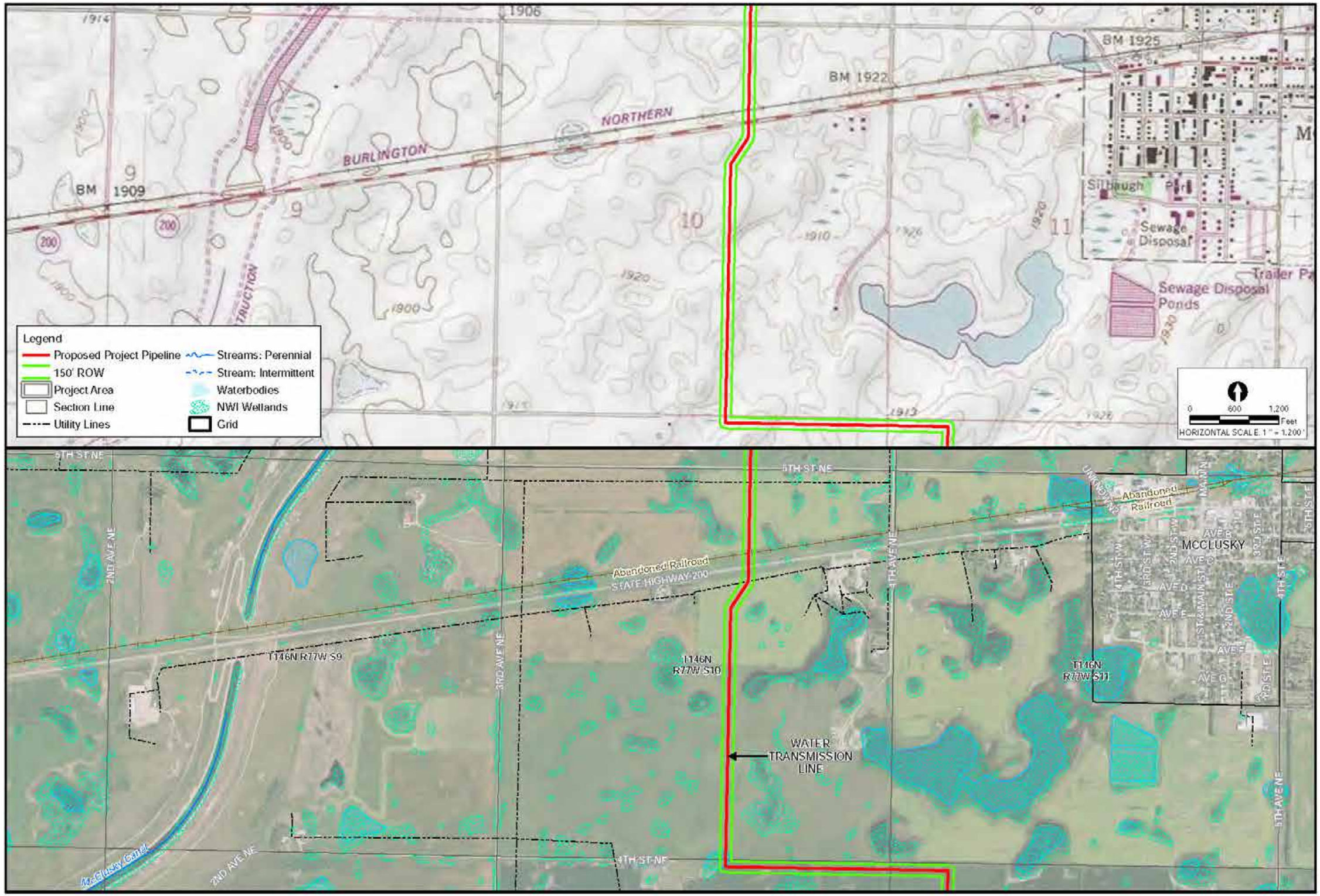
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. H4



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PLAN SHEET- SEGMENT H

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
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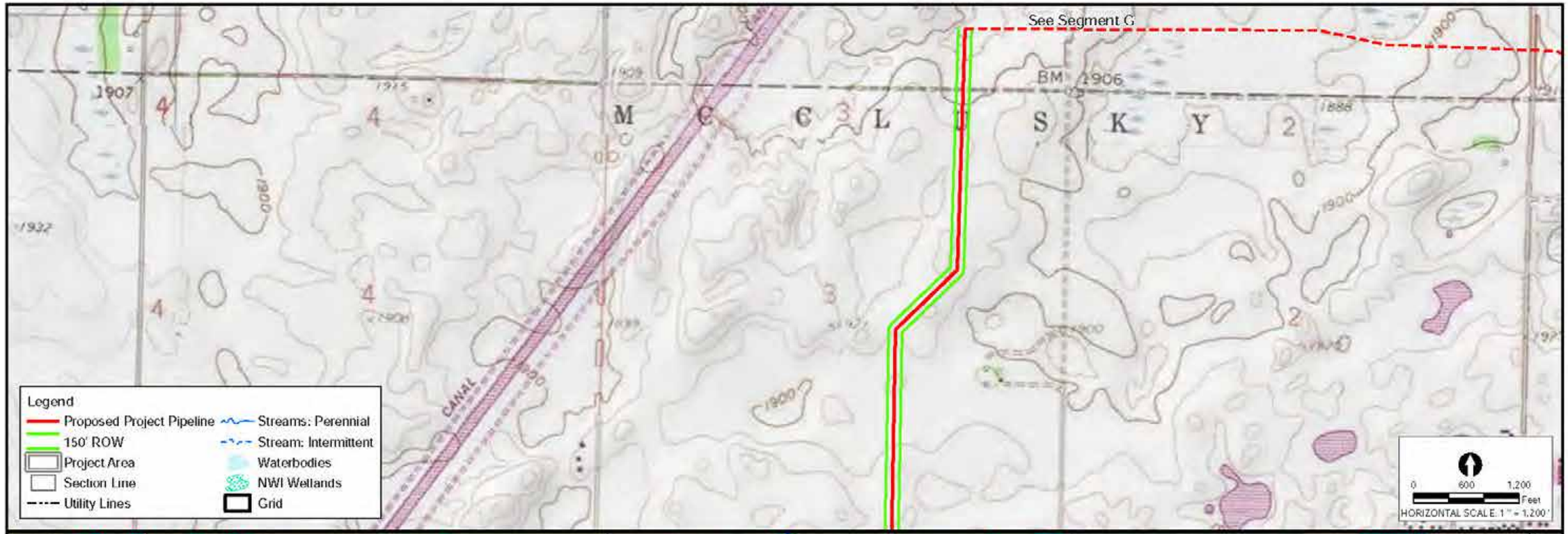
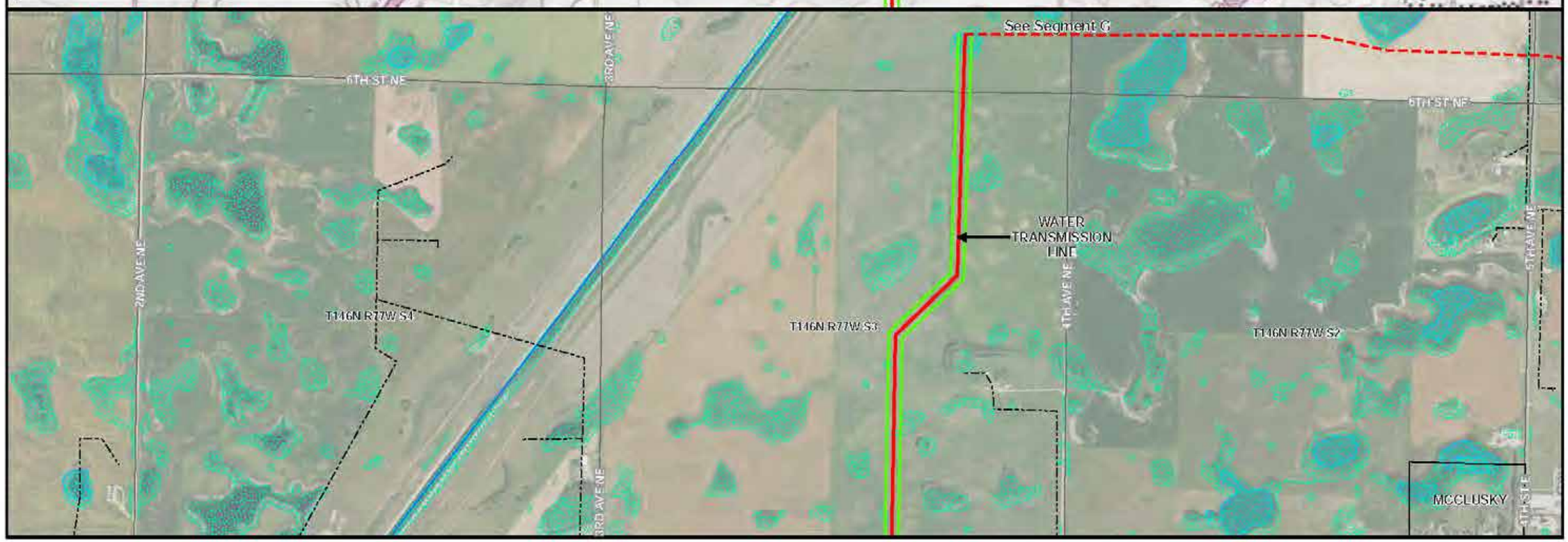
SCALE: AS SHOWN
JOB NO. 00700-2019-017
FIGURE NO: H5





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PLAN SHEET- SEGMENT H

Eastern North Dakota Alternate Water Supply Project

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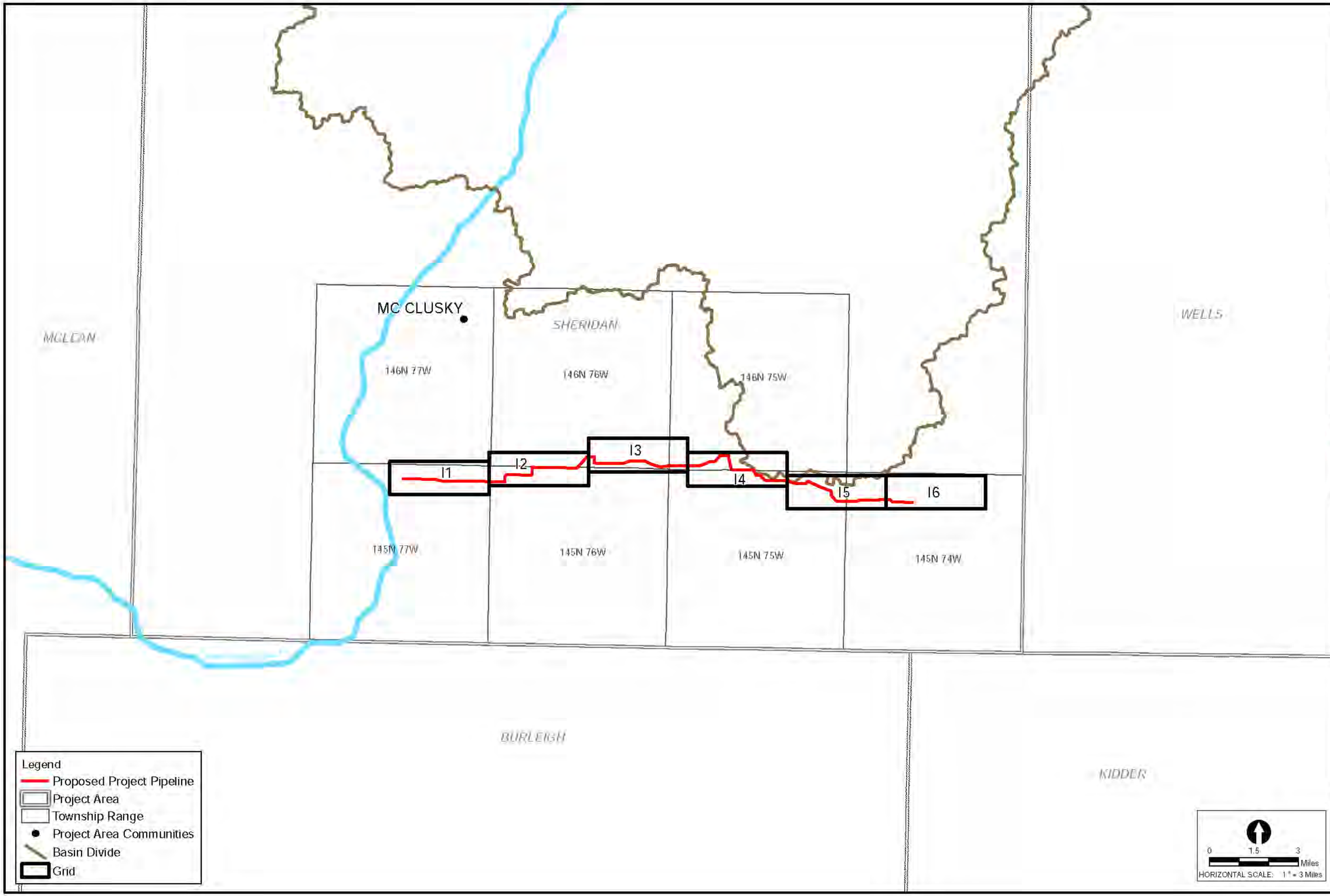
JOB NO. 00200-2019-017
FIGURE NO. H6



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INDEX SHEET- SEGMENT I

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
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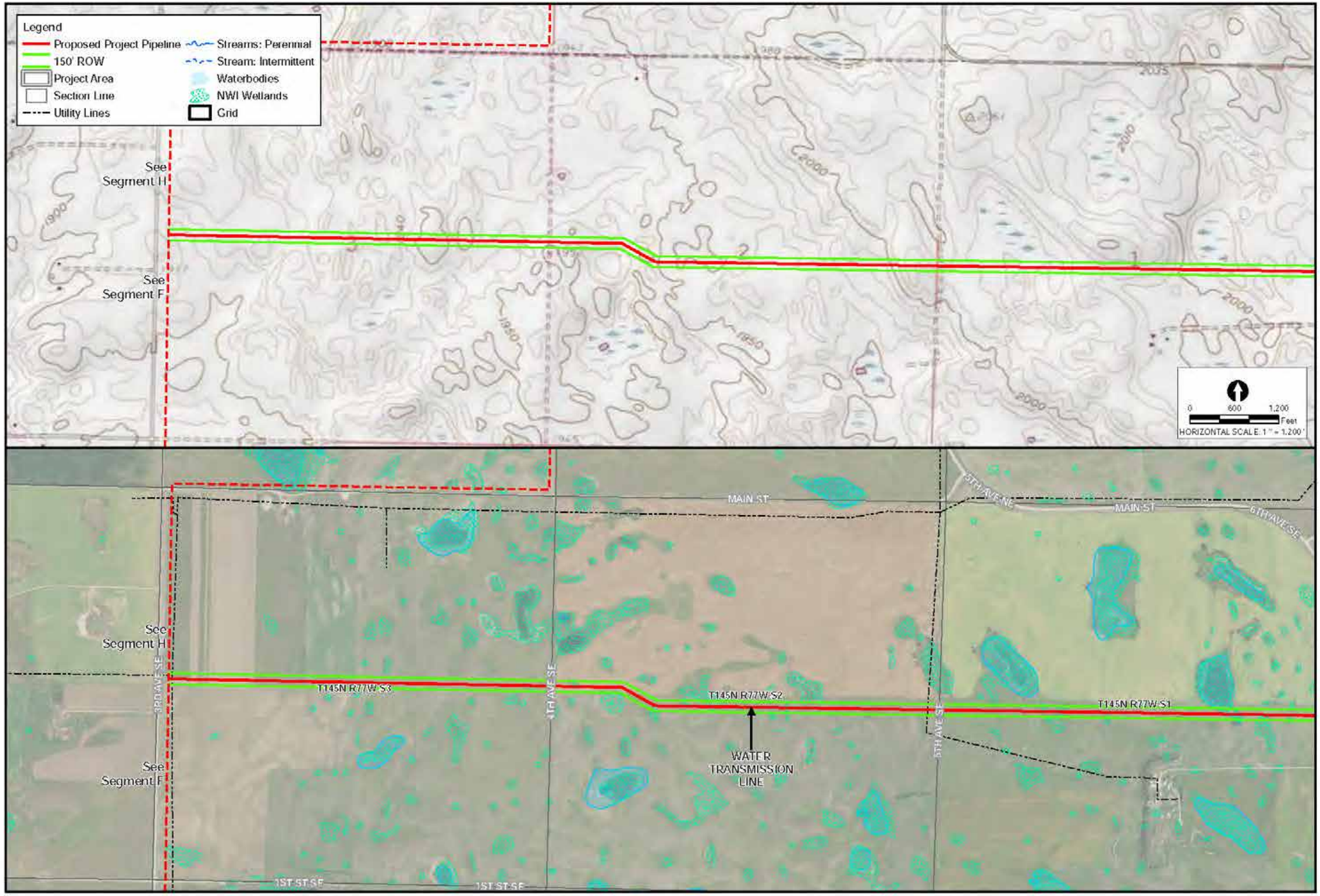
SCALE: AS SHOWN
JOB NO. 00200-2019-017
FIGURE NO. 01



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PLAN SHEET- SEGMENT I

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
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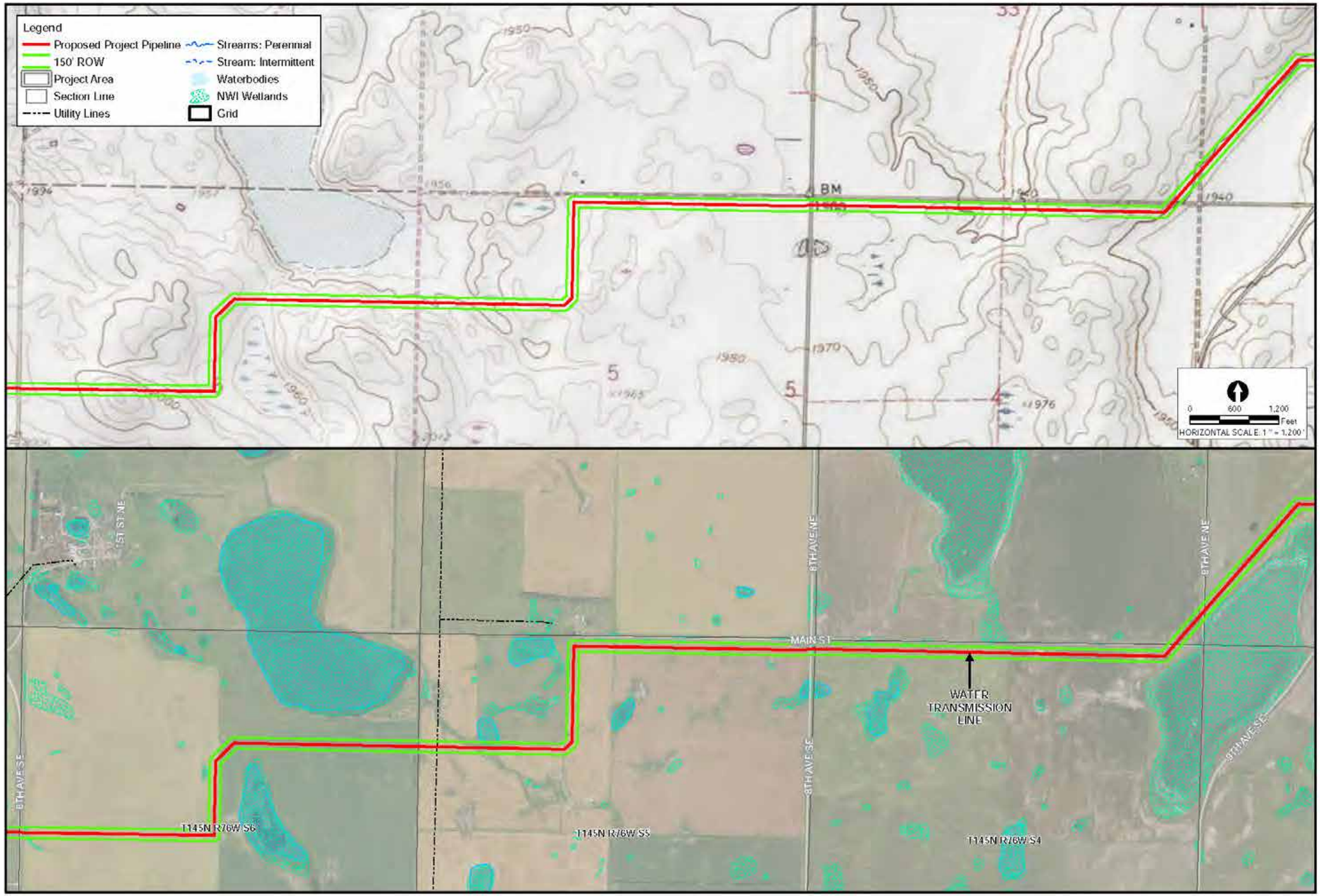
SCALE: AS SHOWN
JOB NO. 00700-2019-017
FIGURE NO. I1



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PLAN SHEET- SEGMENT I

Eastern North Dakota Alternate Water Supply Project

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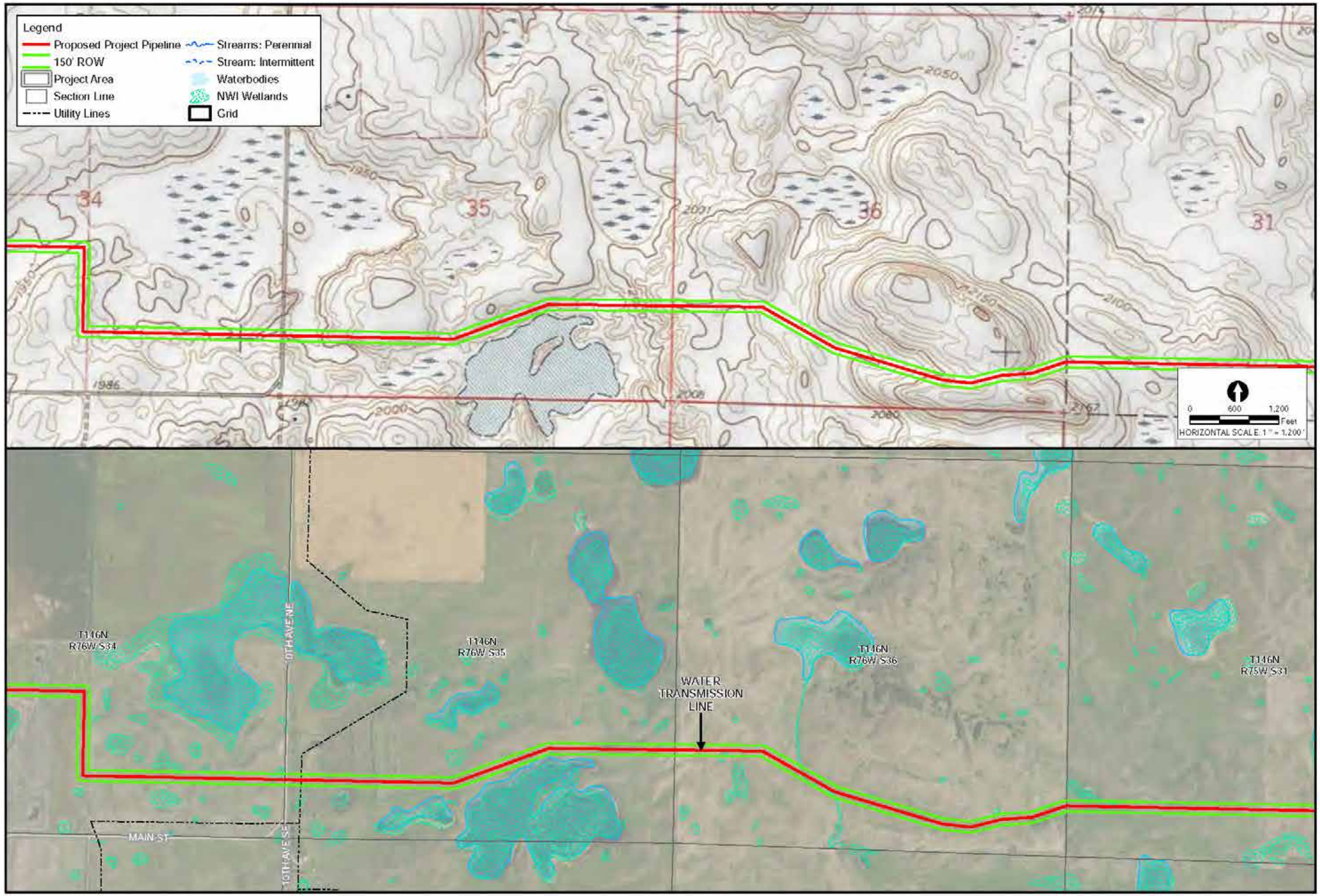
JOB NO. 00200-2019-017
FIGURE NO. 12



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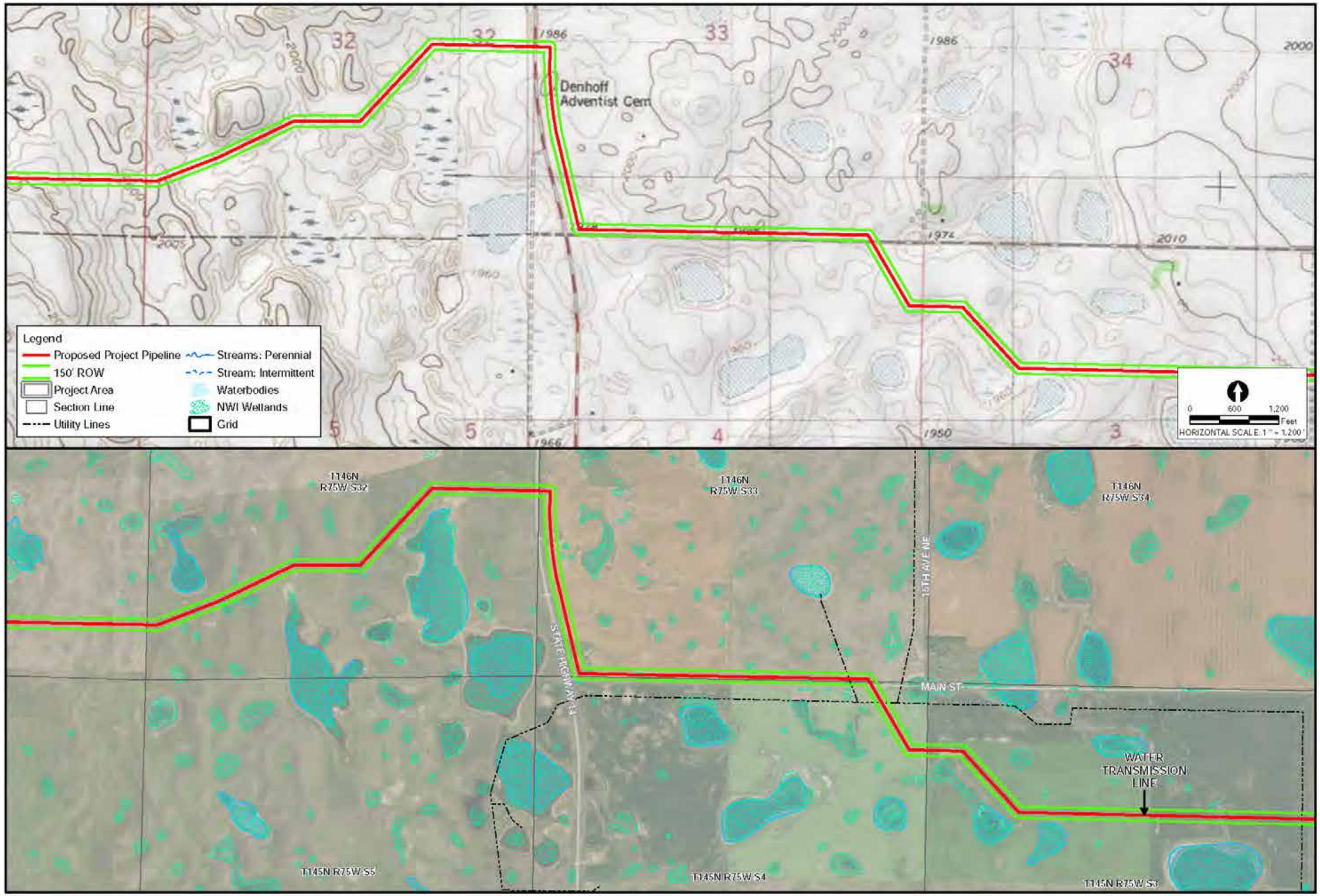
JOB NO. 00200-2019-017
FIGURE NO. 13



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PLAN SHEET- SEGMENT I

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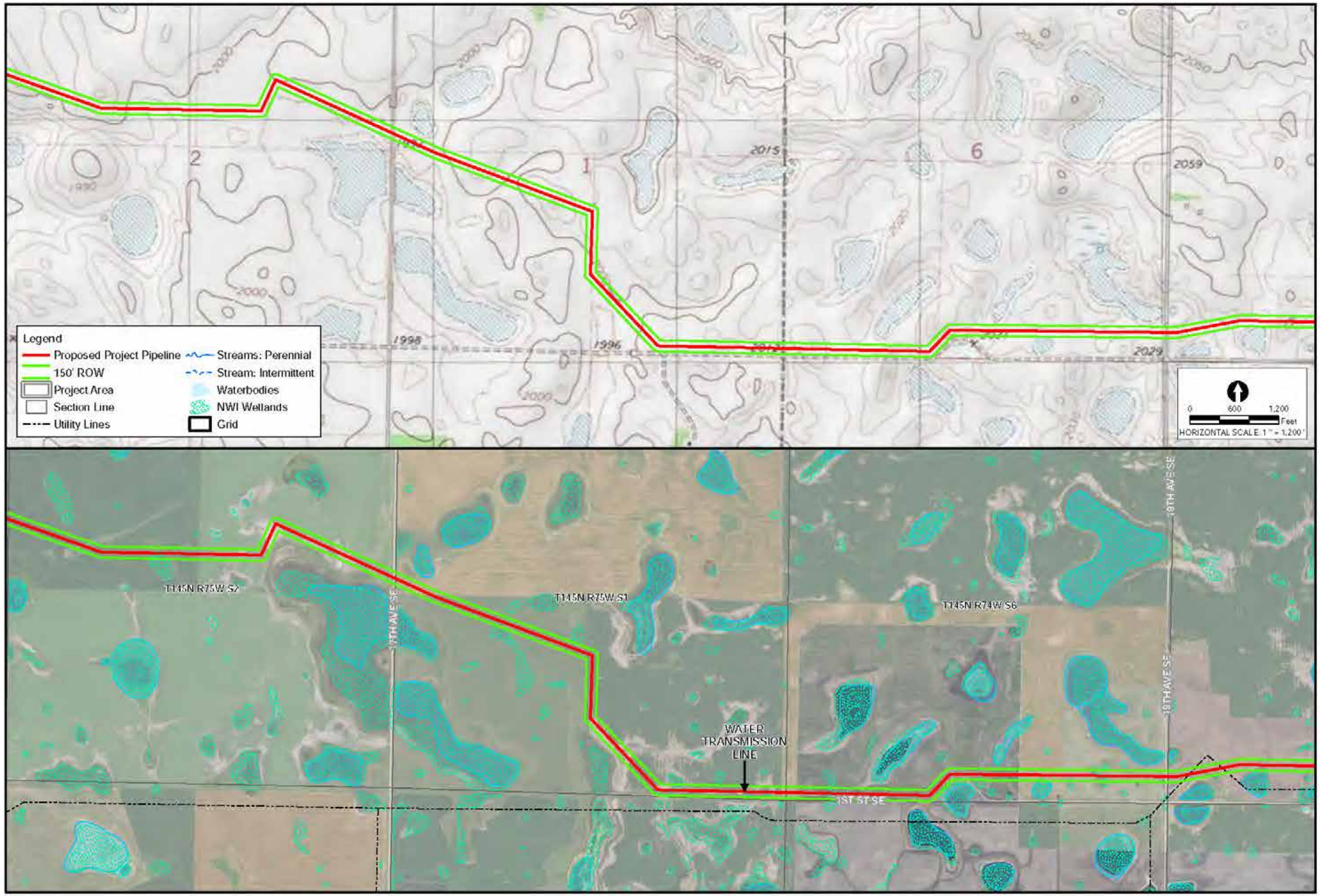
JOB NO. 00200-2019-017
FIGURE NO. 14



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PLAN SHEET- SEGMENT I

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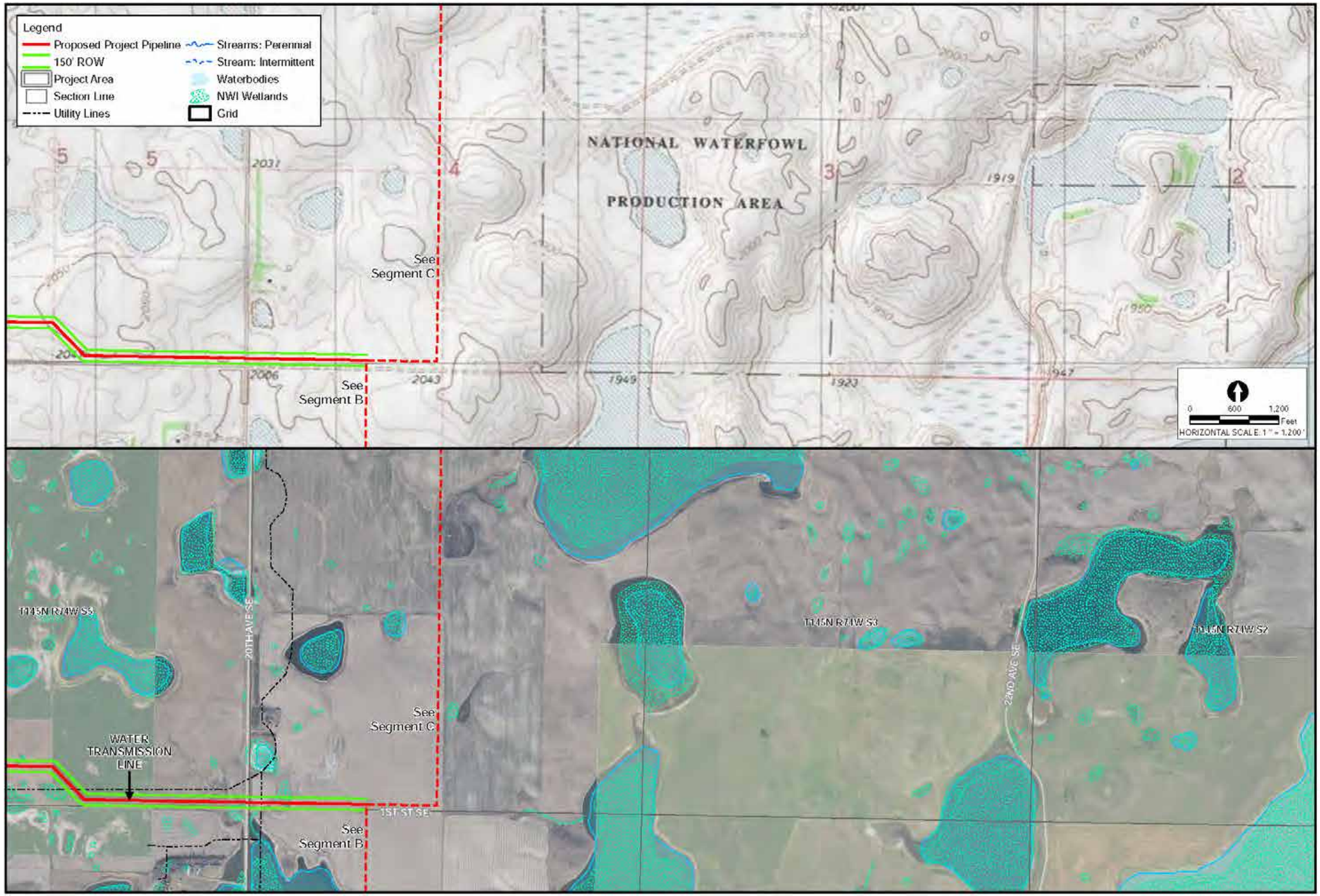
JOB NO. 00200-2019-017
FIGURE NO. 15



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PLAN SHEET- SEGMENT I

Eastern North Dakota Alternate Water Supply Project

DATE: 11/21/2019
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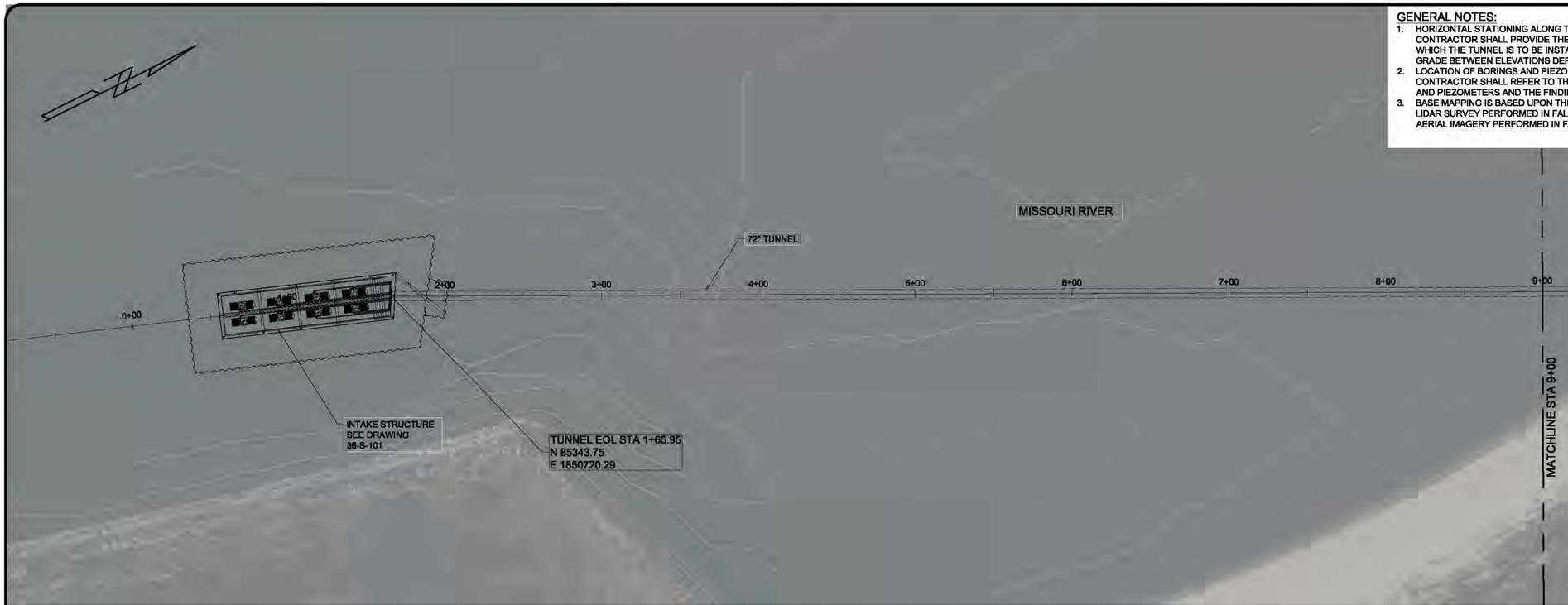
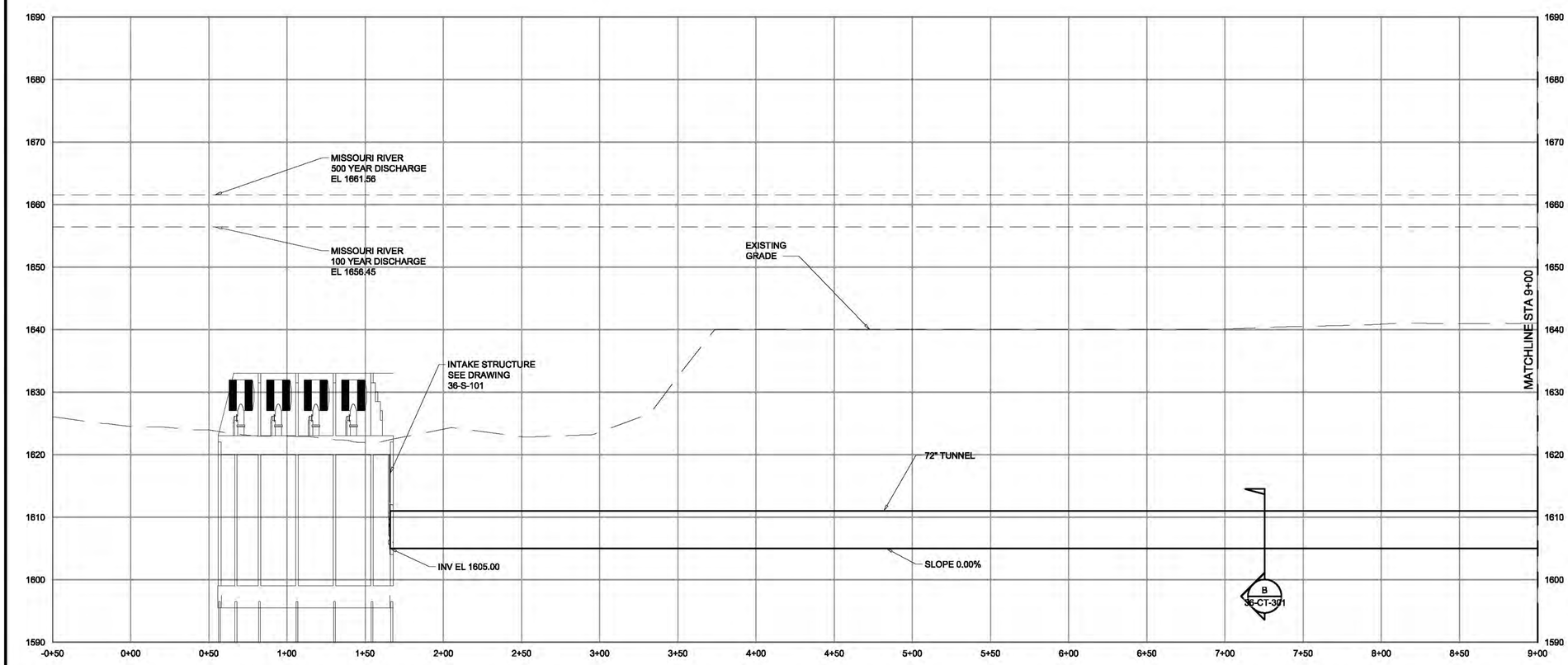
JOB NO. 00200-2019-017
FIGURE NO. 16

Attachment B Facility Drawings

GENERAL NOTES:

1. HORIZONTAL STATIONING ALONG THE TUNNEL ALIGNMENT IS FOR LEVEL LINE MEASUREMENT. CONTRACTOR SHALL PROVIDE THE ACTUAL TUNNEL LENGTH TO BE DETERMINED BY THE SLOPE ON WHICH THE TUNNEL IS TO BE INSTALLED. CONTRACTOR SHALL INSTALL TUNNEL AT A UNIFORM GRADE BETWEEN ELEVATIONS DEPICTED ON THE DRAWINGS.
2. LOCATION OF BORINGS AND PIEZOMETERS INDICATED ON THE DRAWINGS IS APPROXIMATE. CONTRACTOR SHALL REFER TO THE GEOTECHNICAL REPORT FOR ACTUAL LOCATIONS OF THE BORINGS AND PIEZOMETERS AND THE FINDINGS OF THE GEOTECHNICAL INVESTIGATION.
3. BASE MAPPING IS BASED UPON THE FOLLOWING:
   LIDAR SURVEY PERFORMED IN FALL OF 2016
   AERIAL IMAGERY PERFORMED IN FALL OF 2016





10' 0 10' 20'
VERTICAL SCALE 1"=10'

40' 20' 0 40' 80'
HORIZONTAL SCALE 1"=40'

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	CK	APP

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USER: SPA48354
DWG VER:
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XREF2:
XREF3:
XREF4:

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PLAN AND PROFILE
STA 00+00 TO 09+00

BUREAU OF RECLAMATION

EASTERN NORTH DAKOTA
ALTERNATE WATER SUPPLY

MISSOURI RIVER INTAKE
SCREEN STRUCTURE AND TUNNEL

DESIGNED: DES
DETAILED: DET
CHECKED: CHK
APPROVED: APP
DATE: OCTOBER 2019

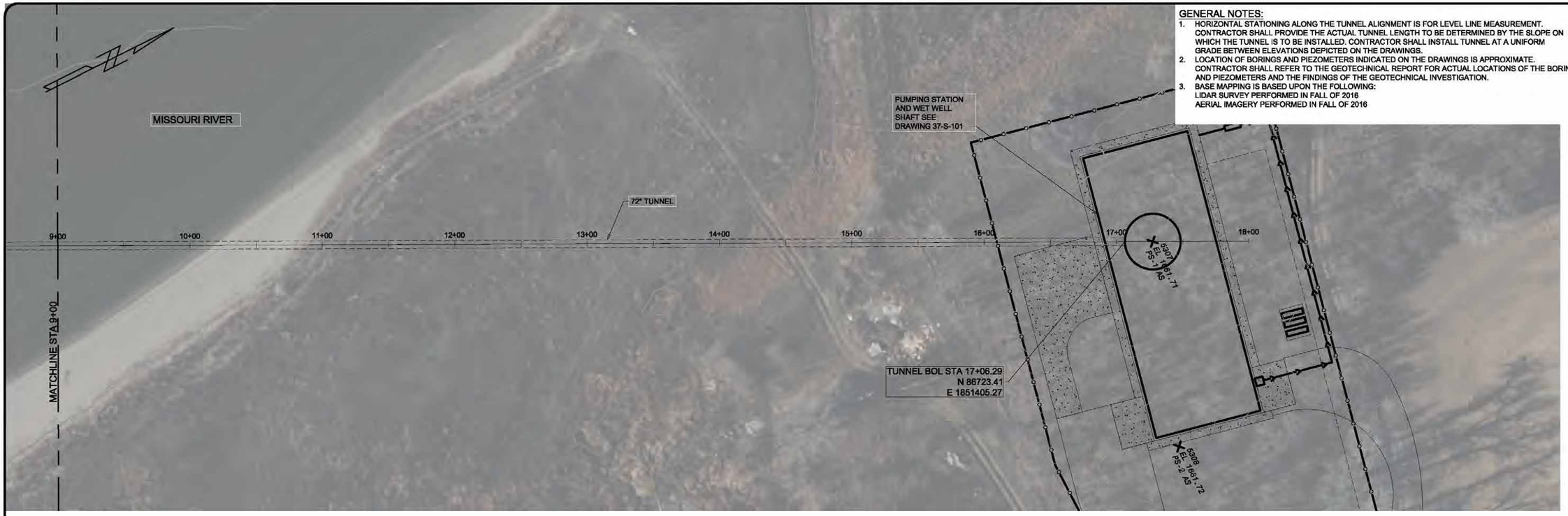
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

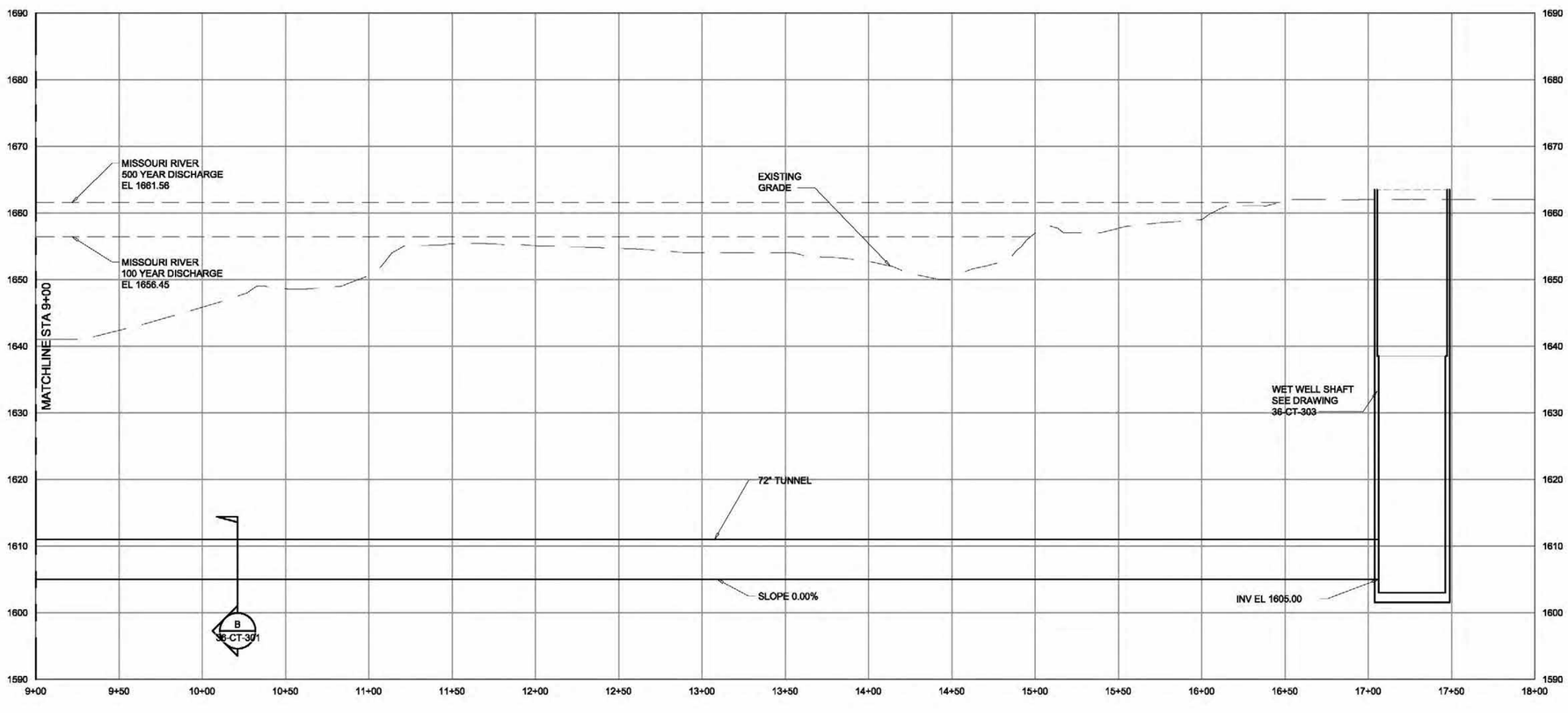
PROJECT NO.
403070

B-1
SHEET
1 OF 26

GENERAL NOTES:

1. HORIZONTAL STATIONING ALONG THE TUNNEL ALIGNMENT IS FOR LEVEL LINE MEASUREMENT. CONTRACTOR SHALL PROVIDE THE ACTUAL TUNNEL LENGTH TO BE DETERMINED BY THE SLOPE ON WHICH THE TUNNEL IS TO BE INSTALLED. CONTRACTOR SHALL INSTALL TUNNEL AT A UNIFORM GRADE BETWEEN ELEVATIONS DEPICTED ON THE DRAWINGS.
2. LOCATION OF BORINGS AND PIEZOMETERS INDICATED ON THE DRAWINGS IS APPROXIMATE. CONTRACTOR SHALL REFER TO THE GEOTECHNICAL REPORT FOR ACTUAL LOCATIONS OF THE BORINGS AND PIEZOMETERS AND THE FINDINGS OF THE GEOTECHNICAL INVESTIGATION.
3. BASE MAPPING IS BASED UPON THE FOLLOWING:
   LIDAR SURVEY PERFORMED IN FALL OF 2016
   AERIAL IMAGERY PERFORMED IN FALL OF 2016





10' 0 10' 20'
VERTICAL SCALE 1"=10'

40' 20' 0 40' 80'
HORIZONTAL SCALE 1"=40'

NO.	BY	CK	APP

REVISIONS AND RECORD OF ISSUE

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PLOTTED 4/17/2020 2:27 PM
USER SPA4934 | DWG VER

XREF1:
XREF2:
XREF3:
XREF4:

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PLAN AND PROFILE STA 09+00 TO 17+06.29

BUREAU OF RECLAMATION

EASTERN NORTH DAKOTA ALTERNATE WATER SUPPLY

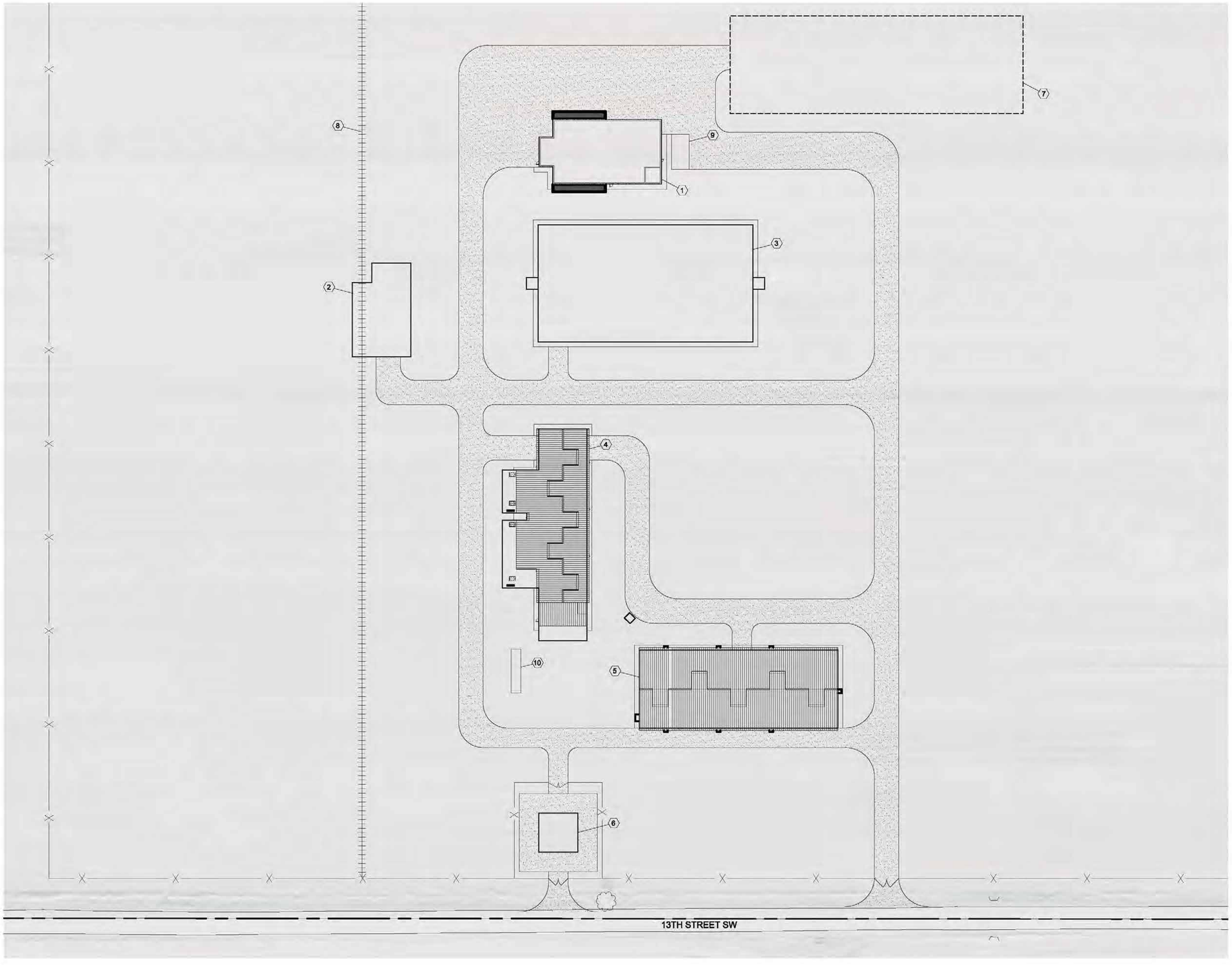
MISSOURI RIVER INTAKE TUNNEL AND PUMPING STATION

DESIGNED: DES
DETAILED: DET
CHECKED: CHK
APPROVED: APP
DATE: OCTOBER 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-2
SHEET
2 OF 26



GENERAL NOTES:

1. SEE RESPECTIVE BUILDING FOR ADDITIONAL INFORMATION.

SHEET NOTES:

1. SEDIMENT REMOVAL PLANT
2. CHLORINE STORAGE ROOM
3. DISINFECTION CONTACT BASIN
4. MAIN PUMPING STATION BUILDING
5. SURGE CONTROL STRUCTURE
6. ELECTRICAL SUB-STATION
7. DRYING BED
8. RAILROAD SPUR FOR CHLORINE DELIVERY
9. VALVE VAULT
10. OUT DOOR SWITCHGEAR

50' 25' 0 50' 100'

SCALE 1"=50'

NO.	BY	CK	APP	DATE	REVISIONS AND RECORD OF ISSUE

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XREF2:
XREF3:
XREF4:

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OVERALL SITE PLAN

BUREAU OF RECLAMATION

EASTERN NORTH DAKOTA ALTERNATE WATER SUPPLY

SEDIMENT REMOVAL PLAN, WTP, AND MAIN PUMPING STATION

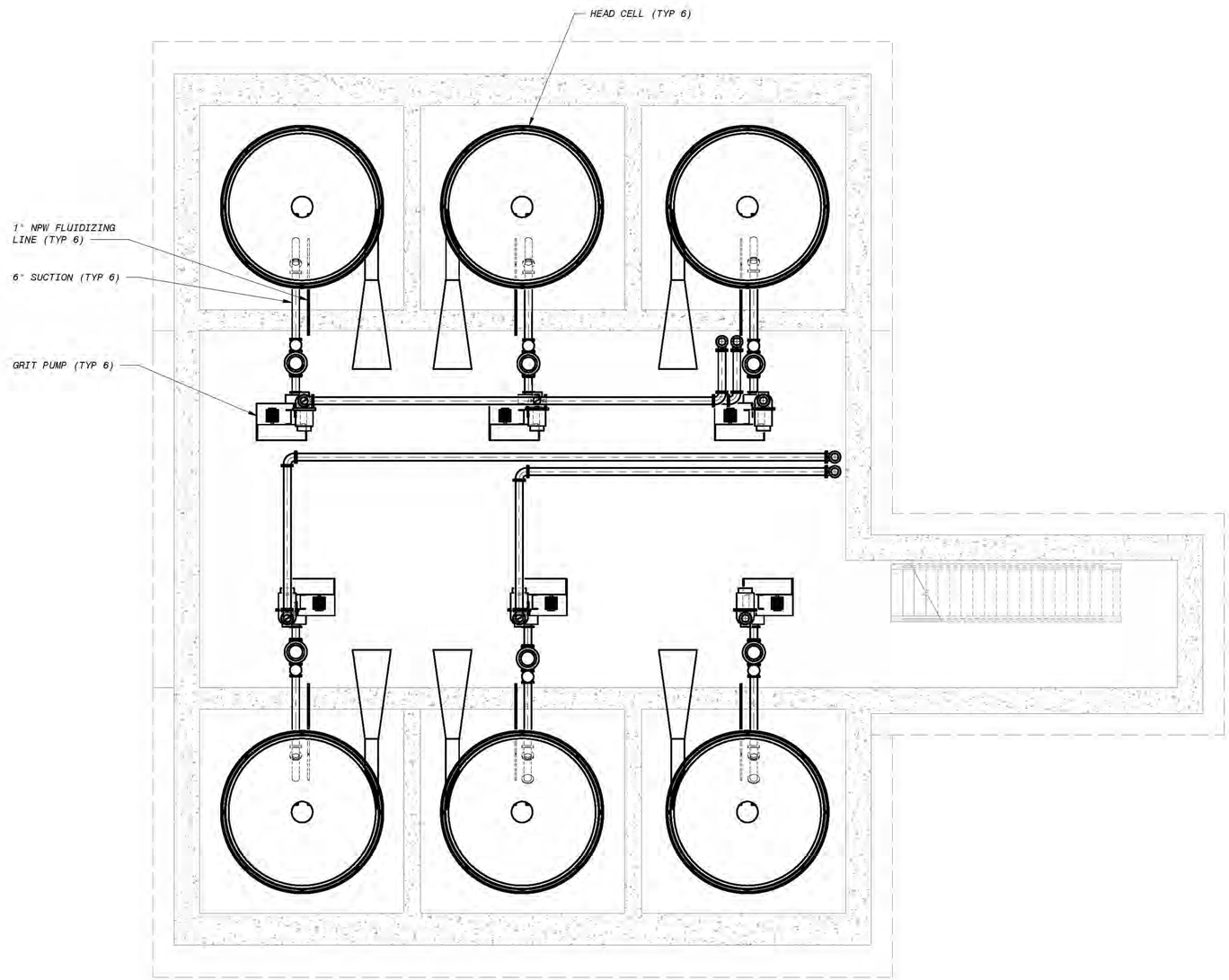
DESIGNED: JAM/SSD/MJC
DETAILED: JAD
CHECKED:
APPROVED:
DATE: OCTOBER 2019

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-3
SHEET
3 OF 26



LOWER LEVEL - PROCESS MECHANICAL PLAN

3/16" = 1'-0"

6" 4' 2' 0' 5' 10'

3/16" = 1'-0"

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

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XREF3:
XREF4:

SAVED:
PLOTTED:
USER:
DWG VER:

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LOWER LEVEL PLAN

EASTERN NORTH DAKOTA ALTERNATIVE WATER SUPPLY

SEDIMENT REMOVAL PLAN

DESIGNED: Designer
DETAILED: Author
CHECKED: Checker
APPROVED: Approver
DATE: OCTOBER 2019

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-4

SHEET
4 OF 26

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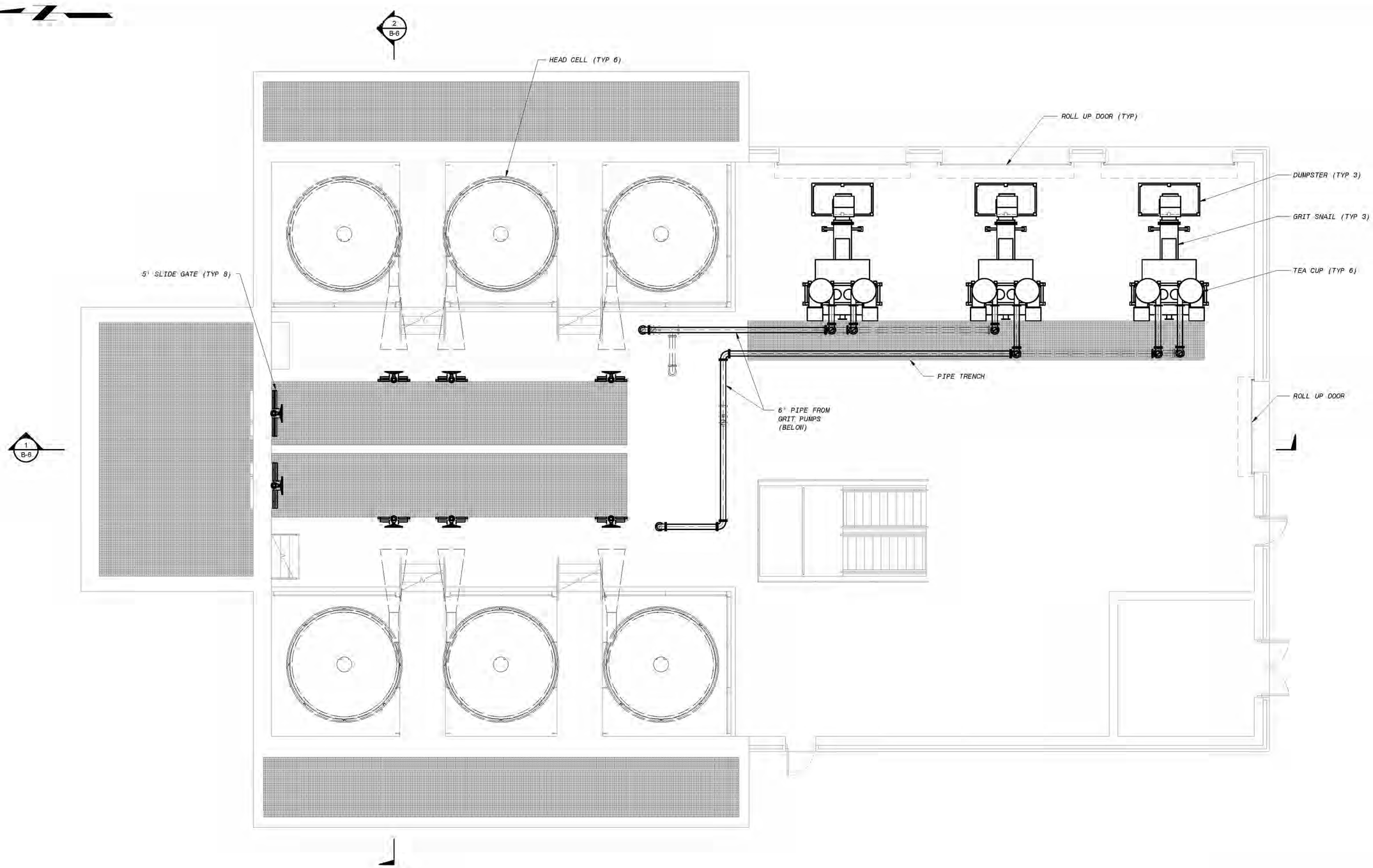

OPERATING LEVEL - PROCESS MECHANICAL PLAN

3/16" = 1'-0"

8" 4' 2' 0' 5' 10'

3/16" = 1'-0"

NO.	BY	CK	APP

REVISIONS AND RECORD OF ISSUE

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XREF4:

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USER:
DWG VER:

BLACK & VEATCH

OPERATING FLOOR PLAN

EASTERN NORTH DAKOTA
ALTERNATIVE WATER SUPPLY

SEDIMENT REMOVAL PLAN

DESIGNED: Designer
DETAILED: Author
CHECKED: Checker
APPROVED: Approver
DATE: OCTOBER 2019

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-5
SHEET
5 OF 26

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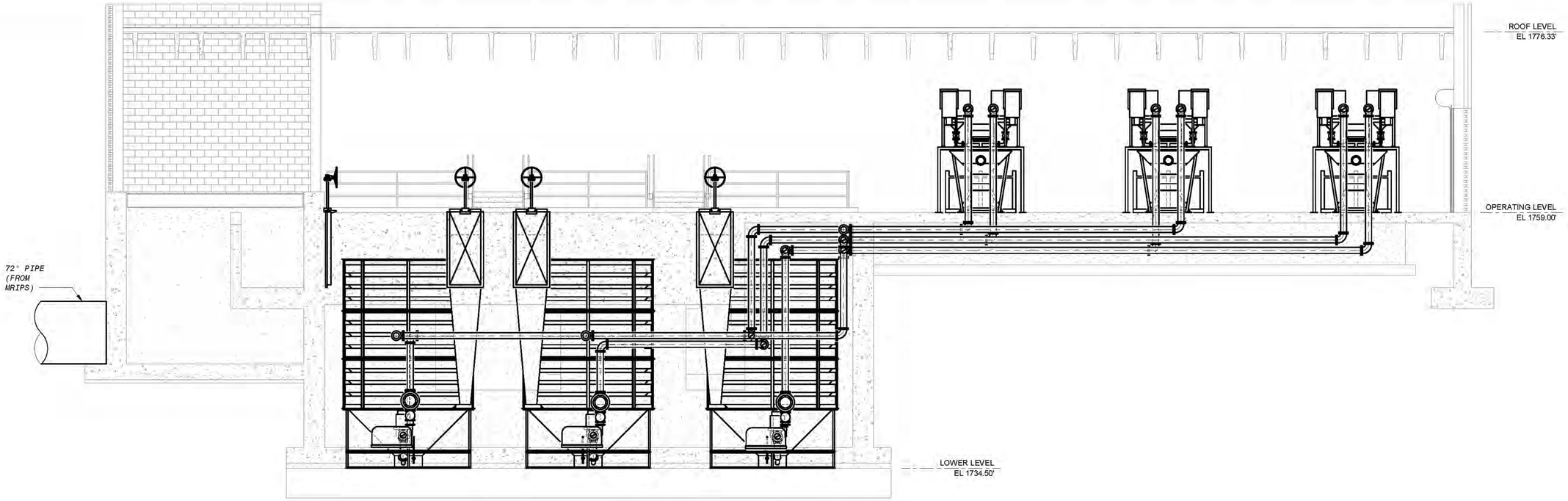
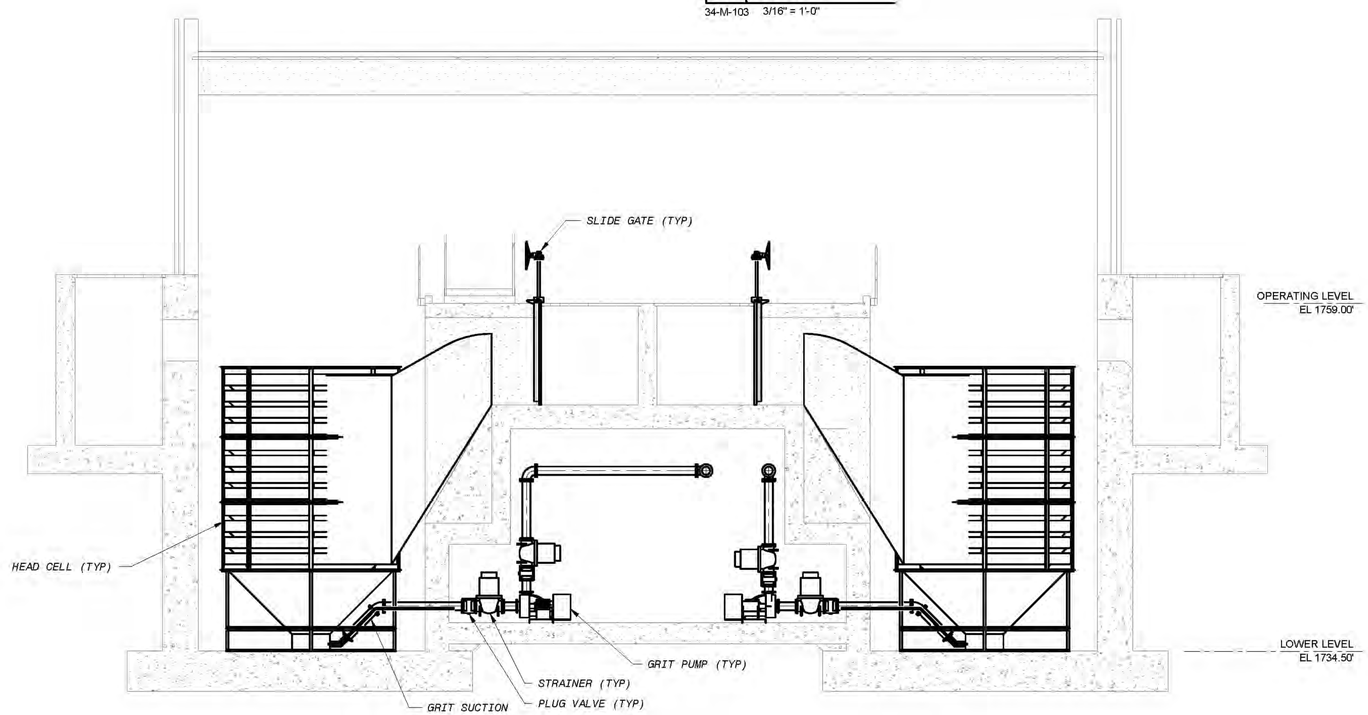


1 Section 1
34-M-103 3/16" = 1'-0"



2 Section 2
34-M-103 3/16" = 1'-0"

6" 4' 2' 0' 5' 10'
3/16" = 1'-0"

NO.	BY	CK	APP	REVISIONS AND RECORD OF ISSUE	DATE

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USER:
DWG VER:

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STRUCTURE SECTIONS

EASTERN NORTH DAKOTA
ALTERNATIVE WATER SUPPLY

SEDIMENT REMOVAL PLANT

DESIGNED: Designer
DETAILED: Author
CHECKED: Checker
APPROVED: Approver
DATE: OCTOBER 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-6
SHEET
6 OF 26

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NORTHWEST PERSPECTIVE

SOUTHEAST PERSPECTIVE

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

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XREF3:
XREF4:

SAVED:
PLOTTED:
USER:
DWG VER:

BLACK & VEATCH

EXTERIOR PERSPECTIVES

EASTERN NORTH DAKOTA ALTERNATIVE WATER SUPPLY

MAIN PUMPING STATION

DESIGNED: RAB
DETAILED: DAY
CHECKED: ---
APPROVED: ---
DATE: OCTOBER 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-7
SHEET
7 OF 26

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DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

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PLOTTED: XREF2:
USER: XREF3:
DWG VER: XREF4:

BLACK & VEATCH

INTERIOR PERSPECTIVES

EASTERN NORTH DAKOTA ALTERNATIVE WATER SUPPLY

MAIN PUMPING STATION

DESIGNED: SET
DETAILED: JGC
CHECKED: ---
APPROVED: ---
DATE: OCTOBER 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-8
SHEET
8 OF 26

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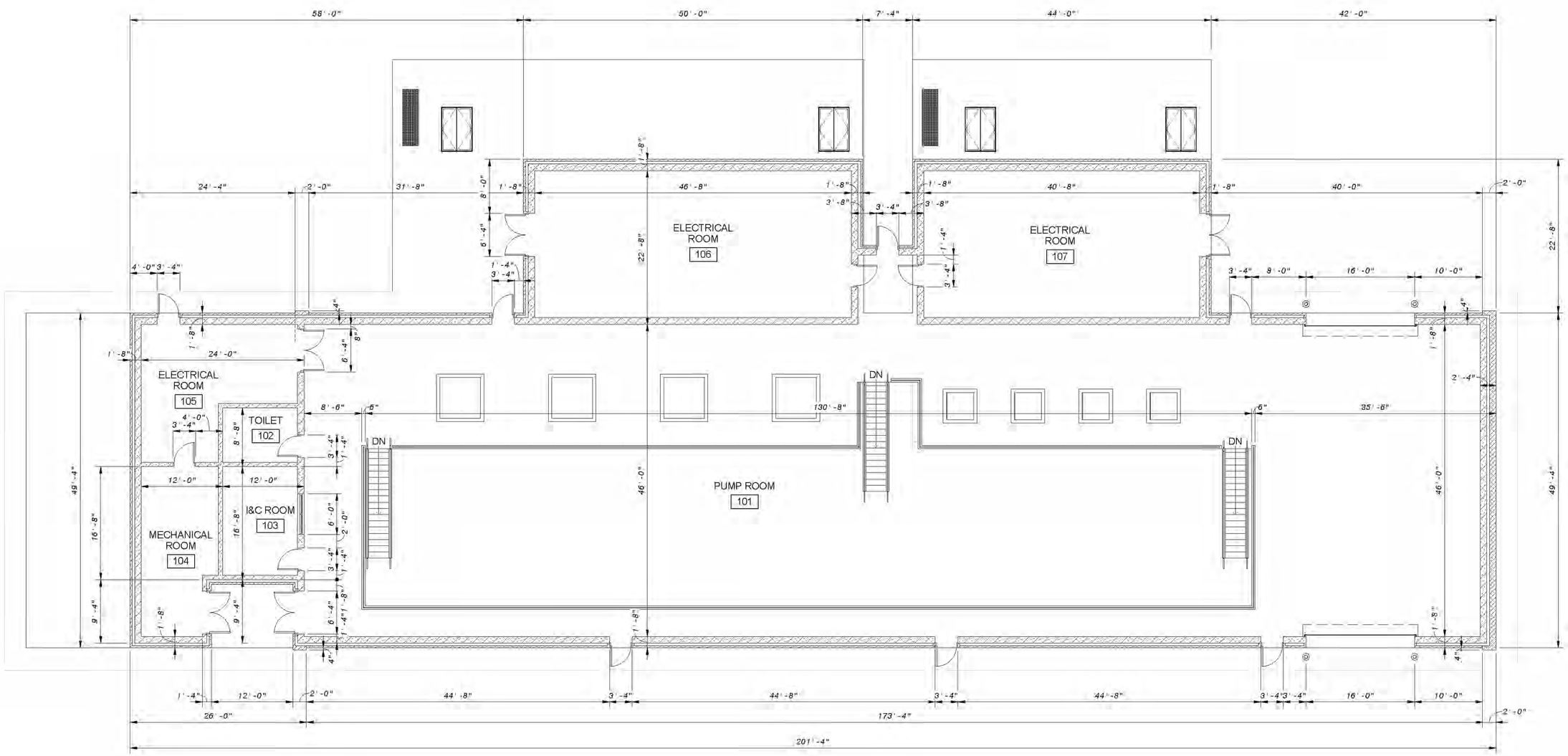

OPERATING FLOOR PLAN

1/8" = 1'-0"

8' 4' 0' 8' 16'

1/8" = 1'-0"

NO.	BY	CK	APP

REVISIONS AND RECORD OF ISSUE

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XREF3:
XREF4:

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PLOTTED:
USER:
DWG VER:

BLACK & VEATCH

OPERATING FLOOR PLAN

EASTERN NORTH DAKOTA ALTERNATIVE WATER SUPPLY (ENDAWS)

MAIN PUMPING STATION

DESIGNED: RAB
DETAILED: DAY
CHECKED: —
APPROVED: —
DATE: OCTOBER 2019

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

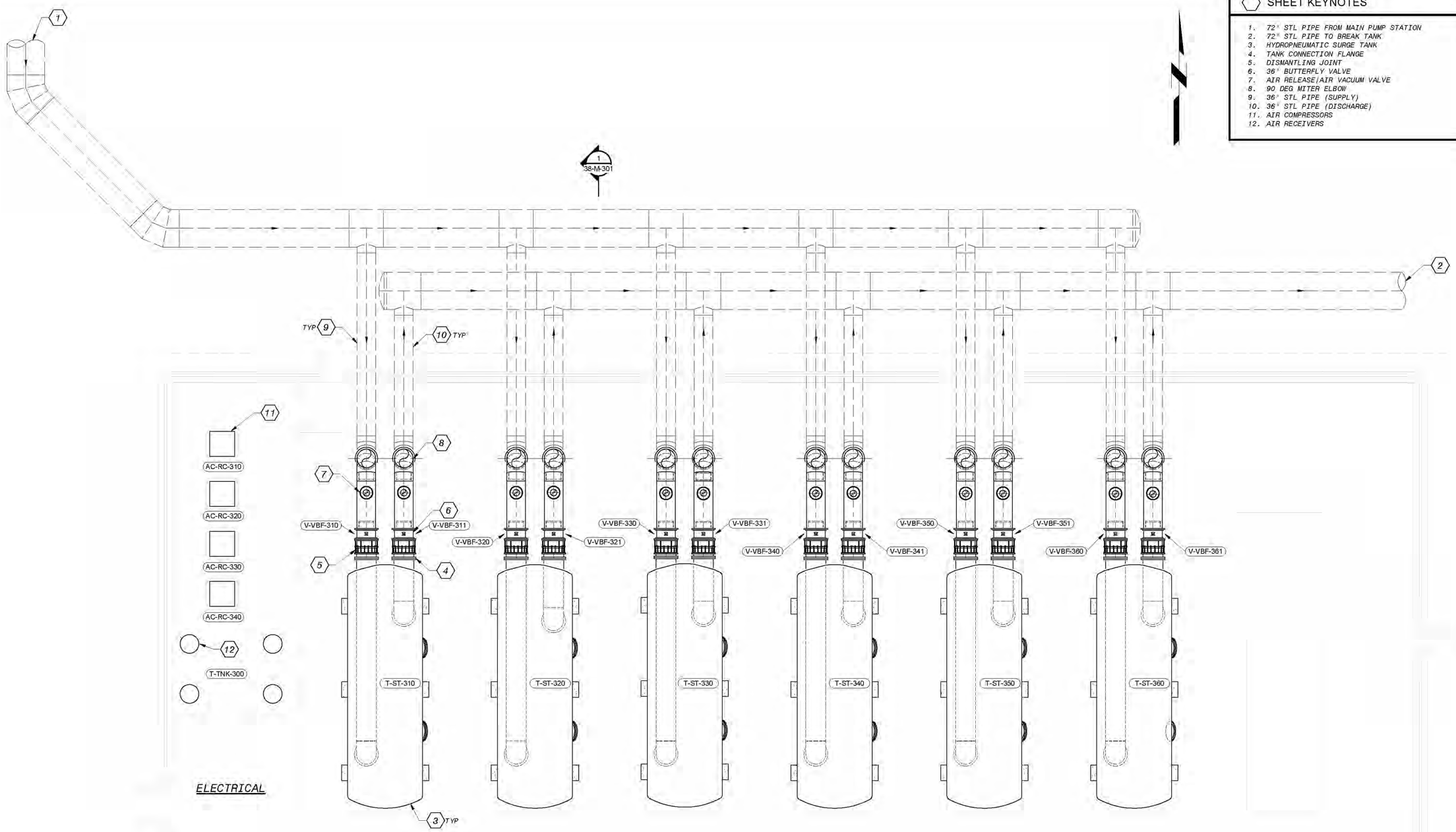
B-9

SHEET
9 OF 26

PLOTTED: 4/17/2019 1:24:22 PM

SHEET KEYNOTES

1. 72" STL PIPE FROM MAIN PUMP STATION
2. 72" STL PIPE TO BREAK TANK
3. HYDROPNEUMATIC SURGE TANK
4. TANK CONNECTION FLANGE
5. DISMANTLING JOINT
6. 36" BUTTERFLY VALVE
7. AIR RELEASE/AIR VACUUM VALVE
8. 90 DEG MITER ELBOW
9. 36" STL PIPE (SUPPLY)
10. 36" STL PIPE (DISCHARGE)
11. AIR COMPRESSORS
12. AIR RECEIVERS



OPERATING LEVEL - PROCESS MECHANICAL PLAN

1/8" = 1'-0"

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

XREF1:
XREF2:
XREF3:
XREF4:
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PLOTTED:
USER:
DWG VER:

BLACK & VEATCH

PROCESS MECHANICAL
OPERATING FLOOR PLAN

EASTERN NORTH DAKOTA
ALTERNATIVE WATER SUPPLY

SURGE CONTROL STRUCTURE

DESIGNED: Designer
DETAILED: Author
CHECKED: Checker
APPROVED: Approver
DATE: OCTOBER 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-10
SHEET
10 OF 26

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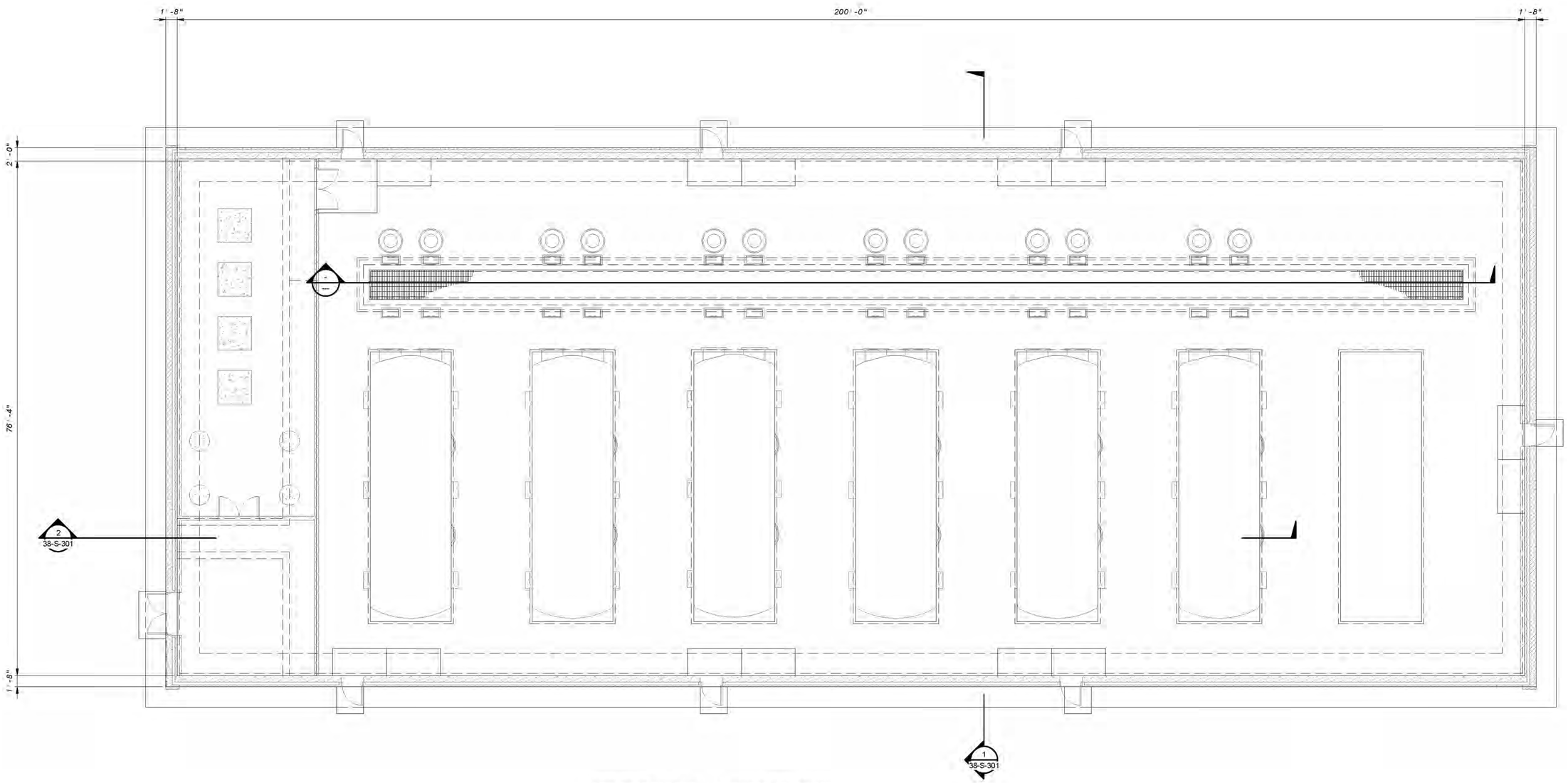

OPERATING LEVEL - STRUCTURAL PLAN

1/8" = 1'-0"

8' 4' 0' 8' 16'

1/8" = 1'-0"

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

XREF1:
XREF2:
XREF3:
XREF4:

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PLOTTED:
USER:
DWG VER:

BLACK & VEATCH

STRUCTURAL
OPERATING FLOOR PLAN

EASTERN NORTH DAKOTA
ALTERNATIVE WATER SUPPLY

SURGE CONTROL STRUCTURE

DESIGNED: SET
DETAILED: JGC
CHECKED: ---
APPROVED: ---
DATE: OCTOBER 2019

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-11
SHEET
11 OF 26

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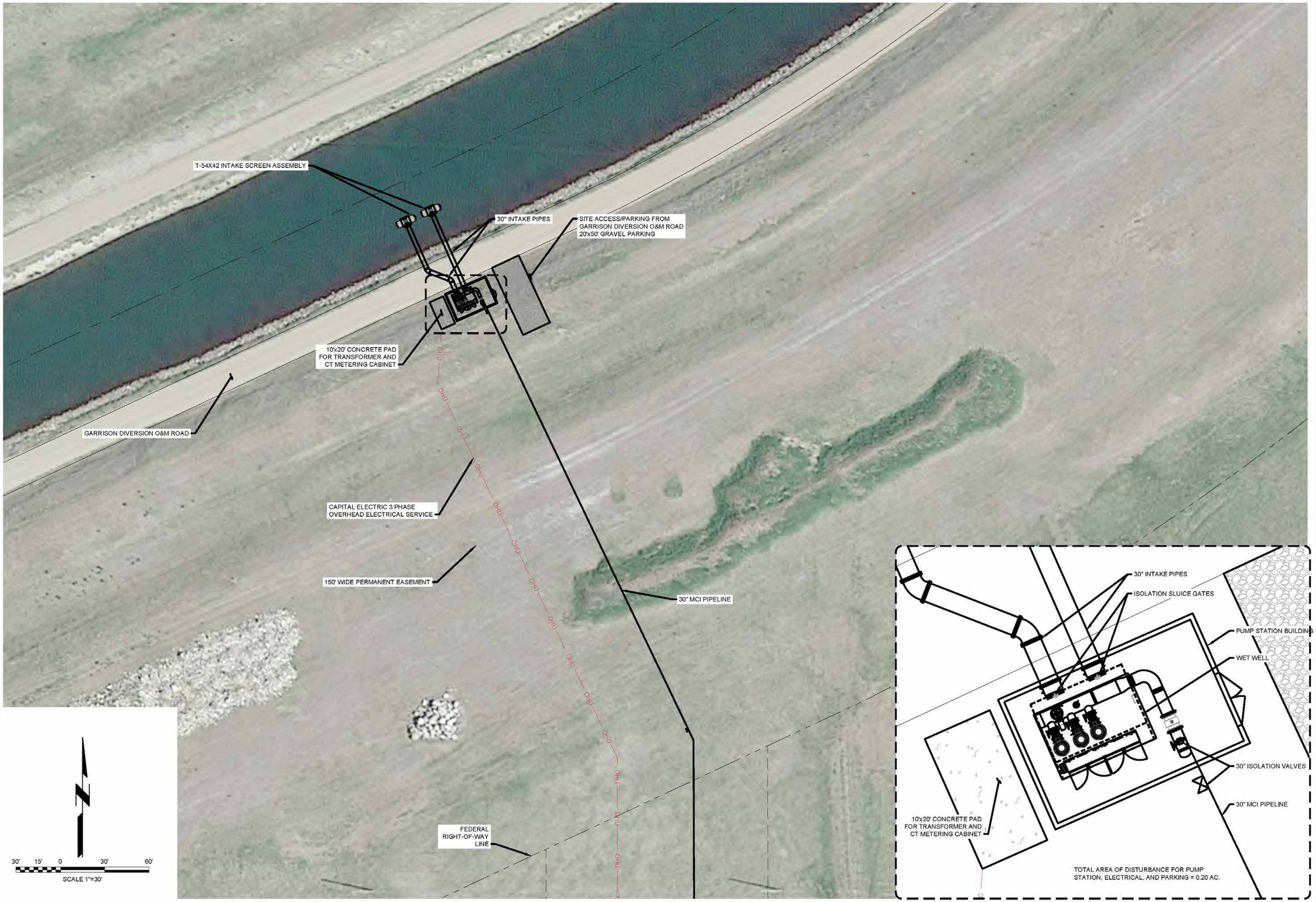

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

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CS-SP MM-2.5 CHD Intake Building Site Plan.dwg
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PLOTTED: 4/17/2020 2:58 PM
USER: RMAROIL
DWG VER:
XREF1:
XREF2:
XREF3:
XREF4:

BLACK & VEATCH

AECOM

SITE PLAN AND
ENLARGED PUMP STATION PLAN

BUREAU OF RECLAMATION

EASTERN NORTH DAKOTA
ALTERNATE WATER SUPPLY

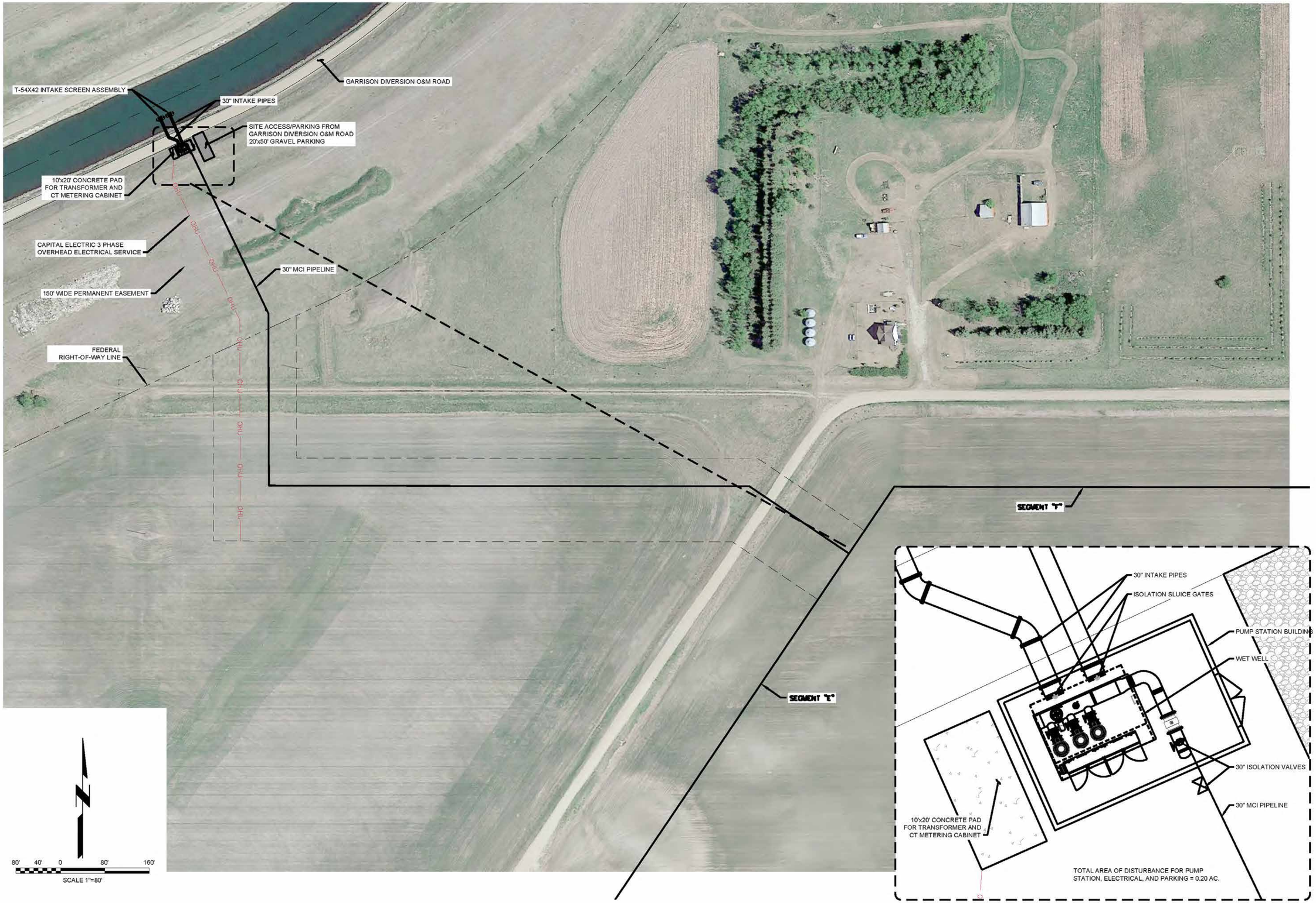
CENTRAL NORTH DAKOTA
INTAKE PUMPING STATION

DESIGNED: RFM
DETAILED: RFM
CHECKED: CC
APPROVED: CC
DATE: SEPTEMBER, 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
198294

B-12
SHEET
12 OF 26



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	PLOTTED: 4/17/2020 2:58 PM	XREF3:			
	USER: RMAROIL	DWG VER:		XREF4:	

BLACK & VEATCH

AECOM

OVERALL UTILITY SITE PLAN AND ENLARGED PUMPING STATION PLAN

BUREAU OF RECLAMATION

EASTERN NORTH DAKOTA ALTERNATE WATER SUPPLY

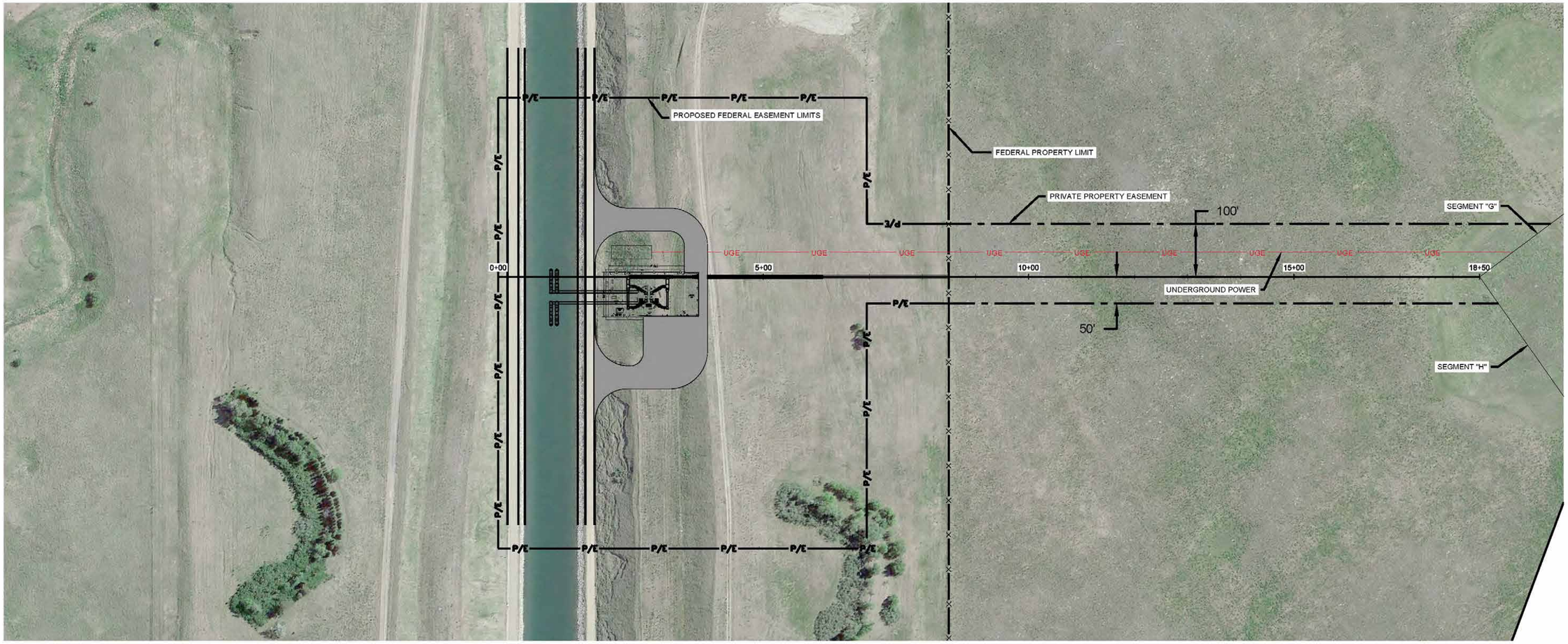
CENTRAL NORTH DAKOTA McCLUSKY CANAL INTAKE

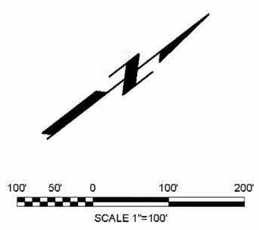
DESIGNED: RFM
DETAILED: RFM
CHECKED: CC
APPROVED: CC
DATE: SEPTEMBER, 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
198294

B-13
SHEET
13 OF 26





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PLOTTED: 4/17/2020 2:15 PM
USER: RMAROIL
XREF1:
XREF2:
XREF3:
XREF4:
DWG VER:

BLACK & VEATCH

AECOM

OVERALL SITE PLAN

EASTERN NORTH DAKOTA ALTERNATE WATER SUPPLY

BUREAU OF RECLAMATION

McKLUSKY CANAL INTAKE PUMP STATION

MILE MARKER 57

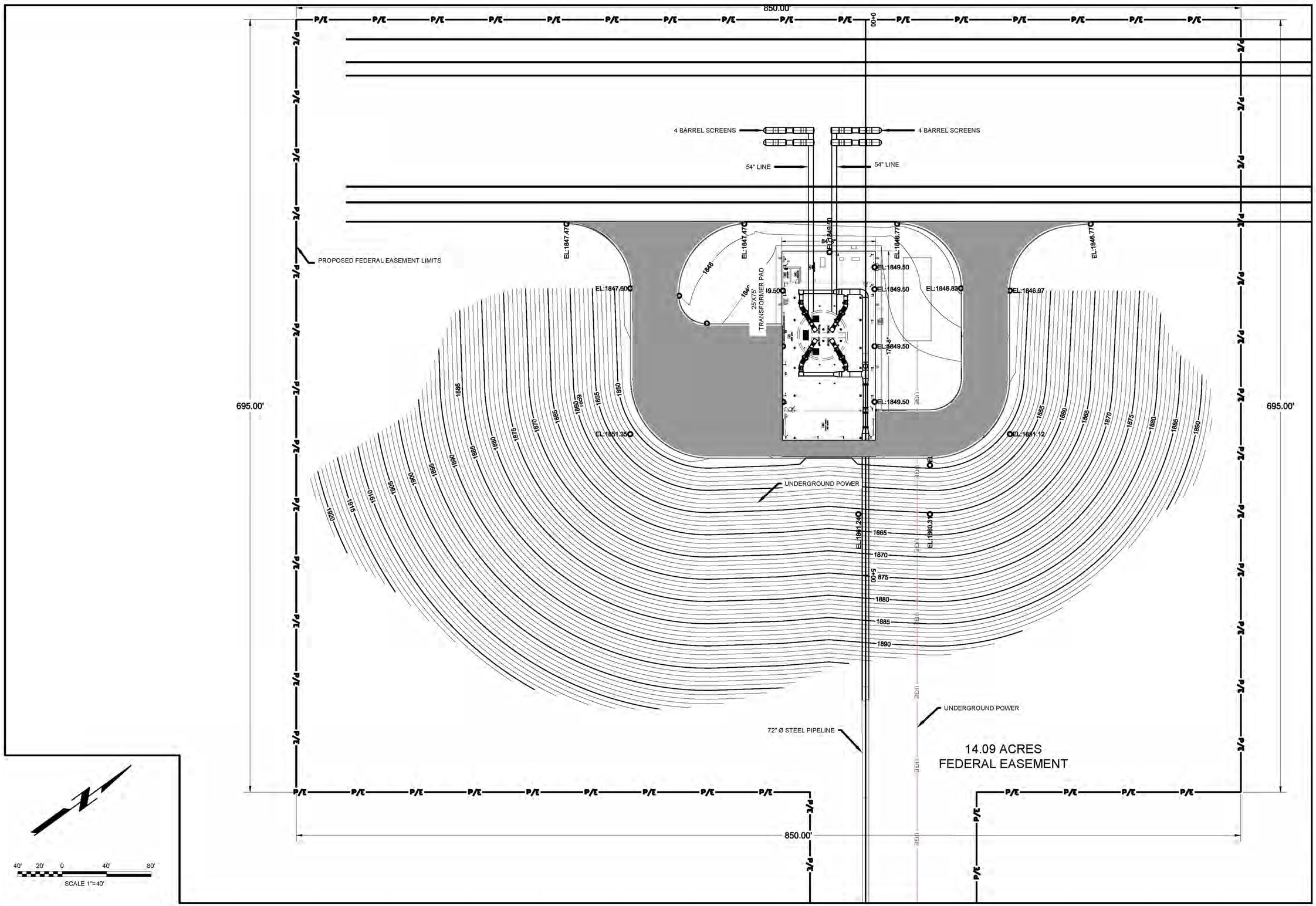
DESIGNED: RFM
DETAILED: RFM
CHECKED: CC
APPROVED: CC
DATE: SEPTEMBER, 2019

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
198294

B-14
SHEET
14 OF 26



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PLOTTED: 4/17/2020 2:34 PM
USER: RMARCHL
DWG VER:
XREF 1:
XREF 2:
XREF3:
XREF4:

BLACK & VEATCH

GRADING PLAN

EASTERN NORTH DAKOTA ALTERNATE WATER SUPPLY

McKLUSKY CANAL INTAKE PUMP STATION

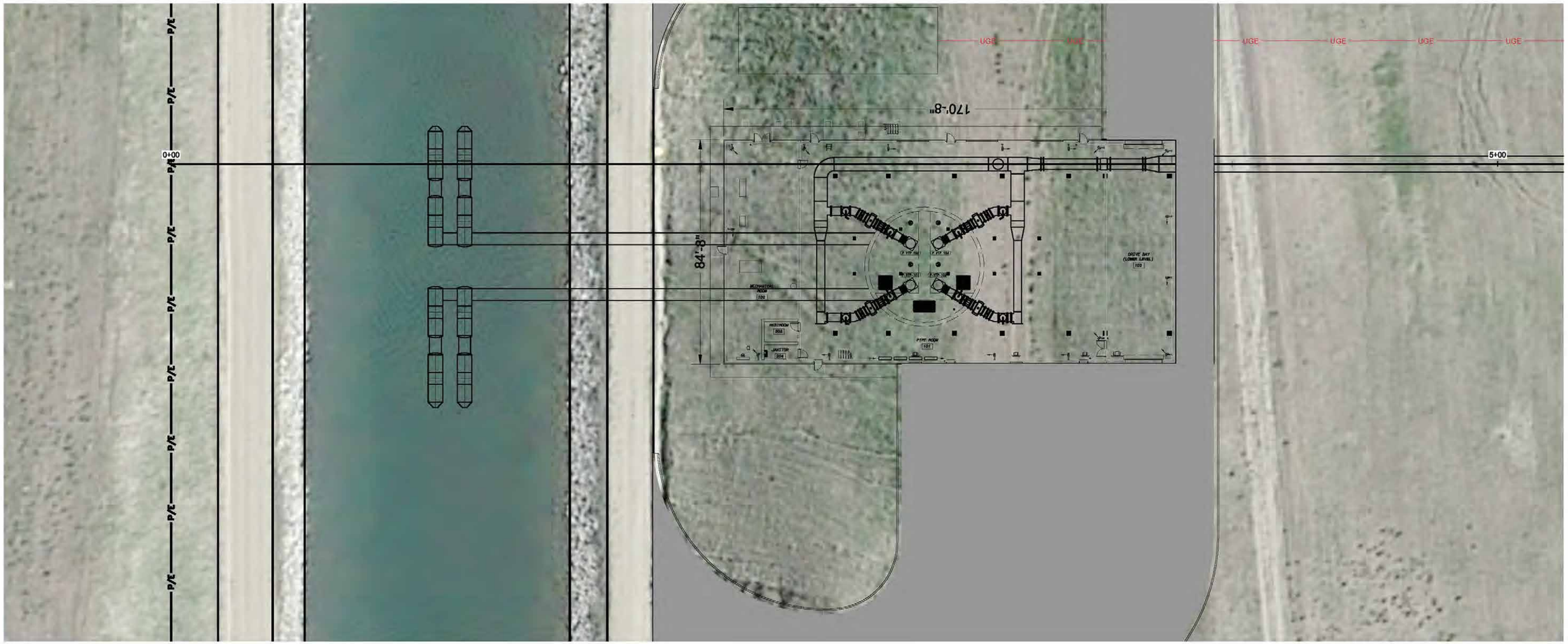
MILE MARKER 57

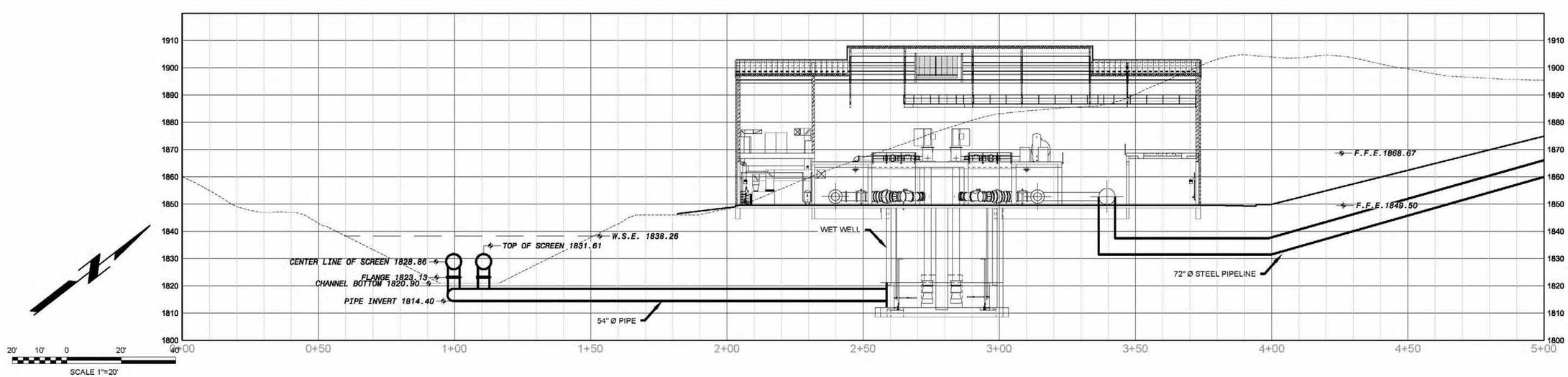
DESIGNED: RFM
DETAILED: RFM
CHECKED: CC
APPROVED: CC
DATE: SEPTEMBER, 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
198294

B-15
SHEET
15 OF 26





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		PLOTTED: 4/17/2020 2:14 PM	XREF3:		
		USER: RMAROIL DWG VER:	XREF4:		

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PLAN AND PROFILE

EASTERN NORTH DAKOTA ALTERNATE WATER SUPPLY

McKLUSKY CANAL INTAKE PUMP STATION

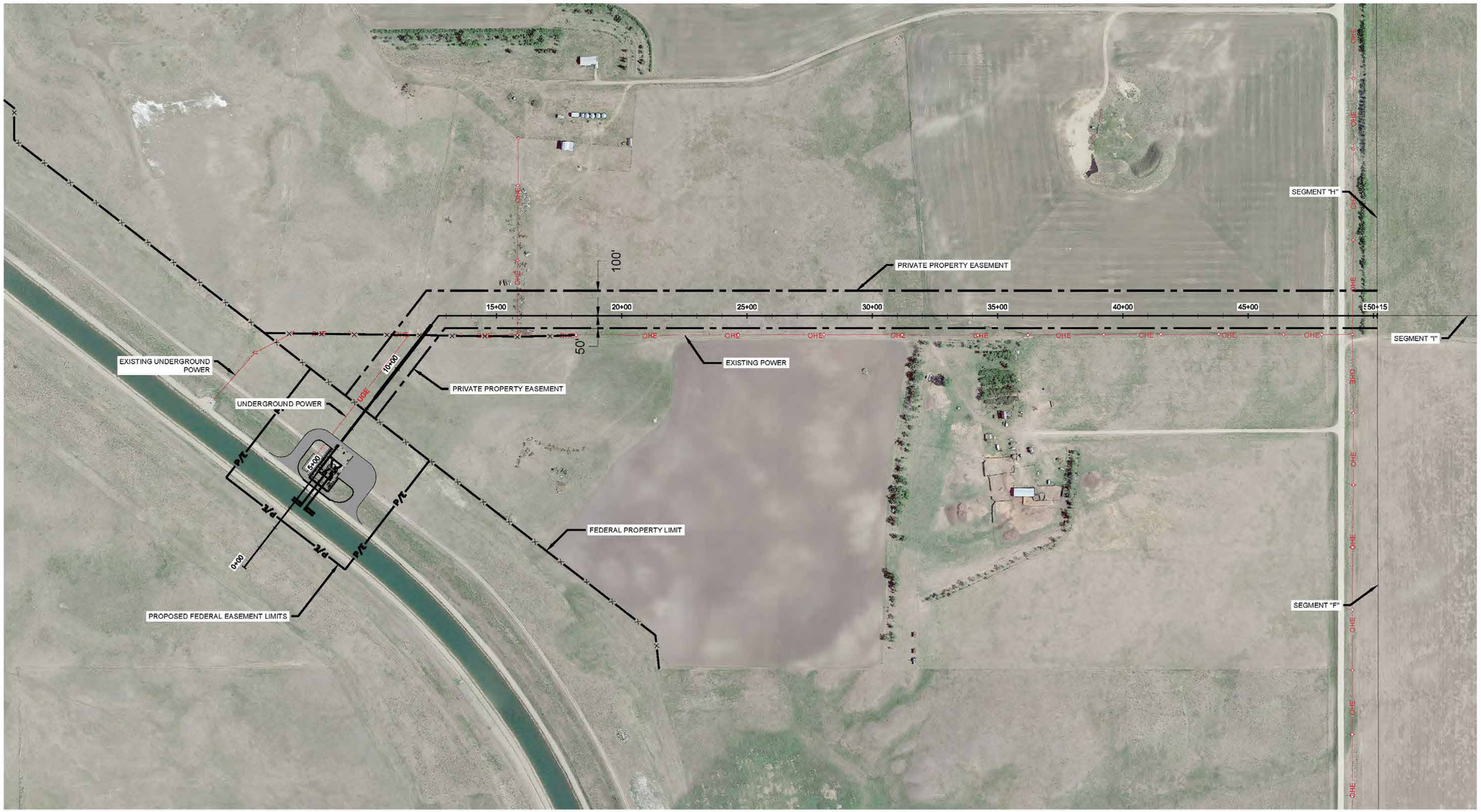
MILE MARKER 57

DESIGNED: RFM
DETAILED: RFM
CHECKED: CC
APPROVED: CC
DATE: SEPTEMBER, 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
198294

B-16
SHEET
16 OF 26



200' 100' 0 200' 400'
SCALE 1"=200'

NO.	BY	CK	APP

DATE | REVISIONS AND RECORD OF ISSUE

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CS-SP MM-49 Intake Building Site Plan.dwg
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PLOTTED: 4/17/2020 2:19 PM
USER: RMAROHL
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XREF4:
DWG VER:

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AECOM

EASTERN NORTH DAKOTA ALTERNATE WATER SUPPLY

BUREAU OF RECLAMATION

McKLUSKY CANAL INTAKE PUMP STATION

MILE MARKER 49

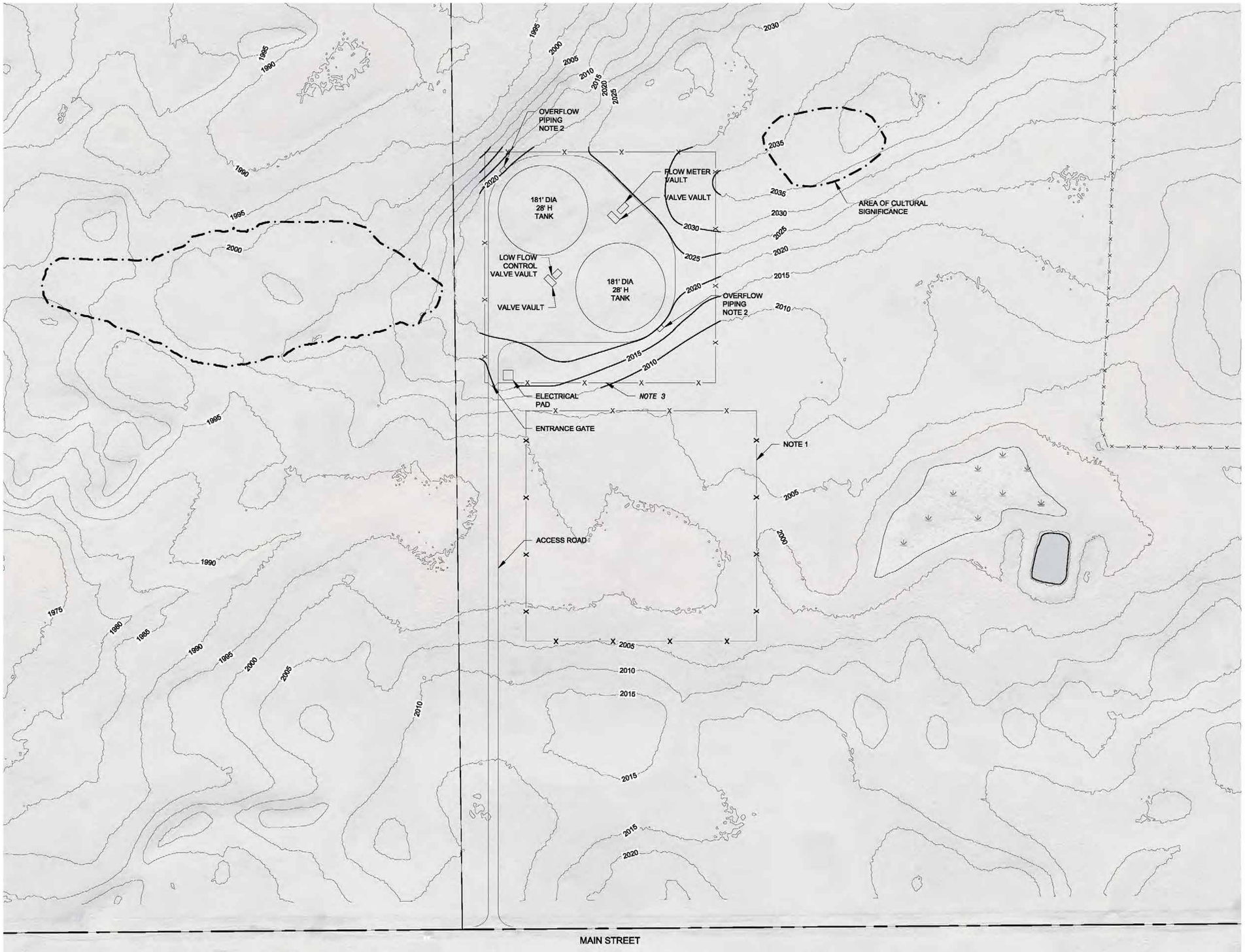
OVERALL UTILITY SITE PLAN

DESIGNED: RFM
DETAILED: RFM
CHECKED: CC
APPROVED: CC
DATE: SEPTEMBER, 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
198294

B-17
SHEET
17 OF 26



GENERAL NOTES:

1. AREA DESIGNED FOR FUTURE EMERGENCY OVERFLOW RETENTION POND.
2. ROUTE EMERGENCY OVERFLOW PIPING TO RETENTION POND.
3. SLOPE/GRADE SITE TO POND.

SHEET NOTES:

100' 50' 0 100' 200'

SCALE 1"=100'

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	CK	APP

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PLOTTED: 4/17/2020 2:24 PM

USER: SPAN8354

XREF1 XREF2 XREF3 XREF4

DWG VER:

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RES

OVERALL SITE PLAN

EASTERN NORTH DAKOTA ALTERNATE WATER SUPPLY

BUREAU OF RECLAMATION

HYDRAULIC BREAK TANKS

DESIGNED: JRR

DETAILED: JAD

CHECKED:

APPROVED:

DATE: OCTOBER 2019

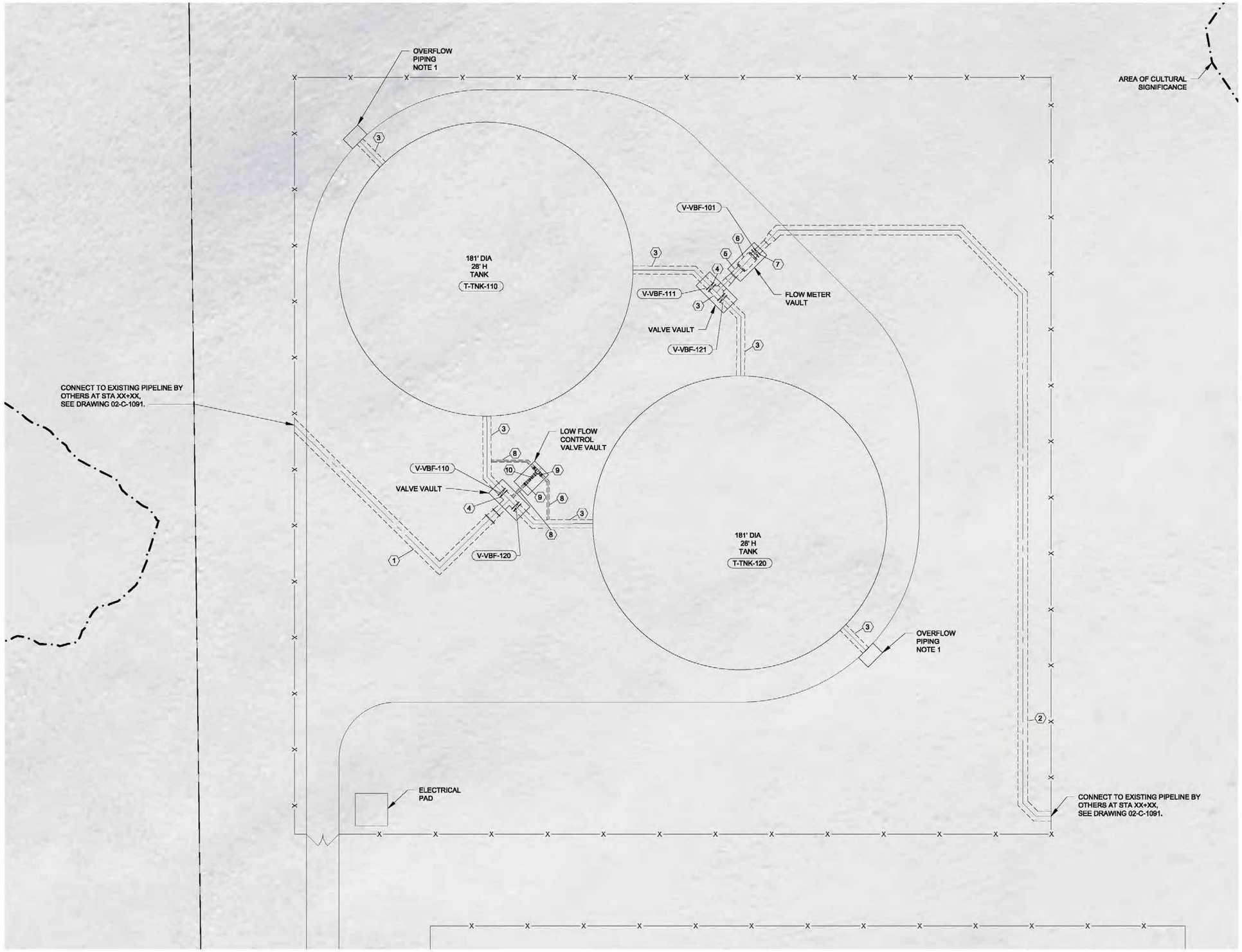
0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 403070

B-18

SHEET 18 OF 26



GENERAL NOTES:

1. ROUTE EMERGENCY OVERFLOW PIPING TO RETENTION POND.

SHEET NOTES:

1. 72" STL PIPE
2. 72" STL PIPE
3. 60" STL PIPE
4. 60" BFV
5. 48" STL PIPE
6. 48" ELECTROMAGNETIC FLOW METER
7. 36" BFV
8. 18" STL PIPE
9. 18" BFV
10. 14" CONTROL VALVE

30' 20' 10' 0 30' 60'

SCALE 1"=30'

NO.	BY	CK	APP	DATE	REVISIONS AND RECORD OF ISSUE

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PLOTTED: 4/17/2020 2:22 PM
USER: SPA18354 | DWG VER:

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OVERALL PIPING PLAN

EASTERN NORTH DAKOTA ALTERNATE WATER SUPPLY

BUREAU OF RECLAMATION

HYDRAULIC BREAK TANKS

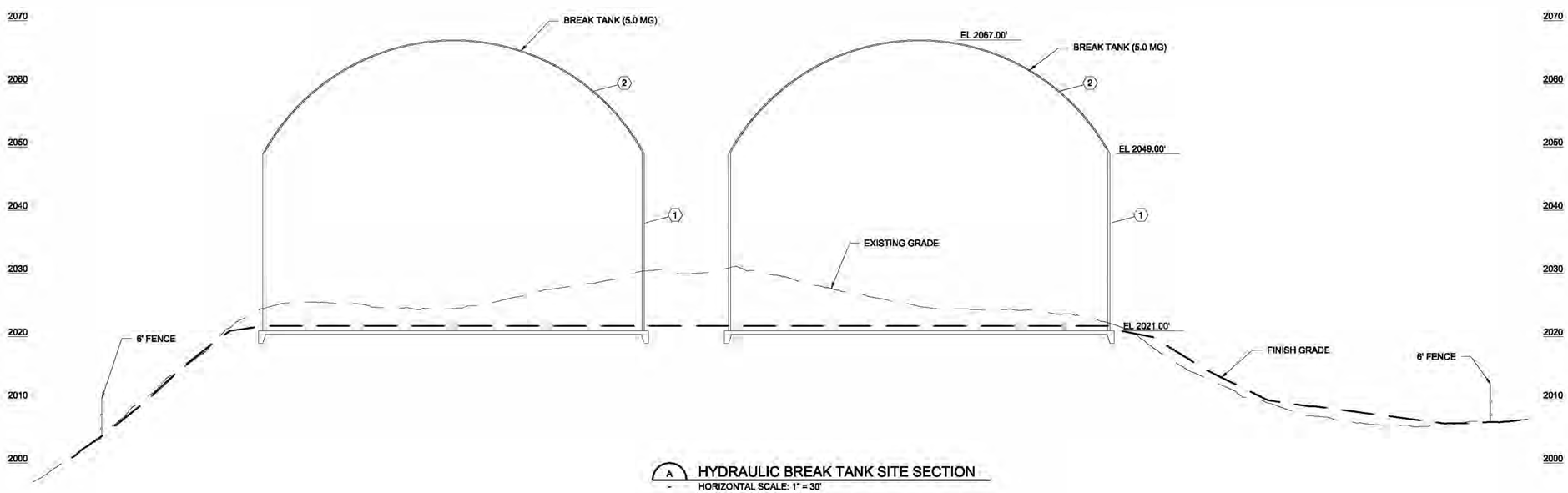
DESIGNED: JRR
DETAILED: JAD
CHECKED:
APPROVED:
DATE: OCTOBER 2019

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 403070

B-19
SHEET 19 OF 26



A HYDRAULIC BREAK TANK SITE SECTION

HORIZONTAL SCALE: 1" = 30'
VERTICAL SCALE: 1" = 10'

GENERAL NOTES:

SHEET NOTES:

1. AWWA D110 PRE-STRESSED CONCRETE CIRCULAR TANK.
2. PRECAST DOME ROOF.

30' 20' 10' 0 30' 60'

SCALE 1"=30'

NO.	BY	CK	APP	DATE	REVISIONS AND RECORD OR ISSUE

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PLOTTED: 4/17/2020 1:54 PM
USER: SPA98354 | DWG VER:

SHEET 1 | SHEET 2 | SHEET 3 | SHEET 4

BLACK & VEATCH

SITE PROFILE

BUREAU OF RECLAMATION

EASTERN NORTH DAKOTA ALTERNATE WATER SUPPLY

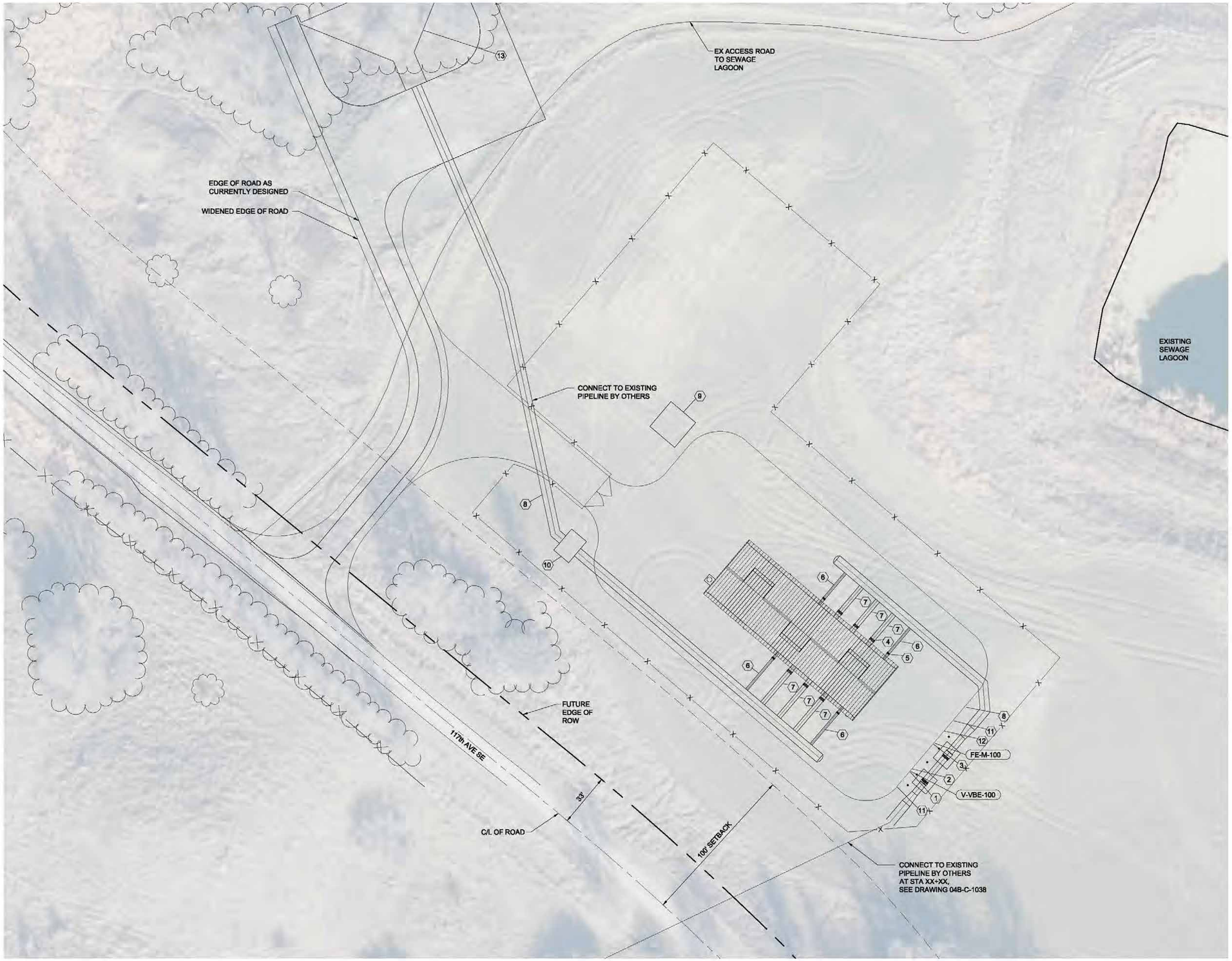
HYDRAULIC BREAK TANKS

DESIGNED: JRR
DETAILED: JAD
CHECKED:
APPROVED:
DATE: OCTOBER 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-20
SHEET
20 OF 26



GENERAL NOTES:

SHEET NOTES:

1. 48" BUTTERFLY VALVE W/ELECTRIC ACTUATOR
2. 48" DISMANTLING JOINT
3. 48" ELECTROMAGNETIC FLOW METER
4. 36" HARNESSED MECHANICAL COUPLING (TYP)
5. 18" HARNESSED MECHANICAL COUPLING (TYP)
6. 18" STL PIPE
7. 36" STL PIPE
8. 72" STL PIPE
9. ELECTRICAL PAD
10. WEIR VAULT
11. 72" X 48" REDUCER
12. 48" STEEL PIPE
13. DISCHARGE STRUCTURE

30' 20' 10' 0 30' 60'

SCALE 1"=30'

NO.	BY	CK	APP	DATE	REVISIONS AND RECORD OF ISSUE

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XREF 2:
XREF 3:
XREF 4:
DWG VER:

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RES

OVERALL SITE PIPING PLAN

BUREAU OF RECLAMATION

EASTERN NORTH DAKOTA ALTERNATE WATER SUPPLY

SHEYENNE RIVER OUTFALL CONTROL VALVE STRUCTURE

DESIGNED: MJC
DETAILED: JAD
CHECKED:
APPROVED:
DATE: OCTOBER 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-21
SHEET
21 OF 26

NORTHEAST PERSPECTIVE

SOUTHEAST PERSPECTIVE

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

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XREF2:
XREF3:
XREF4:

SAVED:
PLOTTED:
USER:
DWG VER:

BLACK & VEATCH

EXTERIOR PERSPECTIVES

EASTERN NORTH DAKOTA ALTERNATIVE WATER SUPPLY

BUREAU OF RECLAMATION

CARRINGTON

SHEYENNE RIVER OUTFALL CONTROL VALVE STRUCTURE

DESIGNED: RAB
DETAILED: SMH
CHECKED: ---
APPROVED: ---
DATE: OCTOBER 2019

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-22
SHEET
22 OF 26

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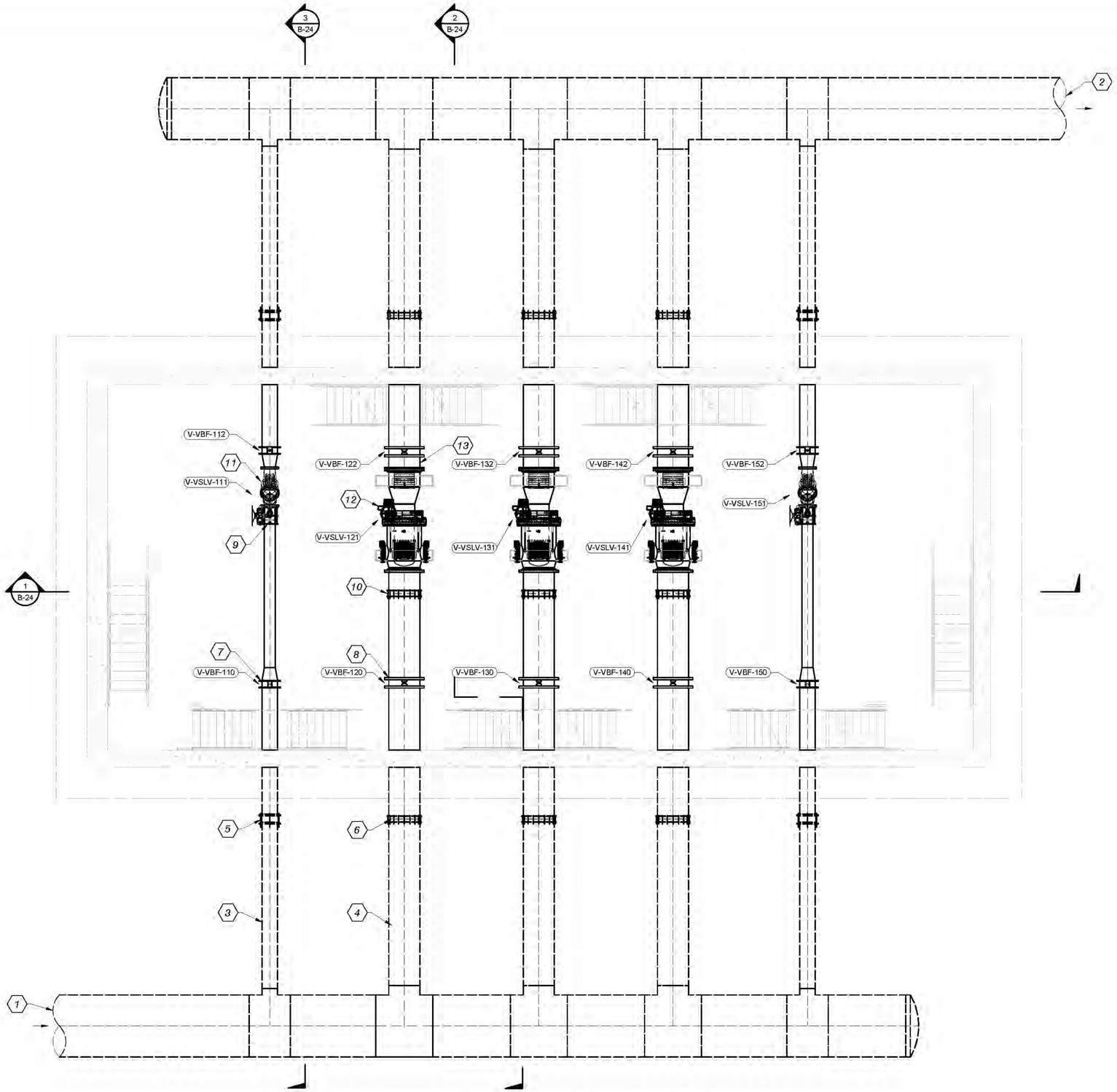

LOWER LEVEL - PROCESS MECHANICAL PLAN

3/16" = 1'-0"

GENERAL SHEET NOTES

SHEET KEYNOTES

1. 72" STL PIPE FROM BREAK TANKS.
2. 72" STL PIPE TO DISCHARGE STRUCTURE.
3. 18" STL PIPE.
4. 36" STL PIPE.
5. 18" HARNESSED MECHANICAL COUPLING.
6. 36" HARNESSED MECHANICAL COUPLING.
7. 18" BUTTERFLY VALVE.
8. 36" BUTTERFLY VALVE.
9. 12" DISMANTLING JOINT.
10. 36" DISMANTLING JOINT.
11. 12" SLEEVE VALVE.
12. 36" INLET - 24" SLEEVE VALVE.
13. 12" LONG SPOOL PIECE.

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

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XREF2:
XREF3:
XREF4:
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PLOTTED:
USER:
DWG VER:

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LOWER LEVEL PLAN

EASTERN NORTH DAKOTA ALTERNATIVE WATER SUPPLY

SHEYENNE RIVER OUTFALL CONTROL VALVE STRUCTURE

DESIGNED: Designer
DETAILED: Author
CHECKED: Checker
APPROVED: Approver
DATE: OCTOBER 2019

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-23
SHEET
23 OF 26

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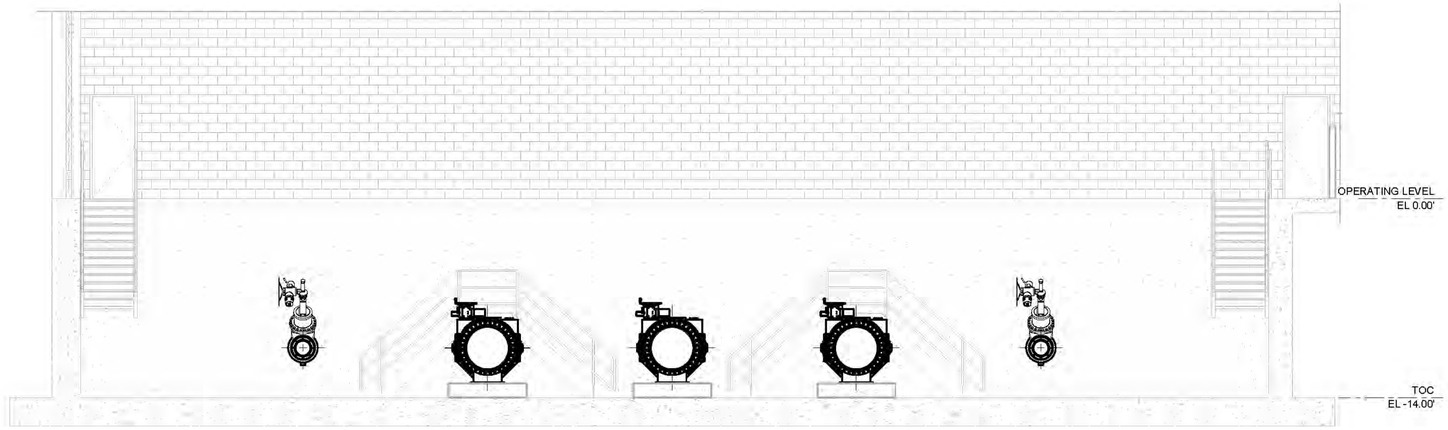
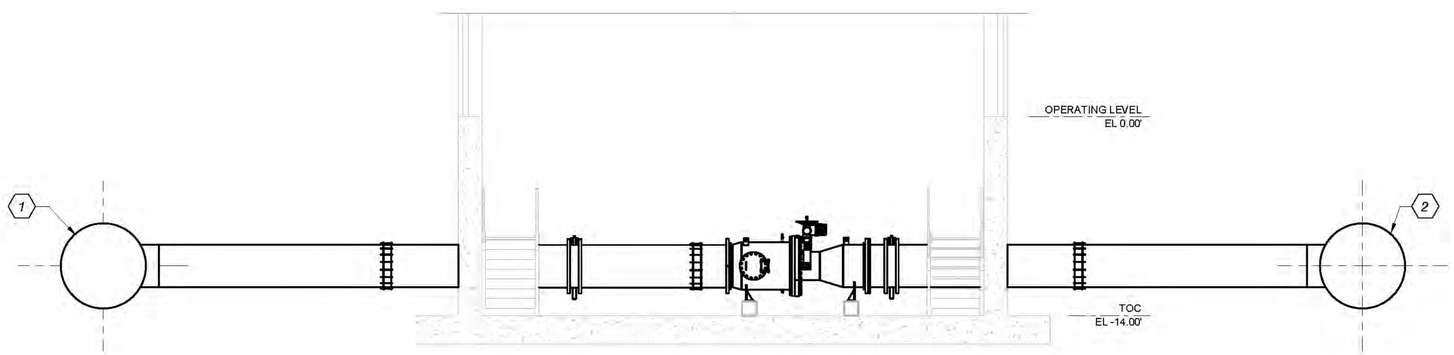
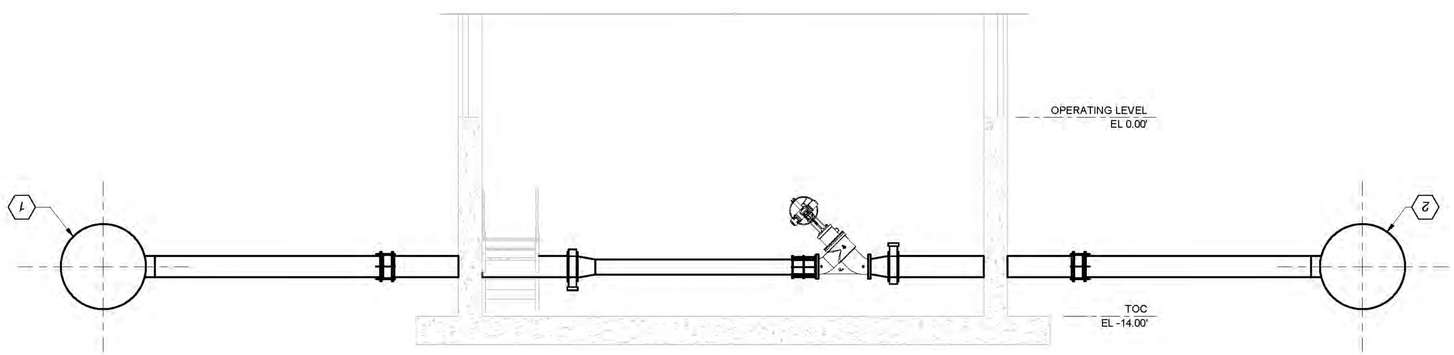


1 B-23 SECTION 3/16" = 1'-0"



2 B-23 SECTION 3/16" = 1'-0"



3 B-23 SECTION 3/16" = 1'-0"

GENERAL SHEET NOTES

SHEET KEYNOTES

1. 72" DISCHARGE HEADER.
2. 72" FROM HYDRAULIC BREAK TANK.

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

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STRUCTURE SECTIONS

EASTERN NORTH DAKOTA ALTERNATIVE WATER SUPPLY

CONTROL VALVE STRUCTURE PROCESS MECHANICAL

DESIGNED: Designer
DETAILED: Author
CHECKED: Checker
APPROVED: Approver
DATE: OCTOBER 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 403070

B-24
SHEET 24 OF 26

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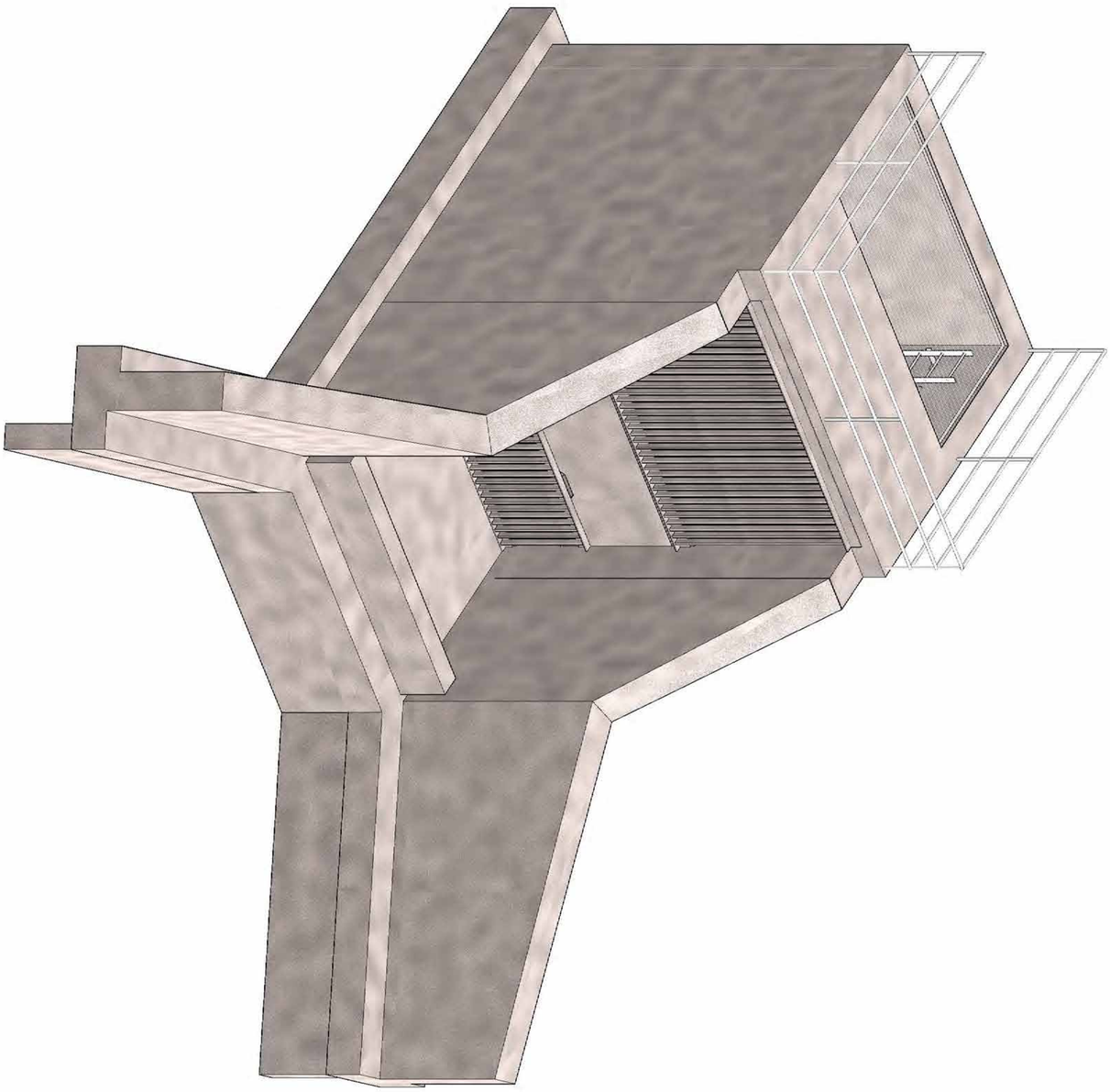

DESIGNED: SET
DETAILED: JGC
CHECKED: ---
APPROVED: ---
DATE: OCTOBER 2019

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT FULL SCALE

PROJECT NO.
403070

B-25
SHEET
25 OF 26

GARRISON DIVERSION

EASTERN NORTH DAKOTA
ALTERNATIVE WATER SUPPLY

BUREAU OF RECLAMATION

BLACK & VEATCH

AE2S

SHEYENNE RIVER OUTFALL
DISCHARGE STRUCTURE

EXTERIOR PERSPECTIVE

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

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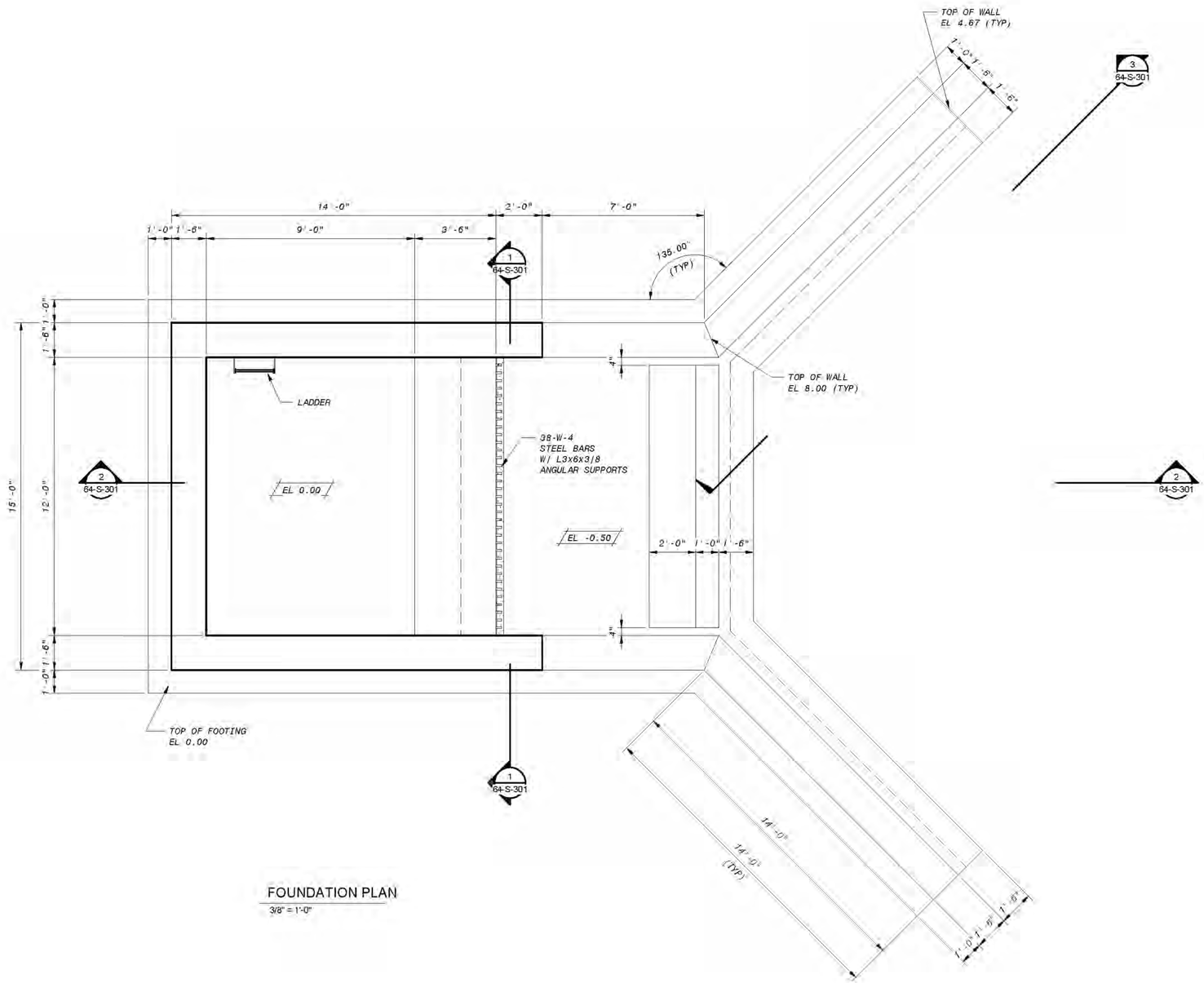

FOUNDATION PLAN

3/8" = 1'-0"

8' 4' 0' 8' 16'

1/8" = 1'-0"

NO.	BY	CK	APP

DATE: REVISIONS AND RECORD OF ISSUE

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XREF2:
XREF3:
XREF4:

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BLACK & VEATCH

RES

STRUCTURAL PLAN

EASTERN NORTH DAKOTA ALTERNATIVE WATER SUPPLY

SHEYENNE RIVER OUTFALL DISCHARGE STRUCTURE

DESIGNED: SET
DETAILED: JGC
CHECKED: —
APPROVED: —
DATE: OCTOBER 2019

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
403070

B-26

SHEET
26 OF 26

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Attachment C Cost Estimates

ENDAWS

Opinion of Probable Construction Cost
Pipeline Estimate
Segment A
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Pipeline						
Division 2 Site Construction						
Clearing and Grubbing	119,886	LF	$ 22	$ 2,637,492	$ 27	$ 3,259,535
Division 2 Site Construction				***$ 2,637,492***		***$ 3,259,535***
Division 13 Special Construction						
13.47.13.13 Test Station, Ground Bed, etc.	121,440	LF	$ 7	$ 850,080	$ 9	$ 1,050,568
Division 13 Special Construction				***$ 850,080***		***$ 1,050,568***
Division 31 Earthwork						
31.63.29 84-inch Trenchless Crossing	1,554	LF	$ 3,600	$ 5,594,400	$ 4,449	$ 6,913,818
31.23.33 Trench Safety	119,886	LF	$ 2	$ 239,772	$ 2	$ 296,321
Division 31 Earthwork				***$ 5,834,172***		***$ 7,210,140***
Division 32 Exterior Improvements						
32.11.23 Aggregate Base Driveways	23	EA	$ 10,000	$ 230,000	$ 12,358	$ 284,245
03.01.26.76 Road Surface St Replmt	8,750	SF	$ 10	$ 87,500	$ 12	$ 108,137
32.31.13 Permanent Fencing and Gates	46	EA	$ 2,000	$ 92,000	$ 2,472	$ 113,698
32.92.21 Storm Water Pollution Prevention Plan	119,886	LF	$ 2	$ 239,772	$ 2	$ 296,321
32.92.21 Drilled Seeding	119,886	LF	$ 10	$ 1,198,860	$ 12	$ 1,481,607
Division 32 Exterior Improvements				***$ 1,848,132***		***$ 2,284,007***
Division 33 Utilities						
33.14.00 Testing	121,440	LF	$ 3	$ 303,600	$ 3	$ 375,203
Division 33 Utilities				***$ 303,600***		***$ 375,203***
Division 40 Process Interconnections						
40.05.24 72-inch CL 150 Steel Pipe	7,920	LF	$ 661	$ 5,235,120	$ 817	$ 6,469,804
40.05.24 72-inch CL 200 Steel Pipe	13,200	LF	$ 661	$ 8,725,200	$ 817	$ 10,783,006
40.05.24 72-inch CL 250 Steel Pipe	80,784	LF	$ 711	$ 57,437,424	$ 879	$ 70,983,827
40.05.24 72-inch CL 300 Steel Pipe	13,200	LF	$ 801	$ 10,573,200	$ 990	$ 13,066,850
40.05.24 72-inch CL 350 Steel Pipe	6,336	LF	$ 935	$ 5,924,160	$ 1,156	$ 7,321,351
40.05.31.12 4" PVC Conduit and Handhole Boxes	121,440	LF	$ 8	$ 971,520	$ 10	$ 1,200,649
40.05.41 Flowable Fill Encase. - Road Crossings	280	LF	$ 194	$ 54,443	$ 240	$ 67,283
40.05.41 Flowable Fill Encase. - 0.7D Embed.	1,000	LF	$ 136	$ 136,108	$ 168	$ 168,209
40.05.51.13 Air Valve with Vault & Appurtenances	46	EA	$ 30,000	$ 1,380,000	$ 37,075	$ 1,705,468
40.05.51.13 Sec. Blowoff Valve Vault & Appurtenances	46	EA	$ 75,000	$ 3,450,000	$ 92,688	$ 4,263,670
Division 40 Process Interconnections				***$ 93,887,175***		***$ 116,030,116***
Totals				**$ 105,361,000**		**$ 130,210,000**
Price Per Mile						**$ 5,661,000**

Mark-Ups

Item	Rate	Construction Subtotal	Percent of Total
Construction Subtotal		$ 105,361,000	80.9%
Subcontractor Markups		included in construction subtotal	
Design Allowance		-	0.0%
Direct Cost Subtotal		$ 105,361,000	80.9%
General Requirements	6.0%	$ 6,322,000	4.9%
Contractor's Fee	8.0%	$ 8,429,000	6.5%
Bonds and Insurance	1.5%	$ 1,580,000	1.2%
Subtotal		$ 121,692,000	93.5%
Contingency	7.0%	$ 8,518,000	6.5%
Grand Total		**$ 130,210,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Pipeline Estimate
Segment B
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Pipeline						
Division 2 Site Construction						
Clearing and Grubbing	166,176	LF	$ 22	$ 3,655,872	$ 27	$ 4,518,149
Division 2 Site Construction				***$ 3,655,872***		***$ 4,518,149***
Division 13 Special Construction						
13.47.13.13 Test Station, Ground Bed, etc.	168,432	LF	$ 7	$ 1,179,024	$ 9	$ 1,457,109
Division 13 Special Construction				***$ 1,179,024***		***$ 1,457,109***
Division 31 Earthwork						
31.63.29 84-inch Trenchless Crossing	2,256	LF	$ 3,600	$ 8,121,600	$ 4,449	$ 10,037,166
31.23.33 Trench Safety	166,176	LF	$ 2	$ 332,352	$ 2	$ 410,741
Division 31 Earthwork				***$ 8,453,952***		***$ 10,447,907***
Division 32 Exterior Improvements						
32.11.23 Aggregate Base Driveways	32	EA	$ 10,000	$ 320,000	$ 12,359	$ 395,475
32.11.23 Road Surface St Replmt	6,875	SF	$ 10	$ 68,750	$ 12	$ 84,965
32.31.13 Permanent Fencing and Gates	64	EA	$ 2,000	$ 128,000	$ 2,472	$ 158,190
32.92.21 Storm Water Pollution Prevention Plan	166,176	LF	$ 2	$ 332,352	$ 2	$ 410,741
32.92.21 Drilled Seeding	166,176	LF	$ 10	$ 1,661,760	$ 12	$ 2,053,704
Division 32 Exterior Improvements				***$ 2,510,862***		***$ 3,103,076***
Division 33 Utilities						
33.14.00 Testing	168,432	LF	$ 3	$ 421,080	$ 3	$ 520,396
Division 33 Utilities				***$ 421,080***		***$ 520,396***
Division 40 Process Interconnections						
40.05.24 72-inch CL 150 Steel Pipe	168,432	LF	$ 661	$ 111,333,552	$ 817	$ 137,592,762
40.05.31.12 4" PVC Conduit and Handhole Boxes	168,432	LF	$ 8	$ 1,347,456	$ 10	$ 1,665,268
40.05.41 Flowable Fill Encase. - Road Crossings	220	LF	$ 194	$ 42,777	$ 240	$ 52,866
40.05.41 Flowable Fill Encase. - 0.7D Embed.	700	LF	$ 136	$ 95,276	$ 168	$ 117,747
40.05.51.13 Air Valve with Vault & Appurtenances	64	EA	$ 30,000	$ 1,920,000	$ 37,076	$ 2,372,853
40.05.51.13 Sec. Blowoff Valve Vault & Appurtenances	64	EA	$ 75,000	$ 4,800,000	$ 92,690	$ 5,932,131
40.05.51.13 54" Gate Valve	1	EA	$ 325,000	$ 325,000	$ 401,655	$ 401,655
40.05.51.13 16'x20' Valve Vault & Appurtenances	1	LS	$ 25,000	$ 25,000	$ 30,897	$ 30,897
Division 40 Process Interconnections				***$ 119,889,061***		***$ 148,166,178***
Totals				**$ 136,110,000**		**$ 168,213,000**
Price Per Mile						**$ 5,273,000**

Mark-Ups

Item	Rate	Construction Subtotal	Percent of Total
Construction Subtotal		$ 136,110,000	80.9%
Subcontractor Markups		included in construction subtotal	
Design Allowance		$ -	0.0%
Direct Cost Subtotal		$ 136,110,000	80.9%
General Requirements	6.0%	$ 8,167,000	4.9%
Contractor's Fee	8.0%	$ 10,889,000	6.5%
Bonds and Insurance	1.5%	$ 2,042,000	1.2%
Subtotal		$ 157,208,000	93.5%
Contingency	7.0%	$ 11,005,000	6.5%
Grand Total		**$ 168,213,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Pipeline Estimate
Segment C
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Pipeline						
Division 2 Site Construction						
Clearing and Grubbing	91,320	LF	$ 22	$ 2,009,040	$ 27	$ 2,482,883
Division 2 Site Construction				***$ 2,009,040***		***$ 2,482,883***
Division 13 Special Construction						
13.47.13.13 Test Station, Ground Bed, etc.	92,400	LF	$ 7	$ 646,800	$ 9	$ 799,351
Division 13 Special Construction				***$ 646,800***		***$ 799,351***
Division 31 Earthwork						
31.63.29 84-inch Trenchless Crossing	1,080	LF	$ 3,600	$ 3,888,000	$ 4,449	$ 4,805,006
31.23.33 Trench Safety	91,320	LF	$ 2	$ 182,640	$ 2	$ 225,717
Division 31 Earthwork				***$ 4,070,640***		***$ 5,030,723***
Division 32 Exterior Improvements						
32.11.23 Aggregate Base Driveways	18	EA	$ 10,000	$ 180,000	$ 12,359	$ 222,454
32.11.23 Road Surface St Replmt	3,750	SF	$ 10	$ 37,500	$ 12	$ 46,345
32.31.13 Permanent Fencing and Gates	36	EA	$ 2,000	$ 72,000	$ 2,472	$ 88,982
32.92.21 Storm Water Pollution Prevention Plan	91,320	LF	$ 2	$ 182,640	$ 2	$ 225,717
32.92.21 Drilled Seeding	91,320	LF	$ 10	$ 913,200	$ 12	$ 1,128,583
Division 32 Exterior Improvements				***$ 1,385,340***		***$ 1,712,080***
Division 33 Utilities						
33.14.00 Testing	92,400	LF	$ 3	$ 231,000	$ 3	$ 285,483
Division 33 Utilities				***$ 231,000***		***$ 285,483***
Division 40 Process Interconnections						
40.05.24 72-inch CL 150 Steel Pipe	92,400	LF	$ 661	$ 61,076,400	$ 817	$ 75,481,606
40.05.31.12 4" PVC Conduit and Handhole Boxes	92,400	LF	$ 8	$ 739,200	$ 10	$ 913,544
40.05.41 Flowable Fill Encase. - Road Crossings	120	LF	$ 194	$ 23,333	$ 240	$ 28,836
40.05.41 Flowable Fill Encase. - 0.7D Embed.	600	LF	$ 136	$ 81,665	$ 168	$ 100,926
40.05.51.13 Air Valve with Vault & Appurtenances	36	EA	$ 30,000	$ 1,080,000	$ 37,076	$ 1,334,724
40.05.51.13 Sec. Blowoff Valve Vault & Appurtenances	36	EA	$ 75,000	$ 2,700,000	$ 92,689	$ 3,336,810
40.05.51.13 54" Gate Valve	1	EA	$ 325,000	$ 325,000	$ 401,653	$ 401,653
40.05.51.13 16'x20' Valve Vault & Appurtenances	1	LS	$ 25,000	$ 25,000	$ 30,896	$ 30,896
Division 40 Process Interconnections				***$ 66,050,598***		***$ 81,628,996***
Totals				**$ 74,393,000**		**$ 115,692,000**
Price Per Mile						**$ 6,611,000**

Mark-Ups

Item	Rate	Construction Subtotal	Percent of Total
Construction Subtotal		$ 74,393,000	80.9%
Subcontractor Markups		included in construction subtotal	
Design Allowance		$ -	0.0%
Direct Cost Subtotal		$ 74,393,000	80.9%
General Requirements	6.0%	$ 4,464,000	4.9%
Contractor's Fee	8.0%	$ 5,951,000	6.5%
Bonds and Insurance	1.5%	$ 1,116,000	1.2%
Subtotal		$ 85,924,000	93.5%
Contingency	7.0%	$ 6,015,000	6.5%
Grand Total		**$ 91,939,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Pipeline Estimate
Segment D
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Pipeline						
Division 2 Site Construction						
Clearing and Grubbing	484,289	LF	$ 22	$ 10,654,358	$ 27	$ 13,167,190
Division 2 Site Construction				***$ 10,654,358***		***$ 13,167,190***
Division 13 Special Construction						
13.47.13.13 Test Station, Ground Bed, etc.	492,096	LF	$ 7	$ 3,444,672	$ 9	$ 4,257,098
Division 13 Special Construction				***$ 3,444,672***		***$ 4,257,098***
Division 31 Earthwork						
31.63.29 84-inch Trenchless Crossing	7,807	LF	$ 3,600	$ 28,105,200	$ 4,449	$ 34,733,816
31.23.33 Trench Safety	484,289	LF	$ 2	$ 968,578	$ 2	$ 1,197,017
Division 31 Earthwork				***$ 29,073,778***		***$ 35,930,833***
Division 32 Exterior Improvements						
32.11.23 Aggregate Base Driveways	94	EA	$ 10,000	$ 940,000	$ 12,359	$ 1,161,699
32.11.23 Road Surface St Replmt	32,500	SF	$ 10	$ 325,000	$ 12	$ 401,651
32.31.13 Permanent Fencing and Gates	188	EA	$ 2,000	$ 376,000	$ 2,472	$ 464,680
32.92.21 Storm Water Pollution Prevention Plan	484,289	LF	$ 2	$ 968,578	$ 2	$ 1,197,017
32.92.21 Drilled Seeding	484,289	LF	$ 10	$ 4,842,890	$ 12	$ 5,985,086
Division 32 Exterior Improvements				***$ 7,452,468***		***$ 9,210,134***
Division 33 Utilities						
33.14.00 Testing	492,096	LF	$ 3	$ 1,230,240	$ 3	$ 1,520,392
Division 33 Utilities				***$ 1,230,240***		***$ 1,520,392***
Division 40 Process Interconnections						
40.05.24 72-inch CL 150 Steel Pipe	102,432	LF	$ 661	$ 67,707,552	$ 817	$ 83,676,388
40.05.24 72-inch CL 200 Steel Pipe	58,080	LF	$ 661	$ 38,390,880	$ 817	$ 47,445,375
40.05.24 72-inch CL 250 Steel Pipe	97,680	LF	$ 711	$ 69,450,480	$ 879	$ 85,830,386
40.05.24 72-inch CL 300 Steel Pipe	233,904	LF	$ 801	$ 187,357,104	$ 990	$ 231,545,305
40.05.31.12 4" PVC Conduit and Handhole Boxes	492,096	LF	$ 8	$ 3,936,768	$ 10	$ 4,865,255
40.05.41 Flowable Fill Encase. - Road Crossings	1,040	LF	$ 194	$ 202,218	$ 240	$ 249,911
40.05.41 Flowable Fill Encase. - 0.7D Embed.	4,100	LF	$ 136	$ 558,043	$ 168	$ 689,657
40.05.51.13 Air Valve with Vault & Appurtenances	188	EA	$ 30,000	$ 5,640,000	$ 37,076	$ 6,970,195
40.05.51.13 Pri. Blowoff Valve Vault & Appurtenances	3	EA	$ 100,000	$ 300,000	$ 123,585	$ 370,755
40.05.51.13 Sec. Blowoff Valve Vault & Appurtenances	188	EA	$ 75,000	$ 14,100,000	$ 92,689	$ 17,425,487
40.05.51.13 54" Gate Valve	2	EA	$ 325,000	$ 650,000	$ 401,651	$ 803,303
40.05.51.13 16'x20' Valve Vault & Appurtenances	2	LS	$ 25,000	$ 50,000	$ 30,896	$ 61,793
Division 40 Process Interconnections				***$ 388,343,045***		***$ 479,933,810***
Totals				**$ 440,199,000**		**$ 544,019,000**
Price Per Mile						**$ 5,837,000**

Mark-Ups

Item	Rate	Construction Subtotal	Percent of Total
Construction Subtotal		$ 440,199,000	80.9%
Subcontractor Markups		included in construction subtotal	
Design Allowance		$ -	0.0%
Direct Cost Subtotal		$ 440,199,000	80.9%
General Requirements	6.0%	$ 26,412,000	4.9%
Contractor's Fee	8.0%	$ 35,216,000	6.5%
Bonds and Insurance	1.5%	$ 6,603,000	1.2%
Subtotal		$ 508,430,000	93.5%
Contingency	7.0%	$ 35,590,000	6.5%
Grand Total		**$ 544,020,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Pipeline Estimate
Segment E
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Pipeline						
Division 2 Site Construction						
Clearing and Grubbing	30,880	LF	$ 22	$ 679,360	$ 27	$ 839,600
Division 2 Site Construction				***$ 679,360***		***$ 839,600***
Division 13 Special Construction						
13.47.13.13 Test Station, Ground Bed, etc.	31,680	LF	$ 7	$ 221,760	$ 9	$ 274,066
Division 13 Special Construction				***$ 221,760***		***$ 274,066***
Division 31 Earthwork						
31.63.29 84-inch Trenchless Crossing	800	LF	$ 3,600	$ 2,880,000	$ 4,449	$ 3,559,304
31.23.33 Trench Safety	30,880	LF	$ 2	$ 61,760	$ 2	$ 76,327
Division 31 Earthwork				***$ 2,941,760***		***$ 3,635,631***
Division 32 Exterior Improvements						
32.11.23 Aggregate Base Driveways	6	EA	$ 10,000	$ 60,000	$ 12,359	$ 74,152
32.11.23 Road Surface St Replmt	2,500	SF	$ 10	$ 25,000	$ 12	$ 30,897
32.31.13 Permanent Fencing and Gates	12	EA	$ 2,000	$ 24,000	$ 2,472	$ 29,661
32.92.21 Storm Water Pollution Prevention Plan	30,880	LF	$ 2	$ 61,760	$ 2	$ 76,327
32.92.21 Drilled Seeding	30,880	LF	$ 10	$ 308,800	$ 12	$ 381,636
Division 32 Exterior Improvements				***$ 479,560***		***$ 592,674***
Division 33 Utilities						
33.14.00 Testing	31,680	LF	$ 3	$ 79,200	$ 3	$ 97,881
Division 33 Utilities				***$ 79,200***		***$ 97,881***
Division 40 Process Interconnections						
40.05.24 72-inch CL 350 Steel Pipe	31,680	LF	$ 935	$ 29,620,800	$ 1,156	$ 36,607,443
40.05.31.12 4" PVC Conduit and Handhole Boxes	31,680	LF	$ 8	$ 253,440	$ 10	$ 313,219
40.05.41 Flowable Fill Encase. - Road Crossings	80	LF	$ 194	$ 15,555	$ 240	$ 19,224
40.05.41 Flowable Fill Encase. - 0.7D Embed.	200	LF	$ 136	$ 27,222	$ 168	$ 33,642
40.05.51.13 Air Valve with Vault & Appurtenances	12	EA	$ 30,000	$ 360,000	$ 37,076	$ 444,913
40.05.51.13 Sec. Blowoff Valve Vault & Appurtenances	12	EA	$ 75,000	$ 900,000	$ 92,690	$ 1,112,283
Division 40 Process Interconnections				***$ 31,177,017***		***$ 38,530,723***
Totals				**$ 35,579,000**		**$ 43,971,000**
Price Per Mile						**$ 7,329,000**

Mark-Ups

Item	Rate	Construction Subtotal	Percent of Total
Construction Subtotal		$ 35,579,000	80.9%
Subcontractor Markups		included in construction subtotal	
Design Allowance		-	0.0%
Direct Cost Subtotal		$ 35,579,000	80.9%
General Requirements	6.0%	$ 2,135,000	4.9%
Contractor's Fee	8.0%	$ 2,846,000	6.5%
Bonds and Insurance	1.5%	$ 534,000	1.2%
Subtotal		$ 41,094,000	93.5%
Contingency	7.0%	$ 2,877,000	6.5%
Grand Total		**$ 43,971,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Pipeline Estimate
Segment E
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Pipeline						
Division 2 Site Construction						
Clearing and Grubbing	30,880	LF	$ 22	$ 679,360	$ 27	$ 839,576
Division 2 Site Construction				***$ 221,760***		***$ 274,058***
Division 13 Special Construction						
13.47.13.13 Test Station, Ground Bed, etc.	31,680	LF	$ 7	$ 221,760	$ 9	$ 274,058
Division 13 Special Construction				***$ 221,760***		***$ 274,058***
Division 31 Earthwork						
31.63.29 84-inch Trenchless Crossing	800	LF	$ 3,600	$ 2,880,000	$ 4,449	$ 3,559,200
31.23.33 Trench Safety	30,880	LF	$ 2	$ 61,760	$ 2	$ 76,325
Division 31 Earthwork				***$ 2,941,760***		***$ 3,635,525***
Division 32 Exterior Improvements						
32.11.23 Aggregate Base Driveways	6	EA	$ 10,000	$ 60,000	$ 12,358	$ 74,150
32.11.23 Road Surface St Replmt	2,500	SF	$ 10	$ 25,000	$ 12	$ 30,896
32.31.13 Permanent Fencing and Gates	12	EA	$ 2,000	$ 24,000	$ 2,472	$ 29,660
32.92.21 Storm Water Pollution Prevention Plan	30,880	LF	$ 2	$ 61,760	$ 2	$ 76,325
32.92.21 Drilled Seeding	30,880	LF	$ 10	$ 308,800	$ 12	$ 381,625
Division 32 Exterior Improvements				***$ 479,560***		***$ 592,656***
Division 33 Utilities						
33.14.00 Testing	31,680	LF	$ 3	$ 79,200	$ 3	$ 97,878
Division 33 Utilities				***$ 79,200***		***$ 97,878***
Division 40 Process Interconnections						
40.05.19 30-inch Ductile Iron Pipe	31,680	LF	$ 208	$ 6,589,440	$ 257	$ 8,143,449
40.05.31.12 4" PVC Conduit and Handhole Boxes	31,680	LF	$ 8	$ 253,440	$ 10	$ 313,210
40.05.41 Flowable Fill Encase. - Road Crossings	80	LF	$ 194	$ 15,555	$ 240	$ 19,224
40.05.41 Flowable Fill Encase. - 0.7D Embed.	200	LF	$ 136	$ 27,222	$ 168	$ 33,641
40.05.51.13 Air Valve with Vault & Appurtenances	12	EA	$ 30,000	$ 360,000	$ 37,075	$ 444,900
40.05.51.13 Sec. Blowoff Valve Vault & Appurtenances	12	EA	$ 75,000	$ 900,000	$ 92,687	$ 1,112,250
Division 40 Process Interconnections				***$ 8,145,657***		***$ 10,066,674***
Totals				**$ 12,547,000**		**$ 15,506,000**
Price Per Mile						**$ 2,584,000**

Mark-Ups

Item	Rate	Construction Subtotal	Percent of Total
Construction Subtotal		$ 12,547,000	80.9%
Subcontractor Markups		included in construction subtotal	
Design Allowance		-	0.0%
Direct Cost Subtotal		$ 12,547,000	80.9%
General Requirements	6.0%	$ 753,000	4.9%
Contractor's Fee	8.0%	$ 1,004,000	6.5%
Bonds and Insurance	1.5%	$ 188,000	1.2%
Subtotal		$ 14,492,000	93.5%
Contingency	7.0%	$ 1,014,000	6.5%
Grand Total		**$ 15,506,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Pipeline Estimate
Segment F
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Pipeline						
Division 2 Site Construction						
Clearing and Grubbing	34,198	LF	$ 22	$ 752,356	$ 27	$ 929,804
Division 2 Site Construction				***$ 752,356***		***$ 929,804***
Division 13 Special Construction						
13.47.13.13 Test Station, Ground Bed, etc.	34,848	LF	$ 7	$ 243,936	$ 9	$ 301,470
Division 13 Special Construction				***$ 243,936***		***$ 301,470***
Division 31 Earthwork						
31.63.29 84-inch Trenchless Crossing	650	LF	$ 3,600	$ 2,340,000	$ 4,449	$ 2,891,904
31.23.33 Trench Safety	34,198	LF	$ 2	$ 68,396	$ 2	$ 84,528
Division 31 Earthwork				***$ 2,408,396***		***$ 2,976,432***
Division 32 Exterior Improvements						
32.11.23 Aggregate Base Driveways	7	EA	$ 10,000	$ 70,000	$ 12,359	$ 86,510
32.11.23 Road Surface St Replmt	2,500	SF	$ 10	$ 25,000	$ 12	$ 30,896
32.31.13 Permanent Fencing and Gates	14	EA	$ 2,000	$ 28,000	$ 2,472	$ 34,604
32.92.21 Storm Water Pollution Prevention Plan	34,198	LF	$ 2	$ 68,396	$ 2	$ 84,528
32.92.21 Drilled Seeding	34,198	LF	$ 10	$ 341,980	$ 12	$ 422,638
Division 32 Exterior Improvements				***$ 533,376***		***$ 659,176***
Division 33 Utilities						
33.14.00 Testing	34,848	LF	$ 3	$ 87,120	$ 3	$ 107,668
Division 33 Utilities				***$ 87,120***		***$ 107,668***
Division 40 Process Interconnections						
40.05.24 72-inch CL 150 Steel Pipe	34,848	LF	$ 661	$ 23,034,528	$ 817	$ 28,467,373
40.05.31.12 4" PVC Conduit and Handhole Boxes	34,848	LF	$ 8	$ 278,784	$ 10	$ 344,537
40.05.41 Flowable Fill Encase. - Road Crossings	80	LF	$ 194	$ 15,555	$ 240	$ 19,224
40.05.41 Flowable Fill Encase. - 0.7D Embed.	300	LF	$ 136	$ 40,832	$ 168	$ 50,463
40.05.51.13 Air Valve with Vault & Appurtenances	14	EA	$ 30,000	$ 420,000	$ 37,076	$ 519,060
40.05.51.13 Sec. Blowoff Valve Vault & Appurtenances	14	EA	$ 75,000	$ 1,050,000	$ 92,689	$ 1,297,649
Division 40 Process Interconnections				***$ 24,839,699***		***$ 30,698,306***
Totals				**$ 28,865,000**		**$ 35,673,000**
Price Per Mile						**$ 5,405,000**

Mark-Ups

Item	Rate	Construction Subtotal	Percent of Total
Construction Subtotal		$ 28,865,000	80.9%
Subcontractor Markups		included in construction subtotal	
Design Allowance		$ -	0.0%
Direct Cost Subtotal		$ 28,865,000	80.9%
General Requirements	6.0%	$ 1,732,000	4.9%
Contractor's Fee	8.0%	$ 2,309,000	6.5%
Bonds and Insurance	1.5%	$ 433,000	1.2%
Subtotal		$ 33,339,000	93.5%
Contingency	7.0%	$ 2,334,000	6.5%
Grand Total		**$ 35,673,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Pipeline Estimate
Segment G
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Pipeline						
Division 2 Site Construction						
Clearing and Grubbing	160,101	LF	$ 22	$ 3,522,222	$ 27	$ 4,352,964
Division 2 Site Construction				***$ 3,522,222***		***$ 4,352,964***
Division 13 Special Construction						
13.47.13.13 Test Station, Ground Bed, etc.	167,376	LF	$ 7	$ 1,171,632	$ 9	$ 1,447,970
Division 13 Special Construction				***$ 1,171,632***		***$ 1,447,970***
Division 31 Earthwork						
31.63.29 84-inch Trenchless Crossing	7,275	LF	$ 3,600	$ 26,190,000	$ 4,449	$ 32,367,104
31.23.33 Trench Safety	160,101	LF	$ 2	$ 320,202	$ 2	$ 395,724
Division 31 Earthwork				***$ 26,510,202***		***$ 32,762,828***
Division 32 Exterior Improvements						
32.11.23 Aggregate Base Driveways	32	EA	$ 10,000	$ 320,000	$ 12,359	$ 395,474
32.11.23 Road Surface St Replmt	10,000	SF	$ 10	$ 100,000	$ 12	$ 123,586
32.31.13 Permanent Fencing and Gates	64	EA	$ 2,000	$ 128,000	$ 2,472	$ 158,190
32.92.21 Storm Water Pollution Prevention Plan	160,101	LS	$ 2	$ 320,202	$ 2	$ 395,724
32.92.21 Drilled Seeding	160,101	LF	$ 10	$ 1,601,010	$ 12	$ 1,978,620
Division 32 Exterior Improvements				***$ 2,469,212***		***$ 3,051,594***
Division 33 Utilities						
33.14.00 Testing	167,376	LF	$ 3	$ 418,440	$ 3	$ 517,132
Division 33 Utilities				***$ 418,440***		***$ 517,132***
Division 40 Process Interconnections						
40.05.24 72-inch CL 150 Steel Pipe	167,376	LF	$ 661	$ 110,635,536	$ 817	$ 136,729,741
40.05.31.12 4" PVC Conduit and Handhole Boxes	167,376	LF	$ 8	$ 1,339,008	$ 10	$ 1,654,823
40.05.41 Flowable Fill Encase. - Road Crossings	320	LF	$ 194	$ 62,221	$ 240	$ 76,896
40.05.41 Flowable Fill Encase. - 0.7D Embed.	2,400	LF	$ 136	$ 326,659	$ 168	$ 403,704
40.05.51.13 Air Valve with Vault & Appurtenances	64	EA	$ 30,000	$ 1,920,000	$ 37,076	$ 2,372,846
40.05.51.13 Sec. Blowoff Valve Vault & Appurtenances	64	EA	$ 75,000	$ 4,800,000	$ 92,689	$ 5,932,115
40.05.51.13 54" Gate Valve	1	EA	$ 325,000	$ 325,000	$ 401,654	$ 401,654
40.05.51.13 16'x20' Valve Vault & Appurtenances	1	LS	$ 25,000	$ 25,000	$ 30,896	$ 30,896
Division 40 Process Interconnections				***$ 119,433,424***		***$ 147,602,675***
Totals				**$ 153,525,000**		**$ 189,735,000**
Price Per Mile						**$ 5,985,000**

Mark-Ups

Item	Rate	Construction Subtotal	Percent of Total
Construction Subtotal		$ 153,525,000	80.9%
Subcontractor Markups		included in construction subtotal	
Design Allowance		$ -	0.0%
Direct Cost Subtotal		$ 153,525,000	80.9%
General Requirements	6.0%	$ 9,212,000	4.9%
Contractor's Fee	8.0%	$ 12,282,000	6.5%
Bonds and Insurance	1.5%	$ 2,303,000	1.2%
Subtotal		$ 177,322,000	93.5%
Contingency	7.0%	$ 12,413,000	6.5%
Grand Total		**$ 189,735,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Pipeline Estimate
Segment H
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Pipeline						
Division 2 Site Construction						
Clearing and Grubbing	45,895	LF	$ 22	$ 1,009,690	$ 27	$ 1,247,831
Division 2 Site Construction				***$ 1,009,690***		***$ 1,247,831***
Division 13 Special Construction						
13.47.13.13 Test Station, Ground Bed, etc.	47,520	LF	$ 7	$ 332,640	$ 9	$ 411,095
Division 13 Special Construction				***$ 332,640***		***$ 411,095***
Division 31 Earthwork						
31.63.29 84-inch Trenchless Crossing	1625	LF	$ 3,600	$ 5,850,000	$ 4,449	$ 7,229,753
31.23.33 Trench Safety	45,895	LF	$ 2	$ 91,790	$ 2	$ 113,439
Division 31 Earthwork				***$ 5,941,790***		***$ 7,343,192***
Division 32 Exterior Improvements						
32.11.23 Aggregate Base Driveways	9	EA	$ 10,000	$ 90,000	$ 12,359	$ 111,227
32.11.23 Road Surface St Replmt	1,250	SF	$ 10	$ 12,500	$ 12	$ 15,448
32.31.13 Permanent Fencing and Gates	18	EA	$ 2,000	$ 36,000	$ 2,472	$ 44,491
32.92.21 Storm Water Pollution Prevention Plan	45,895	LS	$ 2	$ 91,790	$ 2	$ 113,439
32.92.21 Drilled Seeding	45,895	LF	$ 10	$ 458,950	$ 12	$ 567,196
Division 32 Exterior Improvements				***$ 689,240***		***$ 851,801***
Division 33 Utilities						
33.14.00 Testing	47,520	LF	$ 3	$ 118,800	$ 3	$ 146,820
Division 33 Utilities				***$ 118,800***		***$ 146,820***
Division 40 Process Interconnections						
40.05.24 72-inch CL 150 Steel Pipe	47,520	LF	$ 661	$ 31,410,720	$ 817	$ 38,819,100
40.05.31.12 4" PVC Conduit and Handhole Boxes	47,520	LF	$ 8	$ 380,160	$ 10	$ 469,823
40.05.41 Flowable Fill Encase. - Road Crossings	40	LF	$ 194	$ 7,778	$ 240	$ 9,612
40.05.41 Flowable Fill Encase. - 0.7D Embed.	400	LF	$ 136	$ 54,443	$ 168	$ 67,284
40.05.51.13 Air Valve with Vault & Appurtenances	18	EA	$ 30,000	$ 540,000	$ 37,076	$ 667,362
40.05.51.13 Sec. Blowoff Valve Vault & Appurtenances	18	EA	$ 75,000	$ 1,350,000	$ 92,689	$ 1,668,404
Division 40 Process Interconnections				***$ 33,743,101***		***$ 41,701,585***
Totals				**$ 41,835,000**		**$ 51,702,000**
Price Per Mile						**$ 5,745,000**

Mark-Ups

Item	Rate	Construction Subtotal	Percent of Total
Construction Subtotal		$ 41,835,000	80.9%
Subcontractor Markups		included in construction subtotal	
Design Allowance		$ -	0.0%
Direct Cost Subtotal		$ 41,835,000	80.9%
General Requirements	6.0%	$ 2,510,000	4.9%
Contractor's Fee	8.0%	$ 3,347,000	6.5%
Bonds and Insurance	1.5%	$ 628,000	1.2%
Subtotal		$ 48,320,000	93.5%
Contingency	7.0%	$ 3,382,000	6.5%
Grand Total		**$ 51,702,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Pipeline Estimate
Segment I
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Pipeline						
Division 2 Site Construction						
Clearing and Grubbing	97,692	LF	$ 22	$ 2,149,224	$ 27	$ 2,656,114
Division 2 Site Construction				***$ 2,149,224***		***$ 2,656,114***
Division 13 Special Construction						
13.47.13.13 Test Station, Ground Bed, etc.	99,792	LF	$ 7	$ 698,544	$ 9	$ 863,294
Division 13 Special Construction				***$ 698,544***		***$ 863,294***
Division 31 Earthwork						
31.63.29 84-inch Trenchless Crossing	2,100	LF	$ 3,600	$ 7,560,000	$ 4,449	$ 9,343,010
31.23.33 Trench Safety	97,692	LF	$ 2	$ 195,384	$ 2	$ 241,465
Division 31 Earthwork				***$ 7,755,384***		***$ 9,584,475***
Division 32 Exterior Improvements						
32.11.23 Aggregate Base Driveways	19	EA	$ 10,000	$ 190,000	$ 12,358	$ 234,811
32.11.23 Road Surface St Replmt	5,625	SF	$ 10	$ 56,250	$ 12	$ 69,516
32.31.13 Permanent Fencing and Gates	38	EA	$ 2,000	$ 76,000	$ 2,472	$ 93,924
32.92.21 Storm Water Pollution Prevention Plan	97,692	LS	$ 2	$ 195,384	$ 2	$ 241,465
32.92.21 Drilled Seeding	97,692	LF	$ 10	$ 976,920	$ 12	$ 1,207,325
Division 32 Exterior Improvements				***$ 1,494,554***		***$ 1,847,041***
Division 33 Utilities						
33.14.00 Testing	99,792	LF	$ 3	$ 249,480	$ 3	$ 308,319
Division 33 Utilities				***$ 249,480***		***$ 308,319***
Division 40 Process Interconnections						
40.05.24 72-inch CL 150 Steel Pipe	99,792	LF	$ 661	$ 65,962,512	$ 817	$ 81,519,634
40.05.31.12 4" PVC Conduit and Handhole Boxes	99,792	LF	$ 8	$ 798,336	$ 10	$ 986,622
40.05.41 Flowable Fill Encase. - Road Crossings	180	LF	$ 194	$ 34,999	$ 240	$ 43,254
40.05.41 Flowable Fill Encase. - 0.7D Embed.	800	LF	$ 136	$ 108,886	$ 168	$ 134,567
40.05.51.13 Air Valve with Vault & Appurtenances	38	EA	$ 30,000	$ 1,140,000	$ 37,075	$ 1,408,867
40.05.51.13 Sec. Blowoff Valve Vault & Appurtenances	38	EA	$ 75,000	$ 2,850,000	$ 92,689	$ 3,522,167
40.05.51.13 54" Gate Valve	1	EA	$ 325,000	$ 325,000	$ 401,651	$ 401,651
40.05.51.13 16'x20' Valve Vault & Appurtenances	1	LS	$ 25,000	$ 25,000	$ 30,896	$ 30,896
Division 40 Process Interconnections				***$ 71,244,733***		***$ 88,047,656***
Totals				**$ 83,592,000**		**$ 103,307,000**
Price Per Mile						**$ 5,466,000**

Mark-Ups

Item	Rate	Construction Subtotal	Percent of Total
Construction Subtotal		$ 83,592,000	80.9%
Subcontractor Markups		included in construction subtotal	
Design Allowance		$ -	0.0%
Direct Cost Subtotal		$ 83,592,000	80.9%
General Requirements	6.0%	$ 5,016,000	4.9%
Contractor's Fee	8.0%	$ 6,687,000	6.5%
Bonds and Insurance	1.5%	$ 1,254,000	1.2%
Subtotal		$ 96,549,000	93.5%
Contingency	7.0%	$ 6,758,000	6.5%
Grand Total		**$ 103,307,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
Missouri River Intake and Pumping Station
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Sitework						
Division 2 Site Construction						
Utilities	1	LS	$ 2,100,000	$ 2,100,000	$ 3,076,539	$ 3,076,539
Property and Easements	1	LS	$ 200,000	$ 200,000	$ 293,004	$ 293,004
Commissioning	1	LS	$ 600,000	$ 600,000	$ 879,011	$ 879,011
Division 2 Site Construction				***$ 2,900,000***		***$ 4,248,553***
Sitework Subtotal				**$ 2,900,000**		**$ 4,248,553**
Intake Structure						
Division 2 Site Construction						
Roadway and Ditch Grading - Established	4,800	LF	$ 164	$ 784,800	$ 240	$ 1,149,746
Approach/Culvert	3	EA	$ 5,450	$ 16,350	$ 7,984	$ 23,953
Clearing, Restoration, Subgrade Prep	1	LS	$ 136,250	$ 136,250	$ 199,609	$ 199,609
Erosion and Sediment Control	1	LS	$ 81,750	$ 81,750	$ 119,765	$ 119,765
Grading and Seeding	5	AC	$ 2,616	$ 13,080	$ 3,832	$ 19,162
Cofferdam sheet piling	53,000	SF	$ 49	$ 2,599,650	$ 72	$ 3,808,535
Excavation	7,000	CY	$ 14	$ 101,021	$ 21	$ 147,998
Soil stabilization Granular material	2,660	CY	$ 45	$ 118,991	$ 66	$ 174,325
Intake Support Structure Piling	1,260	LF	$ 45	$ 56,309	$ 65	$ 82,494
Intake Support Structure - Walls	142	CY	$ 1,032	$ 146,527	$ 1,512	$ 214,665
Intake Support Structure - Grade beams	140	CY	$ 714	$ 99,970	$ 1,046	$ 146,458
Intake Support Structure - Bottom Slab	120	CY	$ 631	$ 75,698	$ 924	$ 110,899
Miscellaneous steel members	140	CY	$ 1,225	$ 171,567	$ 1,795	$ 251,348
Intake Support Structure - Debris Deflector	15	CY	$ 1,032	$ 15,478	$ 1,512	$ 22,676
Intake Support Structure Misc. Fittings (48 inch Stainless Steel Flanged sleeves)	8	EA	$ 14,279	$ 114,232	$ 20,919	$ 167,352
Intake Screens	8	EA	$ 55,590	$ 444,720	$ 81,440	$ 651,523
Inlet Misc. Fittings (6' x 6' Access hatch)	1	EA	$ 21,800	$ 21,800	$ 31,937	$ 31,937
Air Scour Pipe (8 inch Poly)	13,600	LF	$ 19	$ 252,008	$ 27	$ 369,196
Division 2 Site Construction				***$ 5,250,202***		***$ 7,691,642***
Intake Structure Subtotal				**$ 5,250,202**		**$ 7,691,642**
Tunnel						
Division 2 Site Construction						
MTBM Machine, setup, removal	1	LS	$ 5,159,452	$ 5,159,452	$ 7,558,692	$ 7,558,692
Entry Seal	1	LS	$ 81,750	$ 81,750	$ 119,765	$ 119,765
Exit Seal	1	LS	$ 376,050	$ 376,050	$ 550,920	$ 550,920
72-inch PermaLok Pipe	1,620	LF	$ 2,379	$ 3,854,741	$ 3,486	$ 5,647,267
Soil conditioner	1	LS	$ 54,500	$ 54,500	$ 79,844	$ 79,844
Intermediate Jacking Station	4	EA	$ 13,080	$ 52,320	$ 19,162	$ 76,650
Cutters	1	LS	$ 21,800	$ 21,800	$ 31,937	$ 31,937
Misc supplies	1	LS	$ 34,008	$ 34,008	$ 49,822	$ 49,822
Muck Removal	2,427	CY	$ 25	$ 60,845	$ 37	$ 89,139
Final Cleanup	1	LS	$ 37,023	$ 37,023	$ 54,239	$ 54,239
Division 2 Site Construction				***$ 9,732,489***		***$ 14,258,275***
Tunnel Subtotal				**$ 9,732,489**		**$ 14,258,275**
River Intake Pump Station and Wetwell						
Division 2 Site Construction						
Site Preparation						
Clear and Grub	5	AC	$ 3,526	$ 17,630	$ 5,166	$ 25,828
Earthwork						
Structural excavation - Wet Well	21,907	CY	$ 14	$ 316,153	$ 21	$ 463,170
Structural excavation - Main building	2,573	CY	$ 14	$ 37,133	$ 21	$ 54,400
Compacted Fill	15,006	CY	$ 26	$ 393,702	$ 38	$ 576,781
Structural fill	457	CY	$ 45	$ 20,443	$ 66	$ 29,950
Sheet Piling	48,000	SF	$ 44	$ 2,092,800	$ 64	$ 3,065,990
Soil stabilization Granular material	1,820	CY	$ 45	$ 81,415	$ 66	$ 119,275
Yard Pipe						
72" Steel - 100 PSI	200	LF	$ 584	$ 116,848	$ 856	$ 171,184
42" Steel - 100 PSI	80	LF	$ 246	$ 19,707	$ 361	$ 28,871
36" Steel - 100 PSI	10	LF	$ 217	$ 2,169	$ 318	$ 3,178

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
16" Steel - 100 PSI	80	LF	$ 145	$ 11,584	$ 212	$ 16,970
Pipe Excavation	1,844	CY	$ 15	$ 27,356	$ 22	$ 40,076
Pipe Bedding	182	CY	$ 32	$ 5,866	$ 47	$ 8,594
Pipe Backfill	1,416	CY	$ 19	$ 26,362	$ 27	$ 38,621
Compaction	1,416	CY	$ 5	$ 7,146	$ 7	$ 10,469
Spoil Haul off	430	CY	$ 14	$ 5,985	$ 20	$ 8,769
Site Improvements						
Rough site grading	24,232	SY	$ 3	$ 65,768	$ 4	$ 96,351
Gravel Road (30' wide and 6" deep)	833	SY	$ 7	$ 5,974	$ 11	$ 8,753
Chain Link Fence	1,868	LF	$ 34	$ 63,160	$ 50	$ 92,531
Entrance Gate	2	EA	$ 7,686	$ 15,371	$ 11,259	$ 22,519
Division 2 Site Construction				***$ 3,332,573***		***$ 4,882,280***
Division 3 Concrete						
Slab on grade/footings - Wet Well	493	CY	$ 631	$ 310,992	$ 924	$ 455,609
Walls - Wet Well	3,055	CY	$ 1,032	$ 3,152,397	$ 1,512	$ 4,618,320
Slab on grade/footings - Pump Piping Area	212	CY	$ 631	$ 133,733	$ 924	$ 195,921
Walls - Pump Piping Area	174	CY	$ 1,032	$ 179,547	$ 1,512	$ 263,040
Walls - Flow Meter Vault	26	CY	$ 1,032	$ 26,829	$ 1,512	$ 39,305
Elevated Slab - Flow Meter Vault (Roof)	10	CY	$ 1,225	$ 12,255	$ 1,795	$ 17,953
Slab on grade/footings - Pump Station Main Operation Area	114	CY	$ 631	$ 71,913	$ 924	$ 105,354
Slab on grade/footings - Flow meter vault	10	CY	$ 631	$ 6,308	$ 924	$ 9,242
Elevated Slab - Wet Well	463	CY	$ 1,225	$ 567,395	$ 1,795	$ 831,245
Suspended Slab - Pump Area	190	CY	$ 1,225	$ 232,840	$ 1,795	$ 341,116
Suspended Slab - Operating Area	402	CY	$ 1,225	$ 492,641	$ 1,795	$ 721,729
Division 3 Concrete				***$ 5,186,852***		***$ 7,598,833***
Division 4 Masonry						
12" CMU	8,650	SF	$ 26	$ 221,098	$ 37	$ 323,913
6" CMU	850	SF	$ 14	$ 11,609	$ 20	$ 17,007
Division 4 Masonry				***$ 232,707***		***$ 340,921***
Division 5 Metals						
Structural Steel	7	TON	$ 4,218	$ 29,529	$ 6,180	$ 43,261
Miscellaneous steel members	1	TON	$ 4,218	$ 4,218	$ 6,180	$ 6,180
Metal decking	12,200	SF	$ 10	$ 127,661	$ 15	$ 187,025
Standing seam roof	12,200	SF	$ 11	$ 140,294	$ 17	$ 205,533
Guard post	15	EA	$ 491	$ 7,358	$ 719	$ 10,779
Guardrail	460	LF	$ 77	$ 35,549	$ 113	$ 52,080
Hatch, 5'x5'	1	EA	$ 4,308	$ 4,308	$ 6,311	$ 6,311
Division 5 Metals				***$ 348,917***		***$ 511,170***
Division 7 Thermal and Moisture Protection						
Roof insulation	12,200	SF	$ 3	$ 31,649	$ 4	$ 46,367
Wall insulation	850	SF	$ 2	$ 1,723	$ 3	$ 2,525
Division 7 Thermal and Moisture Protection				***$ 33,373***		***$ 48,891***
Division 8 Openings						
Hollow metal (with security hardware)	600	SF	$ 109	$ 65,400	$ 160	$ 95,812
Roll-up door with motor	2	EA	$ 3,931	$ 7,863	$ 5,760	$ 11,519
Covers for slab openings	116	SF	$ 55	$ 6,322	$ 80	$ 9,262
Division 8 Openings				***$ 79,585***		***$ 116,593***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,890	$ 55,890
Division 9 Finishes				***$ 38,150***		***$ 55,890***
Division 14 Conveying Systems						
Bridge Crane (15 ton)	1	EA	$ 74,405	$ 74,405	$ 109,005	$ 109,005
Division 14 Conveying Systems				***$ 74,405***		***$ 109,005***
Division 22 Plumbing						
Plumbing	1	LS	$ 545,000	$ 545,000	$ 798,435	$ 798,435
Division 22 Plumbing				***$ 545,000***		***$ 798,435***
Division 23 HVAC						
HVAC	1	LS	$ 763,000	$ 763,000	$ 1,117,809	$ 1,117,809
Division 23 HVAC				***$ 763,000***		***$ 1,117,809***
Division 26 Electrical						
Electrical	1	LS	$ 2,725,000	$ 2,725,000	$ 3,992,175	$ 3,992,175
VFD's-1,250 hp	4	EA	$ 245,250	$ 981,000	$ 359,296	$ 1,437,183
VFD's-250 hp	4	EA	$ 81,750	$ 327,000	$ 119,765	$ 479,061
Division 26 Electrical				***$ 4,033,000***		***$ 5,908,419***

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Division 40 Process Interconnections						
Process Piping						
42" STL Discharge Pipe	40	LF	$ 294	$ 11,774	$ 431	$ 17,249
36" STL Discharge Pipe	10	LF	$ 252	$ 2,517	$ 369	$ 3,687
18" STL Discharge Pipe	40	LF	$ 128	$ 5,120	$ 188	$ 7,500
16" STL Discharge Pipe	10	LF	$ 110	$ 1,105	$ 162	$ 1,619
42"x36" STL Reducer	4	EA	$ 18,312	$ 73,248	$ 26,827	$ 107,310
18"x16" STL Reducer	4	EA	$ 2,671	$ 10,682	$ 3,912	$ 15,649
Conc Pipe Supports	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,162
Conc Valve Support	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,162
Valves						
42" Butterfly Valves, w/ elect actuator	4	EA	$ 33,678	$ 134,712	$ 49,339	$ 197,356
18" Butterfly Valves, w/ elect actuator	4	EA	$ 10,817	$ 43,268	$ 15,847	$ 63,389
42" Ball Valve, w/ elect actuator	4	EA	$ 77,278	$ 309,112	$ 113,214	$ 452,855
18" Ball Valve, w/ elect actuator	4	EA	$ 35,380	$ 141,521	$ 51,833	$ 207,331
42" Dismantling Joint	4	EA	$ 10,397	$ 41,587	$ 15,232	$ 60,926
36" Dismantling Joint	4	EA	$ 8,566	$ 34,265	$ 12,550	$ 50,199
18" Dismantling Joint	4	EA	$ 3,640	$ 14,559	$ 5,332	$ 21,330
16" Dismantling Joint	4	EA	$ 3,204	$ 12,815	$ 4,694	$ 18,775
8" Combination Air Valve	4	EA	$ 3,734	$ 14,937	$ 5,471	$ 21,883
4" Combination Air Valve	4	EA	$ 2,644	$ 10,577	$ 3,874	$ 15,496
8" Air Valve/Air Vacuum	4	EA	$ 5,424	$ 21,695	$ 7,946	$ 31,784
4" Air Valve/Air Vacuum	6	EA	$ 2,971	$ 17,828	$ 4,353	$ 26,118
42" Double Door Check Valve	4	EA	$ 49,047	$ 196,188	$ 71,855	$ 287,420
18" Double Door Check Valve	4	EA	$ 18,703	$ 74,813	$ 27,401	$ 109,602
I&C						
Instrumentation & SCADA	1	LS	$ 1,199,000	$ 1,199,000	$ 1,756,557	$ 1,756,557
Division 40 Process Interconnections				***$ 2,397,484***		***$ 3,512,359***
Division 43 Process Handling and Storage Equipment						
Vertical Turbine pump, High Flow (165 CFS, 69 TDH, 500 HP)	4	EA	$ 301,300	$ 1,205,200	$ 441,410	$ 1,765,640
Vertical Turbine pump, Low Flow (20 CFS, 61 TDH, 100 HP)	4	EA	$ 101,200	$ 404,800	$ 148,260	$ 593,039
Steel Tank - 2,500 gal	1	EA	$ 14,552	$ 14,552	$ 21,318	$ 21,318
Air units on intake screen-50 hp	3	EA	$ 9,483	$ 28,449	$ 13,893	$ 41,678
Surge Tank	1	LS	$ 2,834,000	$ 2,834,000	$ 4,151,862	$ 4,151,862
Division 43 Process Handling and Storage Equipment				***$ 4,487,001***		***$ 6,573,538***
River Intake Pump Station Subtotal and Wetwell				**$ 21,552,046**		**$ 31,574,144**
Totals				**$ 39,435,000**		**$ 57,773,000**

Mark-Ups

Item		Construction Subtotal	Percent of Total
Construction Subtotal		$ 39,435,000	68.3%
Subcontractor Markups		included in construction subtotal	
Design Allowance		-	0.0%
Direct Cost Subtotal		$ 39,435,000	68.3%
Contractor's General Conditions	15.0%	$ 5,915,000	10.2%
Contingency	30.0%	$ 11,831,000	20.5%
Bonds and Insurance	1.5%	$ 592,000	1.0%
Grand Total		**$ 57,773,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
Sediment Removal Plant
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Sitework						
Division 2 Site Construction						
Utilities	1	LS	$ 1,500,000	$ 1,500,000	$ 2,197,584	$ 2,197,584
Property	1	LS	$ 300,000	$ 300,000	$ 439,517	$ 439,517
Division 2 Site Construction				***$ 1,800,000***		***$ 2,637,101***
Sitework Subtotal				**$ 1,800,000**		**$ 2,637,101**
Grit Basin Building						
Division 2 Site Construction						
Structural excavation	7,881	CY	$ 14	$ 113,735	$ 21	$ 166,629
Compacted Fill	4,465	CY	$ 26	$ 117,145	$ 38	$ 171,624
Drying Bed	6,693	CY	$ 25	$ 166,772	$ 37	$ 244,331
Division 2 Site Construction				***$ 397,653***		***$ 582,583***
Division 3 Concrete						
Slab on grade/footings	615	CY	$ 631	$ 387,952	$ 924	$ 568,371
Walls	890	CY	$ 1,032	$ 918,374	$ 1,512	$ 1,345,470
Floors	161	CY	$ 1,225	$ 197,302	$ 1,795	$ 289,058
Division 3 Concrete				***$ 1,503,628***		***$ 2,202,898***
Division 4 Masonry						
16" CMU	5,715	SF	$ 22	$ 126,830	$ 33	$ 185,812
Division 4 Masonry				***$ 126,830***		***$ 185,812***
Division 5 Metals						
Miscellaneous steel members	1	TON	$ 4,218	$ 4,218	$ 6,180	$ 6,180
Metal decking	7,459	SF	$ 10	$ 78,051	$ 15	$ 114,349
Standing seam roof	7,459	SF	$ 11	$ 85,775	$ 17	$ 125,665
Division 5 Metals				***$ 168,044***		***$ 246,194***
Division 7 Thermal and Moisture Protection						
Roof insulation	7,459	SF	$ 3	$ 19,350	$ 4	$ 28,349
Wall insulation	5,715	SF	$ 2	$ 11,587	$ 3	$ 16,975
Division 7 Thermal and Moisture Protection				***$ 30,937***		***$ 45,324***
Division 8 Openings						
Hollow metal (with security hardware)	49	SF	$ 109	$ 5,341	$ 160	$ 7,825
Roll-up door with motor	2	EA	$ 3,931	$ 7,863	$ 5,760	$ 11,519
Covers for slab openings	32	SF	$ 55	$ 1,744	$ 80	$ 2,555
Division 8 Openings				***$ 14,948***		***$ 21,899***
Division 10 Specialties						
Miscellaneous specialties	1	LS	$ 5,450	$ 5,450	$ 7,985	$ 7,985
Division 10 Specialties				***$ 5,450***		***$ 7,985***
Division 22 Plumbing						
Plumbing	1	LS	$ 330,270	$ 330,270	$ 483,864	$ 483,864
Division 22 Plumbing				***$ 330,270***		***$ 483,864***
Division 23 HVAC						
HVAC	1	LS	$ 462,160	$ 462,160	$ 677,090	$ 677,090
Division 23 HVAC				***$ 462,160***		***$ 677,090***
Division 26 Electrical						
Electrical	1	LS	$ 719,400	$ 719,400	$ 1,053,961	$ 1,053,961
Division 26 Electrical				***$ 719,400***		***$ 1,053,961***
Division 40 Process Interconnections						
Process Piping						
Pipe support	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,163
4" Grit pipe	576	LF	$ 32	$ 18,207	$ 46	$ 26,675
6" Grit pipe	30	LF	$ 51	$ 1,537	$ 75	$ 2,252
4" Strainer	6	EA	$ 3,270	$ 19,620	$ 4,791	$ 28,744
Instrumentation						
Instrumentation	1	LS	$ 335,720	$ 335,720	$ 491,849	$ 491,849
Division 40 Process Interconnections				***$ 388,164***		***$ 568,682***
Division 43 Process Handling and Storage Equipment						
Headcell, Teacup, and Snail	6	EA	$ 434,471	$ 2,606,824	$ 636,524	$ 3,819,143
Grit Pump	6	EA	$ 32,700	$ 196,200	$ 47,907	$ 287,444
3'x5' slide gates	6	EA	$ 10,791	$ 64,746	$ 15,809	$ 94,857

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
6'x5' slide gates	2	EA	$ 17,658	$ 35,316	$ 25,870	$ 51,740
Dumpster	3	EA	$ 2,180	$ 6,540	$ 3,194	$ 9,581
Division 43 Process Handling and Storage Equipment				***$ 2,909,626***		***$ 4,262,765***
Grit Building Subtotal				**$ 7,057,000**		**$ 10,339,000**
Residuals						
Division 40 Process Interconnections						
Process Piping	1	LS				
Division 40 Process Interconnections						
Division 43 Process Handling and Storage Equipment						
Drying Beds	1	EA				
Division 43 Process Handling and Storage Equipment						
Residuals Subtotal						
Totals				**$ 8,857,000**		**$ 12,976,000**

Mark-Ups

Item		Construction	Percent of
Construction Subtotal		$ 8,857,000	68.3%
Subcontractor Markups		included in construction subtotal	
Design Allowance		-	0.0%
Direct Cost Subtotal		$ 8,857,000	68.3%
Contractor's General Conditions	15.0%	$ 1,329,000	10.2%
Contingency	30.0%	$ 2,657,000	20.5%
Bonds and Insurance	1.5%	$ 133,000	1.0%
Grand Total		**$ 12,976,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
Water Treatment Plant
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Sitework						
Division 2 Site Construction						
Earthwork						
Site excavation	39273	CY	$ 14	$ 566,772	$ 21	$ 830,334
Embankment & fill	13091	CY	$ 26	$ 343,459	$ 38	$ 503,176
Wasting - haul off	26182	CY	$ 4	$ 99,599	$ 6	$ 145,915
Load wasting - haul off	26182	CY	$ 3	$ 65,638	$ 4	$ 96,162
Finish grading	23564	SY	$ 1	$ 32,106	$ 2	$ 47,036
Clear & grub	40	AC	$ 1,710	$ 68,401	$ 2,505	$ 100,208
Restoration	1	LS	$ 10,900	$ 10,900	$ 15,969	$ 15,969
Septic Leach Field	1	LS	$ 136,250	$ 136,250	$ 199,609	$ 199,609
Yard Piping						
72" Steel - Washburn Pipeline to Sedimentation Basin	275	LF	$ 584	$ 160,666	$ 856	$ 235,379
72" Steel - Washburn Pipeline to PS	155	LF	$ 584	$ 90,557	$ 856	$ 132,668
72" Steel - Sedimentation basin to Contact basin	100	LF	$ 584	$ 58,424	$ 856	$ 85,592
72" Steel - Contact basin to PS	100	LF	$ 584	$ 58,424	$ 856	$ 85,592
72" tee	3	EA	$ 105,294	$ 315,882	$ 154,258	$ 462,774
72" elbow	1	EA	$ 62,675	$ 62,675	$ 91,820	$ 91,820
Misc. fittings	1	LS	$ 30,520	$ 30,520	$ 44,712	$ 44,712
72" Butterfly valve	9	EA	$ 49,050	$ 441,450	$ 71,859	$ 646,734
Site Improvements						
Miscellaneous steel members	38000	SF	$ 4	$ 151,597	$ 6	$ 222,093
Prime coat	4222	SY	$ 3	$ 11,229	$ 4	$ 16,450
Concrete curb & gutter	1000	LF	$ 16	$ 16,383	$ 24	$ 24,001
Marking & signage	1	LS	$ 16,350	$ 16,350	$ 23,953	$ 23,953
Landscaping	1	LS	$ 54,500	$ 54,500	$ 79,844	$ 79,844
Chain link	3000	LF	$ 31	$ 93,816	$ 46	$ 137,443
Gate	2	EA	$ 5,444	$ 10,888	$ 7,976	$ 15,951
Storm drainage	1	LS	$ 109,000	$ 109,000	$ 159,687	$ 159,687
Yard accessories	1	LS	$ 545,000	$ 545,000	$ 798,437	$ 798,437
Utilities and Rail	1	LS	$ 4,000,000	$ 4,000,000	$ 5,860,090	$ 5,860,090
Property	1	LS	$ 300,000	$ 300,000	$ 439,507	$ 439,507
Division 2 Site Construction				***$ 7,850,487***		***$ 11,501,140***
Sitework Subtotal				**$ 7,850,487**		**$ 11,501,140**
Propane Yard						
Division 2 Site Construction						
Structural excavation	2003	CY	$ 14	$ 28,906	$ 21	$ 42,349
Compact fill	308	CY	$ 26	$ 8,081	$ 38	$ 11,839
Structural backfill	370	CY	$ 45	$ 16,551	$ 66	$ 24,248
Wasting - haul off	1695	CY	$ 4	$ 6,448	$ 6	$ 9,446
Load wasting - haul off	1695	CY	$ 3	$ 4,249	$ 4	$ 6,225
Division 2 Site Construction				***$ 64,236***		***$ 94,107***
Division 3 Concrete						
Slab on grade/footings	370	CY	$ 631	$ 233,402	$ 924	$ 341,939
Walls	148	CY	$ 1,032	$ 152,718	$ 1,512	$ 223,736
Division 3 Concrete				***$ 386,120***		***$ 565,675***
Division 26 Electrical						
Electrical	1	LS	$ 43,600	$ 43,600	$ 63,875	$ 63,875
Division 26 Electrical				***$ 43,600***		***$ 63,875***
Division 40 Process Interconnections						
Gas piping	1	LS	$ 13,625	$ 13,625	$ 19,961	$ 19,961
Division 40 Process Interconnections				***$ 13,625***		***$ 19,961***
Division 43 Process Handling and Storage Equipment						
Propane tank	2	EA	$ 77,866	$ 155,732	$ 114,075	$ 228,151
Division 43 Process Handling and Storage Equipment				***$ 155,732***		***$ 228,151***
Propane Yard Subtotal				**$ 663,313**		**$ 971,769**
Disinfection Contact Basin						
Division 2 Site Construction						
Earthwork						

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Structural excavation	26209	CY	$ 14	$ 378,238	$ 21	$ 554,127
Structural fill	13936	CY	$ 45	$ 623,407	$ 66	$ 913,306
Yard Piping						
72" Steel MLCP	30	LF	$ 584	$ 17,527	$ 856	$ 25,678
Pipe Excavation	424	CY	$ 15	$ 6,290	$ 22	$ 9,215
Pipe Bedding	68	CY	$ 32	$ 2,192	$ 47	$ 3,211
Pipe Backfill	302	CY	$ 19	$ 5,622	$ 27	$ 8,237
Compaction	302	CY	$ 5	$ 1,524	$ 7	$ 2,233
Spoil Haul off	122	CY	$ 14	$ 1,698	$ 20	$ 2,488
24" Basin Drain	200	LF	$ 147	$ 29,430	$ 216	$ 43,116
2" PVC Chlorine Solution	154	LF	$ 37	$ 5,739	$ 55	$ 8,408
Division 2 Site Construction				***$ 1,071,668***		***$ 1,570,018***
Division 3 Concrete						
Slab on grade/footings	1971	CY	$ 631	$ 1,243,338	$ 924	$ 1,821,518
Walls	2530	CY	$ 1,032	$ 2,610,659	$ 1,512	$ 3,824,675
Top Slabs	59	CY	$ 631	$ 37,218	$ 924	$ 54,525
Division 3 Concrete				***$ 3,891,215***		***$ 5,700,718***
Division 5 Metals						
Structural Steel	59	TON	$ 4,218	$ 248,889	$ 6,180	$ 364,629
Guardrail	721	LF	$ 77	$ 55,720	$ 113	$ 81,630
Alum. Stairs	2	EA	$ 2,180	$ 4,360	$ 3,194	$ 6,387
Fiberglass covers for Disinfection Contact Basin	22525	SF	$ 7	$ 147,314	$ 10	$ 215,818
Division 5 Metals				***$ 456,282***		***$ 668,464***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,891	$ 55,891
Division 9 Finishes				***$ 38,150***		***$ 55,891***
Division 26 Electrical						
Electrical	1	LS	$ 27,250	$ 27,250	$ 39,922	$ 39,922
Division 26 Electrical				***$ 27,250***		***$ 39,922***
Division 40 Process Interconnections						
Process Piping						
Pipe support	1	LS	$ 3,270	$ 3,270	$ 4,791	$ 4,791
2" PVC Chlorine Solution	154	LF	$ 37	$ 5,739	$ 55	$ 8,408
Mechanical Insulation & heat tracing	1	LS	$ 5,450	$ 5,450	$ 7,984	$ 7,984
Valves						
Gate Valves - 24"	2	EA	$ 45,081	$ 90,162	$ 66,045	$ 132,090
I&C						
Instrumentation	1	LS	$ 13,080	$ 13,080	$ 19,162	$ 19,162
Division 40 Process Interconnections				***$ 117,702***		***$ 172,436***
Division 43 Process Handling and Storage Equipment						
Slide gates - 36'' sq with electric actuator	4	EA	$ 10,791	$ 43,164	$ 15,809	$ 63,236
Slide gates - 72" sq with electric actuator	1	EA	$ 17,658	$ 17,658	$ 25,869	$ 25,869
Division 43 Process Handling and Storage Equipment				***$ 60,822***		***$ 89,106***
Disinfection Contact Basin Subtotal				**$ 5,663,089**		**$ 8,296,554**
Chlorine Building						
Division 2 Site Construction						
Earthwork						
Structural excavation	2245	CY	$ 14	$ 32,399	$ 21	$ 47,465
Structural fill	978	CY	$ 45	$ 43,749	$ 66	$ 64,094
Site Improvements						
Railroad tracks, rail spur	125	LF	$ 38	$ 4,769	$ 56	$ 6,986
Division 2 Site Construction				***$ 80,917***		***$ 118,545***
Division 3 Concrete						
Slab on grade/footings	371	CY	$ 631	$ 234,033	$ 924	$ 342,863
Division 3 Concrete				***$ 234,033***		***$ 342,863***
Division 4 Masonry						
12" CMU	5134	SF	$ 16	$ 82,430	$ 24	$ 120,762
8" CMU	1100	SF	$ 9	$ 9,520	$ 13	$ 13,947
Brick veneer	5294	SF	$ 15	$ 80,729	$ 22	$ 118,269
Division 4 Masonry				***$ 172,679***		***$ 252,978***
Division 5 Metals						
Structural Steel	2	TON	$ 4,218	$ 8,437	$ 6,180	$ 12,360
Metal decking	5300	SF	$ 10	$ 55,459	$ 15	$ 81,249
Standing seam roof	5300	SF	$ 11	$ 60,947	$ 17	$ 89,289
Guard post	4	EA	$ 491	$ 1,962	$ 719	$ 2,874
Division 5 Metals				***$ 126,805***		***$ 185,773***
Division 7 Thermal and Moisture Protection						
Roof insulation	5300	SF	$ 3	$ 13,749	$ 4	$ 20,143
Wall insulation	5294	SF	$ 2	$ 10,733	$ 3	$ 15,724
Division 7 Thermal and Moisture Protection				***$ 24,482***		***$ 35,867***

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Division 8 Openings						
Hollow metal (with security hardware)	224	SF	$ 109	$ 24,416	$ 160	$ 35,770
Roll-up door with motor	1	EA	$ 3,931	$ 3,931	$ 5,760	$ 5,760
Windows	4	EA	$ 1,635	$ 6,540	$ 2,395	$ 9,581
Division 8 Openings				***$ 34,887***		***$ 51,111***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,891	$ 55,891
Division 9 Finishes				***$ 38,150***		***$ 55,891***
Division 22 Plumbing						
Plumbing	1	LS	$ 158,050	$ 158,050	$ 231,547	$ 231,547
Division 22 Plumbing				***$ 158,050***		***$ 231,547***
Division 23 HVAC						
HVAC	1	LS	$ 218,000	$ 218,000	$ 319,375	$ 319,375
Division 23 HVAC				***$ 218,000***		***$ 319,375***
Division 26 Electrical						
Electrical	1	LS	$ 147,150	$ 147,150	$ 215,578	$ 215,578
Division 26 Electrical				***$ 147,150***		***$ 215,578***
Division 40 Process Interconnections						
Process Piping						
Pipe support	1	LS	$ 3,270	$ 3,270	$ 4,791	$ 4,791
2" PVC Chlorine Solution	100	LF	$ 37	$ 3,727	$ 55	$ 5,460
1" PVC Chlorine Gas Piping	300	LF	$ 28	$ 8,368	$ 41	$ 12,259
Valves						
Chlorine valves	20	EA	$ 545	$ 10,900	$ 798	$ 15,969
I&C						
Instrumentation	1	LS	$ 70,850	$ 70,850	$ 103,797	$ 103,797
Division 40 Process Interconnections				***$ 97,115***		***$ 142,275***
Division 43 Process Handling and Storage Equipment						
Chlorinators - small	3	EA	$ 65,400	$ 196,200	$ 95,812	$ 287,437
Chlorinators - large	3	EA	$ 98,100	$ 294,300	$ 143,719	$ 431,156
Evaporators	2	EA	$ 65,400	$ 130,800	$ 95,812	$ 191,625
Automatic Changeover System	2	EA	$ 32,700	$ 65,400	$ 47,906	$ 95,812
Scales	2	EA	$ 19,620	$ 39,240	$ 28,744	$ 57,487
Emergency Chlorine Scrubber	1	EA	$ 130,800	$ 130,800	$ 191,625	$ 191,625
Monorail - electric hoist	1	EA	$ 16,895	$ 16,895	$ 24,752	$ 24,752
Division 43 Process Handling and Storage Equipment				***$ 873,635***		***$ 1,279,895***
Chlorine Building Subtotal				**$ 2,205,903**		**$ 3,231,698**
Dechlorination Facility						
Division 2 Site Construction						
Earthwork						
Structural excavation	1291	CY	$ 14	$ 18,631	$ 21	$ 27,295
Structural fill	735	CY	$ 45	$ 32,879	$ 66	$ 48,169
Yard Piping						
1-1/2" PVC Piping	200	LF	$ 36	$ 7,126	$ 52	$ 10,440
Division 2 Site Construction				***$ 58,637***		***$ 85,904***
Division 3 Concrete						
Slab on grade/footings	208	CY	$ 631	$ 131,210	$ 924	$ 192,225
Division 3 Concrete				***$ 131,210***		***$ 192,225***
Division 4 Masonry						
12" CMU	1547	SF	$ 16	$ 24,838	$ 24	$ 36,388
8" CMU	347	SF	$ 9	$ 3,003	$ 13	$ 4,400
Brick veneer	1579	SF	$ 15	$ 24,078	$ 22	$ 35,275
Division 4 Masonry				***$ 51,920***		***$ 76,063***
Division 5 Metals						
Misc. metals	1	LS	$ 4,218	$ 4,218	$ 6,180	$ 6,180
Metal decking	2500	SF	$ 10	$ 26,160	$ 15	$ 38,325
Standing seam roof	2500	SF	$ 11	$ 28,749	$ 17	$ 42,118
Guard post	4	EA	$ 491	$ 1,962	$ 719	$ 2,874
Division 5 Metals				***$ 61,089***		***$ 89,497***
Division 7 Thermal and Moisture Protection						
Roof insulation	2500	SF	$ 3	$ 6,486	$ 4	$ 9,501
Wall insulation	1579	SF	$ 2	$ 3,201	$ 3	$ 4,690
Division 7 Thermal and Moisture Protection				***$ 9,687***		***$ 14,191***
Division 8 Openings						
Hollow metal (with security hardware)	140	SF	$ 109	$ 15,260	$ 160	$ 22,356
Roll-up door with motor	1	EA	$ 3,931	$ 3,931	$ 5,760	$ 5,760
Windows	3	EA	$ 1,635	$ 4,905	$ 2,395	$ 7,186
Division 8 Openings				***$ 24,096***		***$ 35,302***
Division 9 Finishes						

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Painting	1	LS	$ 38,150	$ 38,150	$ 55,891	$ 55,891
Division 9 Finishes				***$ 38,150***		***$ 55,891***
Division 22 Plumbing						
Plumbing	1	LS	$ 68,125	$ 68,125	$ 99,805	$ 99,805
Division 22 Plumbing				***$ 68,125***		***$ 99,805***
Division 23 HVAC						
HVAC	1	LS	$ 95,375	$ 95,375	$ 139,727	$ 139,727
Division 23 HVAC				***$ 95,375***		***$ 139,727***
Division 26 Electrical						
Electrical	1	LS	$ 43,600	$ 43,600	$ 63,875	$ 63,875
Division 26 Electrical				***$ 43,600***		***$ 63,875***
Division 40 Process Interconnections						
Process Piping						
Pipe support	1	LS	$ 3,270	$ 3,270	$ 4,791	$ 4,791
1-1/2" PVC Piping	200	LF	$ 36	$ 7,126	$ 52	$ 10,440
Valves						
PVC ball valves	12	EA	$ 545	$ 6,540	$ 798	$ 9,581
I&C						
Instrumentation	1	LS	$ 19,620	$ 19,620	$ 28,744	$ 28,744
Division 40 Process Interconnections				***$ 36,556***		***$ 53,556***
Division 43 Process Handling and Storage Equipment						
Fiberglass chemical storage tank (5000 gallons)	1	EA	$ 13,080	$ 13,080	$ 19,162	$ 19,162
Checmial metering pumps	4	EA	$ 6,540	$ 26,160	$ 9,581	$ 38,325
Division 43 Process Handling and Storage Equipment				***$ 39,240***		***$ 57,487***
Dechlorination Facility Subtotal				**$ 657,685**		**$ 963,523**
Office Building						
Division 2 Site Construction						
Structural excavation	6256	CY	$ 14	$ 90,284	$ 21	$ 132,268
Compact fill	791	CY	$ 26	$ 20,753	$ 38	$ 30,403
Structural backfill	587	CY	$ 45	$ 26,259	$ 66	$ 38,469
Wasting - haul off	5464	CY	$ 4	$ 20,786	$ 6	$ 30,451
Load wasting - haul off	5465	CY	$ 3	$ 13,701	$ 4	$ 20,072
Division 2 Site Construction				***$ 171,782***		***$ 251,664***
Division 3 Concrete						
Cast-in-Place Concrete						
Slab on grade/footings	867	CY	$ 631	$ 546,917	$ 924	$ 801,246
Walls	810	CY	$ 1,032	$ 835,824	$ 1,512	$ 1,224,501
Walls - Sodium Bisulfite	25	CY	$ 1,032	$ 25,797	$ 1,512	$ 37,793
Column Footings	91	CY	$ 1,413	$ 128,618	$ 2,071	$ 188,428
Perimeter footing	345	CY	$ 631	$ 217,631	$ 924	$ 318,835
Column- roof	178	CY	$ 1,413	$ 251,582	$ 2,071	$ 368,573
Precast Concrete						
Precast suspended slab roof	15840	SF	$ 33	$ 517,968	$ 48	$ 758,835
Division 3 Concrete				***$ 2,524,337***		***$ 3,698,211***
Division 4 Masonry						
Face Brick	14580	SF	$ 13	$ 192,137	$ 19	$ 281,485
12" CMU	14580	SF	$ 13	$ 188,481	$ 19	$ 276,130
Bond beam	972	LF	$ 4	$ 4,196	$ 6	$ 6,147
Division 4 Masonry				***$ 384,814***		***$ 563,761***
Division 5 Metals						
Structural Steel	17	TON	$ 4,218	$ 71,714	$ 6,180	$ 105,062
Stairs	1	LS	$ 32,700	$ 32,700	$ 47,906	$ 47,906
Handrail	225	LF	$ 63	$ 14,129	$ 92	$ 20,699
Grating	10000	SF	$ 37	$ 365,586	$ 54	$ 535,592
Division 5 Metals				***$ 484,129***		***$ 709,260***
Division 7 Thermal and Moisture Protection						
Roof insulation	15840	SF	$ 3	$ 41,092	$ 4	$ 60,201
Wall insulation	14580	SF	$ 2	$ 29,559	$ 3	$ 43,305
Division 7 Thermal and Moisture Protection				***$ 70,652***		***$ 103,506***
Division 8 Openings						
Hollow metal (with security hardware)	525	SF	$ 136	$ 71,531	$ 200	$ 104,795
Roll-up door with motor	2	EA	$ 3,931	$ 7,863	$ 5,760	$ 11,519
Division 8 Openings				***$ 79,394***		***$ 116,314***
Division 9 Finishes						
Painting	1	LS	$ 218,000	$ 218,000	$ 319,375	$ 319,375
Division 9 Finishes				***$ 218,000***		***$ 319,375***
Division 10 Specialties						
Hallway/Entrance	1200	SF	$ 218	$ 261,600	$ 319	$ 383,250
Offices	1080	SF	$ 218	$ 235,440	$ 319	$ 344,925
Break Room	666	SF	$ 218	$ 145,188	$ 319	$ 212,704

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Control Room	666	SF	$ 273	$ 181,485	$ 399	$ 265,880
Storage	399	SF	$ 273	$ 108,728	$ 399	$ 159,288
Shop/Garage	1152	SF	$ 273	$ 313,920	$ 399	$ 459,900
Electrical Room	1656	SF	$ 273	$ 451,260	$ 399	$ 661,106
Generator Room	1000	SF	$ 273	$ 272,500	$ 399	$ 399,219
Lab	528	SF	$ 327	$ 172,656	$ 479	$ 252,945
Bathrooms/Locker Room	704	SF	$ 273	$ 191,840	$ 399	$ 281,050
Lab Equipment	1	LS	$ 27,250	$ 27,250	$ 39,922	$ 39,922
Furniture	1	LS	$ 27,250	$ 27,250	$ 39,922	$ 39,922
Division 10 Specialties				***$ 2,389,117***		***$ 3,500,110***
Division 22 Plumbing						
Plumbing	1	LS	$ 348,800	$ 348,800	$ 511,000	$ 511,000
Fire sprinkler system	1	LS	$ 92,650	$ 92,650	$ 135,734	$ 135,734
Division 22 Plumbing				***$ 441,450***		***$ 646,734***
Division 23 HVAC						
HVAC	1	LS	$ 523,200	$ 523,200	$ 766,500	$ 766,500
Division 23 HVAC				***$ 523,200***		***$ 766,500***
Division 26 Electrical						
Generator (500 KW)	1	LS	$ 110,090	$ 110,090	$ 161,284	$ 161,284
Electrical	1	LS	$ 1,277,480	$ 1,277,480	$ 1,871,537	$ 1,871,537
Division 26 Electrical				***$ 1,387,570***		***$ 2,032,821***
Division 40 Process Interconnections						
Instruments	1	LS	$ 378,230	$ 378,230	$ 554,116	$ 554,116
Division 40 Process Interconnections				***$ 378,230***		***$ 554,116***
Division 43 Process Handling and Storage Equipment						
Sodium Bisulfite	1	LS	$ 223,705	$ 223,705	$ 327,732	$ 327,732
Division 43 Process Handling and Storage Equipment				***$ 223,705***		***$ 327,732***
Office Building Subtotal				**$ 9,276,378**		**$ 13,590,104**
Totals				**$ 26,317,000**		**$ 38,555,000**

Mark-Ups

Item		Construction	Percent of
Construction Subtotal		$ 26,317,000	68.3%
Subcontractor Markups		included in construction subtotal	
Design Allowance		-	0.0%
Direct Cost Subtotal		$ 26,317,000	68.3%
Contractor's General Conditions	15.0%	$ 3,948,000	10.2%
Contingency	30.0%	$ 7,895,000	20.5%
Bonds and Insurance	1.5%	$ 395,000	1.0%
Grand Total		**$ 38,555,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
Main Pumping Station 1
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Main Pump Station 1						
Division 2 Site Construction						
Earthwork						
Structural excavation - Wet Well	9,244	CY	$ 14	$ 133,406	$ 21	$ 195,441
Compacted Fill	2,343	CY	$ 26	$ 61,472	$ 38	$ 90,057
Structural fill	457	CY	$ 45	$ 20,443	$ 66	$ 29,950
Structural excavation - Main Bldg	2,573	CY	$ 14	$ 37,133	$ 21	$ 54,399
Support Structure Piling	6,100	LF	$ 58	$ 355,722	$ 85	$ 521,136
Yard Piping						
72" Steel MLCP	1,713	LF	$ 584	$ 1,000,803	$ 856	$ 1,466,187
42" Steel MLCP	80	LF	$ 246	$ 19,707	$ 361	$ 28,871
36" Steel MLCP	10	LF	$ 217	$ 2,169	$ 318	$ 3,178
18" Steel MLCP	80	LF	$ 156	$ 12,456	$ 228	$ 18,248
Pipe Excavation	5,891	CY	$ 15	$ 87,392	$ 22	$ 128,031
Pipe Bedding	1,182	CY	$ 32	$ 38,097	$ 47	$ 55,813
Pipe Backfill	2,894	CY	$ 19	$ 53,878	$ 27	$ 78,932
Compaction	2,894	CY	$ 5	$ 14,605	$ 7	$ 21,397
Spoil Haul off	2,997	CY	$ 14	$ 41,716	$ 20	$ 61,115
Site Improvements						
Rough site grading	71,111	SY	$ 3	$ 193,002	$ 4	$ 282,750
Gravel Road (30' wide and 6" deep)	151	SY	$ 7	$ 1,083	$ 11	$ 1,587
Miscellaneous steel members	6,682	LF	$ 34	$ 225,930	$ 50	$ 330,990
Entrance Gate	3	EA	$ 7,686	$ 23,057	$ 11,259	$ 33,778
Division 2 Site Construction				***$ 2,322,071***		***$ 3,401,858***
Division 3 Concrete						
Slab on grade/footings - Wet Well	493	CY	$ 631	$ 310,992	$ 924	$ 455,607
Walls - Wet Well	1,715	CY	$ 1,032	$ 1,769,676	$ 1,512	$ 2,592,594
Slab on grade/footings - Pump Piping Area	212	CY	$ 631	$ 133,733	$ 924	$ 195,920
Walls - Pump Piping Area	174	CY	$ 1,032	$ 179,547	$ 1,512	$ 263,039
Walls - Flow Meter Vault	26	CY	$ 1,032	$ 26,829	$ 1,512	$ 39,305
Elevated Slab - Flow Meter Vault (Roof)	10	CY	$ 1,225	$ 12,255	$ 1,795	$ 17,953
Slab on grade/footings - PS Main Operation Area	114	CY	$ 631	$ 71,913	$ 924	$ 105,353
Slab on grade/footings - Flow meter vault	10	CY	$ 631	$ 6,308	$ 924	$ 9,242
Elevated Slab - Pump Station Operation area	118	CY	$ 1,225	$ 144,606	$ 1,795	$ 211,850
Elevated Slab - Wet well	463	CY	$ 1,225	$ 567,395	$ 1,795	$ 831,240
Suspended Slab - Pump Area	190	CY	$ 1,225	$ 232,840	$ 1,795	$ 341,114
Slab on grade - Flow meter vault	10	CY	$ 631	$ 6,308	$ 924	$ 9,242
Suspended Slab - Operating Area	402	CY	$ 1,225	$ 492,641	$ 1,795	$ 721,725
Division 3 Concrete				***$ 3,955,045***		***$ 5,794,181***
Division 4 Masonry						
12" CMU	8,650	SF	$ 16	$ 138,882	$ 24	$ 203,463
6" CMU	850	SF	$ 9	$ 7,356	$ 13	$ 10,777
Division 4 Masonry				***$ 146,238***		***$ 214,240***
Division 5 Metals						
Structural Steel	7	TON	$ 4,218	$ 29,529	$ 6,180	$ 43,261
Miscellaneous steel members	1	TON	$ 4,218	$ 4,218	$ 6,180	$ 6,180
Metal decking	12,200	SF	$ 10	$ 127,661	$ 15	$ 187,024
Standing seam roof	12,200	SF	$ 11	$ 140,294	$ 17	$ 205,532
Guard post	15	EA	$ 491	$ 7,358	$ 719	$ 10,779
Guardrail	460	LF	$ 77	$ 35,549	$ 113	$ 52,080
Hatch, 5'x5'	1	EA	$ 4,308	$ 4,308	$ 6,311	$ 6,311
Division 5 Metals				***$ 348,917***		***$ 511,167***
Division 7 Thermal and Moisture Protection						
Roof insulation	12,200	SF	$ 3	$ 31,649	$ 4	$ 46,366
Wall insulation	850	SF	$ 2	$ 1,723	$ 3	$ 2,525
Division 7 Thermal and Moisture Protection				***$ 33,373***		***$ 48,891***
Division 8 Openings						
Hollow metal (with security hardware)	600	SF	$ 109	$ 65,400	$ 160	$ 95,812
Roll-up door with motor	1	EA	$ 3,931	$ 3,931	$ 5,760	$ 5,760
Covers for slab openings	116	SF	$ 55	$ 6,322	$ 80	$ 9,262

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Division 8 Openings				***$ 75,653***		***$ 110,833***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,890	$ 55,890
Division 9 Finishes				***$ 38,150***		***$ 55,890***
Division 10 Specialties						
Miscellaneous specialties	1	LS	$ 5,450	$ 5,450	$ 7,984	$ 7,984
Division 10 Specialties				***$ 5,450***		***$ 7,984***
Division 14 Conveying Systems						
Bridge Crane (15 ton)	1	EA	$ 74,405	$ 74,405	$ 109,004	$ 109,004
Division 14 Conveying Systems				***$ 74,405***		***$ 109,004***
Division 22 Plumbing						
Plumbing	1	LS	$ 27,250	$ 27,250	$ 39,922	$ 39,922
Division 22 Plumbing				***$ 27,250***		***$ 39,922***
Division 23 HVAC						
HVAC	1	LS	$ 109,000	$ 109,000	$ 159,686	$ 159,686
Division 23 HVAC				***$ 109,000***		***$ 159,686***
Division 26 Electrical						
Sitework	1	LS	$ 872,000	$ 872,000	$ 1,277,489	$ 1,277,489
Pumping station	1	LS	$ 656,180	$ 656,180	$ 961,310	$ 961,310
VFD's - 5,500 hp	4	EA	$ 1,079,100	$ 4,316,400	$ 1,580,892	$ 6,323,570
VFD's - 800 hp	4	EA	$ 156,960	$ 627,840	$ 229,948	$ 919,792
Division 26 Electrical				***$ 6,472,420***		***$ 9,482,161***
Division 40 Process Interconnections						
Process Piping						
42" STL Discharge Pipe	40	LF	$ 294	$ 11,774	$ 431	$ 17,249
36" STL Discharge Pipe	10	LF	$ 252	$ 2,517	$ 369	$ 3,687
18" STL Discharge Pipe	40	LF	$ 128	$ 5,120	$ 188	$ 7,500
16" STL Discharge Pipe	10	LF	$ 117	$ 1,171	$ 172	$ 1,715
42"x36" STL Reducer	4	EA	$ 18,312	$ 73,248	$ 26,827	$ 107,309
18"x16" STL Reducer	4	EA	$ 2,671	$ 10,682	$ 3,912	$ 15,649
Conc Pipe Supports	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,162
Conc Valve Support	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,162
Valves						
42" Butterfly Valves, w/ elect actuator	4	EA	$ 33,678	$ 134,712	$ 49,339	$ 197,355
18" Butterfly Valves, w/ elect actuator	4	EA	$ 10,817	$ 43,268	$ 15,847	$ 63,389
42" Ball Valve, w/ elect actuator	4	EA	$ 77,278	$ 309,112	$ 113,213	$ 452,853
18" Ball Valve, w/ elect actuator	4	EA	$ 35,380	$ 141,521	$ 51,832	$ 207,330
42" Dismantling Joint	4	EA	$ 10,397	$ 41,587	$ 15,231	$ 60,926
36" Dismantling Joint	4	EA	$ 8,566	$ 34,265	$ 12,550	$ 50,198
18" Dismantling Joint	4	EA	$ 3,640	$ 14,559	$ 5,332	$ 21,329
16" Dismantling Joint	4	EA	$ 3,204	$ 12,815	$ 4,694	$ 18,774
8" Combination Air Valve	4	EA	$ 3,734	$ 14,937	$ 5,471	$ 21,883
4" Combination Air Valve	4	EA	$ 2,644	$ 10,577	$ 3,874	$ 15,496
8" Air Valve/Air Vacuum	4	EA	$ 5,424	$ 21,695	$ 7,946	$ 31,784
4" Air Valve/Air Vacuum	6	EA	$ 2,971	$ 17,828	$ 4,353	$ 26,118
42" Double Door Check Valve	4	EA	$ 49,047	$ 196,188	$ 71,854	$ 287,418
18" Double Door Check Valve	4	EA	$ 20,992	$ 83,969	$ 30,754	$ 123,015
I&C						
Sitework	1	LS	$ 10,900	$ 10,900	$ 15,969	$ 15,969
Pumping station	1	LS	$ 552,630	$ 552,630	$ 809,609	$ 809,609
Division 40 Process Interconnections				***$ 1,771,236***		***$ 2,594,879***
Division 43 Process Handling and Storage Equipment						
Vertical Turbine pump, High Flow (165 CFS, 720 TDH, 6000 HP)	4	EA	$ 881,763	$ 3,527,050	$ 1,291,791	$ 5,167,164
Vertical Turbine pump, Low Flow (20 CFS, 422 TDH, 600 HP)	4	EA	$ 152,950	$ 611,800	$ 224,073	$ 896,293
Division 43 Process Handling and Storage Equipment				***$ 4,138,850***		***$ 6,063,457***
Main Pump Station 1 Subtotal				**$ 19,518,059**		**$ 28,594,154**
Surge Control Building						
Division 2 Site Construction						
Structural excavation - Wet Well	3,414	CY	$ 14	$ 49,269	$ 21	$ 72,180
Compacted Fill	604	CY	$ 26	$ 15,847	$ 38	$ 23,216
Structural fill	400	CY	$ 45	$ 17,893	$ 66	$ 26,214
Division 2 Site Construction				***$ 83,010***		***$ 121,610***
Division 3 Concrete						
Slab on grade/footings - Wet Well	1,572	CY	$ 631	$ 991,642	$ 924	$ 1,452,766

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Walls - Wet Well	144	CY	$ 1,032	$ 148,591	$ 1,512	$ 217,687
Division 3 Concrete				***$ 1,140,233***		***$ 1,670,453***
Division 4 Masonry						
12" CMU	13,602	SF	$ 16	$ 218,390	$ 24	$ 319,943
6" CMU	1,236	SF	$ 9	$ 10,697	$ 13	$ 15,671
Division 4 Masonry				***$ 229,087***		***$ 335,614***
Division 5 Metals						
Metal decking	18,568	SF	$ 10	$ 194,296	$ 15	$ 284,645
Standing seam roof	18,568	SF	$ 11	$ 213,523	$ 17	$ 312,813
Division 5 Metals				***$ 407,818***		***$ 597,458***
Division 7 Thermal and Moisture Protection						
Roof insulation	18,568	SF	$ 3	$ 48,169	$ 4	$ 70,568
Wall insulation	14,838	SF	$ 2	$ 30,083	$ 3	$ 44,071
Division 7 Thermal and Moisture Protection				***$ 78,252***		***$ 114,639***
Division 8 Openings						
Hollow metal (with security hardware)	283	SF	$ 109	$ 30,847	$ 160	$ 45,191
Covers for slab openings	900	SF	$ 55	$ 49,050	$ 80	$ 71,859
Division 8 Openings				***$ 79,897***		***$ 117,050***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,890	$ 55,890
Division 9 Finishes				***$ 38,150***		***$ 55,890***
Division 22 Plumbing						
Plumbing	1	LS	$ 442,540	$ 442,540	$ 648,326	$ 648,326
Division 22 Plumbing				***$ 442,540***		***$ 648,326***
Division 23 HVAC						
HVAC	1	LS	$ 619,556	$ 619,556	$ 907,656	$ 907,656
Division 23 HVAC				***$ 619,556***		***$ 907,656***
Division 26 Electrical						
Electrical	1	LS	$ 555,900	$ 555,900	$ 814,399	$ 814,399
Surge tank area	1	LS	$ 32,700	$ 32,700	$ 47,906	$ 47,906
Division 26 Electrical				***$ 588,600***		***$ 862,305***
Division 40 Process Interconnections						
Process Piping						
36" STL Discharge Pipe	660	LF	$ 252	$ 166,109	$ 369	$ 243,352
Conc Pipe Supports	30	EA	$ 1,635	$ 49,050	$ 2,395	$ 71,859
SS piping & valves (1-1/2" pipe, valves, level probes)	1	LS	$ 52,320	$ 52,320	$ 76,649	$ 76,649
Valves						
36" Butterfly Valves, w/ elect actuator	12	EA	$ 29,318	$ 351,817	$ 42,951	$ 515,416
8" Combination Air Valve	12	EA	$ 3,734	$ 44,811	$ 5,471	$ 65,649
Instrumentation						
Instrumentation	1	LS	$ 259,420	$ 259,420	$ 380,053	$ 380,053
Surge tank area	1	LS	$ 10,900	$ 10,900	$ 15,969	$ 15,969
Division 40 Process Interconnections				***$ 934,428***		***$ 1,368,946***
Division 43 Process Handling and Storage Equipment						
Compressed air system	3	EA	$ 65,400	$ 196,200	$ 95,812	$ 287,435
Surge Tank	6	EA	$ 130,800	$ 784,800	$ 191,623	$ 1,149,740
Receivers	4	EA	$ 13,080	$ 52,320	$ 19,162	$ 76,649
Division 43 Process Handling and Storage Equipment				***$ 1,033,320***		***$ 1,513,824***
Surge Control Building Subtotal				**$ 5,674,890**		**$ 8,313,772**
Totals				**$ 25,193,000**		**$ 36,908,000**

Mark-Ups

Item		Construction Subtotal	Percent of Total
Construction Subtotal		$ 25,193,000	68.3%
Subcontractor Markups		included in construction subtotal	
Design Allowance		-	0.0%
Direct Cost Subtotal		$ 25,193,000	68.3%
Contractor's General Conditions	15.0%	$ 3,779,000	10.2%
Contingency	30.0%	$ 7,558,000	20.5%
Bonds and Insurance	1.5%	$ 378,000	1.0%
Grand Total		**$ 36,908,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
Main Pumping Station 2
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Main Pump Station 2						
Division 2 Site Construction						
Earthwork						
Structural excavation - Wet Well	9,244	CY	$ 14	$ 133,406	$ 21	$ 195,441
Compacted Fill	2,343	CY	$ 26	$ 61,472	$ 38	$ 90,057
Structural fill	457	CY	$ 45	$ 20,443	$ 66	$ 29,950
Structural excavation - Main Bldg	2,573	CY	$ 14	$ 37,133	$ 21	$ 54,400
Support Structure Piling	6,100	LF	$ 58	$ 355,722	$ 85	$ 521,136
Yard Piping						
72" Steel MLCP	1,713	LF	$ 584	$ 1,000,803	$ 856	$ 1,466,188
42" Steel MLCP	80	LF	$ 246	$ 19,707	$ 361	$ 28,871
36" Steel MLCP	10	LF	$ 217	$ 2,169	$ 318	$ 3,178
18" Steel MLCP	80	LF	$ 156	$ 12,456	$ 228	$ 18,248
Pipe Excavation	5,891	CY	$ 15	$ 87,392	$ 22	$ 128,031
Pipe Bedding	1,182	CY	$ 32	$ 38,097	$ 47	$ 55,813
Pipe Backfill	2,894	CY	$ 19	$ 53,878	$ 27	$ 78,932
Compaction	2,894	CY	$ 5	$ 14,605	$ 7	$ 21,397
Spoil Haul off	2,997	CY	$ 14	$ 41,716	$ 20	$ 61,115
Site Improvements						
Rough site grading	71,111	SY	$ 3	$ 193,002	$ 4	$ 282,751
Gravel Road (30' wide and 6" deep)	151	SY	$ 7	$ 1,083	$ 11	$ 1,587
Chain Link Fence	6,682	LF	$ 34	$ 225,930	$ 50	$ 330,991
Entrance Gate	3	EA	$ 7,686	$ 23,057	$ 11,259	$ 33,778
Division 2 Site Construction				***$ 2,322,071***		***$ 3,401,861***
Division 3 Concrete						
Slab on grade/footings - Wet Well	493	CY	$ 631	$ 310,992	$ 924	$ 455,607
Walls - Wet Well	1,715	CY	$ 1,032	$ 1,769,676	$ 1,512	$ 2,592,596
Slab on grade/footings - Pump Piping Area	212	CY	$ 631	$ 133,733	$ 924	$ 195,920
Walls - Pump Piping Area	174	CY	$ 1,032	$ 179,547	$ 1,512	$ 263,039
Walls - Flow Meter Vault	26	CY	$ 1,032	$ 26,829	$ 1,512	$ 39,305
Elevated Slab - Flow Meter Vault (Roof)	10	CY	$ 1,225	$ 12,255	$ 1,795	$ 17,953
Slab on grade/footings - PS Main Operation Area	114	CY	$ 631	$ 71,913	$ 924	$ 105,353
Slab on grade/footings - Flow meter vault	10	CY	$ 631	$ 6,308	$ 924	$ 9,242
Elevated Slab - Pump Station Operation area	118	CY	$ 1,225	$ 144,606	$ 1,795	$ 211,850
Elevated Slab - Wet well	463	CY	$ 1,225	$ 567,395	$ 1,795	$ 831,241
Suspended Slab - Pump Area	190	CY	$ 1,225	$ 232,840	$ 1,795	$ 341,114
Slab on grade - Flow meter vault	10	CY	$ 631	$ 6,308	$ 924	$ 9,242
Suspended Slab - Operating Area	402	CY	$ 1,225	$ 492,641	$ 1,795	$ 721,725
Division 3 Concrete				***$ 3,955,045***		***$ 5,794,187***
Division 4 Masonry						
12" CMU	8,650	SF	$ 16	$ 138,882	$ 24	$ 203,463
6" CMU	850	SF	$ 9	$ 7,356	$ 13	$ 10,777
Division 4 Masonry				***$ 146,238***		***$ 214,241***
Division 5 Metals						
Structural Steel	7	TON	$ 4,218	$ 29,529	$ 6,180	$ 43,261
Miscellaneous steel members	1	TON	$ 4,218	$ 4,218	$ 6,180	$ 6,180
Metal decking	12,200	SF	$ 10	$ 127,661	$ 15	$ 187,025
Standing seam roof	12,200	SF	$ 11	$ 140,294	$ 17	$ 205,532
Guard post	15	EA	$ 491	$ 7,358	$ 719	$ 10,779
Guardrail	460	LF	$ 77	$ 35,549	$ 113	$ 52,080
Hatch, 5'x5'	1	EA	$ 4,308	$ 4,308	$ 6,311	$ 6,311
Division 5 Metals				***$ 348,917***		***$ 511,168***
Division 7 Thermal and Moisture Protection						

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Roof insulation	12,200	SF	$ 3	$ 31,649	$ 4	$ 46,367
Wall insulation	850	SF	$ 2	$ 1,723	$ 3	$ 2,525
Division 7 Thermal and Moisture Protection				***$ 33,373***		***$ 48,891***
Division 8 Openings						
Hollow metal (with security hardware)	600	SF	$ 109	$ 65,400	$ 160	$ 95,812
Roll-up door with motor	1	EA	$ 3,931	$ 3,931	$ 5,760	$ 5,760
Covers for slab openings	116	SF	$ 55	$ 6,322	$ 80	$ 9,262
Division 8 Openings				***$ 75,653***		***$ 110,833***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,890	$ 55,890
Division 9 Finishes				***$ 38,150***		***$ 55,890***
Division 10 Specialties						
Miscellaneous specialties	1	LS	$ 5,450	$ 5,450	$ 7,984	$ 7,984
Division 10 Specialties				***$ 5,450***		***$ 7,984***
Division 14 Conveying Systems						
Bridge Crane (15 ton)	1	EA	$ 74,405	$ 74,405	$ 109,004	$ 109,004
Division 14 Conveying Systems				***$ 74,405***		***$ 109,004***
Division 22 Plumbing						
Plumbing	1	LS	$ 27,250	$ 27,250	$ 39,922	$ 39,922
Division 22 Plumbing				***$ 27,250***		***$ 39,922***
Division 23 HVAC						
HVAC	1	LS	$ 109,000	$ 109,000	$ 159,686	$ 159,686
Division 23 HVAC				***$ 109,000***		***$ 159,686***
Division 26 Electrical						
Sitework	1	LS	$ 872,000	$ 872,000	$ 1,277,490	$ 1,277,490
Pumping station	1	LS	$ 656,180	$ 656,180	$ 961,311	$ 961,311
VFD's - 5,500 hp	4	EA	$ 1,079,100	$ 4,316,400	$ 1,580,894	$ 6,323,576
VFD's - 800 hp	4	EA	$ 156,960	$ 627,840	$ 229,948	$ 919,793
Division 26 Electrical				***$ 6,472,420***		***$ 9,482,170***
Division 40 Process Interconnections						
Process Piping						
42" STL Discharge Pipe	40	LF	$ 294	$ 11,774	$ 431	$ 17,249
36" STL Discharge Pipe	10	LF	$ 252	$ 2,517	$ 369	$ 3,687
18" STL Discharge Pipe	40	LF	$ 128	$ 5,120	$ 188	$ 7,500
16" STL Discharge Pipe	10	LF	$ 117	$ 1,171	$ 172	$ 1,715
42"x36" STL Reducer	4	EA	$ 18,312	$ 73,248	$ 26,827	$ 107,309
18"x16" STL Reducer	4	EA	$ 2,671	$ 10,682	$ 3,912	$ 15,649
Conc Pipe Supports	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,162
Conc Valve Support	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,162
Valves						
42" Butterfly Valves, w/ elect actuator	4	EA	$ 33,678	$ 134,712	$ 49,339	$ 197,355
18" Butterfly Valves, w/ elect actuator	4	EA	$ 10,817	$ 43,268	$ 15,847	$ 63,389
42" Ball Valve, w/ elect actuator	4	EA	$ 77,278	$ 309,112	$ 113,213	$ 452,853
18" Ball Valve, w/ elect actuator	4	EA	$ 35,380	$ 141,521	$ 51,832	$ 207,330
42" Dismantling Joint	4	EA	$ 10,397	$ 41,587	$ 15,232	$ 60,926
36" Dismantling Joint	4	EA	$ 8,566	$ 34,265	$ 12,550	$ 50,199
18" Dismantling Joint	4	EA	$ 3,640	$ 14,559	$ 5,332	$ 21,329
16" Dismantling Joint	4	EA	$ 3,204	$ 12,815	$ 4,694	$ 18,775
8" Combination Air Valve	4	EA	$ 3,734	$ 14,937	$ 5,471	$ 21,883
4" Combination Air Valve	4	EA	$ 2,644	$ 10,577	$ 3,874	$ 15,496
8" Air Valve/Air Vacuum	4	EA	$ 5,424	$ 21,695	$ 7,946	$ 31,784
4" Air Valve/Air Vacuum	6	EA	$ 2,971	$ 17,828	$ 4,353	$ 26,118
42" Double Door Check Valve	4	EA	$ 49,047	$ 196,188	$ 71,855	$ 287,418
18" Double Door Check Valve	4	EA	$ 20,992	$ 83,969	$ 30,754	$ 123,015
I&C						
Sitework	1	LS	$ 10,900	$ 10,900	$ 15,969	$ 15,969
Pumping station	1	LS	$ 552,630	$ 552,630	$ 809,609	$ 809,609
Division 40 Process Interconnections				***$ 1,771,236***		***$ 2,594,882***
Division 43 Process Handling and Storage Equipment						
Vertical Turbine pump, High Flow (165 CFS, 484 TDH, 4000 HP)	4	EA	$ 776,250	$ 3,105,000	$ 1,137,215	$ 4,548,861
Vertical Turbine pump, Low Flow (20 CFS, 285 TDH, 450 HP)	4	EA	$ 123,050	$ 492,200	$ 180,270	$ 721,079
Division 43 Process Handling and Storage Equipment				***$ 3,597,200***		***$ 5,269,940***
Main Pump Station 2 Subtotal				***$ 18,976,409***		***$ 27,800,659***

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Surge Control Building						
Division 2 Site Construction						
Structural excavation - Wet Well	3,414	CY	$ 14	$ 49,269	$ 21	$ 72,180
Compacted Fill	604	CY	$ 26	$ 15,847	$ 38	$ 23,216
Structural fill	400	CY	$ 45	$ 17,893	$ 66	$ 26,214
Division 2 Site Construction				***$ 83,010***		***$ 121,610***
Division 3 Concrete						
Slab on grade/footings - Wet Well	1,572	CY	$ 631	$ 991,642	$ 924	$ 1,452,767
Walls - Wet Well	144	CY	$ 1,032	$ 148,591	$ 1,512	$ 217,687
Division 3 Concrete				***$ 1,140,233***		***$ 1,670,455***
Division 4 Masonry						
12" CMU	13,602	SF	$ 16	$ 218,390	$ 24	$ 319,943
6" CMU	1,236	SF	$ 9	$ 10,697	$ 13	$ 15,671
Division 4 Masonry				***$ 229,087***		***$ 335,615***
Division 5 Metals						
Metal decking	18,568	SF	$ 10	$ 194,296	$ 15	$ 284,645
Standing seam roof	18,568	SF	$ 11	$ 213,523	$ 17	$ 312,813
Division 5 Metals				***$ 407,818***		***$ 597,458***
Division 7 Thermal and Moisture Protection						
Roof insulation	18,568	SF	$ 3	$ 48,169	$ 4	$ 70,568
Wall insulation	14,838	SF	$ 2	$ 30,083	$ 3	$ 44,071
Division 7 Thermal and Moisture Protection				***$ 78,252***		***$ 114,640***
Division 8 Openings						
Hollow metal (with security hardware)	283	SF	$ 109	$ 30,847	$ 160	$ 45,191
Covers for slab openings	900	SF	$ 55	$ 49,050	$ 80	$ 71,859
Division 8 Openings				***$ 79,897***		***$ 117,050***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,890	$ 55,890
Division 9 Finishes				***$ 38,150***		***$ 55,890***
Division 22 Plumbing						
Plumbing	1	LS	$ 442,540	$ 442,540	$ 648,326	$ 648,326
Division 22 Plumbing				***$ 442,540***		***$ 648,326***
Division 23 HVAC						
HVAC	1	LS	$ 619,556	$ 619,556	$ 907,657	$ 907,657
Division 23 HVAC				***$ 619,556***		***$ 907,657***
Division 26 Electrical						
Electrical	1	LS	$ 555,900	$ 555,900	$ 814,400	$ 814,400
Surge tank area	1	LS	$ 32,700	$ 32,700	$ 47,906	$ 47,906
Division 26 Electrical				***$ 588,600***		***$ 862,306***
Division 40 Process Interconnections						
Process Piping						
36" STL Discharge Pipe	660	LF	$ 252	$ 166,109	$ 369	$ 243,352
Conc Pipe Supports	30	EA	$ 1,635	$ 49,050	$ 2,395	$ 71,859
SS piping & valves (1-1/2" pipe, valves, level probes)	1	LS	$ 52,320	$ 52,320	$ 76,649	$ 76,649
Valves						
36" Butterfly Valves, w/ elect actuator	12	EA	$ 29,318	$ 351,817	$ 42,951	$ 515,416
8" Combination Air Valve	12	EA	$ 3,734	$ 44,811	$ 5,471	$ 65,649
Instrumentation						
Instrumentation	1	LS	$ 259,420	$ 259,420	$ 380,053	$ 380,053
Surge tank area	1	LS	$ 10,900	$ 10,900	$ 15,969	$ 15,969
Division 40 Process Interconnections				***$ 934,428***		***$ 1,368,948***
Division 43 Process Handling and Storage Equipment						
Compressed air system	3	EA	$ 65,400	$ 196,200	$ 95,812	$ 287,435
Surge Tank	6	EA	$ 130,800	$ 784,800	$ 191,624	$ 1,149,741
Receivers	4	EA	$ 13,080	$ 52,320	$ 19,162	$ 76,649
Division 43 Process Handling and Storage Equipment				***$ 1,033,320***		***$ 1,513,826***
Surge Control Building Subtotal				**$ 5,674,890**		**$ 8,313,780**
Totals				**$ 24,651,000**		**$ 36,114,000**

Mark-Ups

Item	Construction Subtotal	Percent of Total
Construction Subtotal	$ 24,651,000	68.3%
Subcontractor Markups	included in construction subtotal	

Design Allowance			-	0.0%
Direct Cost Subtotal		$	24,651,000	68.3%
Contractor's General Conditions	15.0%	$	3,698,000	10.2%
Contingency	30.0%	$	7,395,000	20.5%
Bonds and Insurance	1.5%	$	370,000	1.0%
Grand Total		**$**	**36,114,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
Central North Dakota Intake and Pumping Station
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Intake Screens						
Division 2 Site Construction						
Clearing, Restoration, Subgrade Prep	1	LS	$ 136,250	$ 136,250	$ 199,616	$ 199,616
Erosion and Sediment Control	1	LS	$ 38,150	$ 38,150	$ 55,892	$ 55,892
Grading and Seeding	1.3	AC	$ 2,616	$ 3,401	$ 3,833	$ 4,982
Excavation	2,431	CY	$ 14	$ 35,077	$ 21	$ 51,390
Soil stabilization Granular material	333	CY	$ 45	$ 14,911	$ 66	$ 21,846
Intake Support Structure - Anchor Pad	8	CY	$ 631	$ 5,047	$ 924	$ 7,394
Intake Misc. Fittings (48 inch Stainless Steel Flanged sleeves)	2	EA	$ 14,279	$ 28,558	$ 20,920	$ 41,839
Intake Screens	2	EA	$ 55,590	$ 111,180	$ 81,443	$ 162,886
Division 2 Site Construction				***$ 372,573***		***$ 545,845***
Intake Screens Subtotal				**$ 372,573**		**$ 545,845**
Central North Dakota Intake Pump Station						
Division 2 Site Construction						
Site Preparation						
Clear and Grub	1.3	AC	$ 3,526	$ 4,584	$ 5,166	$ 6,716
Earthwork						
Structural excavation - Wet Well	1,667	CY	$ 14	$ 24,053	$ 21	$ 35,239
Structural excavation - Main building	1,852	CY	$ 14	$ 26,725	$ 21	$ 39,154
Compacted Fill	593	CY	$ 26	$ 15,547	$ 38	$ 22,778
Structural fill	30	CY	$ 45	$ 1,325	$ 66	$ 1,942
Sheet Piling	10,000	SF	$ 44	$ 436,000	$ 64	$ 638,770
Soil stabilization Granular material	59	CY	$ 45	$ 2,651	$ 66	$ 3,884
Yard Pipe						
30" Ductile Iron Pipe	1,784	LF	$ 192	$ 341,993	$ 281	$ 501,043
Pipe Excavation	3,964	CY	$ 15	$ 58,812	$ 22	$ 86,164
Pipe Bedding	165	CY	$ 32	$ 5,324	$ 47	$ 7,800
Pipe Backfill	463	CY	$ 19	$ 8,611	$ 27	$ 12,615
Compaction	463	CY	$ 5	$ 2,334	$ 7	$ 3,420
Spoil Haul off	154	CY	$ 14	$ 2,146	$ 20	$ 3,144
Site Improvements						
Rough site grading	968	SY	$ 3	$ 2,627	$ 4	$ 3,849
Gravel Road (30' wide and 6" deep)	115	SY	$ 7	$ 825	$ 11	$ 1,208
Entrance Gate	2	EA	$ 7,686	$ 15,371	$ 11,260	$ 22,520
Utilities (Offsite Power)	1	LS	$ 817,500	$ 817,500	$ 1,197,693	$ 1,197,693
Division 2 Site Construction				***$ 1,766,429***		***$ 2,587,938***
Division 3 Concrete						
Slab on grade/footings - Wet Well	33	CY	$ 631	$ 20,607	$ 924	$ 30,190
Walls - Wet Well	67	CY	$ 1,032	$ 68,792	$ 1,512	$ 100,785
Slab on grade/footings - Pump Station	62	CY	$ 631	$ 38,939	$ 924	$ 57,048
Walls - Pump Piping Area	58	CY	$ 1,032	$ 59,620	$ 1,512	$ 87,347
Slab on grade/footings - Transformer and CT Metering Cabinet	15	CY	$ 631	$ 9,345	$ 924	$ 13,692
Suspended Slab - Pump Station	26	CY	$ 1,225	$ 31,953	$ 1,795	$ 46,814
Division 3 Concrete				***$ 229,256***		***$ 335,875***
Division 4 Masonry						
6" CMU	3,120	SF	$ 14	$ 42,612	$ 20	$ 62,430
Division 4 Masonry				***$ 42,612***		***$ 62,430***
Division 5 Metals						
Structural Steel	7	TON	$ 4,218	$ 29,529	$ 6,180	$ 43,262
Miscellaneous steel members	1	TON	$ 4,218	$ 4,218	$ 6,180	$ 6,180
Metal decking	704	SF	$ 10	$ 7,367	$ 15	$ 10,793
Standing seam roof	704	SF	$ 11	$ 8,096	$ 17	$ 11,861
Guard post	4	EA	$ 491	$ 1,962	$ 719	$ 2,874

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Guardrail	20	LF	$ 77	$ 1,546	$ 113	$ 2,264
Hatch, 5'x5'	2	EA	$ 4,308	$ 8,616	$ 6,311	$ 12,623
Division 5 Metals				***$ 61,334***		***$ 89,858***
Division 7 Thermal and Moisture Protection						
Roof insulation	704	SF	$ 3	$ 1,826	$ 4	$ 2,676
Wall insulation	1,560	SF	$ 2	$ 3,163	$ 3	$ 4,634
Division 7 Thermal and Moisture Protection				***$ 4,989***		***$ 7,309***
Division 8 Openings						
Hollow metal (with security hardware)	150	SF	$ 109	$ 16,350	$ 160	$ 23,954
Covers for slab openings	50	SF	$ 55	$ 2,725	$ 80	$ 3,992
Division 8 Openings				***$ 19,075***		***$ 27,946***
Division 9 Finishes						
Painting	1	LS	$ 21,800	$ 21,800	$ 31,938	$ 31,938
Division 9 Finishes				***$ 21,800***		***$ 31,938***
Division 22 Plumbing						
Plumbing	1	LS	$ 109,000	$ 109,000	$ 159,692	$ 159,692
Division 22 Plumbing				***$ 109,000***		***$ 159,692***
Division 23 HVAC						
HVAC	1	LS	$ 381,500	$ 381,500	$ 558,923	$ 558,923
Division 23 HVAC				***$ 381,500***		***$ 558,923***
Division 26 Electrical						
Electrical	1	LS	$ 1,635,000	$ 1,635,000	$ 2,395,386	$ 2,395,386
VFD's-700 hp	3	EA	$ 190,750	$ 572,250	$ 279,462	$ 838,385
Division 26 Electrical				***$ 2,207,250***		***$ 3,233,771***
Division 40 Process Interconnections						
Process Piping						
18" STL Discharge Pipe	40	LF	$ 128	$ 5,120	$ 188	$ 7,500
16" STL Discharge Pipe	10	LF	$ 110	$ 1,105	$ 162	$ 1,619
18"x16" STL Reducer	4	EA	$ 2,671	$ 10,682	$ 3,912	$ 15,650
Conc Pipe Supports	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,163
Conc Valve Support	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,163
Valves						
30" Butterfly Valves, w/ elect actuator	2	EA	$ 21,042	$ 42,085	$ 30,829	$ 61,657
18" Butterfly Valves, w/ elect actuator	3	EA	$ 10,817	$ 32,451	$ 15,848	$ 47,543
30" Gate Valve, w/ elect actuator	1	EA	$ 68,779	$ 68,779	$ 100,766	$ 100,766
18" Dismantling Joint	3	EA	$ 3,640	$ 10,919	$ 5,333	$ 15,998
4" Combination Air Valve	3	EA	$ 2,644	$ 7,933	$ 3,874	$ 11,622
4" Air Valve/Air Vacuum	3	EA	$ 2,971	$ 8,914	$ 4,353	$ 13,059
I&C						
Instrumentation & SCADA	1	LS	$ 327,000	$ 327,000	$ 479,077	$ 479,077
Division 40 Process Interconnections				***$ 541,148***		***$ 792,818***
Division 43 Process Handling and Storage Equipment						
Vertical Turbine pump, Low Flow (20 CFS, 482 TDH, 700 HP)	3	EA	$ 158,700	$ 476,100	$ 232,506	$ 697,519
Slide Gates - 36" Sq. w/ electric actuator	2	EA	$ 10,791	$ 21,582	$ 15,810	$ 31,619
Division 43 Process Handling and Storage Equipment				***$ 476,100***		***$ 697,519***
Central North Dakota Intake Pump Station Subtotal				**$ 5,882,073**		**$ 8,617,637**
Totals				**$ 6,255,000**		**$ 9,163,000**

Mark-Ups

Item		Construction Subtotal	Percent of Total
Construction Subtotal		$ 6,255,000	68.3%
Subcontractor Markups		included in construction subtotal	
Design Allowance		-	0.0%
Direct Cost Subtotal		$ 6,255,000	68.3%
Contractor's General Conditions	15.0%	$ 938,000	10.2%
Contingency	30.0%	$ 1,877,000	20.5%
Bonds and Insurance	1.5%	$ 94,000	1.0%
Grand Total		**$ 9,164,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
McClusky Canal Intake and Pumping Station 1 (MM57)
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Intake Screens						
Division 2 Site Construction						
Clearing, Restoration, Subgrade Prep	1	LS	$ 136,250	$ 136,250	$ 199,613	$ 199,613
Erosion and Sediment Control	1	LS	$ 81,750	$ 81,750	$ 119,768	$ 119,768
Grading and Seeding	3	AC	$ 2,616	$ 7,848	$ 3,833	$ 11,498
Excavation	6,481	CY	$ 14	$ 93,538	$ 21	$ 137,038
Soil stabilization Granular material	1,111	CY	$ 45	$ 49,704	$ 66	$ 72,819
Intake Support Structure - Anchor Pad	32	CY	$ 631	$ 20,186	$ 924	$ 29,574
Intake Misc. Fittings (48 inch Stainless Steel Flanged sleeves)	8	EA	$ 14,279	$ 114,232	$ 20,919	$ 167,356
Intake Screens	8	EA	$ 55,590	$ 444,720	$ 81,442	$ 651,537
Air Scour Pipe (8 inch Poly)	4,000	LF	$ 19	$ 74,120	$ 27	$ 108,589
Box Culvert Replacement	1	LS	$ 470,000	$ 360,000	$ 688,573	$ 688,573
Plug Removal	1	LS	$ 250,000	$ 250,000	$ 366,262	$ 366,262
Division 2 Site Construction				***$ 1,632,348***		***$ 2,552,627***
Intake Screens Subtotal				**$ 1,632,348**		**$ 2,552,627**
Canal Intake Pump Station 1						
Division 2 Site Construction						
Site Preparation						
Clear and Grub	4.38	AC	$ 3,526	$ 15,444	$ 5,166	$ 22,626
Earthwork						
Structural excavation - Wet Well	10,667	CY	$ 14	$ 153,937	$ 21	$ 225,525
Structural excavation - Main building	38,000	CY	$ 14	$ 548,401	$ 21	$ 803,434
Compacted Fill	15,006	CY	$ 26	$ 393,702	$ 38	$ 576,793
Structural fill	338	CY	$ 45	$ 15,118	$ 66	$ 22,149
Sheet Piling	14,450	SF	$ 44	$ 630,010	$ 64	$ 922,996
Soil stabilization Granular material	676	CY	$ 45	$ 30,237	$ 66	$ 44,298
Yard Pipe						
72" Steel - 100 PSI	1,584	LF	$ 584	$ 925,436	$ 856	$ 1,355,810
54" Steel - 100 PSI	490	LF	$ 387	$ 189,606	$ 567	$ 277,781
Pipe Excavation	10,887	CY	$ 15	$ 161,508	$ 22	$ 236,617
Pipe Bedding	332	CY	$ 32	$ 10,703	$ 47	$ 15,680
Pipe Backfill	2,159	CY	$ 19	$ 40,199	$ 27	$ 58,894
Compaction	2,159	CY	$ 5	$ 10,897	$ 7	$ 15,965
Spoil Haul off	720	CY	$ 14	$ 10,018	$ 20	$ 14,678
Site Improvements						
Rough site grading	35,720	SY	$ 3	$ 96,948	$ 4	$ 142,033
Utilities (Off-Site Power)	1	LS	$ 1,000,000	$ 1,000,000	$ 1,465,050	$ 1,465,050
Division 2 Site Construction				***$ 4,232,164***		***$ 6,200,330***
Division 3 Concrete						
Slab on grade/footings - Wet Well	255	CY	$ 631	$ 160,560	$ 924	$ 235,228
Slab on Grade - Concrete Surfacing	942	CY	$ 631	$ 594,348	$ 925	$ 870,749
Slab on grade/footings - Pump Piping Area	712	CY	$ 631	$ 448,970	$ 924	$ 657,763
Walls - Wet Well	335	CY	$ 1,032	$ 346,169	$ 1,512	$ 507,155
Walls - Pump Piping Area	7	CY	$ 1,032	$ 7,615	$ 1,512	$ 11,157
Elevated Slab - Wet Well	53	CY	$ 1,225	$ 65,148	$ 1,795	$ 95,446
Suspended Slab - Pump Area	363	CY	$ 1,225	$ 444,802	$ 1,795	$ 651,658
Suspended Slab - Mech Room and Drive Bay	307	CY	$ 1,225	$ 376,523	$ 1,795	$ 551,626
Division 3 Concrete				***$ 2,444,136***		***$ 3,580,781***
Division 4 Masonry						
12" CMU	18,722	SF	$ 26	$ 478,531	$ 37	$ 701,072
6" CMU	24,307	SF	$ 14	$ 331,972	$ 20	$ 486,356
Division 4 Masonry				***$ 810,503***		***$ 1,187,428***
Division 5 Metals						

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Structural Steel	7	TON	$ 4,218	$ 29,529	$ 6,180	$ 43,262
Miscellaneous steel members	1	TON	$ 4,218	$ 4,218	$ 6,180	$ 6,180
Metal decking	14,393	SF	$ 10	$ 150,604	$ 15	$ 220,643
Standing seam roof	14,393	SF	$ 11	$ 165,508	$ 17	$ 242,477
Guard post	10	EA	$ 491	$ 4,905	$ 719	$ 7,186
Guardrail	180	LF	$ 77	$ 13,911	$ 113	$ 20,380
Hatch, 5'x5'	3	EA	$ 4,308	$ 12,924	$ 6,311	$ 18,934
Division 5 Metals				***$ 381,599***		***$ 559,062***
Division 7 Thermal and Moisture Protection						
Roof insulation	14,393	SF	$ 3	$ 37,337	$ 4	$ 54,701
Wall insulation	24,307	SF	$ 2	$ 49,279	$ 3	$ 72,196
Division 7 Thermal and Moisture Protection				***$ 86,616***		***$ 126,897***
Division 8 Openings						
Hollow metal (with security hardware)	450	SF	$ 109	$ 49,050	$ 160	$ 71,861
Roll-up door with motor	2	EA	$ 3,931	$ 7,863	$ 5,760	$ 11,519
Covers for slab openings	75	SF	$ 55	$ 4,088	$ 80	$ 5,988
Division 8 Openings				***$ 61,000***		***$ 89,368***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,892	$ 55,892
Division 9 Finishes				***$ 38,150***		***$ 55,892***
Division 14 Conveying Systems						
Bridge Crane (15 ton)	1	EA	$ 74,405	$ 74,405	$ 109,007	$ 109,007
Division 14 Conveying Systems				***$ 74,405***		***$ 109,007***
Division 22 Plumbing						
Plumbing	1	LS	$ 545,000	$ 545,000	$ 798,452	$ 798,452
Division 22 Plumbing				***$ 545,000***		***$ 798,452***
Division 23 HVAC						
HVAC	1	LS	$ 763,000	$ 763,000	$ 1,117,833	$ 1,117,833
Division 23 HVAC				***$ 763,000***		***$ 1,117,833***
Division 26 Electrical						
Electrical	1	LS	$ 2,725,000	$ 2,725,000	$ 3,992,260	$ 3,992,260
VFD's-1,250 hp	4	EA	$ 245,250	$ 981,000	$ 359,303	$ 1,437,214
VFD's-250 hp	4	EA	$ 81,750	$ 327,000	$ 119,768	$ 479,071
Division 26 Electrical				***$ 4,033,000***		***$ 5,908,545***
Division 40 Process Interconnections						
Process Piping						
42" STL Discharge Pipe	40	LF	$ 294	$ 11,772	$ 431	$ 17,247
36" STL Discharge Pipe	10	LF	$ 252	$ 2,517	$ 369	$ 3,687
18" STL Discharge Pipe	40	LF	$ 128	$ 5,120	$ 188	$ 7,500
16" STL Discharge Pipe	10	LF	$ 110	$ 1,105	$ 162	$ 1,619
42"x36" STL Reducer	4	EA	$ 18,312	$ 73,248	$ 26,828	$ 107,312
18"x16" STL Reducer	4	EA	$ 2,671	$ 10,682	$ 3,912	$ 15,650
Conc Pipe Supports	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,163
Conc Valve Support	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,163
Valves						
42" Butterfly Valves, w/ elect actuator	4	EA	$ 33,678	$ 134,712	$ 49,340	$ 197,360
18" Butterfly Valves, w/ elect actuator	4	EA	$ 10,817	$ 43,268	$ 15,848	$ 63,390
42" Ball Valve, w/ elect actuator	4	EA	$ 77,278	$ 309,112	$ 113,216	$ 452,865
18" Ball Valve, w/ elect actuator	4	EA	$ 35,380	$ 141,521	$ 51,834	$ 207,335
42" Dismantling Joint	4	EA	$ 10,397	$ 41,587	$ 15,232	$ 60,928
36" Dismantling Joint	4	EA	$ 8,566	$ 34,265	$ 12,550	$ 50,200
18" Dismantling Joint	4	EA	$ 3,640	$ 14,559	$ 5,333	$ 21,330
16" Dismantling Joint	4	EA	$ 3,204	$ 12,815	$ 4,694	$ 18,775
8" Combination Air Valve	4	EA	$ 3,734	$ 14,937	$ 5,471	$ 21,884
4" Combination Air Valve	4	EA	$ 2,644	$ 10,577	$ 3,874	$ 15,496
8" Air Valve/Air Vacuum	4	EA	$ 5,424	$ 21,695	$ 7,946	$ 31,784
4" Air Valve/Air Vacuum	6	EA	$ 2,971	$ 17,828	$ 4,353	$ 26,118
42" Double Door Check Valve	4	EA	$ 49,047	$ 196,188	$ 71,856	$ 287,426
18" Double Door Check Valve	4	EA	$ 18,703	$ 74,813	$ 27,401	$ 109,605
I&C						
Instrumentation & SCADA	1	LS	$ 1,199,000	$ 1,199,000	$ 1,756,594	$ 1,756,594
Division 40 Process Interconnections				***$ 2,397,482***		***$ 3,512,430***
Division 43 Process Handling and Storage Equipment						

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Vertical Turbine pump, High Flow (165 CFS, 79 TDH, 700 HP)	4	EA	$ 310,500	$ 1,242,000	$ 454,898	$ 1,819,592
Vertical Turbine pump, Low Flow (20 CFS, 71 TDH, 125 HP)	4	EA	$ 100,050	$ 400,200	$ 146,578	$ 586,313
Air units on intake screen-50 hp	3	EA	$ 9,483	$ 28,449	$ 13,893	$ 41,679
Division 43 Process Handling and Storage Equipment				***$ 1,670,649***		***$ 2,447,584***
Canal Intake Pump Station 1 Subtotal				**$ 17,537,706**		**$ 25,693,608**
Totals				**$ 19,170,000**		**$ 28,246,000**

Mark-Ups

Item		Construction Subtotal	Percent of Total
Construction Subtotal		$ 19,170,000	68.3%
Subcontractor Markups		included in construction subtotal	
Design Allowance		-	0.0%
Direct Cost Subtotal		$ 19,170,000	68.3%
Contractor's General Conditions	15.0%	$ 2,876,000	10.2%
Contingency	30.0%	$ 5,751,000	20.5%
Bonds and Insurance	1.5%	$ 288,000	1.0%
Grand Total		**$ 28,085,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
McClusky Canal Intake and Pumping Station 2 (MM49)
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Intake Screens						
Division 2 Site Construction						
Clearing, Restoration, Subgrade Prep	1	LS	$ 136,250	$ 136,250	$ 199,606	$ 199,606
Erosion and Sediment Control	1	LS	$ 81,750	$ 81,750	$ 119,763	$ 119,763
Grading and Seeding	3	AC	$ 2,616	$ 7,848	$ 3,832	$ 11,497
Excavation	6,481	CY	$ 14	$ 93,538	$ 21	$ 137,033
Soil stabilization Granular material	1,111	CY	$ 45	$ 49,704	$ 66	$ 72,816
Intake Support Structure - Anchor Pad	32	CY	$ 631	$ 20,186	$ 924	$ 29,573
Intake Misc. Fittings (48 inch Stainless Steel Flanged sleeves)	8	EA	$ 14,279	$ 114,232	$ 20,919	$ 167,349
Intake Screens	8	EA	$ 55,590	$ 444,720	$ 81,439	$ 651,512
Air Scour Pipe (8 inch Poly)	4,000	LF	$ 19	$ 74,120	$ 27	$ 108,585
Box Culvert Replacement	1	LS	$ 470,000	$ 470,000	$ 688,548	$ 688,548
Division 2 Site Construction				***$ 1,492,348***		***$ 2,186,282***
Intake Screens Subtotal				**$ 1,492,348**		**$ 2,186,282**
Canal Intake Pump Station 2						
Division 2 Site Construction						
Site Preparation						
Clear and Grub	4.38	AC	$ 3,526	$ 15,444	$ 5,166	$ 22,625
Earthwork						
Structural excavation - Wet Well	8,000	CY	$ 14	$ 115,453	$ 21	$ 169,138
Structural excavation - Main building	19,000	CY	$ 14	$ 274,200	$ 21	$ 401,702
Compacted Fill	6,759	CY	$ 26	$ 177,338	$ 38	$ 259,799
Structural fill	338	CY	$ 45	$ 15,118	$ 66	$ 22,148
Sheet Piling	14,450	SF	$ 44	$ 630,010	$ 64	$ 922,962
Soil stabilization Granular material	676	CY	$ 45	$ 30,237	$ 66	$ 44,296
Yard Pipe						
72" Steel - 100 PSI	4,752	LF	$ 584	$ 2,776,308	$ 856	$ 4,067,277
54" Steel - 100 PSI	510	LF	$ 387	$ 197,345	$ 567	$ 289,109
Pipe Excavation	28,572	CY	$ 15	$ 423,866	$ 22	$ 620,962
Pipe Bedding	863	CY	$ 32	$ 27,810	$ 47	$ 40,742
Pipe Backfill	5,696	CY	$ 19	$ 106,035	$ 27	$ 155,341
Compaction	5,696	CY	$ 5	$ 28,744	$ 7	$ 42,109
Spoil Haul off	1,899	CY	$ 14	$ 26,426	$ 20	$ 38,714
Site Improvements						
Rough site grading	35,720	SY	$ 3	$ 96,948	$ 4	$ 142,028
Utilities (Off-Site Power)	1	LS	$ 2,000,000	$ 2,000,000	$ 2,929,989	$ 2,929,989
Division 2 Site Construction				***$ 6,941,282***		***$ 10,168,942***
Division 3 Concrete						
Slab on grade/footings - Wet Well	255	CY	$ 631	$ 160,560	$ 924	$ 235,219
Slab on Grade - Concrete Surfacing	942	CY	$ 631	$ 594,348	$ 925	$ 870,716
Slab on grade/footings - Pump Piping Area	712	CY	$ 631	$ 448,970	$ 924	$ 657,739
Walls - Wet Well	343	CY	$ 1,032	$ 353,744	$ 1,512	$ 518,233
Walls - Pump Piping Area	7	CY	$ 1,032	$ 7,615	$ 1,512	$ 11,156
Elevated Slab - Wet Well	53	CY	$ 1,225	$ 65,148	$ 1,795	$ 95,442
Suspended Slab - Pump Area	363	CY	$ 1,225	$ 444,802	$ 1,795	$ 651,633
Suspended Slab - Mech Room and Drive Bay	307	CY	$ 1,225	$ 376,523	$ 1,795	$ 551,605
Division 3 Concrete				***$ 2,451,711***		***$ 3,591,744***
Division 4 Masonry						
12" CMU	18,722	SF	$ 26	$ 478,531	$ 37	$ 701,046
6" CMU	24,307	SF	$ 14	$ 331,972	$ 20	$ 486,338
Division 4 Masonry				***$ 810,503***		***$ 1,187,383***
Division 5 Metals						
Structural Steel	7	TON	$ 4,218	$ 29,529	$ 6,180	$ 43,260

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Miscellaneous steel members	1	TON	$ 4,218	$ 4,218	$ 6,180	$ 6,180
Metal decking	14,393	SF	$ 10	$ 150,604	$ 15	$ 220,634
Standing seam roof	14,393	SF	$ 11	$ 165,508	$ 17	$ 242,468
Guard post	10	EA	$ 491	$ 4,905	$ 719	$ 7,186
Guardrail	180	LF	$ 77	$ 13,911	$ 113	$ 20,379
Hatch, 5'x5'	3	EA	$ 4,308	$ 12,924	$ 6,311	$ 18,933
Division 5 Metals				***$ 381,599***		***$ 559,041***
Division 7 Thermal and Moisture Protection						
Roof insulation	14,393	SF	$ 3	$ 37,337	$ 4	$ 54,699
Wall insulation	24,307	SF	$ 2	$ 49,279	$ 3	$ 72,194
Division 7 Thermal and Moisture Protection				***$ 86,616***		***$ 126,893***
Division 8 Openings						
Hollow metal (with security hardware)	450	SF	$ 109	$ 49,050	$ 160	$ 71,858
Roll-up door with motor	2	EA	$ 3,931	$ 7,863	$ 5,759	$ 11,519
Covers for slab openings	75	SF	$ 55	$ 4,088	$ 80	$ 5,988
Division 8 Openings				***$ 61,000***		***$ 89,365***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,890	$ 55,890
Division 9 Finishes				***$ 38,150***		***$ 55,890***
Division 14 Conveying Systems						
Bridge Crane (15 ton)	1	EA	$ 74,405	$ 74,405	$ 109,003	$ 109,003
Division 14 Conveying Systems				***$ 74,405***		***$ 109,003***
Division 22 Plumbing						
Plumbing	1	LS	$ 545,000	$ 545,000	$ 798,422	$ 798,422
Division 22 Plumbing				***$ 545,000***		***$ 798,422***
Division 23 HVAC						
HVAC	1	LS	$ 763,000	$ 763,000	$ 1,117,791	$ 1,117,791
Division 23 HVAC				***$ 763,000***		***$ 1,117,791***
Division 26 Electrical						
Electrical	1	LS	$ 2,725,000	$ 2,725,000	$ 3,992,111	$ 3,992,111
VFD's-1,250 hp	4	EA	$ 245,250	$ 981,000	$ 359,290	$ 1,437,160
VFD's-250 hp	4	EA	$ 81,750	$ 327,000	$ 119,763	$ 479,053
Division 26 Electrical				***$ 4,033,000***		***$ 5,908,324***
Division 40 Process Interconnections						
Process Piping						
42" STL Discharge Pipe	40	LF	$ 294	$ 11,772	$ 431	$ 17,246
36" STL Discharge Pipe	10	LF	$ 252	$ 2,517	$ 369	$ 3,687
18" STL Discharge Pipe	40	LF	$ 128	$ 5,120	$ 188	$ 7,500
16" STL Discharge Pipe	10	LF	$ 110	$ 1,105	$ 162	$ 1,619
42"x36" STL Reducer	4	EA	$ 18,312	$ 73,248	$ 26,827	$ 107,308
18"x16" STL Reducer	4	EA	$ 2,671	$ 10,682	$ 3,912	$ 15,649
Conc Pipe Supports	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,162
Conc Valve Support	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,162
Valves						
42" Butterfly Valves, w/ elect actuator	4	EA	$ 33,678	$ 134,712	$ 49,338	$ 197,353
18" Butterfly Valves, w/ elect actuator	4	EA	$ 10,817	$ 43,268	$ 15,847	$ 63,388
42" Ball Valve, w/ elect actuator	4	EA	$ 77,278	$ 309,112	$ 113,212	$ 452,848
18" Ball Valve, w/ elect actuator	4	EA	$ 35,380	$ 141,521	$ 51,832	$ 207,327
42" Dismantling Joint	4	EA	$ 10,397	$ 41,587	$ 15,231	$ 60,925
36" Dismantling Joint	4	EA	$ 8,566	$ 34,265	$ 12,549	$ 50,198
18" Dismantling Joint	4	EA	$ 3,640	$ 14,559	$ 5,332	$ 21,329
16" Dismantling Joint	4	EA	$ 3,204	$ 12,815	$ 4,694	$ 18,774
8" Combination Air Valve	4	EA	$ 3,734	$ 14,937	$ 5,471	$ 21,883
4" Combination Air Valve	4	EA	$ 2,644	$ 10,577	$ 3,874	$ 15,495
8" Air Valve/Air Vacuum	4	EA	$ 5,424	$ 21,695	$ 7,946	$ 31,783
4" Air Valve/Air Vacuum	6	EA	$ 2,971	$ 17,828	$ 4,353	$ 26,117
42" Double Door Check Valve	4	EA	$ 49,047	$ 196,188	$ 71,854	$ 287,415
18" Double Door Check Valve	4	EA	$ 18,703	$ 74,813	$ 27,400	$ 109,601
I&C						
Instrumentation & SCADA	1	LS	$ 1,199,000	$ 1,199,000	$ 1,756,529	$ 1,756,529
Division 40 Process Interconnections				***$ 2,397,482***		***$ 3,512,299***
Division 43 Process Handling and Storage Equipment						
Vertical Turbine pump, High Flow (165 CFS, 104 TDH, 900 HP)	4	EA	$ 324,300	$ 1,297,200	$ 475,098	$ 1,900,391

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Vertical Turbine pump, Low Flow (20 CFS, 96 TDH, 150 HP)	4	EA	$ 102,350	$ 409,400	$ 149,942	$ 599,769
Air units on intake screen-50 hp	3	EA	$ 9,483	$ 28,449	$ 13,893	$ 41,678
Division 43 Process Handling and Storage Equipment				***$ 1,735,049***		***$ 2,541,838***
Canal Intake Pump Station Subtotal				**$ 20,318,799**		**$ 29,766,933**
Totals				**$ 21,811,000**		**$ 31,953,000**

Mark-Ups

Item		Construction Subtotal	Percent of Total
Construction Subtotal		$ 21,811,000	68.3%
Subcontractor Markups		included in construction subtotal	
Design Allowance		-	0.0%
Direct Cost Subtotal		$ 21,811,000	68.3%
Contractor's General Conditions	15.0%	$ 3,272,000	10.2%
Contingency	30.0%	$ 6,543,000	20.5%
Bonds and Insurance	1.5%	$ 327,000	1.0%
Grand Total		**$ 31,953,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
McClusky Canal Main Pumping Station 1
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
McClusky Main Pump Station 1						
Division 2 Site Construction						
Earthwork						
Structural excavation - Wet Well	9,244	CY	$ 14	$ 133,406	$ 21	$ 195,444
Compacted Fill	2,343	CY	$ 26	$ 61,472	$ 38	$ 90,058
Structural fill	457	CY	$ 45	$ 20,443	$ 66	$ 29,950
Structural excavation - Main Bldg	2,573	CY	$ 14	$ 37,133	$ 21	$ 54,400
Support Structure Piling	6,100	LF	$ 58	$ 355,722	$ 85	$ 521,144
Yard Piping						
72" Steel MLCP	1,713	LF	$ 584	$ 1,000,803	$ 856	$ 1,466,209
42" Steel MLCP	80	LF	$ 246	$ 19,707	$ 361	$ 28,872
36" Steel MLCP	10	LF	$ 217	$ 2,169	$ 318	$ 3,178
18" Steel MLCP	80	LF	$ 156	$ 12,456	$ 228	$ 18,248
Pipe Excavation	5,891	CY	$ 15	$ 87,392	$ 22	$ 128,033
Pipe Bedding	1,182	CY	$ 32	$ 38,097	$ 47	$ 55,814
Pipe Backfill	2,894	CY	$ 19	$ 53,878	$ 27	$ 78,933
Compaction	2,894	CY	$ 5	$ 14,605	$ 7	$ 21,397
Spoil Haul off	2,997	CY	$ 14	$ 41,716	$ 20	$ 61,116
Site Improvements						
Rough site grading	71,111	SY	$ 3	$ 193,002	$ 4	$ 282,755
Gravel Road (30' wide and 6" deep)	151	SY	$ 7	$ 1,083	$ 11	$ 1,587
Chain Link Fence	6,682	LF	$ 34	$ 225,930	$ 50	$ 330,995
Entrance Gate	3	EA	$ 7,686	$ 23,057	$ 11,260	$ 33,779
Division 2 Site Construction				***$ 2,322,071***		***$ 3,401,910***
Division 3 Concrete						
Slab on grade/footings - Wet Well	493	CY	$ 631	$ 310,992	$ 924	$ 455,614
Walls - Wet Well	1,715	CY	$ 1,032	$ 1,769,676	$ 1,512	$ 2,592,633
Slab on grade/footings - Pump Piping Area	212	CY	$ 631	$ 133,733	$ 924	$ 195,923
Walls - Pump Piping Area	174	CY	$ 1,032	$ 179,547	$ 1,512	$ 263,043
Walls - Flow Meter Vault	26	CY	$ 1,032	$ 26,829	$ 1,512	$ 39,305
Elevated Slab - Flow Meter Vault (Roof)	10	CY	$ 1,225	$ 12,255	$ 1,795	$ 17,954
Slab on grade/footings - PS Main Operation Area	114	CY	$ 631	$ 71,913	$ 924	$ 105,355
Slab on grade/footings - Flow meter vault	10	CY	$ 631	$ 6,308	$ 924	$ 9,242
Elevated Slab - Pump Station Operation area	118	CY	$ 1,225	$ 144,606	$ 1,795	$ 211,853
Elevated Slab - Wet well	463	CY	$ 1,225	$ 567,395	$ 1,795	$ 831,253
Suspended Slab - Pump Area	190	CY	$ 1,225	$ 232,840	$ 1,795	$ 341,119
Slab on grade - Flow meter vault	10	CY	$ 631	$ 6,308	$ 924	$ 9,242
Suspended Slab - Operating Area	402	CY	$ 1,225	$ 492,641	$ 1,795	$ 721,736
Division 3 Concrete				***$ 3,955,045***		***$ 5,794,269***
Division 4 Masonry						
12" CMU	8,650	SF	$ 16	$ 138,882	$ 24	$ 203,466
6" CMU	850	SF	$ 9	$ 7,356	$ 13	$ 10,777
Division 4 Masonry				***$ 146,238***		***$ 214,244***
Division 5 Metals						
Structural Steel	7	TON	$ 4,218	$ 29,529	$ 6,180	$ 43,261
Miscellaneous steel members	1	TON	$ 4,218	$ 4,218	$ 6,180	$ 6,180
Metal decking	12,200	SF	$ 10	$ 127,661	$ 15	$ 187,027
Standing seam roof	12,200	SF	$ 11	$ 140,294	$ 17	$ 205,535
Guard post	15	EA	$ 491	$ 7,358	$ 719	$ 10,779
Guardrail	460	LF	$ 77	$ 35,549	$ 113	$ 52,081
Hatch, 5'x5'	1	EA	$ 4,308	$ 4,308	$ 6,311	$ 6,311
Division 5 Metals				***$ 348,917***		***$ 511,175***
Division 7 Thermal and Moisture Protection						

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Roof insulation	12,200	SF	$ 3	$ 31,649	$ 4	$ 46,367
Wall insulation	850	SF	$ 2	$ 1,723	$ 3	$ 2,525
Division 7 Thermal and Moisture Protection				***$ 33,373***		***$ 48,892***
Division 8 Openings						
Hollow metal (with security hardware)	600	SF	$ 109	$ 65,400	$ 160	$ 95,813
Roll-up door with motor	1	EA	$ 3,931	$ 3,931	$ 5,760	$ 5,760
Covers for slab openings	116	SF	$ 55	$ 6,322	$ 80	$ 9,262
Division 8 Openings				***$ 75,653***		***$ 110,835***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,891	$ 55,891
Division 9 Finishes				***$ 38,150***		***$ 55,891***
Division 10 Specialties						
Miscellaneous specialties	1	LS	$ 5,450	$ 5,450	$ 7,984	$ 7,984
Division 10 Specialties				***$ 5,450***		***$ 7,984***
Division 14 Conveying Systems						
Bridge Crane (15 ton)	1	EA	$ 74,405	$ 74,405	$ 109,006	$ 109,006
Division 14 Conveying Systems				***$ 74,405***		***$ 109,006***
Division 22 Plumbing						
Plumbing	1	LS	$ 27,250	$ 27,250	$ 39,922	$ 39,922
Division 22 Plumbing				***$ 27,250***		***$ 39,922***
Division 23 HVAC						
HVAC	1	LS	$ 109,000	$ 109,000	$ 159,689	$ 159,689
Division 23 HVAC				***$ 109,000***		***$ 159,689***
Division 26 Electrical						
Sitework	1	LS	$ 872,000	$ 872,000	$ 1,277,508	$ 1,277,508
Pumping station	1	LS	$ 656,180	$ 656,180	$ 961,325	$ 961,325
VFD's - 5,500 hp	4	EA	$ 1,079,100	$ 4,316,400	$ 1,580,917	$ 6,323,666
VFD's - 800 hp	4	EA	$ 156,960	$ 627,840	$ 229,951	$ 919,806
Division 26 Electrical				***$ 6,472,420***		***$ 9,482,305***
Division 40 Process Interconnections						
Process Piping						
42" STL Discharge Pipe	40	LF	$ 294	$ 11,774	$ 431	$ 17,250
36" STL Discharge Pipe	10	LF	$ 252	$ 2,517	$ 369	$ 3,687
18" STL Discharge Pipe	40	LF	$ 128	$ 5,120	$ 188	$ 7,500
16" STL Discharge Pipe	10	LF	$ 117	$ 1,171	$ 172	$ 1,715
42"x36" STL Reducer	4	EA	$ 18,312	$ 73,248	$ 26,828	$ 107,311
18"x16" STL Reducer	4	EA	$ 2,671	$ 10,682	$ 3,912	$ 15,649
Conc Pipe Supports	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,163
Conc Valve Support	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,163
Valves						
42" Butterfly Valves, w/ elect actuator	4	EA	$ 33,678	$ 134,712	$ 49,339	$ 197,358
18" Butterfly Valves, w/ elect actuator	4	EA	$ 10,817	$ 43,268	$ 15,847	$ 63,390
42" Ball Valve, w/ elect actuator	4	EA	$ 77,278	$ 309,112	$ 113,215	$ 452,860
18" Ball Valve, w/ elect actuator	4	EA	$ 35,380	$ 141,521	$ 51,833	$ 207,333
42" Dismantling Joint	4	EA	$ 10,397	$ 41,587	$ 15,232	$ 60,927
36" Dismantling Joint	4	EA	$ 8,566	$ 34,265	$ 12,550	$ 50,199
18" Dismantling Joint	4	EA	$ 3,640	$ 14,559	$ 5,332	$ 21,330
16" Dismantling Joint	4	EA	$ 3,204	$ 12,815	$ 4,694	$ 18,775
8" Combination Air Valve	4	EA	$ 3,734	$ 14,937	$ 5,471	$ 21,883
4" Combination Air Valve	4	EA	$ 2,644	$ 10,577	$ 3,874	$ 15,496
8" Air Valve/Air Vacuum	4	EA	$ 5,424	$ 21,695	$ 7,946	$ 31,784
4" Air Valve/Air Vacuum	6	EA	$ 2,971	$ 17,828	$ 4,353	$ 26,118
42" Double Door Check Valve	4	EA	$ 49,047	$ 196,188	$ 71,856	$ 287,422
18" Double Door Check Valve	4	EA	$ 20,992	$ 83,969	$ 30,754	$ 123,017
I&C						
Sitework	1	LS	$ 10,900	$ 10,900	$ 15,969	$ 15,969
Pumping station	1	LS	$ 552,630	$ 552,630	$ 809,621	$ 809,621
Division 40 Process Interconnections				***$ 1,771,236***		***$ 2,594,919***
Division 43 Process Handling and Storage Equipment						
Vertical Turbine pump, High Flow (165 CFS, 244 TDH, 2000 HP)	4	EA	$ 531,300	$ 2,125,200	$ 778,372	$ 3,113,487
Vertical Turbine pump, Low Flow (20 CFS, 175 TDH, 250 HP)	4	EA	$ 100,050	$ 400,200	$ 146,576	$ 586,306
Division 43 Process Handling and Storage Equipment				***$ 2,525,400***		***$ 3,699,793***
McClusky Main Pump Station 1 Subtotal				**$ 17,904,609**		**$ 26,230,833**

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Surge Control Building						
Division 2 Site Construction						
Structural excavation - Wet Well	3,414	CY	$ 14	$ 49,269	$ 21	$ 72,181
Compacted Fill	604	CY	$ 26	$ 15,847	$ 38	$ 23,216
Structural fill	400	CY	$ 45	$ 17,893	$ 66	$ 26,214
Division 2 Site Construction				***$ 83,010***		***$ 121,612***
Division 3 Concrete						
Slab on grade/footings - Wet Well	1,572	CY	$ 631	$ 991,642	$ 924	$ 1,452,788
Walls - Wet Well	144	CY	$ 1,032	$ 148,591	$ 1,512	$ 217,690
Division 3 Concrete				***$ 1,140,233***		***$ 1,670,479***
Division 4 Masonry						
12" CMU	13,602	SF	$ 16	$ 218,390	$ 24	$ 319,948
6" CMU	1,236	SF	$ 9	$ 10,697	$ 13	$ 15,672
Division 4 Masonry				***$ 229,087***		***$ 335,619***
Division 5 Metals						
Metal decking	18,568	SF	$ 10	$ 194,296	$ 15	$ 284,649
Standing seam roof	18,568	SF	$ 11	$ 213,523	$ 17	$ 312,818
Division 5 Metals				***$ 407,818***		***$ 597,467***
Division 7 Thermal and Moisture Protection						
Roof insulation	18,568	SF	$ 3	$ 48,169	$ 4	$ 70,569
Wall insulation	14,838	SF	$ 2	$ 30,083	$ 3	$ 44,072
Division 7 Thermal and Moisture Protection				***$ 78,252***		***$ 114,641***
Division 8 Openings						
Hollow metal (with security hardware)	283	SF	$ 109	$ 30,847	$ 160	$ 45,192
Covers for slab openings	900	SF	$ 55	$ 49,050	$ 80	$ 71,860
Division 8 Openings				***$ 79,897***		***$ 117,052***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,891	$ 55,891
Division 9 Finishes				***$ 38,150***		***$ 55,891***
Division 22 Plumbing						
Plumbing	1	LS	$ 442,540	$ 442,540	$ 648,335	$ 648,335
Division 22 Plumbing				***$ 442,540***		***$ 648,335***
Division 23 HVAC						
HVAC	1	LS	$ 619,556	$ 619,556	$ 907,670	$ 907,670
Division 23 HVAC				***$ 619,556***		***$ 907,670***
Division 26 Electrical						
Electrical	1	LS	$ 555,900	$ 555,900	$ 814,412	$ 814,412
Surge tank area	1	LS	$ 32,700	$ 32,700	$ 47,907	$ 47,907
Division 26 Electrical				***$ 588,600***		***$ 862,318***
Division 40 Process Interconnections						
Process Piping						
36" STL Discharge Pipe	660	LF	$ 252	$ 166,109	$ 369	$ 243,356
Conc Pipe Supports	30	EA	$ 1,635	$ 49,050	$ 2,395	$ 71,860
SS piping & valves (1-1/2" pipe, valves, level probes)	1	LS	$ 52,320	$ 52,320	$ 76,650	$ 76,650
Valves						
36" Butterfly Valves, w/ elect actuator	12	EA	$ 29,318	$ 351,817	$ 42,952	$ 515,423
8" Combination Air Valve	12	EA	$ 3,734	$ 44,811	$ 5,471	$ 65,650
Instrumentation						
Instrumentation	1	LS	$ 259,420	$ 259,420	$ 380,059	$ 380,059
Surge tank area	1	LS	$ 10,900	$ 10,900	$ 15,969	$ 15,969
Division 40 Process Interconnections				***$ 934,428***		***$ 1,368,967***
Division 43 Process Handling and Storage Equipment						
Compressed air system	3	EA	$ 65,400	$ 196,200	$ 95,813	$ 287,439
Surge Tank	6	EA	$ 130,800	$ 784,800	$ 191,626	$ 1,149,757
Receivers	4	EA	$ 13,080	$ 52,320	$ 19,163	$ 76,650
Division 43 Process Handling and Storage Equipment				***$ 1,033,320***		***$ 1,513,847***
Surge Control Building Subtotal				**$ 5,674,890**		**$ 8,313,898**
Totals				**$ 23,579,000**		**$ 34,545,000**

Mark-Ups

Item	Construction Subtotal	Percent of Total
Construction Subtotal	$ 23,579,000	68.3%
Subcontractor Markups	included in construction subtotal	

Design Allowance			-	0.0%
Direct Cost Subtotal		$	23,579,000	68.3%
Contractor's General Conditions	15.0%	$	3,537,000	10.2%
Contingency	30.0%	$	7,074,000	20.5%
Bonds and Insurance	1.5%	$	354,000	1.0%
Grand Total		**$**	**34,544,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
McClusky Canal Main Pumping Station 2
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
McClusky Main Pump Station 2						
Division 2 Site Construction						
Earthwork						
Structural excavation - Wet Well	9,244	CY	$ 14	$ 133,406	$ 21	$ 195,439
Compacted Fill	2,343	CY	$ 26	$ 61,472	$ 38	$ 90,056
Structural fill	457	CY	$ 45	$ 20,443	$ 66	$ 29,949
Structural excavation - Main Bldg	2,573	CY	$ 14	$ 37,133	$ 21	$ 54,399
Support Structure Piling	6,100	LF	$ 58	$ 355,722	$ 85	$ 521,130
Yard Piping						
72" Steel MLCP	1,713	LF	$ 584	$ 1,000,803	$ 856	$ 1,466,170
42" Steel MLCP	80	LF	$ 246	$ 19,707	$ 361	$ 28,871
36" Steel MLCP	10	LF	$ 217	$ 2,169	$ 318	$ 3,178
18" Steel MLCP	80	LF	$ 156	$ 12,456	$ 228	$ 18,247
Pipe Excavation	5,891	CY	$ 15	$ 87,392	$ 22	$ 128,029
Pipe Bedding	1,182	CY	$ 32	$ 38,097	$ 47	$ 55,812
Pipe Backfill	2,894	CY	$ 19	$ 53,878	$ 27	$ 78,931
Compaction	2,894	CY	$ 5	$ 14,605	$ 7	$ 21,396
Spoil Haul off	2,997	CY	$ 14	$ 41,716	$ 20	$ 61,114
Site Improvements						
Rough site grading	71,111	SY	$ 3	$ 193,002	$ 4	$ 282,747
Gravel Road (30' wide and 6" deep)	151	SY	$ 7	$ 1,083	$ 11	$ 1,587
Chain Link Fence	6,682	LF	$ 34	$ 225,930	$ 50	$ 330,987
Entrance Gate	3	EA	$ 7,686	$ 23,057	$ 11,259	$ 33,778
Division 2 Site Construction				***$ 2,322,071***		***$ 3,401,820***
Division 3 Concrete						
Slab on grade/footings - Wet Well	493	CY	$ 631	$ 310,992	$ 924	$ 455,601
Walls - Wet Well	1,715	CY	$ 1,032	$ 1,769,676	$ 1,512	$ 2,592,564
Slab on grade/footings - Pump Piping Area	212	CY	$ 631	$ 133,733	$ 924	$ 195,918
Walls - Pump Piping Area	174	CY	$ 1,032	$ 179,547	$ 1,512	$ 263,036
Walls - Flow Meter Vault	26	CY	$ 1,032	$ 26,829	$ 1,512	$ 39,304
Elevated Slab - Flow Meter Vault (Roof)	10	CY	$ 1,225	$ 12,255	$ 1,795	$ 17,953
Slab on grade/footings - PS Main Operation Area	114	CY	$ 631	$ 71,913	$ 924	$ 105,352
Slab on grade/footings - Flow meter vault	10	CY	$ 631	$ 6,308	$ 924	$ 9,241
Elevated Slab - Pump Station Operation area	118	CY	$ 1,225	$ 144,606	$ 1,795	$ 211,847
Elevated Slab - Wet well	463	CY	$ 1,225	$ 567,395	$ 1,795	$ 831,231
Suspended Slab - Pump Area	190	CY	$ 1,225	$ 232,840	$ 1,795	$ 341,110
Slab on grade - Flow meter vault	10	CY	$ 631	$ 6,308	$ 924	$ 9,241
Suspended Slab - Operating Area	402	CY	$ 1,225	$ 492,641	$ 1,795	$ 721,716
Division 3 Concrete				***$ 3,955,045***		***$ 5,794,116***
Division 4 Masonry						
12" CMU	8,650	SF	$ 16	$ 138,882	$ 24	$ 203,461
6" CMU	850	SF	$ 9	$ 7,356	$ 13	$ 10,777
Division 4 Masonry				***$ 146,238***		***$ 214,238***
Division 5 Metals						
Structural Steel	7	TON	$ 4,218	$ 29,529	$ 6,180	$ 43,260
Miscellaneous steel members	1	TON	$ 4,218	$ 4,218	$ 6,180	$ 6,180
Metal decking	12,200	SF	$ 10	$ 127,661	$ 15	$ 187,022
Standing seam roof	12,200	SF	$ 11	$ 140,294	$ 17	$ 205,530
Guard post	15	EA	$ 491	$ 7,358	$ 719	$ 10,779
Guardrail	460	LF	$ 77	$ 35,549	$ 113	$ 52,079
Hatch, 5'x5'	1	EA	$ 4,308	$ 4,308	$ 6,311	$ 6,311
Division 5 Metals				***$ 348,917***		***$ 511,161***
Division 7 Thermal and Moisture Protection						

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Roof insulation	12,200	SF	$ 3	$ 31,649	$ 4	$ 46,366
Wall insulation	850	SF	$ 2	$ 1,723	$ 3	$ 2,525
Division 7 Thermal and Moisture Protection				***$ 33,373***		***$ 48,891***
Division 8 Openings						
Hollow metal (with security hardware)	600	SF	$ 109	$ 65,400	$ 160	$ 95,811
Roll-up door with motor	1	EA	$ 3,931	$ 3,931	$ 5,759	$ 5,759
Covers for slab openings	116	SF	$ 55	$ 6,322	$ 80	$ 9,262
Division 8 Openings				***$ 75,653***		***$ 110,832***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,890	$ 55,890
Division 9 Finishes				***$ 38,150***		***$ 55,890***
Division 10 Specialties						
Miscellaneous specialties	1	LS	$ 5,450	$ 5,450	$ 7,984	$ 7,984
Division 10 Specialties				***$ 5,450***		***$ 7,984***
Division 14 Conveying Systems						
Bridge Crane (15 ton)	1	EA	$ 74,405	$ 74,405	$ 109,003	$ 109,003
Division 14 Conveying Systems				***$ 74,405***		***$ 109,003***
Division 22 Plumbing						
Plumbing	1	LS	$ 27,250	$ 27,250	$ 39,921	$ 39,921
Division 22 Plumbing				***$ 27,250***		***$ 39,921***
Division 23 HVAC						
HVAC	1	LS	$ 109,000	$ 109,000	$ 159,684	$ 159,684
Division 23 HVAC				***$ 109,000***		***$ 159,684***
Division 26 Electrical						
Sitework	1	LS	$ 872,000	$ 872,000	$ 1,277,474	$ 1,277,474
Pumping station	1	LS	$ 656,180	$ 656,180	$ 961,299	$ 961,299
VFD's - 5,500 hp	4	EA	$ 1,079,100	$ 4,316,400	$ 1,580,875	$ 6,323,498
VFD's - 800 hp	4	EA	$ 156,960	$ 627,840	$ 229,945	$ 919,782
Division 26 Electrical				***$ 6,472,420***		***$ 9,482,054***
Division 40 Process Interconnections						
Process Piping						
42" STL Discharge Pipe	40	LF	$ 294	$ 11,774	$ 431	$ 17,249
36" STL Discharge Pipe	10	LF	$ 252	$ 2,517	$ 369	$ 3,687
18" STL Discharge Pipe	40	LF	$ 128	$ 5,120	$ 188	$ 7,500
16" STL Discharge Pipe	10	LF	$ 117	$ 1,171	$ 172	$ 1,715
42"x36" STL Reducer	4	EA	$ 18,312	$ 73,248	$ 26,827	$ 107,308
18"x16" STL Reducer	4	EA	$ 2,671	$ 10,682	$ 3,912	$ 15,649
Conc Pipe Supports	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,162
Conc Valve Support	8	EA	$ 1,635	$ 13,080	$ 2,395	$ 19,162
Valves						
42" Butterfly Valves, w/ elect actuator	4	EA	$ 33,678	$ 134,712	$ 49,338	$ 197,353
18" Butterfly Valves, w/ elect actuator	4	EA	$ 10,817	$ 43,268	$ 15,847	$ 63,388
42" Ball Valve, w/ elect actuator	4	EA	$ 77,278	$ 309,112	$ 113,212	$ 452,848
18" Ball Valve, w/ elect actuator	4	EA	$ 35,380	$ 141,521	$ 51,832	$ 207,327
42" Dismantling Joint	4	EA	$ 10,397	$ 41,587	$ 15,231	$ 60,925
36" Dismantling Joint	4	EA	$ 8,566	$ 34,265	$ 12,549	$ 50,198
18" Dismantling Joint	4	EA	$ 3,640	$ 14,559	$ 5,332	$ 21,329
16" Dismantling Joint	4	EA	$ 3,204	$ 12,815	$ 4,694	$ 18,774
8" Combination Air Valve	4	EA	$ 3,734	$ 14,937	$ 5,471	$ 21,883
4" Combination Air Valve	4	EA	$ 2,644	$ 10,577	$ 3,874	$ 15,495
8" Air Valve/Air Vacuum	4	EA	$ 5,424	$ 21,695	$ 7,946	$ 31,783
4" Air Valve/Air Vacuum	6	EA	$ 2,971	$ 17,828	$ 4,353	$ 26,117
42" Double Door Check Valve	4	EA	$ 49,047	$ 196,188	$ 71,854	$ 287,415
18" Double Door Check Valve	4	EA	$ 20,992	$ 83,969	$ 30,753	$ 123,014
I&C						
Sitework	1	LS	$ 10,900	$ 10,900	$ 15,968	$ 15,968
Pumping station	1	LS	$ 552,630	$ 552,630	$ 809,599	$ 809,599
Division 40 Process Interconnections				***$ 1,771,236***		***$ 2,594,850***
Division 43 Process Handling and Storage Equipment						
Vertical Turbine pump, High Flow (165 CFS, 340 TDH, 2750 HP)	4	EA	$ 650,900	$ 2,603,600	$ 953,564	$ 3,814,257
Vertical Turbine pump, Low Flow (20 CFS, 96 TDH, 150 HP)	4	EA	$ 102,350	$ 409,400	$ 149,942	$ 599,768
Division 43 Process Handling and Storage Equipment				***$ 3,013,000***		***$ 4,414,026***
McClusky Main Pump Station 2 Subtotal				**$ 18,392,209**		**$ 26,944,468**

Surge Control Building						
Item	**Quantity**	**Unit**	**Raw Unit Price ($)**	**Construction Subtotal ($)**	**Markup Unit Price ($)**	**Grand Total ($)**
Division 2 Site Construction						
Structural excavation - Wet Well	3,414	CY	$ 14	$ 49,269	$ 21	$ 72,179
Compacted Fill	604	CY	$ 26	$ 15,847	$ 38	$ 23,215
Structural fill	400	CY	$ 45	$ 17,893	$ 66	$ 26,214
Division 2 Site Construction				***$ 83,010***		***$ 121,609***
Division 3 Concrete						
Slab on grade/footings - Wet Well	1,572	CY	$ 631	$ 991,642	$ 924	$ 1,452,750
Walls - Wet Well	144	CY	$ 1,032	$ 148,591	$ 1,512	$ 217,685
Division 3 Concrete				***$ 1,140,233***		***$ 1,670,434***
Division 4 Masonry						
12" CMU	13,602	SF	$ 16	$ 218,390	$ 24	$ 319,939
6" CMU	1,236	SF	$ 9	$ 10,697	$ 13	$ 15,671
Division 4 Masonry				***$ 229,087***		***$ 335,611***
Division 5 Metals						
Metal decking	18,568	SF	$ 10	$ 194,296	$ 15	$ 284,642
Standing seam roof	18,568	SF	$ 11	$ 213,523	$ 17	$ 312,809
Division 5 Metals				***$ 407,818***		***$ 597,451***
Division 7 Thermal and Moisture Protection						
Roof insulation	18,568	SF	$ 3	$ 48,169	$ 4	$ 70,567
Wall insulation	14,838	SF	$ 2	$ 30,083	$ 3	$ 44,071
Division 7 Thermal and Moisture Protection				***$ 78,252***		***$ 114,638***
Division 8 Openings						
Hollow metal (with security hardware)	283	SF	$ 109	$ 30,847	$ 160	$ 45,191
Covers for slab openings	900	SF	$ 55	$ 49,050	$ 80	$ 71,858
Division 8 Openings				***$ 79,897***		***$ 117,049***
Division 9 Finishes						
Painting	1	LS	$ 38,150	$ 38,150	$ 55,890	$ 55,890
Division 9 Finishes				***$ 38,150***		***$ 55,890***
Division 22 Plumbing						
Plumbing	1	LS	$ 442,540	$ 442,540	$ 648,318	$ 648,318
Division 22 Plumbing				***$ 442,540***		***$ 648,318***
Division 23 HVAC						
HVAC	1	LS	$ 619,556	$ 619,556	$ 907,646	$ 907,646
Division 23 HVAC				***$ 619,556***		***$ 907,646***
Division 26 Electrical						
Electrical	1	LS	$ 555,900	$ 555,900	$ 814,390	$ 814,390
Surge tank area	1	LS	$ 32,700	$ 32,700	$ 47,905	$ 47,905
Division 26 Electrical				***$ 588,600***		***$ 862,295***
Division 40 Process Interconnections						
Process Piping						
36" STL Discharge Pipe	660	LF	$ 252	$ 166,109	$ 369	$ 243,349
Conc Pipe Supports	30	EA	$ 1,635	$ 49,050	$ 2,395	$ 71,858
SS piping & valves (1-1/2" pipe, valves, level probes)	1	LS	$ 52,320	$ 52,320	$ 76,648	$ 76,648
Valves						
36" Butterfly Valves, w/ elect actuator	12	EA	$ 29,318	$ 351,817	$ 42,951	$ 515,410
8" Combination Air Valve	12	EA	$ 3,734	$ 44,811	$ 5,471	$ 65,648
Instrumentation						
Instrumentation	1	LS	$ 259,420	$ 259,420	$ 380,049	$ 380,049
Surge tank area	1	LS	$ 10,900	$ 10,900	$ 15,968	$ 15,968
Division 40 Process Interconnections				***$ 934,428***		***$ 1,368,931***
Division 43 Process Handling and Storage Equipment						
Compressed air system	3	EA	$ 65,400	$ 196,200	$ 95,811	$ 287,432
Surge Tank	6	EA	$ 130,800	$ 784,800	$ 191,621	$ 1,149,727
Receivers	4	EA	$ 13,080	$ 52,320	$ 19,162	$ 76,648
Division 43 Process Handling and Storage Equipment				***$ 1,033,320***		***$ 1,513,807***
Surge Control Building Subtotal				**$ 5,674,890**		**$ 8,313,678**
Totals				**$ 24,067,000**		**$ 35,258,000**

Mark-Ups

Item	Construction Subtotal	Percent of Total
Construction Subtotal	$ 24,067,000	68.3%
Subcontractor Markups	included in construction subtotal	

Design Allowance			-	0.0%
Direct Cost Subtotal		$	24,067,000	68.3%
Contractor's General Conditions	15.0%	$	3,610,000	10.2%
Contingency	30.0%	$	7,220,000	20.5%
Bonds and Insurance	1.5%	$	361,000	1.0%
Grand Total		**$**	**35,258,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
Hydraulic Break Tanks Location 1 (Alt A&B)
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Hydraulic Break Tank Location 1						
Division 2 Site Construction						
Earthwork						
Structural excavation	27,180	CY	$ 14	$ 392,251	$ 21	$ 574,626
Compacted Fill	71,399	CY	$ 26	$ 1,873,246	$ 38	$ 2,744,202
Gravel fill	1,160	CY	$ 130	$ 150,666	$ 190	$ 220,717
Yard Piping						
72" Steel Pipe	900	LF	$ 584	$ 525,816	$ 856	$ 770,292
48" Steel Pipe	20	LF	$ 296	$ 5,930	$ 434	$ 8,687
36" Steel Pipe	861	LF	$ 217	$ 186,760	$ 318	$ 273,592
Pipe Excavation	677	CY	$ 15	$ 10,043	$ 22	$ 14,713
Pipe Bedding	677	CY	$ 32	$ 21,821	$ 47	$ 31,966
Pipe Backfill	1,793	CY	$ 19	$ 33,381	$ 27	$ 48,901
Compaction	1,793	CY	$ 5	$ 9,049	$ 7	$ 13,256
Spoil Haul off	1,661	CY	$ 14	$ 23,120	$ 20	$ 33,869
60" Butterfly Valves, w/ elect actuator	4	EA	$ 48,326	$ 193,304	$ 70,795	$ 283,179
48" Butterfly Valves, w/ elect actuator	1	EA	$ 36,948	$ 36,948	$ 54,127	$ 54,127
72"x60" reducer	2	EA	$ 26,487	$ 52,974	$ 38,802	$ 77,604
72"x48" reducer	2	EA	$ 23,980	$ 47,960	$ 35,129	$ 70,259
60" dismantling joint	4	EA	$ 11,422	$ 45,687	$ 16,732	$ 66,929
48" dismantling joint	1	EA	$ 9,242	$ 9,242	$ 13,539	$ 13,539
60" Steel Pipe	188	LF	$ 441	$ 82,993	$ 647	$ 121,580
18" dismantling joint	1	EA	$ 3,531	$ 3,531	$ 5,172	$ 5,172
18" Butterfly Valves	2	EA	$ 15,106	$ 30,212	$ 22,130	$ 44,260
14" Cla-Val Pressure Control Valve	1	EA	$ 26,202	$ 26,202	$ 38,384	$ 38,384
Site Improvements						
Property	1	LS	$ 50,000	$ 50,000	$ 73,247	$ 73,247
Division 2 Site Construction				***$ 3,811,133***		***$ 5,583,100***
Division 3 Concrete						
Cast-in-Place Concrete						
Elevated Slab - Vaults	32	CY	$ 631	$ 20,186	$ 924	$ 29,572
Walls - Vaults	40	CY	$ 1,032	$ 41,275	$ 1,512	$ 60,466
Slab on grade/footings - Discharge Structure	8	CY	$ 631	$ 5,047	$ 924	$ 7,393
Walls - Discharge Structure	16	CY	$ 1,032	$ 16,510	$ 1,512	$ 24,186
Precast Concrete						
Prestressed concrete tank (5 mil gal)	2	EA	$ 3,560,567	$ 7,121,134	$ 5,216,034	$ 10,432,069
Division 3 Concrete				***$ 7,204,151***		***$ 10,553,686***
Division 5 Metals						
Access Hatch (72"x72")	5	EA	$ 7,303	$ 36,515	$ 10,698	$ 53,492
Access Hatch (60"x60")	1	EA	$ 5,668	$ 5,668	$ 8,303	$ 8,303
Division 5 Metals				***$ 42,183***		***$ 61,796***
Division 32 Exterior Improvements						
Chain Link Fence	1,868	LF	$ 34	$ 63,160	$ 50	$ 92,527
Entrance Gate	1	EA	$ 7,686	$ 7,686	$ 11,259	$ 11,259
Access Road	11,000	SY	$ 7	$ 78,894	$ 11	$ 115,576
Yard	8,200	SY	$ 7	$ 58,812	$ 11	$ 86,156
Rip-rap	16	CY	$ 114	$ 1,822	$ 167	$ 2,669
Division 32 Exterior Improvements				***$ 210,374***		***$ 308,187***
Totals				**$ 11,268,000**		**$ 16,507,000**

Mark-Ups

Item	Construction Subtotal	Percent of Total
Construction Subtotal	$ 11,268,000	68.3%

Subcontractor Markups	included in construction subtotal			
Design Allowance			-	0.0%
Direct Cost Subtotal		$	11,268,000	68.3%
Contractor's General Conditions	15.0%	$	1,690,000	10.2%
Contingency	30.0%	$	3,380,000	20.5%
Bonds and Insurance	1.5%	$	169,000	1.0%
Grand Total		**$**	**16,507,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
Hydraulic Break Tanks Location 2 (Alt C&E)
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Hydraulic Break Tank Location 2						
Division 2 Site Construction						
Earthwork						
Structural excavation	27,180	CY	$ 14	$ 392,251	$ 21	$ 574,657
Compacted Fill	71,399	CY	$ 26	$ 1,873,246	$ 38	$ 2,744,348
Gravel fill	1,160	CY	$ 130	$ 150,666	$ 190	$ 220,729
Yard Piping						
72" Steel Pipe	900	LF	$ 584	$ 525,816	$ 856	$ 770,333
48" Steel Pipe	20	LF	$ 296	$ 5,930	$ 434	$ 8,687
36" Steel Pipe	861	LF	$ 217	$ 186,760	$ 318	$ 273,607
Pipe Excavation	677	CY	$ 15	$ 10,043	$ 22	$ 14,714
Pipe Bedding	677	CY	$ 32	$ 21,821	$ 47	$ 31,968
Pipe Backfill	1,793	CY	$ 19	$ 33,381	$ 27	$ 48,903
Compaction	1,793	CY	$ 5	$ 9,049	$ 7	$ 13,257
Spoil Haul off	1,661	CY	$ 14	$ 23,120	$ 20	$ 33,871
60" Butterfly Valves, w/ elect actuator	4	EA	$ 48,326	$ 193,304	$ 70,799	$ 283,195
48" Butterfly Valves, w/ elect actuator	1	EA	$ 36,948	$ 36,948	$ 54,130	$ 54,130
72"x60" reducer	2	EA	$ 26,487	$ 52,974	$ 38,804	$ 77,608
72"x48" reducer	2	EA	$ 23,980	$ 47,960	$ 35,131	$ 70,263
60" dismantling joint	4	EA	$ 11,422	$ 45,687	$ 16,733	$ 66,933
48" dismantling joint	1	EA	$ 9,242	$ 9,242	$ 13,539	$ 13,539
60" Steel Pipe	188	LF	$ 441	$ 82,993	$ 647	$ 121,586
18" dismantling joint	1	EA	$ 3,531	$ 3,531	$ 5,173	$ 5,173
18" Butterfly Valves	2	EA	$ 15,106	$ 30,212	$ 22,131	$ 44,262
14" Cla-Val Pressure Control Valve	1	EA	$ 26,202	$ 26,202	$ 38,386	$ 38,386
Site Improvements						
Property	1	LS	$ 75,000	$ 75,000	$ 109,877	$ 109,877
Division 2 Site Construction				***$ 3,836,133***		***$ 5,620,024***
Division 3 Concrete						
Cast-in-Place Concrete						
Elevated Slab - Vaults	32	CY	$ 631	$ 20,186	$ 924	$ 29,573
Walls - Vaults	40	CY	$ 1,032	$ 41,275	$ 1,512	$ 60,469
Slab on grade/footings - Discharge Structure	8	CY	$ 631	$ 5,047	$ 924	$ 7,393
Walls - Discharge Structure	16	CY	$ 1,032	$ 16,510	$ 1,512	$ 24,188
Precast Concrete						
Prestressed concrete tank (5 mil gal)	2	EA	$ 3,560,567	$ 7,121,134	$ 5,216,313	$ 10,432,625
Division 3 Concrete				***$ 7,204,151***		***$ 10,554,249***
Division 5 Metals						
Access Hatch (72"x72")	5	EA	$ 7,303	$ 36,515	$ 10,699	$ 53,495
Access Hatch (60"x60")	1	EA	$ 5,668	$ 5,668	$ 8,304	$ 8,304
Division 5 Metals				***$ 42,183***		***$ 61,799***
Division 32 Exterior Improvements						
Chain Link Fence	1,868	LF	$ 34	$ 63,160	$ 50	$ 92,532
Entrance Gate	1	EA	$ 7,686	$ 7,686	$ 11,259	$ 11,259
Access Drive	2	EA	$ 10,900	$ 21,800	$ 15,969	$ 31,938
Yard	8,200	SY	$ 7	$ 58,812	$ 11	$ 86,161
Rip-rap	16	CY	$ 114	$ 1,822	$ 167	$ 2,669
Division 32 Exterior Improvements				***$ 153,280***		***$ 224,559***
Totals				**$ 11,236,000**		**$ 16,461,000**

Mark-Ups

Item	Construction Subtotal	Percent of Total
Construction Subtotal	$ 11,236,000	68.3%

Subcontractor Markups	included in construction subtotal			
Design Allowance			-	0.0%
Direct Cost Subtotal		$	11,236,000	68.3%
Contractor's General Conditions	15.0%	$	1,685,000	10.2%
Contingency	30.0%	$	3,371,000	20.5%
Bonds and Insurance	1.5%	$	169,000	1.0%
Grand Total		**$**	**16,461,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
Hydraulic Break Tanks Location 3 (Alt D&F)
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Hydraulic Break Tank Location 3						
Division 2 Site Construction						
Earthwork						
Structural excavation	27,180	CY	$ 14	$ 392,251	$ 21	$ 574,676
Compacted Fill	71,399	CY	$ 26	$ 1,873,246	$ 38	$ 2,744,439
Gravel fill	1,160	CY	$ 130	$ 150,666	$ 190	$ 220,736
Yard Piping						
72" Steel Pipe	900	LF	$ 584	$ 525,816	$ 856	$ 770,358
48" Steel Pipe	20	LF	$ 296	$ 5,930	$ 434	$ 8,687
36" Steel Pipe	861	LF	$ 217	$ 186,760	$ 318	$ 273,616
Pipe Excavation	677	CY	$ 15	$ 10,043	$ 22	$ 14,714
Pipe Bedding	677	CY	$ 32	$ 21,821	$ 47	$ 31,969
Pipe Backfill	1,793	CY	$ 19	$ 33,381	$ 27	$ 48,905
Compaction	1,793	CY	$ 5	$ 9,049	$ 7	$ 13,257
Spoil Haul off	1,661	CY	$ 14	$ 23,120	$ 20	$ 33,872
60" Butterfly Valves, w/ elect actuator	4	EA	$ 48,326	$ 193,304	$ 70,801	$ 283,204
48" Butterfly Valves, w/ elect actuator	1	EA	$ 36,948	$ 36,948	$ 54,132	$ 54,132
72"x60" reducer	2	EA	$ 26,487	$ 52,974	$ 38,805	$ 77,611
72"x48" reducer	2	EA	$ 23,980	$ 47,960	$ 35,132	$ 70,265
60" dismantling joint	4	EA	$ 11,422	$ 45,687	$ 16,734	$ 66,935
48" dismantling joint	1	EA	$ 9,242	$ 9,242	$ 13,540	$ 13,540
60" Steel Pipe	188	LF	$ 441	$ 82,993	$ 647	$ 121,590
18" dismantling joint	1	EA	$ 3,531	$ 3,531	$ 5,173	$ 5,173
18" Butterfly Valves	2	EA	$ 15,106	$ 30,212	$ 22,132	$ 44,263
14" Cla-Val Pressure Control Valve	1	EA	$ 26,202	$ 26,202	$ 38,388	$ 38,388
Site Improvements						
Property	1	LS	$ 50,000	$ 50,000	$ 73,254	$ 73,254
Division 2 Site Construction				***$ 3,811,133***		***$ 5,583,583***
Division 3 Concrete						
Cast-in-Place Concrete						
Elevated Slab - Vaults	32	CY	$ 631	$ 20,186	$ 924	$ 29,574
Walls - Vaults	40	CY	$ 1,032	$ 41,275	$ 1,512	$ 60,471
Slab on grade/footings - Discharge Structure	8	CY	$ 631	$ 5,047	$ 924	$ 7,394
Walls - Discharge Structure	16	CY	$ 1,032	$ 16,510	$ 1,512	$ 24,188
Precast Concrete						
Prestressed concrete tank (5 mil gal)	2	EA	$ 3,560,567	$ 7,121,134	$ 5,216,485	$ 10,432,970
Division 3 Concrete				***$ 7,204,151***		***$ 10,554,598***
Division 5 Metals						
Access Hatch (72"x72")	5	EA	$ 7,303	$ 36,515	$ 10,699	$ 53,497
Access Hatch (60"x60")	1	EA	$ 5,668	$ 5,668	$ 8,304	$ 8,304
Division 5 Metals				***$ 42,183***		***$ 61,801***
Division 32 Exterior Improvements						
Chain Link Fence	1,868	LF	$ 34	$ 63,160	$ 50	$ 92,535
Entrance Gate	1	EA	$ 7,686	$ 7,686	$ 11,260	$ 11,260
Access Road	36,670	SY	$ 7	$ 263,005	$ 11	$ 385,321
Yard	8,200	SY	$ 7	$ 58,812	$ 11	$ 86,164
Rip-rap	16	CY	$ 114	$ 1,822	$ 167	$ 2,670
Division 32 Exterior Improvements				***$ 394,485***		***$ 577,948***
Totals				**$ 11,452,000**		**$ 16,778,000**

Mark-Ups

Item	Construction Subtotal	Percent of Total
Construction Subtotal	$ 11,452,000	68.3%

Subcontractor Markups	included in construction subtotal			
Design Allowance			-	0.0%
Direct Cost Subtotal		$	11,452,000	68.3%
Contractor's General Conditions	15.0%	$	1,718,000	10.2%
Contingency	30.0%	$	3,436,000	20.5%
Bonds and Insurance	1.5%	$	172,000	1.0%
Grand Total		**$**	**16,778,000**	100.0%

ENDAWS

Opinion of Probable Construction Cost
Facilities Estimate
Control Valve Structure and Discharge Structure
April 15, 2020

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Sitework						
Division 2 Site Construction						
Site Development	1	LS	$ 1,000,000	$ 1,000,000	$ 1,464,911	$ 1,464,911
Commissioning	1	LS	$ 600,000	$ 600,000	$ 878,946	$ 878,946
Division 2 Site Construction				***$ 1,600,000***		***$ 2,343,857***
Control Valve Structure						
Division 2 Site Construction						
Earthwork						
Structural excavation	14,498	CY	$ 14	$ 209,229	$ 21	$ 306,502
Compacted Fill	6,150	CY	$ 26	$ 161,353	$ 38	$ 236,368
Yard Piping						
72" Steel Pipe	368	LF	$ 554	$ 203,769	$ 811	$ 298,503
48" Steel Pipe	38	LF	$ 290	$ 11,018	$ 425	$ 16,140
36" Steel Pipe	150	LF	$ 198	$ 29,757	$ 291	$ 43,591
Pipe Excavation	1,711	CY	$ 15	$ 25,383	$ 22	$ 37,183
Pipe Bedding	323	CY	$ 32	$ 10,411	$ 47	$ 15,251
Pipe Backfill	952	CY	$ 19	$ 17,724	$ 27	$ 25,963
Compaction	952	CY	$ 5	$ 4,804	$ 7	$ 7,038
Spoil Haul off	759	CY	$ 14	$ 10,565	$ 20	$ 15,476
18" Steel Pipe	100	LF	$ 108	$ 10,791	$ 158	$ 15,808
72"x48" reducer	2	EA	$ 23,980	$ 47,960	$ 35,129	$ 70,257
48" dismantling joint	2	EA	$ 9,242	$ 18,484	$ 13,538	$ 27,077
36" harnessed mechanical coupling	6	EA	$ 6,931	$ 41,587	$ 10,154	$ 60,922
18" harnessed mechanical coupling	4	EA	$ 3,531	$ 14,123	$ 5,172	$ 20,689
48" Butterfly Valves	1	EA	$ 36,948	$ 36,948	$ 54,126	$ 54,126
Pipe Bollard	9	EA	$ 770	$ 6,934	$ 1,129	$ 10,157
72" 45 degree bend	2	EA	$ 38,259	$ 76,518	$ 56,046	$ 112,092
Division 2 Site Construction				***$ 937,357***		***$ 1,373,145***
Division 3 Concrete						
Slab on grade/footings	377	CY	$ 631	$ 237,818	$ 924	$ 348,381
Basement walls	307	CY	$ 1,032	$ 316,788	$ 1,512	$ 464,065
Elevated Slab	10	CY	$ 1,225	$ 12,255	$ 1,795	$ 17,952
Division 3 Concrete				***$ 566,860***		***$ 830,399***
Division 4 Masonry						
8" CMU	7,849	SF	$ 10	$ 77,940	$ 15	$ 114,175
Division 4 Masonry				***$ 77,940***		***$ 114,175***
Division 5 Metals						
Structural Steel	6	TON	$ 4,218	$ 25,311	$ 6,180	$ 37,078
Miscellaneous steel members	2	TON	$ 4,218	$ 8,437	$ 6,180	$ 12,359
Metal decking	2,520	SF	$ 6	$ 15,931	$ 9	$ 23,338
Standing seam roof	2,520	SF	$ 11	$ 28,979	$ 17	$ 42,451
Misc. metals	1	LS	$ 4,905	$ 4,905	$ 7,185	$ 7,185
Stairs	1	LS	$ 38,150	$ 38,150	$ 55,886	$ 55,886
Handrail	32	LF	$ 85	$ 2,717	$ 124	$ 3,980
Division 5 Metals				***$ 124,430***		***$ 182,279***
Division 7 Thermal and Moisture Protection						
Roof insulation	2,520	SF	$ 3	$ 6,537	$ 4	$ 9,577
Wall insulation	7,849	SF	$ 2	$ 15,913	$ 3	$ 23,311
Division 7 Thermal and Moisture Protection				***$ 22,450***		***$ 32,888***
Division 8 Openings						
Hollow metal (with security hardware)	163	SF	$ 109	$ 17,767	$ 160	$ 26,027
Roll-up door with motor	1	EA	$ 3,931	$ 3,931	$ 5,759	$ 5,759
Division 8 Openings				***$ 21,698***		***$ 31,786***

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Division 9 Finishes						
Painting	300	SF	$ 4	$ 1,308	$ 6	$ 1,916
Division 9 Finishes				***$ 1,308***		***$ 1,916***
Division 14 Conveying Systems						
Bridge Crane (5 ton)	1	EA	$ 75,346	$ 75,346	$ 110,376	$ 110,376
Division 14 Conveying Systems				***$ 75,346***		***$ 110,376***
Division 22 Plumbing						
Plumbing	1	LS	$ 9,810	$ 9,810	$ 14,371	$ 14,371
Division 22 Plumbing				***$ 9,810***		***$ 14,371***
Division 23 HVAC						
HVAC	1	LS	$ 38,150	$ 38,150	$ 55,886	$ 55,886
Division 23 HVAC				***$ 38,150***		***$ 55,886***
Division 26 Electrical						
Electrical	1	LS	$ 392,400	$ 392,400	$ 574,831	$ 574,831
48" FM	1	EA	$ 42,899	$ 42,899	$ 62,844	$ 62,844
Division 26 Electrical				***$ 435,299***		***$ 637,675***
Division 32 Exterior Improvements						
Access Road	1,415	SY	$ 7	$ 10,149	$ 11	$ 14,867
Yard	3,013	SY	$ 7	$ 21,610	$ 11	$ 31,656
Chain Link Fence	1,126	LF	$ 34	$ 38,072	$ 50	$ 55,772
Entrance Gate	1	EA	$ 7,686	$ 7,686	$ 11,259	$ 11,259
Division 32 Exterior Improvements				***$ 77,516***		***$ 113,554***
Division 40 Process Interconnections						
Process Piping						
36" Steel Pipe	46	LF	$ 224	$ 10,316	$ 329	$ 15,112
20" Steel Pipe	26	LF	$ 154	$ 4,010	$ 226	$ 5,875
18" Steel Pipe	31	LF	$ 149	$ 4,613	$ 218	$ 6,757
12" Steel Pipe	28	LF	$ 116	$ 3,246	$ 170	$ 4,755
Valves						
20" Sleeve Valve (36" inlet)	3	EA	$ 306,765	$ 920,295	$ 449,383	$ 1,348,150
36" Butterfly Valve	6	EA	$ 25,047	$ 150,280	$ 36,691	$ 220,147
12" Sleeve Valve	2	EA	$ 77,343	$ 154,687	$ 113,301	$ 226,602
18" Butterfly Valve	4	EA	$ 8,539	$ 34,156	$ 12,509	$ 50,035
18" dismantling joint	2	EA	$ 3,116	$ 6,232	$ 4,565	$ 9,130
18"x12" reducer	4	EA	$ 2,725	$ 10,900	$ 3,992	$ 15,968
36" spool	3	EA	$ 3,247	$ 9,740	$ 4,756	$ 14,268
I&C						
Instrumentation	1	LS	$ 183,120	$ 183,120	$ 268,254	$ 268,254
Division 40 Process Interconnections				***$ 1,491,595***		***$ 2,185,054***
Control Valve Structure Subtotal				**$ 3,879,761**		**$ 5,683,502**
Discharge Structure						
Division 2 Site Construction						
Site Work						
Misc. Erosion Control	1	LS	$ 10,900	$ 10,900	$ 15,968	$ 15,968
Strip & Replace top soil	140	CY	$ 11	$ 1,526	$ 16	$ 2,235
Excavation	1600	CY	$ 14	$ 23,091	$ 21	$ 33,826
Concrete Flatwork	185	CY	$ 631	$ 116,701	$ 924	$ 170,956
Riprap	70	CY	$ 123	$ 8,622	$ 180	$ 12,630
Access Gravel+Concrete Subgrade	595	SY	$ 7	$ 4,267	$ 11	$ 6,251
Sheet pile	10400	SF	$ 44	$ 455,140	$ 64	$ 666,740
Sheet pile corrosion coating	4320	SF	$ 12	$ 51,797	$ 18	$ 75,878
Sheet pile cap	290	LF	$ 33	$ 9,483	$ 48	$ 13,892
Seed & erosion control mat	1600	SY	$ 3	$ 5,232	$ 5	$ 7,664
Constricted Site Access	1	LS	$ 218,000	$ 218,000	$ 319,351	$ 319,351
Building						
Flashing and caulking	1	LS	$ 4,142	$ 4,142	$ 6,068	$ 6,068
Painting, walls and mechanical equipment	1	LS	$ 4,905	$ 4,905	$ 7,185	$ 7,185
Miscellaneous metals	1	LS	$ 24,416	$ 24,416	$ 35,767	$ 35,767
Slab on grade/footings	24	CY	$ 631	$ 15,140	$ 924	$ 22,178
Grade Walls	36	CY	$ 1,032	$ 37,148	$ 1,512	$ 54,418
Roof (elevated slab)	8	CY	$ 1,225	$ 9,804	$ 1,795	$ 14,362
Handrail	42	LF	$ 85	$ 3,566	$ 124	$ 5,224
Division 2 Site Construction				***$ 1,003,879***		***$ 1,470,594***

Item	Quantity	Unit	Raw Unit Price ($)	Construction Subtotal ($)	Markup Unit Price ($)	Grand Total ($)
Division 40 Process Interconnections						
Process Piping						
48" HMC	1	EA	$ 4,142	$ 4,142	$ 6,068	$ 6,068
48" tide flex check valve or flap gate	1	EA	$ 33,790	$ 33,790	$ 49,499	$ 49,499
72" Steel Pipe	156	LF	$ 584	$ 91,141	$ 856	$ 133,514
72"x48" reducer	1	EA	$ 23,980	$ 23,980	$ 35,129	$ 35,129
I&C						
Alarms and sensors	1	LS	$ 64,702	$ 64,702	$ 94,783	$ 94,783
Division 40 Process Interconnections				***$ 217,756***		***$ 318,993***
Division 26 Electrical						
Exterior lighting	1	LS	$ 1,831	$ 1,831	$ 2,683	$ 2,683
Transformer and lines	1	LS	$ 97,664	$ 97,664	$ 143,069	$ 143,069
Division 26 Electrical				***$ 99,495***		***$ 145,752***
Discharge Structure Subtotal				**$ 1,321,130**		**$ 1,935,338**
Totals				**$ 5,201,000**		**$ 7,619,000**

Mark-Ups

Item		Construction Subtotal	Percent of Total
Construction Subtotal		$ 5,201,000	68.3%
Subcontractor Markups		included in construction subtotal	
Design Allowance		-	0.0%
Direct Cost Subtotal		$ 5,201,000	68.3%
Contractor's General Conditions	15.0%	$ 780,000	10.2%
Contingency	30.0%	$ 1,560,000	20.5%
Bonds and Insurance	1.5%	$ 78,000	1.0%
Grand Total		**$ 7,619,000**	100.0%