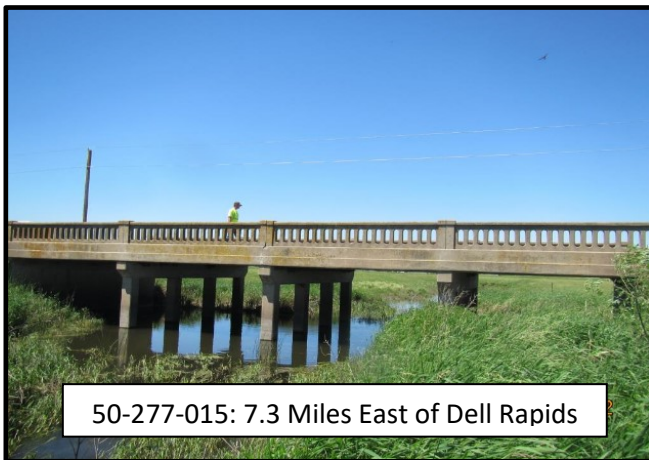
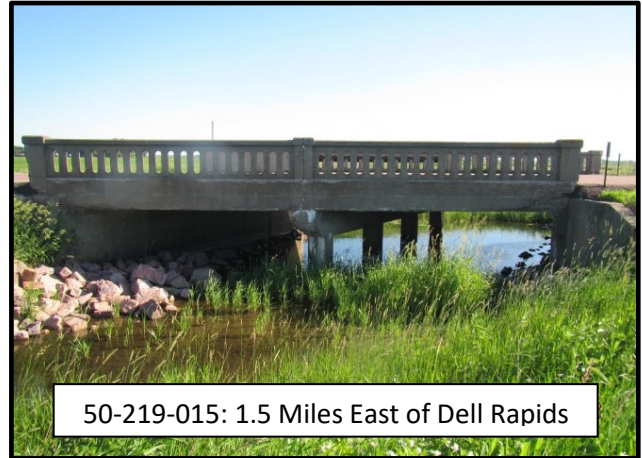
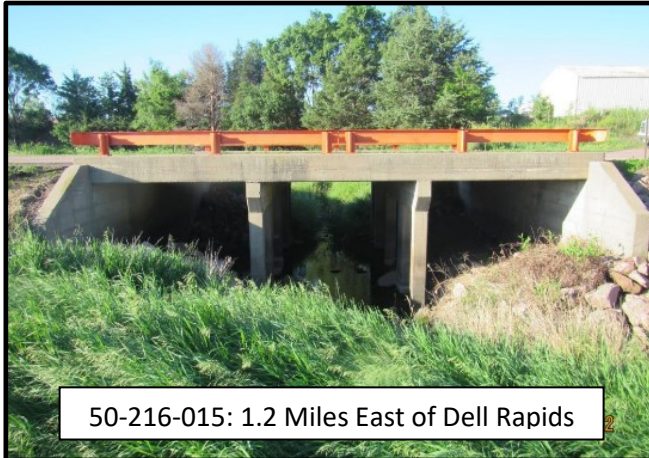


BRIDGE TYPE STUDY

FOR

SRF CONSULTING GROUP, INC.
3701 WAYZATA BOULEVARD, SUITE 100
MINNEAPOLIS, MN 55416

MINNEHAHA COUNTY HIGHWAY DEPARTMENT



STRUCTURES 50-216-015, 50-219-015, 50-277-015 & 50-330-183

CDI PROJECT #2023-038

SEPTEMBER 2023



CIVIL

DESIGN INC Civil Engineers & Land Surveyors

info@civildes.com // www.civildes.com

Bridge Type Study

Structures 50-216-015, 50-219-015, 50-277-015 & 50-330-183

Minnehaha County Highway Department

PE Certification

September 2023

PREPARED BY:

CIVIL DESIGN INC

BROOKINGS, SOUTH DAKOTA

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF SOUTH DAKOTA.



DATE: SEPTEMBER 7, 2023

REGISTRATION No.: 10136

CDI PROJECT #2023-038

BRIDGE TYPE STUDY

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SRF CONSULTING GROUP, INC.
3701 WAYZATA BOULEVARD, SUITE 100
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Structures 50-216-015, 50-219-015, 50-277-015 & 50-330-183

Minnehaha County Highway Department

September 2023

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BRIDGE TYPE STUDY
REPORT FOR 50-216-015

PROJECT DESCRIPTION

Civil Design Inc (CDI) has teamed with SRF Consulting Group, Inc (SRF) to perform a bridge type study for Structure 50-216-015. This 34.0 ft three span continuous concrete bridge was originally constructed in 1922 and reconstructed in 1966 and is reaching the end of its useful life. This structure is currently on the 5-year capital improvement plan & scheduled for future replacement.

The intent of this report is to provide a summary of the existing conditions and present a replacement option based on a one-dimensional hydraulic analysis. An opinion of costs has been provided for budgetary purposes.

SITE LOCATION & ROADWAY CLASSIFICATION

The structure is located in Minnehaha County, South Dakota on Jasper Street (County Highway 104) over an unnamed tributary to the Big Sioux River. The structure is 1.2 miles east of Dell Rapids, SD in accordance with the bridge inspection report. The bridge is 0.4 miles west of the intersection of 476th Avenue and Jasper Street.

Jasper Street is a two-lane, bi-directional, asphalt roadway with a functional classification of Rural Major Collector. The SDDOT Traffic Data website indicates that ADT=870 1.8 miles east of the bridge and ADT=835 0.25 miles west of the bridge. The bridge inspection report notes that the ADT in 2021 was 1,120. Overall, all available data provides confirmation that the ADT is greater than 100 but less than 1,500.

MODELING APPROACH

The site topographic survey included taking cross-sections at predetermined locations. Cross-sections included the channel flowline, stream toes, and overbanks. GeoHECRAS one-dimensional modeling software was utilized to complete an existing conditions model and to compare the results of a proposed structure option. The cross-sections used in the 1D model were placed where the surveyed topo data was available in order to provide the most accurate model utilizing minimal field data. The goal of the analysis was to approximate a replacement structure size needed to meet the design criteria from the SDDOT Drainage Manual and the Minnehaha County Highway Department Project Development & Operations Manual.

A unique feature of this site was the possibility of a channel modification downstream of the structure to allow for future expansion of the L.G. Everest mining operations. The channel modifications would begin approximately 700 feet downstream of 50-216-015. The existing conditions model was modified to include the proposed channel modifications, which resulted in upstream water surface elevations within 0.1-ft of the model that excluded the channel modifications. Therefore, it was assumed that the proposed channel adjustments would have no measurable influences on the water surface elevations at this structure.

DESIGN ELEMENTS**ENVIRONMENTAL CONSIDERATIONS**

- a. Cultural Resource Survey & Categorical Exclusion if Federal Funding is utilized. It is assumed that a Categorical Exclusion would be appropriate but will be determined at a later date.
- b. Wetland delineation and USACE 404 Permit Application (Nationwide Permit No. 14 - Linear Transportation Project)

Bridge Type Study

Structure No. 50-216-015

September 2023

- c. U.S. Army Corps of Engineers (USACE) 2021 Regional Conditions: Box culverts set 1-ft below natural flowline of the stream channel
- d. Submit Notice of Intent to South Dakota Department of Agriculture and Natural Resources (SD DANR)
- e. Verify Topeka Shiner stream and need for temporary diversion channel for fish passage.

ROADWAY ELEMENTS

- a. Function Classification: Rural Major Collector
- b. Horizontal Alignment: Skewed to match the existing channel
- c. Design Speed: 55-mph
- d. Vertical Alignment: Minimum Rate of Vertical Curve (K-Value) = 115
- e. Clear Zone: 15-ft (SDDOT Road Design Manual Table 10-1)
- f. Typical Section: 2-12 ft lanes with 2-ft asphalt shoulders, match existing roadway at project limits; asphalt crowned at 2%; 4:1 fill slopes or less through the clear zone.

GEOTECHNICAL CONSIDERATIONS

A geotechnical investigation will be completed during the preliminary design phase to better determine the extent of shallow bedrock and whether a conventional 4-sided box culvert may be considered or if an alternative structure would need to be considered (rigid frame, 3-sided box, etc.). Civil Design Inc will assist Minnehaha County as needed in determining the Geotechnical Subsurface Investigation requirements for the project prior to initiating final design.

ESTIMATING PEAK FLOW RATES

Peak flows were determined using accepted regional regression equations. See Table 2 for flows utilized in the hydraulic models. No stream gages were found on the unnamed tributary.

Drainage basin areas were determined utilizing USGS online tool StreamStats Version 4.16.0 (<https://streamstats.usgs.gov/ss/>). The StreamStats map of the basin upstream of 50-216-015 is shown in Figure 1. A review of aerial imagery shows several acreages and a small portion of the City of Dell Rapids within the watershed. There are no rural residential developments or other large impervious areas that would be uncharacteristic of rural land use that is typical to the area. The total contributing area at the convergence point of the streams was determined to be 14.1 square miles. At Jasper Street, 8.67 square miles contributes to Structure 50-216-015 and 5.15 square miles contributes to 50-219-015. This results in 62.7% contributing to 50-216-015 and 37.3% contributing to 50-219-015.

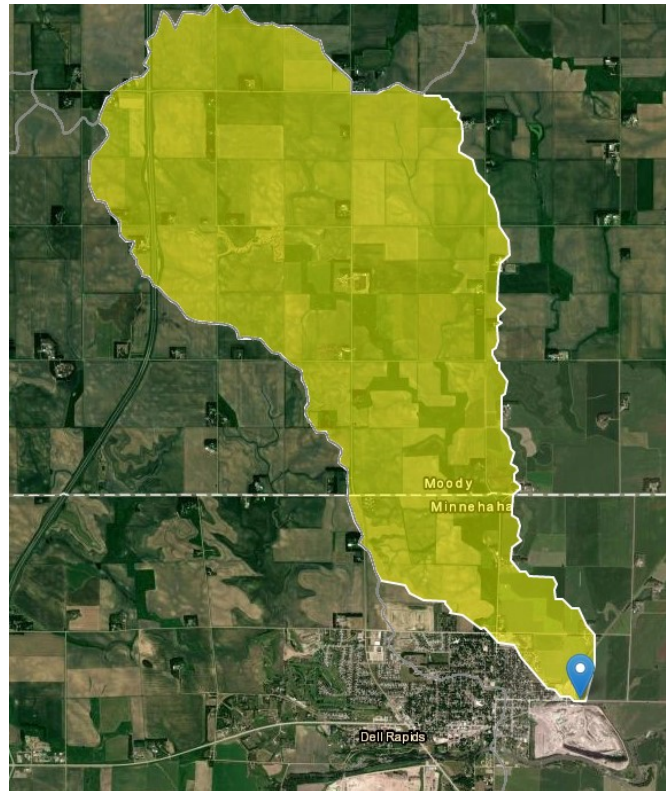


Figure 1: USGS StreamStats Drainage Basin at 50-216-015 (8.67 sq. mi.)

Table 1. Regression Equation Variables and Results (Subregion A)

Flow Return Period (Years)	Regression Equation	Contributing Area (Sq. Mi.)	PII	Calculated Peak Flow Q (cfs)	StreamStats Peak Flow
2	$30.9 CA^{0.513} PII^{6.14}$	14.1	1.14	268	268
5	$85.5 CA^{0.509} PII^{5.45}$	14.1	1.14	672	672
10	$137 CA^{0.510} PII^{5.12}$	14.1	1.14	1,033	1,030
25	$218 CA^{0.513} PII^{4.80}$	14.1	1.14	1,589	1,590
50	$287 CA^{0.517} PII^{4.62}$	14.1	1.14	2,065	2,070
100	$362 CA^{0.521} PII^{4.47}$	14.1	1.14	2,581	2,580
500	$553 CA^{0.531} PII^{4.22}$	14.1	1.14	3,918	3,920

Table 2. Distribution of Flows at Upstream Structures (50-216-015 & 50-219-015)

Flow Return Period (Years)	Drainage Area @ 50-216-015	Peak Flow @ 50-216-015	Drainage Area @ 50-219-015	Peak Flow @ 50-219-015
2	8.67 sq mi (62.7%)	168	5.15 sq mi (37.3%)	100
5	8.67 sq mi (62.7%)	422	5.15 sq mi (37.3%)	250
10	8.67 sq mi (62.7%)	646	5.15 sq mi (37.3%)	384
25	8.67 sq mi (62.7%)	997	5.15 sq mi (37.3%)	593
50	8.67 sq mi (62.7%)	1,299	5.15 sq mi (37.3%)	771
100	8.67 sq mi (62.7%)	1,619	5.15 sq mi (37.3%)	961
500	8.67 sq mi (62.7%)	2,459	5.15 sq mi (37.3%)	1,461

Design & Review Frequency: The design frequency, in accordance with Chapter 7.6.2 of the South Dakota Drainage Manual is the 25-year flood (Local Roads with ADT>100), and the review frequency is the 100-year event. The drainage manual indicates that the allowable design headwater elevation should not exceed 1-ft below the low subgrade shoulder at the lowest point of the roadway.

Section 14.2.3 of the drainage manual discusses freeboard requirements. The drainage manual recommends that replaced bridges have 2-ft of freeboard at the 100-year or match the existing low chord at a minimum. Freeboard is not applicable to the box culvert option presented herein.

Minnehaha County No-Rise Certification: All proposed replacement structures shall not raise the flood elevation from the 100-yr storm event in accordance with the Minnehaha County Highway Department Project Development and Operations Manual. The following is an excerpt from the manual:

No replacement structure shall create a rise in the flood elevation produced by the 100-yr storm (1%-chance storm), or Base Flood Elevation (BFE). To this end, whenever a hydrologic and hydraulic (H&H) analysis is done, including a Type, Size, & Location Study (TS&L), the engineer of record shall certify that their design does not create rise in the BFE.

PROPOSED REPLACEMENT STRUCTURE

With the calculated flows being conducive to a box culvert option and the requirements for scour countermeasures with a bridge option, a cast-in-place box culvert is being presented as the proposed replacement structure. Hydraulic models were compiled for the existing conditions and proposed conditions, and box culvert sizes were analyzed until a structure was found to meet the applicable design criteria. Future structure replacement plans will include the removal of the existing abutments and other substructure components to 1' below the finished ground or to the bottom of the box culvert undercut, whichever is lower, prior to installation of the replacement structure.

2 BARREL 11' X 9' CAST-IN-PLACE CONCRETE BOX CULVERT

Based upon the preliminary hydraulic analysis performed, a 2 barrel 11' x 9' cast-in-place concrete box culvert will meet the design criteria. Barrel widths of 10-ft resulted in an increase in the 100-yr upstream water surface elevation and would not meet the no rise criteria. To align with the stream flowline, a 20° right hand forward (RHF) skew is being proposed. The fill depth from the top of the concrete box culvert to the asphalt roadway shoulder will be approximately 2.7-ft. The proposed profile exceeds the recommended rate of vertical curve for the 55-mph design speed and will approximately match the existing roadway profile. The estimated length of roadway reconstruction to complete the project is 250 lineal feet. Roadway pavement markings and rumble strips will be replaced through the project limits.

In accordance with Chapter 10, Table 10-1 in the SDDOT Road Design Manual, a 15-ft clear zone is required for roadways with AADT from 551 to 1,500. The clear zone area must have recoverable slopes of 4H:1V or flatter.

This proposed option is assuming that the shallow bedrock in the area would be deep enough to accommodate a conventional 4-sided box culvert construction. Geotechnical subsurface investigation will be required to further evaluate the depths of bedrock in the area prior to determining the final replacement structure option. If shallow bedrock is encountered preventing conventional box culvert construction, alternative structures such as a rigid frame bridge span, 3-sided box culvert, or other may be considered.

RIPRAP SIZE AND THICKNESS:

Based on experience with similar projects, SDDOT Class B riprap at a thickness of 2.0 feet is being used for estimating purposes. An apron length of 12-ft is recommended based on the peak outlet velocity. The proposed culvert option does not require a scour analysis.

Table 3: High Water Elevations of Existing and Proposed Option @ 50-216-015

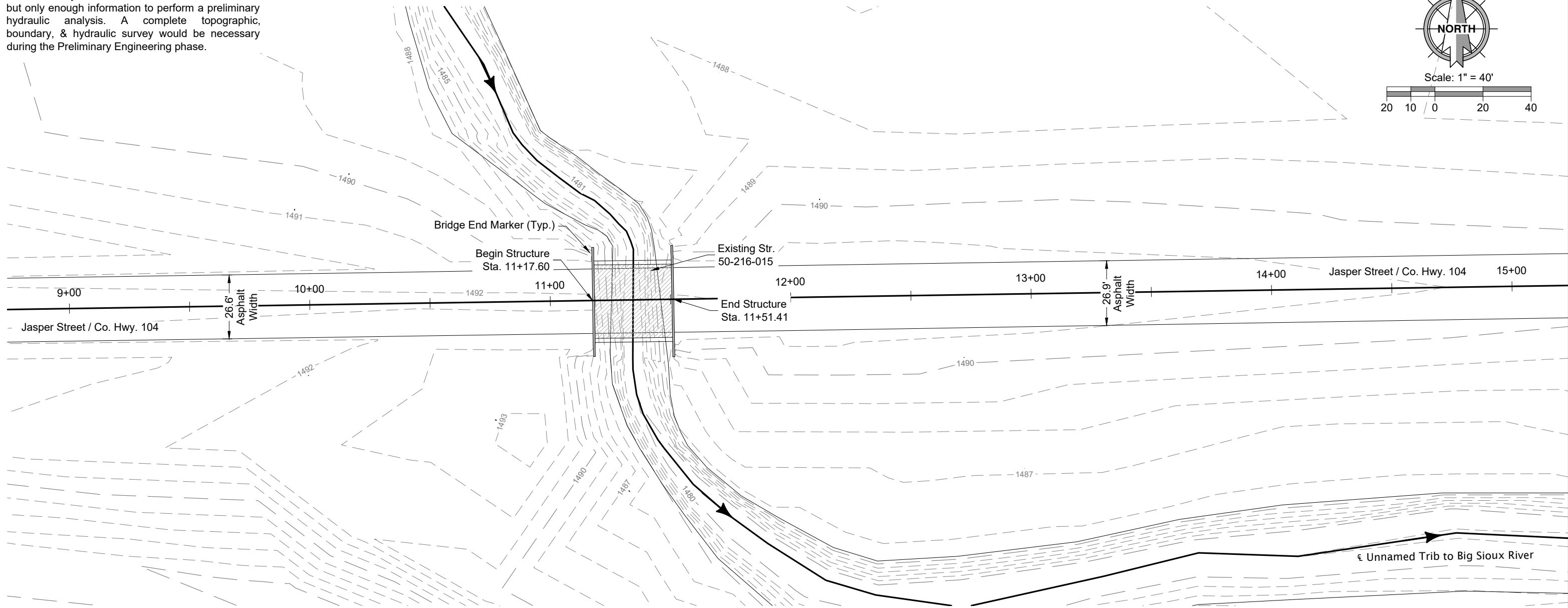
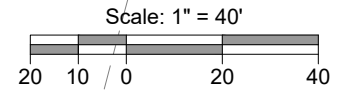
Flow Return Period (Years)	*Peak Flow Q (cfs)	Existing Bridge	2 Cell - 11'x9' CIP Box Culvert
2	168	1484.56	1483.59
5	422	1486.81	1485.52
10	646	1488.00	1486.80
25	997	1489.50	1488.26
50	1,299	1491.36	1489.55
100	1,619	1491.72	1491.05
500	2,459	1492.15	1492.01
Low Chord / Top Inside of Culvert		1490.54	1488.15
100-yr Freeboard		N/A	N/A
Overtopping Flow (cfs)		1,850	1,670
Overtopping Elevation		1486.63	1486.63

**Peak Flows = Calculated peak flows at 50-216-015 using regional regression equations and a steady peak flow distributed based on the ratio of the contributing drainage area. See Table 2.*

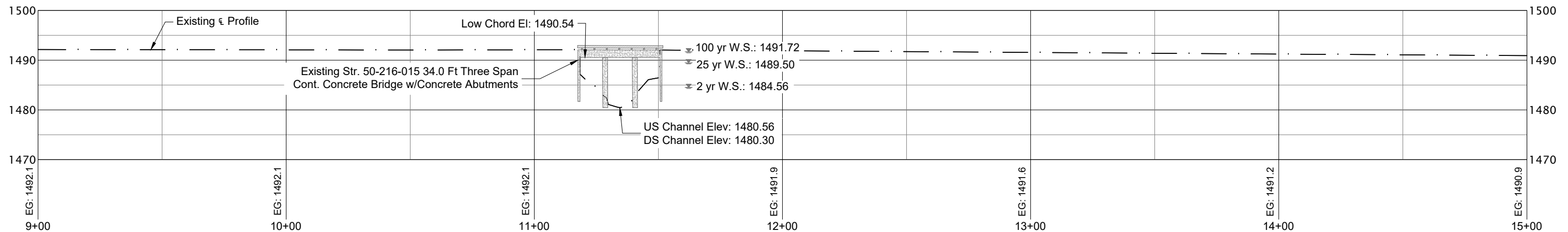
Vertical Datum Used: NAVD 1988

NOTE: Survey does not include all details of the site, but only enough information to perform a preliminary hydraulic analysis. A complete topographic, boundary, & hydraulic survey would be necessary during the Preliminary Engineering phase.

Existing Conditions



Overtopping EL: 1486.63 @ Sta 28+17
Approx. 1,665-ft East of East bridge Abutment



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Minnehaha County - Str. 50-216-015

CAD Filename:
2023-038 Hydraulics

CDI Project No.
2023-038

Drawn By:
CDB

Checked By:
JDP

Scale:
H: 1" = 40'
V: 1" = 20'

Date:
08/16/2023



609 Main Ave S
Brookings, SD
605-696-3200

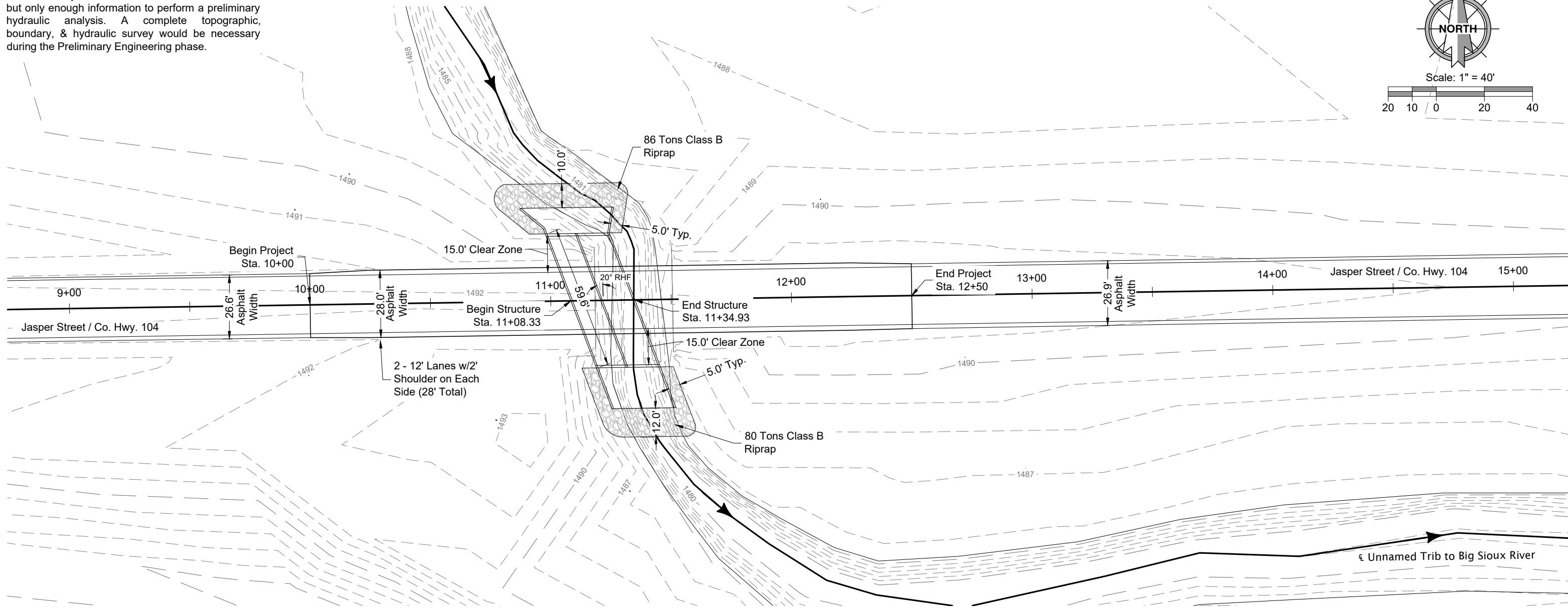
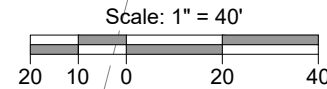
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of No:

Vertical Datum Used: NAVD 1988

NOTE: Survey does not include all details of the site, but only enough information to perform a preliminary hydraulic analysis. A complete topographic, boundary, & hydraulic survey would be necessary during the Preliminary Engineering phase.

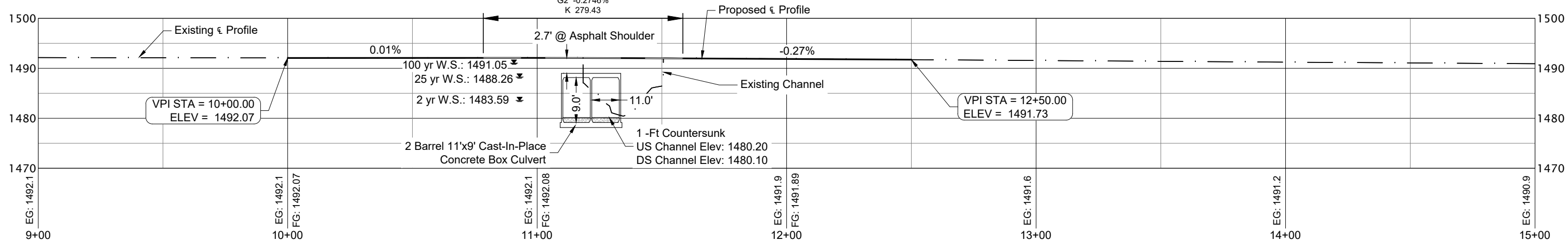
Proposed: 2 Barrel 11'x9' Cast-In-Place Concrete Box Culvert w/20° RHF Skew



PVI 11+18.41
 ELEV 1492.09
 L 80.00
 G1 0.0116%
 G2 -0.2746%
 K 279.43

C.L. Road Profile

Overtopping EL: 1486.63 @ Sta 28+17
 Approx. 1,665-ft East of East bridge Abutment



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MINNEHAHA COUNTY | ENGINEER'S OPINION OF PROBABLE COSTS
Structure No. 50-216-015
Proposed Structure: 2 Barrel 11' X 9' Cast-in-Place Reinforced Concrete Box Culvert w/ 20° RHF Skew

Updated: 8/22/2023



Inflation Percentage = 3.00%

GRADING

BID ITEM NUMBER	SDDOT ITEM NUMBER	DESCRIPTION	BASE BID QUANTITIES	UNIT	CURRENT YEAR 2023		FUTURE YEAR 2028	
					UNIT PRICE	TOTAL BID PRICE	UNIT PRICE	TOTAL BID PRICE
1	009E0010	Mobilization	1	Lump Sum	\$ 65,000.00	\$ 65,000.00	\$ 75,352.81	\$ 75,352.81
2	100E0100	Clearing	1	Lump Sum	\$ 2,500.00	\$ 2,500.00	\$ 2,898.19	\$ 2,898.19
3	110E0600	Remove Fence	150	Ft	\$ 1.50	\$ 225.00	\$ 1.74	\$ 260.84
4	110E1010	Remove Asphalt Concrete Pavement	900	SqYd	\$ 8.00	\$ 7,200.00	\$ 9.27	\$ 8,346.77
5	110E5020	Salvage Traffic Sign	20	Each	\$ 25.00	\$ 500.00	\$ 28.98	\$ 579.64
6	110E5451	Salvage Riprap	100	Ton	\$ 30.00	\$ 3,000.00	\$ 34.78	\$ 3,477.82
7	120E0010	Unclassified Excavation	1200	CuYd	\$ 15.00	\$ 18,000.00	\$ 17.39	\$ 20,866.93
8	120E0600	Contractor Furnished Borrow Excavation	800	CuYd	\$ 25.00	\$ 20,000.00	\$ 28.98	\$ 23,185.48
9	230E0010	Placing Topsoil	250	CuYd	\$ 15.00	\$ 3,750.00	\$ 17.39	\$ 4,347.28
10	260E1010	Base Course	685	Ton	\$ 28.00	\$ 19,180.00	\$ 32.46	\$ 22,234.88
11	320E1200	Asphalt Concrete Composite	340	Ton	\$ 165.00	\$ 56,100.00	\$ 191.28	\$ 65,035.28
12	320E7008	Grind 8" Rumble Strip or Stripe in Asphalt Concrete	0.12	Mile	\$ 16,500.00	\$ 1,980.00	\$ 19,128.02	\$ 2,295.36
13	620E0020	Type 2 Right-of-Way Fence	150	Ft	\$ 12.00	\$ 1,800.00	\$ 13.91	\$ 2,086.69
14	632E2510	Type 2 Object Marker Back to Back	4	Each	\$ 40.00	\$ 160.00	\$ 46.37	\$ 185.48
15	632E3500	Reset Sign	1	Each	\$ 200.00	\$ 200.00	\$ 231.85	\$ 231.85
16	633E1230	High Build Waterborne Pavement Marking Paint, 6" White	600	Ft	\$ 1.00	\$ 600.00	\$ 1.16	\$ 695.56
17	633E1232	High Build Waterborne Pavement Marking Paint, 6" Yellow	90	Ft	\$ 1.00	\$ 90.00	\$ 1.16	\$ 104.33
18	634E0110	Traffic Control Signs	300	SqFt	\$ 6.25	\$ 1,875.00	\$ 7.25	\$ 2,173.64
19	634E0120	Traffic Control, Miscellaneous	1	Lump Sum	\$ 5,000.00	\$ 5,000.00	\$ 5,796.37	\$ 5,796.37
20	634E0275	Type 3 Barricade	10	Each	\$ 150.00	\$ 1,500.00	\$ 173.89	\$ 1,738.91
21	734E0010	Erosion Control	1	Lump Sum	\$ 6,000.00	\$ 6,000.00	\$ 6,955.64	\$ 6,955.64
22	734E0103	Type 3 Erosion Control Blanket	500	SqYd	\$ 4.00	\$ 2,000.00	\$ 4.64	\$ 2,318.55
23	734E0154	12" Diameter Erosion Control Wattle	160	Ft	\$ 4.50	\$ 720.00	\$ 5.22	\$ 834.68
24	734E0604	High Flow Silt Fence	600	Ft	\$ 4.50	\$ 2,700.00	\$ 5.22	\$ 3,130.04
25	734E0900	Temporary Diversion Channel for Fish Passage	1	Each	\$ 17,000.00	\$ 17,000.00	\$ 19,707.66	\$ 19,707.66
26	734E5005	Dewatering	1	Lump Sum	\$ 10,000.00	\$ 10,000.00	\$ 11,592.74	\$ 11,592.74
27	SPECIAL	SW Approach Culvert Work (Tie-into Box)	1	Lump Sum	\$ 7,500.00	\$ 7,500.00	\$ 8,694.56	\$ 8,694.56
28	900E1310	Concrete Washout Facility	1	Each	\$ 1,000.00	\$ 1,000.00	\$ 1,159.27	\$ 1,159.27
SUBTOTAL (GRADING) =					\$ 255,580.00		\$ 296,287.27	

STRUCTURE

BID ITEM NUMBER	SDDOT ITEM NUMBER	DESCRIPTION	BASE BID QUANTITIES	UNIT	CURRENT YEAR 2023		FUTURE YEAR 2028	
					UNIT PRICE	TOTAL BID PRICE	UNIT PRICE	TOTAL BID PRICE
29	250E0030	Incidental Work, Structure	1	Lump Sum	\$ 40,000.00	\$ 40,000.00	\$ 46,370.96	\$ 46,370.96
30	420E0200	Structure Excavation, Box Culvert	130	CuYd	\$ 75.00	\$ 9,750.00	\$ 86.95	\$ 11,302.92
31	421E0200	Box Culvert Undercut	220	CuYd	\$ 150.00	\$ 33,000.00	\$ 173.89	\$ 38,256.04
32	460E0120	Class A45 Concrete, Box Culvert	210	CuYd	\$ 1,000.00	\$ 210,000.00	\$ 1,159.27	\$ 243,447.56
33	480E0100	Reinforcing Steel	27,500	Lb	\$ 5.00	\$ 137,500.00	\$ 5.80	\$ 159,400.19
34	700E0210	Class B Riprap	170	Ton	\$ 55.00	\$ 9,350.00	\$ 63.76	\$ 10,839.21
35	831E0110	Type B Drainage Fabric	235	SqYd	\$ 5.00	\$ 1,175.00	\$ 5.80	\$ 1,362.15
36	831E0300	Reinforcement Fabric (MSE)	320	SqYd	\$ 6.00	\$ 1,920.00	\$ 6.96	\$ 2,225.81
SUBTOTAL (STRUCTURE) =					\$ 442,695.00		\$ 513,204.84	

SUBTOTAL (GRADING + STRUCTURE) = \$ 809,492.10

CONTINGENCY (10%) = \$ 80,949.00

CONSTRUCTION OPINION OF PROBABLE COST = \$ 890,441.10

ENVIRONMENTAL ENGINEERING, WETLAND DELINEATION, CULTURAL RESOURCE, & NEPA (CATEX) = \$ 22,000.00

WETLAND MITIGATION (POTENTIAL) = \$ 35,000.00

PRELIMINARY DESIGN ENGINEERING (HYDRAULICS) = \$ 30,000.00

GEOTECHNICAL SOIL BORINGS & RECOMMENDATIONS = \$ 8,000.00

FINAL DESIGN ENGINEERING (STRUCTURE + GRADING PLANS) + BIDDING = \$ 55,000.00

CONSTRUCTION ENGINEERING = \$ 54,000.00

FISH BIOLOGIST (TOPEKA SHINER REMOVAL) = \$ 4,000.00

QC/QA MATERIAL TESTING = \$ 12,000.00

ENVIRONMENTAL, ENGINEERING, & TESTING TOTAL = \$ 220,000.00

TOTAL ENGINEER'S OPINION OF PROBABLE PROJECT COST = \$ 1,110,441.10

BRIDGE TYPE STUDY
REPORT FOR 50-219-015

PROJECT DESCRIPTION

Civil Design Inc (CDI) has teamed with SRF Consulting Group, Inc (SRF) to perform a bridge type study for Structure 50-219-015. This 36.3 ft two span continuous concrete bridge was originally constructed in 1938 and is reaching the end of its useful life. This structure is currently on the 5-year capital improvement plan & scheduled for future replacement.

The intent of this report is to provide a summary of the existing conditions and present a replacement option based on a one-dimensional hydraulic analysis. An opinion of costs has been provided for budgetary purposes.

SITE LOCATION & ROADWAY CLASSIFICATION

The structure is located in Minnehaha County, South Dakota on Jasper Street (County Highway 104) over an unnamed tributary to the Big Sioux River. The structure is 1.5 miles east of Dell Rapids, SD in accordance with the bridge inspection report. The bridge is 100-ft west of the intersection of 476th Avenue and Jasper Street.

Jasper Street is a two-lane, bi-directional, asphalt roadway with a functional classification of Rural Major Collector. The SDDOT Traffic Data website indicates that ADT=870 1.5 miles east of the bridge and ADT=835 0.6 miles west of the bridge. The bridge inspection report notes that the ADT in 2021 was 1,111. Overall, all available data provides confirmation that the ADT is greater than 100 but less than 1,500.

MODELING APPROACH

The site topographic survey included taking cross-sections at predetermined locations. Cross-sections included the channel flowline, stream toes, and overbanks. GeoHECRAS one-dimensional modeling software was utilized to complete an existing conditions model and to compare the results of a proposed structure option. The cross-sections used in the 1D model were placed where the surveyed topo data was available in order to provide the most accurate model utilizing minimal field data. The goal of the analysis was to approximate a replacement structure size needed to meet the design criteria from the SDDOT Drainage Manual and the Minnehaha County Highway Department Project Development & Operations Manual.

A unique feature of this site was the possibility of a channel modification downstream of the structure to allow for future expansion of the L.G. Everest (LGE) mining operations. The channel modifications would begin downstream of the structure approximately 1,000-ft west of the existing channel centerline and extend east of Structure 50-219-015 another 1,000-ft before turning south to converge with the Big Sioux River. See LGE Channel Realignment plans signed 02/24/2023 by Respec.

The existing conditions model was modified to include the proposed channel modifications. Due to the changes in the channel profile directly downstream of the structure, the water surface elevations were different with the channel modifications included. See summary of results table presented later in this report.

DESIGN ELEMENTS**ENVIRONMENTAL CONSIDERATIONS**

- a. Cultural Resource Survey & Categorical Exclusion if Federal Funding is utilized. It is assumed that a Categorical Exclusion would be appropriate but will be determined at a later date.
- b. Wetland delineation and USACE 404 Permit Application (Nationwide Permit No. 14 - Linear Transportation Project)
- c. U.S. Army Corps of Engineers (USACE) 2021 Regional Conditions: Box culverts set 1-ft below natural flowline of the stream channel
- d. Submit Notice of Intent to South Dakota Department of Agriculture and Natural Resources (SD DANR)
- e. Verify Topeka Shiner stream and need for temporary diversion channel for fish passage.

ROADWAY ELEMENTS

- a. Function Classification: Rural Major Collector
- b. Horizontal Alignment: Skew with the existing or proposed channel
- c. Design Speed: 55-mph
- d. Vertical Alignment: Minimum Rate of Vertical Curve (K-Value) = 115
- e. Clear Zone: 15-ft (SDDOT Road Design Manual Table 10-1)
- f. Typical Section: 2-12 ft lanes with 2-ft asphalt shoulders, match existing roadway at project limits; asphalt crowned at 2%; 4:1 fill slopes or less through the clear zone.

GEOTECHNICAL CONSIDERATIONS

A geotechnical investigation would typically be completed following the Type, Size, & Location (TS&L) meeting and after a replacement structure type has been selected. Civil Design Inc will assist Minnehaha County as needed in determining the Geotechnical Subsurface Investigation requirements for the project prior to initiating final design.

ESTIMATING PEAK FLOW RATES

Peak flows were determined using accepted regional regression equations. See Table 2 for flows utilized in the hydraulic models. No stream gages were found on the unnamed tributary.

The drainage basin areas were determined utilizing USGS online tool StreamStats Version 4.16.0 (<https://streamstats.usgs.gov/ss/>). The StreamStats map of the basin upstream of 50-219-015 is shown in Figure 1. A review of aerial imagery shows several acreages within the watershed. There are no rural residential developments or other large impervious areas that would be uncharacteristic of rural land use that is typical to the area. The total contributing area at the convergence point of the streams was determined to be 14.1 square miles. At Jasper Street, 8.67 square miles contributes to Structure 50-216-015 and 5.15 square miles contributes to 50-219-015. This results in 62.7% contributing to 50-216-015 and 37.3% contributing to 50-219-015.

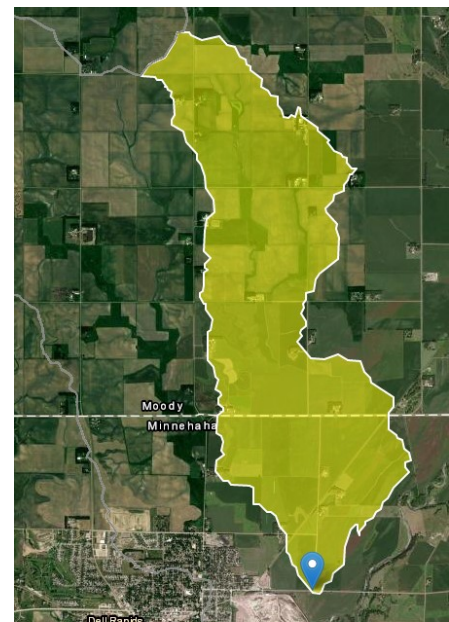


Figure 1: USGS StreamStats Drainage Basin at 50-219-015 (5.15 sq. mi.)

Table 1. Regression Equation Variables and Results (Subregion A)

Flow Return Period (Years)	Regression Equation	Contributing Area (Sq. Mi.)	PII	Calculated Peak Flow Q (cfs)	StreamStats Peak Flow
2	$30.9 CA^{0.513} PII^{6.14}$	14.1	1.14	268	268
5	$85.5 CA^{0.509} PII^{5.45}$	14.1	1.14	672	672
10	$137 CA^{0.510} PII^{5.12}$	14.1	1.14	1,033	1,030
25	$218 CA^{0.513} PII^{4.80}$	14.1	1.14	1,589	1,590
50	$287 CA^{0.517} PII^{4.62}$	14.1	1.14	2,065	2,070
100	$362 CA^{0.521} PII^{4.47}$	14.1	1.14	2,581	2,580
500	$553 CA^{0.531} PII^{4.22}$	14.1	1.14	3,918	3,920

Table 2. Distribution of Flows at Upstream Structures (50-216-015 & 50-219-015)

Flow Return Period (Years)	Drainage Area @ 50-216-015	Peak Flow @ 50-216-015	Drainage Area @ 50-219-015	Peak Flow @ 50-219-015
2	8.67 sq mi (62.7%)	168	5.15 sq mi (37.3%)	100
5	8.67 sq mi (62.7%)	422	5.15 sq mi (37.3%)	250
10	8.67 sq mi (62.7%)	646	5.15 sq mi (37.3%)	384
25	8.67 sq mi (62.7%)	997	5.15 sq mi (37.3%)	593
50	8.67 sq mi (62.7%)	1,299	5.15 sq mi (37.3%)	771
100	8.67 sq mi (62.7%)	1,619	5.15 sq mi (37.3%)	961
500	8.67 sq mi (62.7%)	2,459	5.15 sq mi (37.3%)	1,461

Design & Review Frequency: The design frequency, in accordance with Chapter 7.6.2 of the South Dakota Drainage Manual is the 25-year flood (Local Roads with ADT>100), and the review frequency is the 100-year event. The drainage manual indicates that the allowable design headwater elevation should not exceed 1-ft below the low subgrade shoulder at the lowest point of the roadway.

Section 14.2.3 of the drainage manual discusses freeboard requirements. The drainage manual recommends that replaced bridges have 2-ft of freeboard at the 100-year or match the existing low chord at a minimum. Freeboard is not applicable to the box culvert option presented herein.

Minnehaha County No-Rise Certification: All proposed replacement structures shall not raise the flood elevation from the 100-yr storm event in accordance with the Minnehaha County Highway Department Project Development and Operations Manual. The following is an excerpt from the manual:

No replacement structure shall create a rise in the flood elevation produced by the 100-yr storm (1%-chance storm), or Base Flood Elevation (BFE). To this end, whenever a hydrologic and hydraulic (H&H) analysis is done, including a TS&L, the engineer of record shall certify that their design does not create rise in the BFE.

PROPOSED REPLACEMENT STRUCTURE

With the calculated flows being conducive to a box culvert option and the requirements for scour countermeasures with a bridge option, a cast-in-place box culvert is being presented as the proposed replacement structure. Hydraulic models were compiled for the existing conditions and proposed conditions, and box culvert sizes were analyzed until a structure was found to meet the applicable design criteria. Future structure replacement plans will include the removal of the existing abutments and other substructure components to 1' below the finished ground or to the bottom of the box culvert undercut, whichever is lower, prior to installation of the replacement structure.

3 BARREL 12'X6' CAST-IN-PLACE CONCRETE BOX CULVERT

Based upon the preliminary hydraulic analysis performed, a 3 barrel 12'x6' cast-in-place concrete box culvert will meet the design criteria. Barrel widths of 11-ft resulted in an increase in the 100-yr upstream water surface elevation and would not meet the no rise criteria. Additionally, decreasing the proposed structure size would decrease the flow required to result in roadway overtopping.

The alignment of the structure will be dependent on whether the LGE channel re-alignment project is completed. To match the existing unnamed tributary, a 45° LHF skew is being presented. To more closely align with the LGE channel modifications, a 30° RHF skew would be more appropriate. Additionally, if the alignment is modified, bank and channel protection become more of a concern. The LGE channel modification results in lowering of the channel flowline downstream of 50-219-015. The plans for the channel modifications include a gabion mattress that is toed down around the perimeter. The location of this channel stabilization structure would need to be relocated to align with the new structure. Additional bank protection would need to be provided upstream of the box culvert due to the channel changing direction at the upstream end. See attached exhibits with the LGE channel re-alignment shown.

Regardless of the structure alignment, the fill depth from the top of the concrete box culvert to the asphalt roadway shoulder will be approximately 2.0-ft. The proposed profile exceeds the recommended rate of vertical curve for the 55-mph design speed and will approximately match the existing roadway profile. The estimated length of roadway reconstruction to complete the project is 250 to 300 lineal feet. Roadway pavement markings and rumble strips will be replaced through the project limits.

Overtopping for the existing and proposed option will occur on 476th Avenue prior to overtopping on Jasper St. The overtopping location is approximately 353-ft north at an elevation of 1485.53.

In accordance with Chapter 10, Table 10-1 in the SDDOT Road Design Manual, a 15-ft clear zone is required for roadways with AADT from 551 to 1500. The clear zone area must have recoverable slopes of 4H:1V or flatter.

RIPRAP SIZE AND THICKNESS:

Based on experience with similar projects, SDDOT Class B riprap at a thickness of 2.0 feet is being used for estimating purposes. An apron length of 12-ft is recommended based on the peak outlet velocity. The proposed culvert option does not require a scour analysis.

Table 3: High Water Elevations of Existing and Proposed Option @ 50-219-015

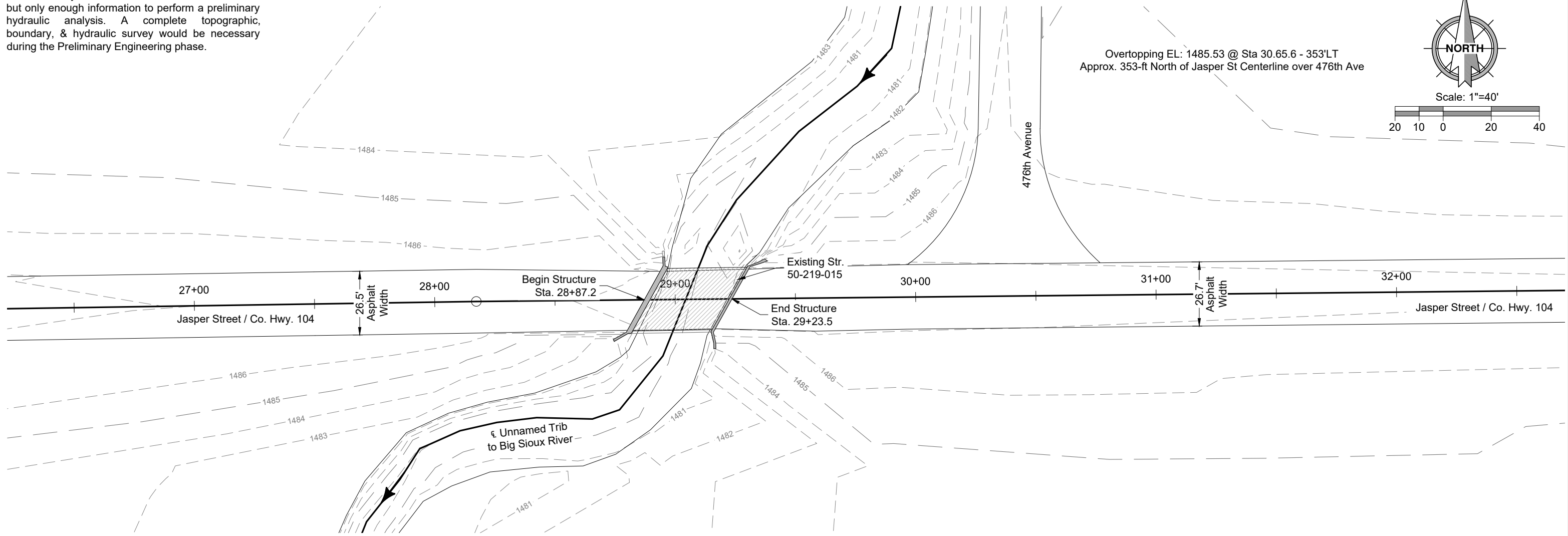
Flow Return Period (Years)	*Peak Flow Q (cfs)	Existing Bridge	3 Cell - 12'x6' CIP Box Culvert	Model Includes LGE Channel Re-alignment Project	
				Existing Bridge	3 Cell - 12'x6' CIP Box Culvert
2	100	1482.55	1481.43	1482.24	1480.58
5	250	1483.62	1482.83	1483.37	1481.98
10	384	1484.16	1483.85	1483.89	1482.87
25	593	1484.67	1484.59	1484.40	1483.99
50	771	1485.09	1485.05	1485.10	1484.88
100	961	1485.61	1485.30	1485.62	1485.60
500	1,461	1485.98	1486.04	1486.55	1486.55
Low Chord / Top Inside of Culvert		1485.24	1484.03	1485.24	1484.03
100-yr Freeboard		None (Pressure)	N/A	N/A	N/A
Overtopping Flow (cfs)		1,380	1,400	1,190	1,160
Overtopping Elevation		1485.53	1485.53	1485.53	1485.53

**Peak Flows = Calculated peak flows at 50-219-015 using regional regression equations and a steady peak flow distributed based on the ratio of the contributing drainage area. See Table 2.*

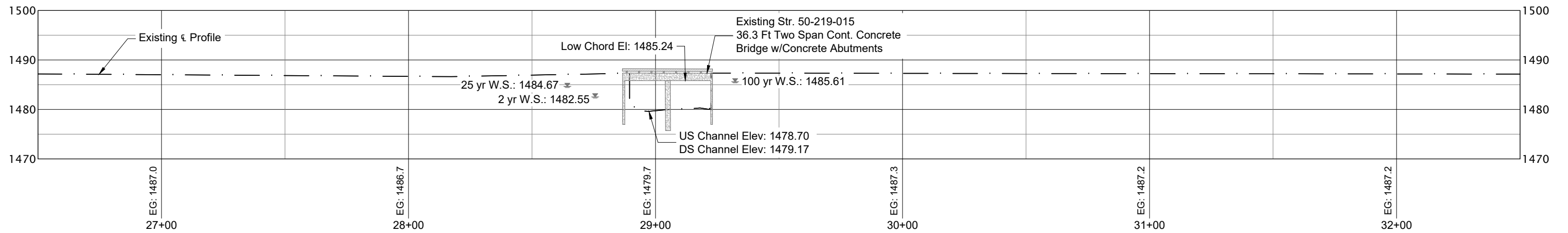
Vertical Datum Used: NAVD 1988

NOTE: Survey does not include all details of the site, but only enough information to perform a preliminary hydraulic analysis. A complete topographic, boundary, & hydraulic survey would be necessary during the Preliminary Engineering phase.

Existing Conditions



C.L. Road Profile



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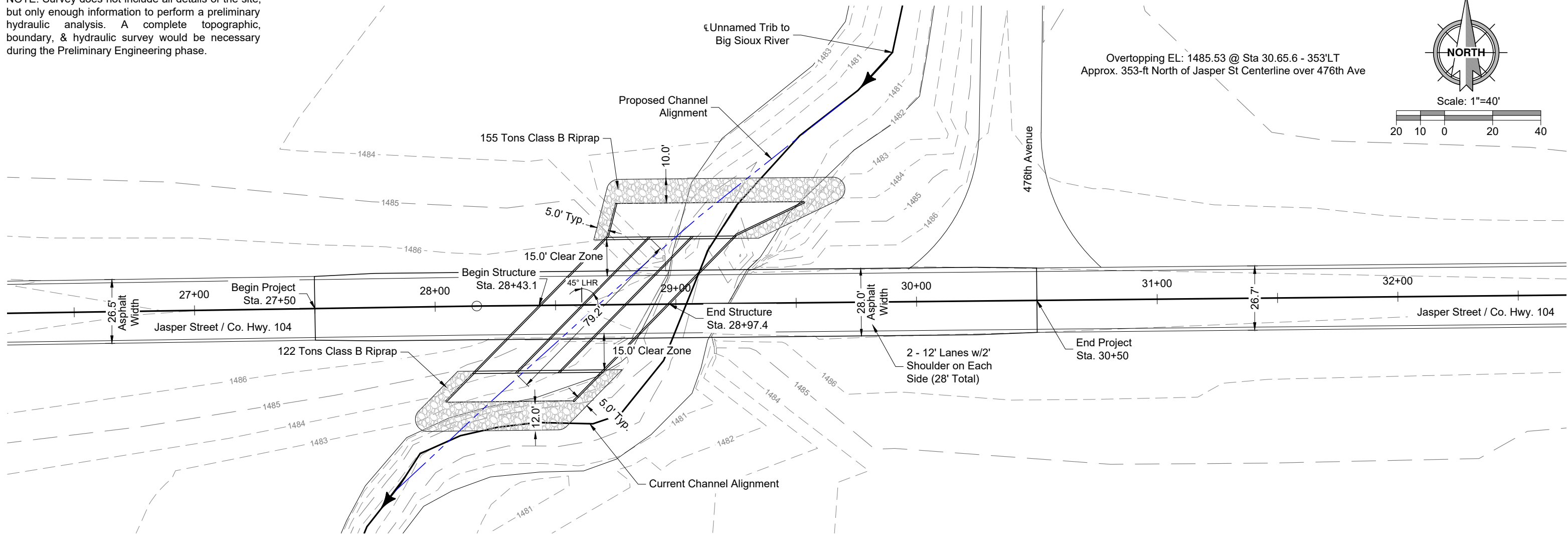
Vertical Datum Used: NAVD 1988

Proposed Option: 3 Barrel 12'x6' Cast-In-Place Concrete Box Culvert w/45° LHF Skew

NOTE: Survey does not include all details of the site, but only enough information to perform a preliminary hydraulic analysis. A complete topographic, boundary, & hydraulic survey would be necessary during the Preliminary Engineering phase.



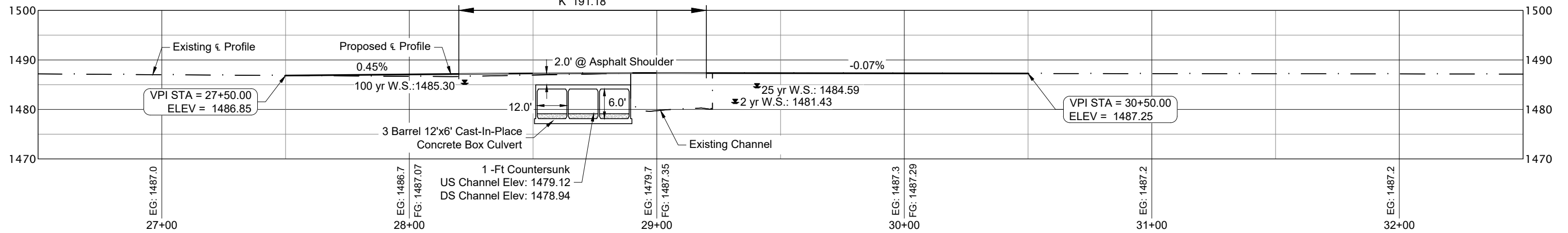
Scale: 1"=40'



Overtopping EL: 1485.53 @ Sta 30.65.6 - 353'LT
Approx. 353-ft North of Jasper St Centerline over 476th Ave

C.L. Road Profile

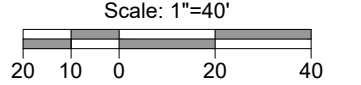
PVI 28+70.00
ELEV 1487.39
L 100.00
G1 0.4500%
G2 -0.0731%
K 191.18



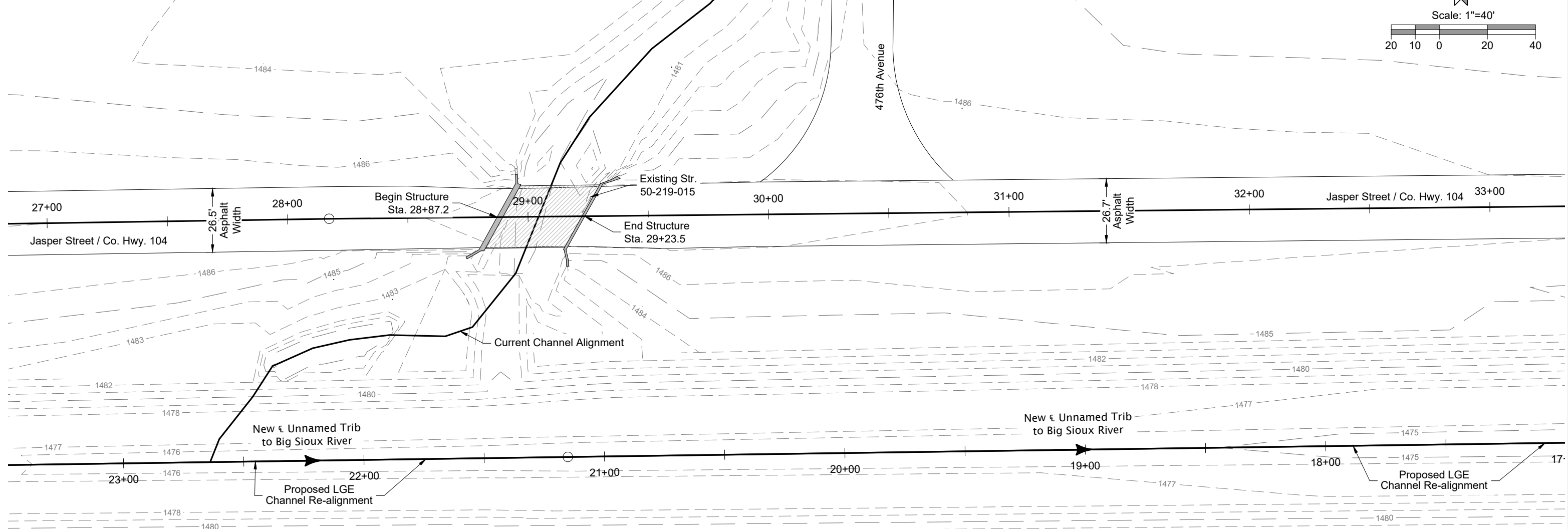
Vertical Datum Used: NAVD 1988

NOTE: Survey does not include all details of the site, but only enough information to perform a preliminary hydraulic analysis. A complete topographic, boundary, & hydraulic survey would be necessary during the Preliminary Engineering phase.

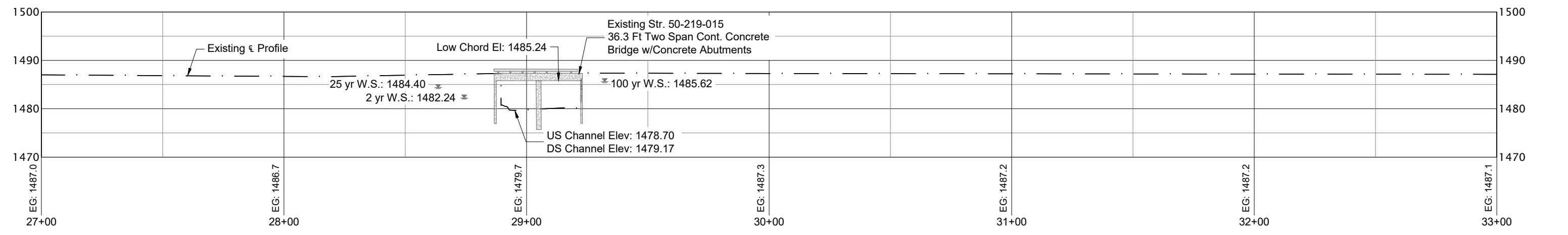
Existing Conditions (Including Proposed LGE Channel Re-Alignment)



Overtopping EL: 1485.53 @ Sta 30.65.6 - 353'LT
Approx. 353-ft North of Jasper St Centerline over 476th Ave



C.L. Road Profile

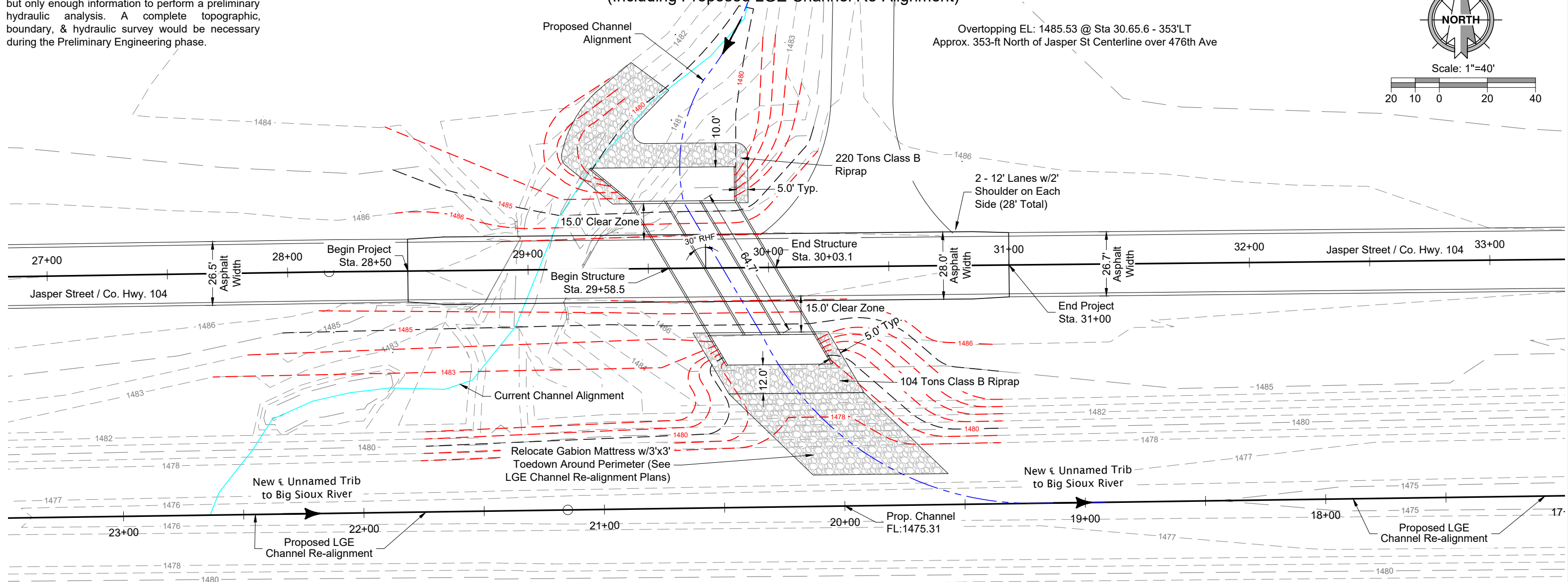
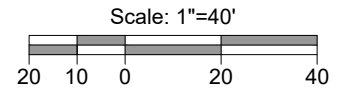


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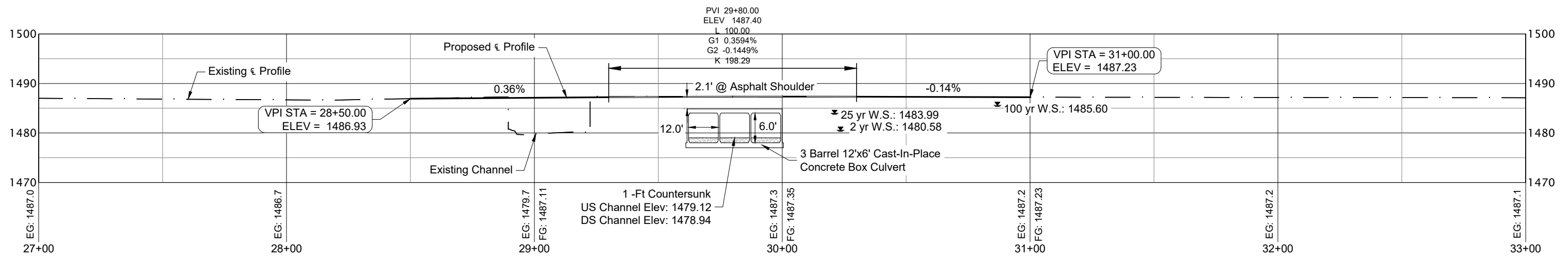
Vertical Datum Used: NAVD 1988

NOTE: Survey does not include all details of the site, but only enough information to perform a preliminary hydraulic analysis. A complete topographic, boundary, & hydraulic survey would be necessary during the Preliminary Engineering phase.

Proposed Option: 3 Barrel 12'x6' Cast-In-Place Concrete Box Culvert w/30° RHF Skew (Including Proposed LGE Channel Re-Alignment)



C.L. Road Profile



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MINNEHAHA COUNTY | ENGINEER'S OPINION OF PROBABLE COSTS
Structure No. 50-219-015
Proposed Structure: 3 Barrel 12' X 6' Cast-in-Place Reinforced Concrete Box Culvert
w/ 45° LHF or 30° RHF Skew

Updated: 8/22/2023



Inflation Percentage = 3.00%

GRADING

BID ITEM NUMBER	SDDOT ITEM NUMBER	DESCRIPTION	BASE BID QUANTITIES	UNIT	CURRENT YEAR 2023		FUTURE YEAR 2028	
					UNIT PRICE	TOTAL BID PRICE	UNIT PRICE	TOTAL BID PRICE
1	009E0010	Mobilization	1	Lump Sum	\$ 75,000.00	\$ 75,000.00	\$ 86,945.56	\$ 86,945.56
2	100E0100	Clearing	1	Lump Sum	\$ 2,000.00	\$ 2,000.00	\$ 2,318.55	\$ 2,318.55
3	110E0600	Remove Fence	0	Ft	\$ 1.50	\$ -	\$ 1.74	\$ -
4	110E1010	Remove Asphalt Concrete Pavement	750	SqYd	\$ 8.00	\$ 6,000.00	\$ 9.27	\$ 6,955.64
5	110E5020	Salvage Traffic Sign	20	Each	\$ 25.00	\$ 500.00	\$ 28.98	\$ 579.64
6	110E5451	Salvage Riprap	50	Ton	\$ 30.00	\$ 1,500.00	\$ 34.78	\$ 1,738.91
7	120E0010	Unclassified Excavation	2500	CuYd	\$ 15.00	\$ 37,500.00	\$ 17.39	\$ 43,472.78
8	120E0600	Contractor Furnished Borrow Excavation	1000	CuYd	\$ 25.00	\$ 25,000.00	\$ 28.98	\$ 28,981.85
9	230E0010	Placing Topsoil	225	CuYd	\$ 15.00	\$ 3,375.00	\$ 17.39	\$ 3,912.55
10	260E1010	Base Course	580	Ton	\$ 28.00	\$ 16,240.00	\$ 32.46	\$ 18,826.61
11	320E1200	Asphalt Concrete Composite	285	Ton	\$ 165.00	\$ 47,025.00	\$ 191.28	\$ 54,514.86
12	320E7008	Grind 8" Rumble Strip or Stripe in Asphalt Concrete	0.10	Mile	\$ 16,500.00	\$ 1,650.00	\$ 19,128.02	\$ 1,912.80
13	620E0020	Type 2 Right-of-Way Fence	0	Ft	\$ 12.00	\$ -	\$ 13.91	\$ -
14	632E2510	Type 2 Object Marker Back to Back	4	Each	\$ 40.00	\$ 160.00	\$ 46.37	\$ 185.48
15	632E3500	Reset Sign	0	Each	\$ 200.00	\$ -	\$ 231.85	\$ -
16	633E1230	High Build Waterborne Pavement Marking Paint, 6" White	500	Ft	\$ 1.00	\$ 500.00	\$ 1.16	\$ 579.64
17	633E1232	High Build Waterborne Pavement Marking Paint, 6" Yellow	70	Ft	\$ 1.00	\$ 70.00	\$ 1.16	\$ 81.15
18	634E0110	Traffic Control Signs	300	SqFt	\$ 6.25	\$ 1,875.00	\$ 7.25	\$ 2,173.64
19	634E0120	Traffic Control, Miscellaneous	1	Lump Sum	\$ 5,000.00	\$ 5,000.00	\$ 5,796.37	\$ 5,796.37
20	634E0275	Type 3 Barricade	10	Each	\$ 150.00	\$ 1,500.00	\$ 173.89	\$ 1,738.91
21	734E0010	Erosion Control	1	Lump Sum	\$ 5,000.00	\$ 5,000.00	\$ 5,796.37	\$ 5,796.37
22	734E0103	Type 3 Erosion Control Blanket	600	SqYd	\$ 4.00	\$ 2,400.00	\$ 4.64	\$ 2,782.26
23	734E0154	12" Diameter Erosion Control Wattle	120	Ft	\$ 4.50	\$ 540.00	\$ 5.22	\$ 626.01
24	734E0604	High Flow Silt Fence	600	Ft	\$ 4.50	\$ 2,700.00	\$ 5.22	\$ 3,130.04
25	734E0900	Temporary Diversion Channel for Fish Passage	1	Each	\$ 15,000.00	\$ 15,000.00	\$ 17,389.11	\$ 17,389.11
26	734E5005	Dewatering	1	Lump Sum	\$ 10,000.00	\$ 10,000.00	\$ 11,592.74	\$ 11,592.74
27	900E1310	Concrete Washout Facility	1	Each	\$ 1,000.00	\$ 1,000.00	\$ 1,159.27	\$ 1,159.27
SUBTOTAL (GRADING) =							\$ 261,535.00	\$ 303,190.75

STRUCTURE

BID ITEM NUMBER	SDDOT ITEM NUMBER	DESCRIPTION	BASE BID QUANTITIES	UNIT	CURRENT YEAR 2023		FUTURE YEAR 2028	
					UNIT PRICE	TOTAL BID PRICE	UNIT PRICE	TOTAL BID PRICE
28	250E0030	Incidental Work, Structure	1	Lump Sum	\$ 40,000.00	\$ 40,000.00	\$ 46,370.96	\$ 46,370.96
29	420E0200	Structure Excavation, Box Culvert	180	CuYd	\$ 75.00	\$ 13,500.00	\$ 86.95	\$ 15,650.20
30	421E0200	Box Culvert Undercut	340	CuYd	\$ 150.00	\$ 51,000.00	\$ 173.89	\$ 59,122.98
31	460E0120	Class A45 Concrete, Box Culvert	275	CuYd	\$ 1,000.00	\$ 275,000.00	\$ 1,159.27	\$ 318,800.37
32	480E0100	Reinforcing Steel	37,000	Lb	\$ 5.00	\$ 185,000.00	\$ 5.80	\$ 214,465.70
33	700E0210	Class B Riprap	325	Ton	\$ 55.00	\$ 17,875.00	\$ 63.76	\$ 20,722.02
34	831E0110	Type B Drainage Fabric	440	SqYd	\$ 5.00	\$ 2,200.00	\$ 5.80	\$ 2,550.40
35	831E0300	Reinforcement Fabric (MSE)	510	SqYd	\$ 6.00	\$ 3,060.00	\$ 6.96	\$ 3,547.38
SUBTOTAL (STRUCTURE) =							\$ 587,635.00	\$ 681,230.02

SUBTOTAL (GRADING + STRUCTURE) = \$ 984,420.77

CONTINGENCY (10%) = \$ 98,442.00

CONSTRUCTION OPINION OF PROBABLE COST = \$ 1,082,862.77

ENVIRONMENTAL ENGINEERING, WETLAND DELINEATION, CULTURAL RESOURCE, & NEPA (CATEX) = \$ 22,000.00

WETLAND MITIGATION (POTENTIAL) = \$ 100,000.00

PRELIMINARY DESIGN ENGINEERING (HYDRAULICS) = \$ 32,000.00

GEOTECHNICAL SOIL BORINGS & RECOMMENDATIONS = \$ 6,500.00

FINAL DESIGN ENGINEERING (STRUCTURE + GRADING PLANS) + BIDDING = \$ 55,000.00

CONSTRUCTION ENGINEERING = \$ 54,000.00

FISH BIOLOGIST (TOPEKA SHINER REMOVAL) = \$ 4,000.00

QC/QA MATERIAL TESTING = \$ 12,000.00

ENVIRONMENTAL, ENGINEERING, & TESTING TOTAL = \$ 285,500.00

TOTAL ENGINEER'S OPINION OF PROBABLE PROJECT COST = \$ 1,368,362.77

BRIDGE TYPE STUDY
REPORT FOR 50-277-015

PROJECT DESCRIPTION

Civil Design Inc (CDI) has teamed with SRF Consulting Group, Inc (SRF) to perform a bridge type study for Structure 50-277-015. This 70.8 ft four span continuous concrete bridge was originally constructed in 1940 and is reaching the end of its useful life. This structure is currently on the 5-year capital improvement plan & scheduled for future replacement.

The intent of this report is to provide a summary of the existing conditions and present a replacement option based on a one-dimensional hydraulic analysis. An opinion of costs has been provided for budgetary purposes.

SITE LOCATION & ROADWAY CLASSIFICATION

The structure is located in Minnehaha County, South Dakota on Jasper Street (County Highway 104) over West Pipestone Creek. The structure is 7.3 miles east of Dell Rapids, SD in accordance with the bridge inspection report. The bridge is 0.3 miles west of the intersection of County Road 113 (482nd Avenue) and Jasper Street.

Jasper Street is a two-lane, bi-directional, asphalt roadway with a functional classification of Rural Major Collector. The SDDOT Traffic Data website indicates that ADT=409 directly east of the bridge and ADT=552 3.4 miles west of the bridge. The bridge inspection report notes that the ADT in 2021 was 506. Overall, all available data provides confirmation that the ADT is greater than 100 but less than 1,500.

MODELING APPROACH

The site topographic survey included taking cross-sections at predetermined locations. Cross-sections included the channel flowline, stream toes, and overbanks. GeoHECRAS one-dimensional modeling software was utilized to complete an existing conditions model and to compare the results of a proposed structure option. The cross-sections used in the 1D model were placed where the surveyed topo data was available in order to provide the most accurate model utilizing minimal field data. The goal of the analysis was to approximate a replacement structure size needed to meet the design criteria from the SDDOT Drainage Manual and the Minnehaha County Highway Department Project Development & Operations Manual.

DESIGN ELEMENTS**ENVIRONMENTAL CONSIDERATIONS**

- a. Cultural Resource Survey & Categorical Exclusion if Federal Funding is utilized. It is assumed that a Categorical Exclusion would be appropriate but will be determined at a later date.
- b. Wetland delineation and USACE 404 Permit Application (Nationwide Permit No. 14 - Linear Transportation Project).
- c. U.S. Army Corps of Engineers (USACE) 2021 Regional Conditions: Box culverts set 1-ft below natural flowline of the stream channel
- d. Submit Notice of Intent to South Dakota Department of Agriculture and Natural Resources (SD DANR)
- e. Verify Topeka Shiner stream and need for temporary diversion channel for fish passage.

ROADWAY ELEMENTS

- a. Function Classification: Rural Major Collector
- b. Horizontal Alignment: 0° Skew to match the existing channel
- c. Design Speed: 55-mph
- d. Vertical Alignment: Minimum Rate of Vertical Curve (K-Value) = 115
- e. Clear Zone: 15-ft (SDDOT Road Design Manual Table 10-1)
- f. Typical Section: 2-12 ft lanes with 2-ft asphalt shoulders, match existing roadway at project limits; asphalt crowned at 2%; 4:1 fill slopes or less through the clear zone.

GEOTECHNICAL CONSIDERATIONS

A geotechnical investigation would typically be completed following the Type, Size, & Location (TS&L) meeting and after a replacement structure type has been selected. Civil Design Inc will assist Minnehaha County as needed in determining the Geotechnical Subsurface Investigation requirements for the project prior to initiating final design.

ESTIMATING PEAK FLOW RATES

Peak flows were determined using accepted regional regression equations. The drainage basin area was determined utilizing USGS online tool StreamStats Version 4.16.0 (<https://streamstats.usgs.gov/ss/>). The StreamStats map of the basin upstream of 50-277-015 is shown in Figure 1. A review of aerial imagery found that the watershed consists of mostly rural agricultural land typical of South Dakota. There are no rural residential developments or other large impervious areas that would be uncharacteristic of rural land use. The contributing area was determined to be 28.12 square miles. There are no stream gages on this branch of West Pipestone Creek. Therefore, the peak flows estimate from the regional regression equations were used in the analysis.

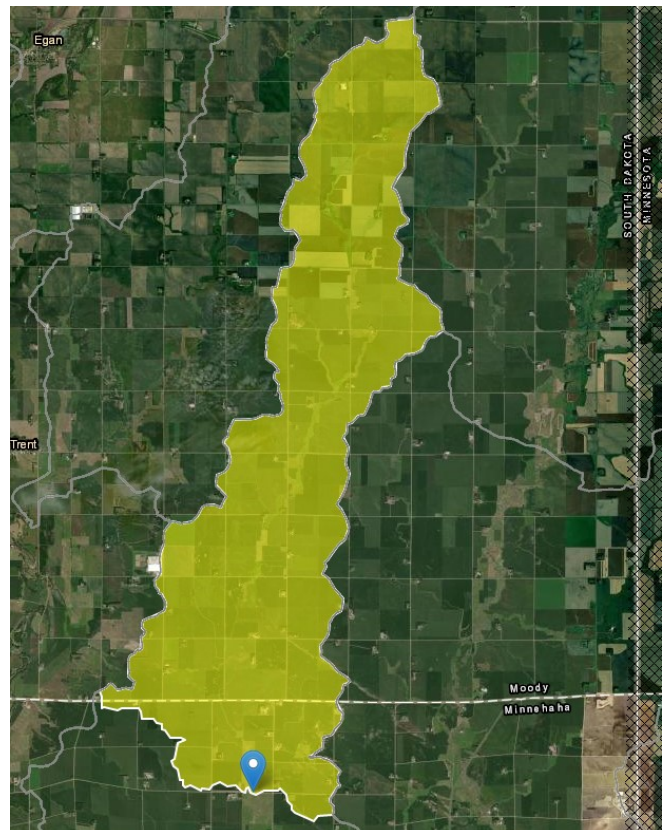


Figure 1: USGS StreamStats Drainage Basin at 50-277-015 (28.12 sq. mi.)

Table 1. Regression Equation Variables and Results (Subregion A)

Flow Return Period (Years)	Regression Equation	Contributing Area (Sq. Mi.)	PII	Calculated Peak Flow Q (cfs)	StreamStats Peak Flow
2	30.9 CA ^{0.513} PII ^{6.14}	28.12	1.16	426	426
5	85.5 CA ^{0.509} PII ^{5.45}	28.12	1.16	1,049	1,050
10	137 CA ^{0.510} PII ^{5.12}	28.12	1.16	1,606	1,610
25	218 CA ^{0.513} PII ^{4.80}	28.12	1.16	2,461	2,460
50	287 CA ^{0.517} PII ^{4.62}	28.12	1.16	3,198	3,200
100	362 CA ^{0.521} PII ^{4.47}	28.12	1.16	3,997	4,000
500	553 CA ^{0.531} PII ^{4.22}	28.12	1.16	6,084	6,080

Design & Review Frequency: The design frequency, in accordance with Chapter 7.6.2 of the South Dakota Drainage Manual is the 25-year flood (Local Roads with ADT>100), and the review frequency is the 100-year event. The drainage manual indicates that the allowable design headwater elevation should not exceed 1-ft below the low subgrade shoulder at the lowest point of the roadway.

Section 14.2.3 of the drainage manual discusses freeboard requirements. The drainage manual recommends that replaced bridges have 2-ft of freeboard at the 100-year or match the existing low chord at a minimum. The existing structure overtops the roadway during a 100-yr flood. Therefore, any proposed replacement bridge option should at least match the existing low chord elevation in accordance with Section 14.2.3. Freeboard is not applicable to the box culvert option presented herein.

Minnehaha County No-Rise Certification: All proposed replacement structures shall not raise the flood elevation from the 100-yr storm event in accordance with the Minnehaha County Highway Department Project Development and Operations Manual. The following is an excerpt from the manual:

No replacement structure shall create a rise in the flood elevation produced by the 100-yr storm (1%-chance storm), or Base Flood Elevation (BFE). To this end, whenever a hydrologic and hydraulic (H&H) analysis is done, including a TS&L, the engineer of record shall certify that their design does not create rise in the BFE.

PROPOSED REPLACEMENT STRUCTURE

The calculated flows are approaching the maximum that is conducive to a box culvert option. However, a berm type bridge option would need to be lengthened when compared to the existing bridge with vertical abutments. For informational purposes, preliminary scour calculations were performed on the existing bridge. Estimated contraction scour for the overtopping flow exceeded 20-ft. Overall, it was anticipated that the length of the bridge to meet the design criteria and to provide for scour protection would result in a box culvert option being the most economical. A box culvert replacement option is being presented.

Hydraulic models were compiled for the existing conditions and proposed conditions, and box culvert sizes were analyzed until a structure was found to meet the applicable design criteria. Future structure replacement plans will include the removal of the existing abutments and other substructure components to 1' below the finished ground or to the bottom of the box culvert undercut, whichever is lower, prior to installation of the replacement structure.

4 BARREL 11' X 9' CAST-IN-PLACE CONCRETE BOX CULVERT

Based upon the preliminary hydraulic analysis performed, a 4 barrel 11' x 9' cast-in-place concrete box culvert will meet the design criteria. Barrel sizes with a 10-ft width resulted in an increase in the 100-yr upstream water surface elevation and would not meet the no rise criteria.

The fill depth from the top of the concrete box culvert to the asphalt roadway shoulder will be approximately 2.3-ft. The proposed profile will approximately match the existing roadway profile and does not require a vertical curve. The estimated length of roadway reconstruction to complete the project is 250 lineal feet. Roadway pavement markings and rumble strips will be replaced through the project limits.

Overtopping for the existing conditions and proposed option will occur at Sta 24+78 or approximately 1,380 feet east of the existing eastern bridge abutment. The overtopping elevation is 1549.71.

In accordance with Chapter 10, Table 10-1 in the SDDOT Road Design Manual, a 15-ft clear zone is required for roadways with AADT from 551 to 1500. The clear zone area must have recoverable slopes of 4H:1V or flatter.

RIPRAP SIZE AND THICKNESS:

Based on experience with similar projects, SDDOT Class B riprap at a thickness of 2.0 feet is being used for estimating purposes. An apron length of 14-ft is recommended based on the peak outlet velocity. The proposed culvert option does not require a scour analysis.

Table 2: High Water Elevations of Existing and Proposed Option @ 50-277-015

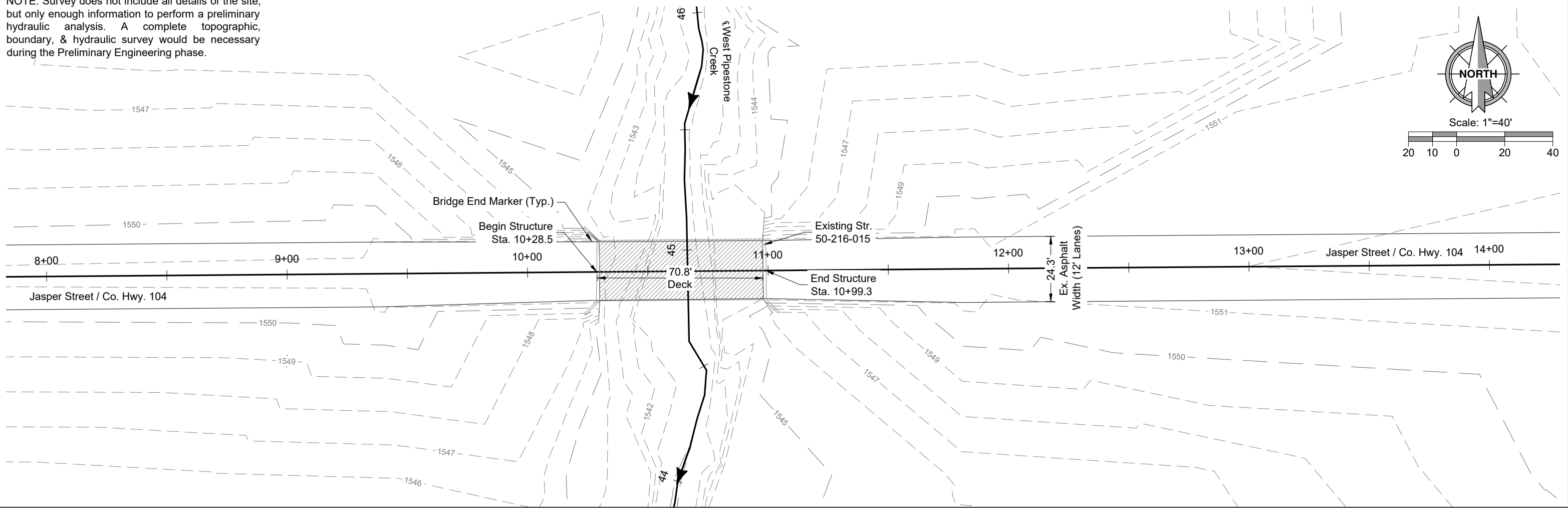
Flow Return Period (Years)	*Peak Flow Q (cfs)	Existing Bridge	4 Cell - 11'x9' CIP Box Culvert
2	426	1546.45	1545.62
5	1,050	1547.49	1546.73
10	1,610	1547.65	1547.41
25	2,460	1548.76	1548.52
50	3,200	1549.79	1549.55
100	4,000	1550.81	1550.40
500	6,080	1551.32	1551.20
Low Chord / Top Inside of Culvert		1550.1	1547.97
100-yr Freeboard		N/A	N/A
Overtopping Flow (cfs)		3,290	3,460
Overtopping Elevation		1549.71	1549.71

*Peak Flows = Calculated peak flows at 50-277-015 using regional regression equations. See Table 1.

Vertical Datum Used: NAVD 1988

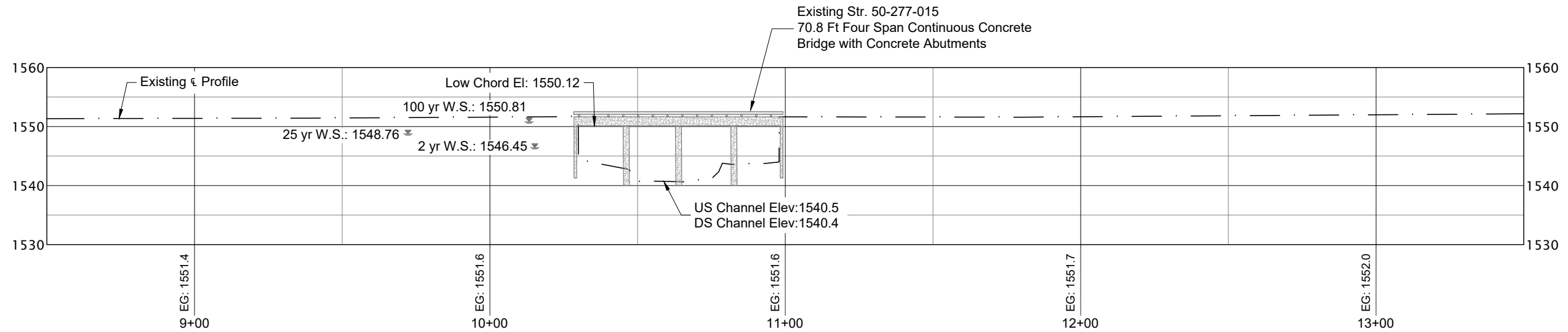
NOTE: Survey does not include all details of the site, but only enough information to perform a preliminary hydraulic analysis. A complete topographic, boundary, & hydraulic survey would be necessary during the Preliminary Engineering phase.

Existing Conditions



Overtopping El: 1549.71 @ Sta 24+78
Approx. 1,380 Ft East of East Bridge Abutment

C.L. Road Profile

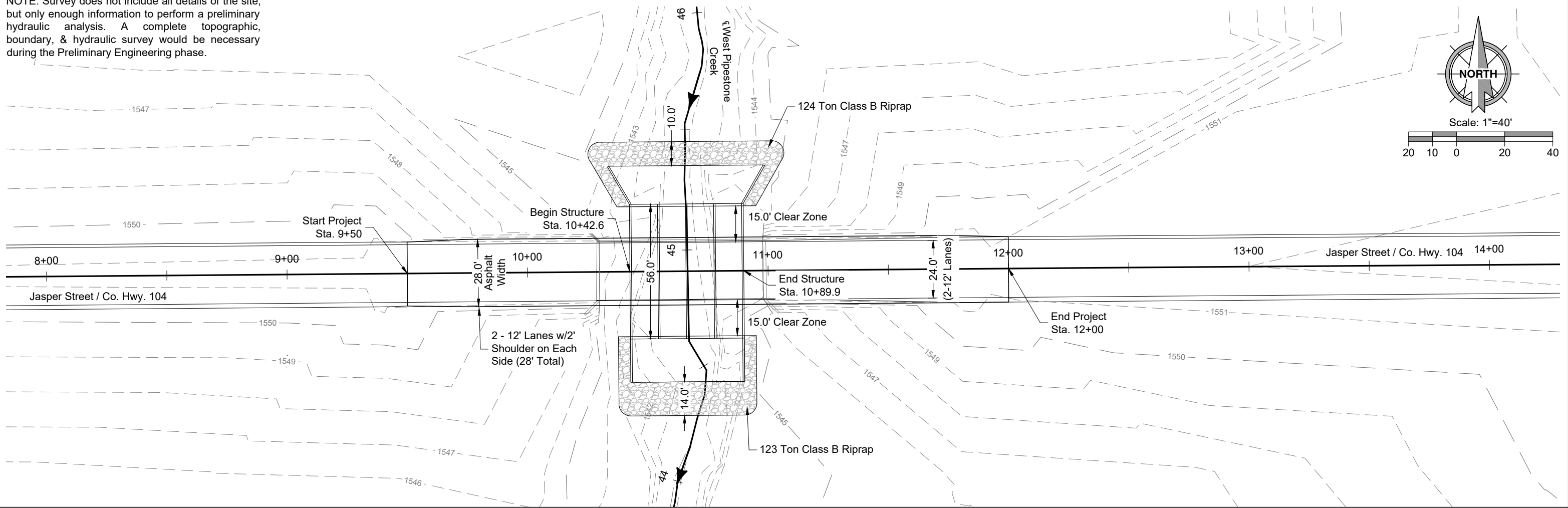


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Vertical Datum Used: NAVD 1988

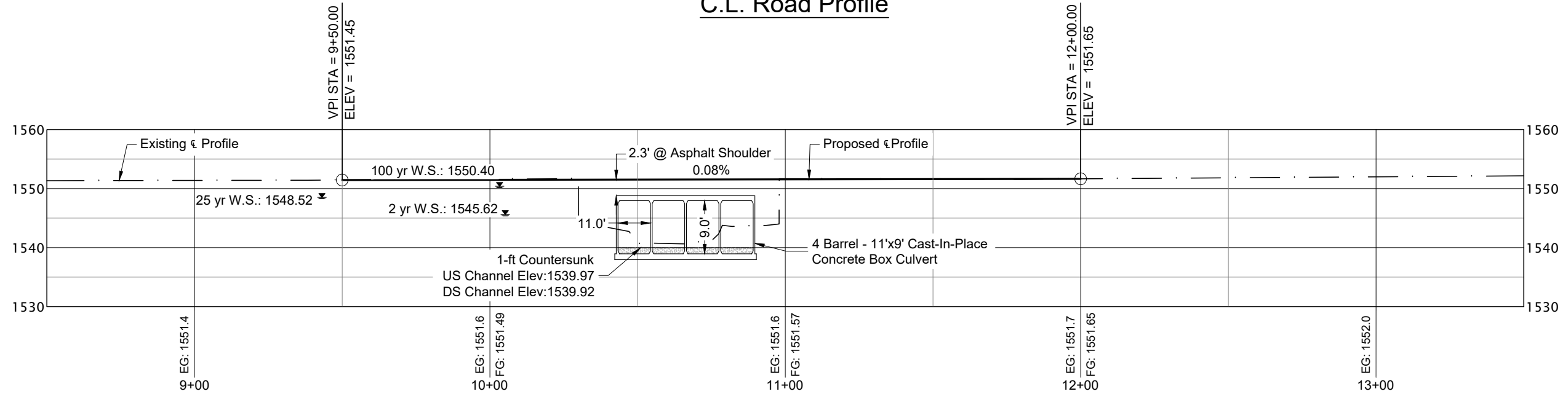
NOTE: Survey does not include all details of the site, but only enough information to perform a preliminary hydraulic analysis. A complete topographic, boundary, & hydraulic survey would be necessary during the Preliminary Engineering phase.

Proposed Option: 4 Barrel 11'x9' Cast-In-Place Concrete Box Culvert



Overtopping El: 1549.71 @ Sta 24+78
Approx. 1,380 Ft East of East Bridge Abutment

C.L. Road Profile



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MINNEHAHA COUNTY | ENGINEER'S OPINION OF PROBABLE COSTS

Structure No. 50-277-015

Proposed Structure: 4 Barrel 11' X 9' Cast-in-Place Reinforced Concrete Box Culvert, No Skew

Updated: 8/22/2023



Inflation Percentage = 3.00%

GRADING

BID ITEM NUMBER	SDDOT ITEM NUMBER	DESCRIPTION	BASE BID QUANTITIES	UNIT	CURRENT YEAR 2023		FUTURE YEAR 2028	
					UNIT PRICE	TOTAL BID PRICE	UNIT PRICE	TOTAL BID PRICE
1	009E0010	Mobilization	1	Lump Sum	\$ 90,000.00	\$ 90,000.00	\$ 104,334.67	\$ 104,334.67
2	100E0100	Clearing	1	Lump Sum	\$ 2,500.00	\$ 2,500.00	\$ 2,898.19	\$ 2,898.19
3	110E0600	Remove Fence	300	Ft	\$ 1.50	\$ 450.00	\$ 1.74	\$ 521.67
4	110E1010	Remove Asphalt Concrete Pavement	675	SqYd	\$ 8.00	\$ 5,400.00	\$ 9.27	\$ 6,260.08
5	110E5020	Salvage Traffic Sign	20	Each	\$ 25.00	\$ 500.00	\$ 28.98	\$ 579.64
6	110E5451	Salvage Riprap	0	Ton	\$ 30.00	\$ -	\$ 34.78	\$ -
7	120E0010	Unclassified Excavation	1500	CuYd	\$ 15.00	\$ 22,500.00	\$ 17.39	\$ 26,083.67
8	120E0600	Contractor Furnished Borrow Excavation	1400	CuYd	\$ 25.00	\$ 35,000.00	\$ 28.98	\$ 40,574.59
9	230E0010	Placing Topsoil	200	CuYd	\$ 15.00	\$ 3,000.00	\$ 17.39	\$ 3,477.82
10	260E1010	Base Course	560	Ton	\$ 28.00	\$ 15,680.00	\$ 32.46	\$ 18,177.42
11	320E1200	Asphalt Concrete Composite	300	Ton	\$ 165.00	\$ 49,500.00	\$ 191.28	\$ 57,384.07
12	320E7008	Grind 8" Rumble Strip or Stripe in Asphalt Concrete	0.10	Mile	\$ 16,500.00	\$ 1,650.00	\$ 19,128.02	\$ 1,912.80
13	620E0020	Type 2 Right-of-Way Fence	300	Ft	\$ 12.00	\$ 3,600.00	\$ 13.91	\$ 4,173.39
14	632E2510	Type 2 Object Marker Back to Back	4	Each	\$ 40.00	\$ 160.00	\$ 46.37	\$ 185.48
15	632E3500	Reset Sign	0	Each	\$ 200.00	\$ -	\$ 231.85	\$ -
16	633E1230	High Build Waterborne Pavement Marking Paint, 6" White	500	Ft	\$ 1.00	\$ 500.00	\$ 1.16	\$ 579.64
17	633E1232	High Build Waterborne Pavement Marking Paint, 6" Yellow	70	Ft	\$ 1.00	\$ 70.00	\$ 1.16	\$ 81.15
18	634E0110	Traffic Control Signs	300	SqFt	\$ 6.25	\$ 1,875.00	\$ 7.25	\$ 2,173.64
19	634E0120	Traffic Control, Miscellaneous	1	Lump Sum	\$ 5,000.00	\$ 5,000.00	\$ 5,796.37	\$ 5,796.37
20	634E0275	Type 3 Barricade	10	Each	\$ 150.00	\$ 1,500.00	\$ 173.89	\$ 1,738.91
21	734E0010	Erosion Control	1	Lump Sum	\$ 6,000.00	\$ 6,000.00	\$ 6,955.64	\$ 6,955.64
22	734E0103	Type 3 Erosion Control Blanket	500	SqYd	\$ 4.00	\$ 2,000.00	\$ 4.64	\$ 2,318.55
23	734E0154	12" Diameter Erosion Control Wattle	120	Ft	\$ 4.50	\$ 540.00	\$ 5.22	\$ 626.01
24	734E0604	High Flow Silt Fence	500	Ft	\$ 4.50	\$ 2,250.00	\$ 5.22	\$ 2,608.37
25	734E0900	Temporary Diversion Channel for Fish Passage	1	Each	\$ 18,000.00	\$ 18,000.00	\$ 20,866.93	\$ 20,866.93
26	734E5005	Dewatering	1	Lump Sum	\$ 10,000.00	\$ 10,000.00	\$ 11,592.74	\$ 11,592.74
27	900E1310	Concrete Washout Facility	1	Each	\$ 1,000.00	\$ 1,000.00	\$ 1,159.27	\$ 1,159.27
SUBTOTAL (GRADING) =							\$ 278,675.00	\$ 323,060.70

STRUCTURE

BID ITEM NUMBER	SDDOT ITEM NUMBER	DESCRIPTION	BASE BID QUANTITIES	UNIT	CURRENT YEAR 2023		FUTURE YEAR 2028	
					UNIT PRICE	TOTAL BID PRICE	UNIT PRICE	TOTAL BID PRICE
28	250E0030	Incidental Work, Structure	1	Lump Sum	\$ 55,000.00	\$ 55,000.00	\$ 63,760.07	\$ 63,760.07
29	420E0200	Structure Excavation, Box Culvert	210	CuYd	\$ 75.00	\$ 15,750.00	\$ 86.95	\$ 18,258.57
30	421E0200	Box Culvert Undercut	383	CuYd	\$ 150.00	\$ 57,450.00	\$ 173.89	\$ 66,600.30
31	460E0120	Class A45 Concrete, Box Culvert	325	CuYd	\$ 1,000.00	\$ 325,000.00	\$ 1,159.27	\$ 376,764.07
32	480E0100	Reinforcing Steel	45,000	Lb	\$ 5.00	\$ 225,000.00	\$ 5.80	\$ 260,836.67
33	700E0210	Class B Riprap	250	Ton	\$ 55.00	\$ 13,750.00	\$ 63.76	\$ 15,940.02
34	831E0110	Type B Drainage Fabric	285	SqYd	\$ 5.00	\$ 1,425.00	\$ 5.80	\$ 1,651.97
35	831E0300	Reinforcement Fabric (MSE)	575	SqYd	\$ 6.00	\$ 3,450.00	\$ 6.96	\$ 3,999.50
SUBTOTAL (STRUCTURE) =							\$ 696,825.00	\$ 807,811.16

SUBTOTAL (GRADING + STRUCTURE) = \$ 1,130,871.86

CONTINGENCY (10%) = \$ 113,087.00

CONSTRUCTION OPINION OF PROBABLE COST = \$ 1,243,958.86

ENVIRONMENTAL ENGINEERING, WETLAND DELINEATION, CULTURAL RESOURCE, & NEPA (CATEX) = \$ 27,000.00

WETLAND MITIGATION (POTENTIAL) = \$ 40,000.00

PRELIMINARY DESIGN ENGINEERING (HYDRAULICS) = \$ 36,000.00

GEOTECHNICAL SOIL BORINGS & RECOMMENDATIONS = \$ 6,500.00

FINAL DESIGN ENGINEERING (STRUCTURE + GRADING PLANS) + BIDDING = \$ 60,000.00

CONSTRUCTION ENGINEERING = \$ 60,000.00

FISH BIOLOGIST (TOPEKA SHINER REMOVAL) = \$ 4,000.00

QC/QA MATERIAL TESTING = \$ 12,000.00

ENVIRONMENTAL, ENGINEERING, & TESTING TOTAL = \$ 245,500.00

TOTAL ENGINEER'S OPINION OF PROBABLE PROJECT COST = \$ 1,489,458.86

BRIDGE TYPE STUDY
REPORT FOR 50-330-183

PROJECT DESCRIPTION

Civil Design Inc (CDI) has teamed with SRF Consulting Group, Inc (SRF) to perform a bridge type study for Structure 50-330-183. This 119.0-ft three span continuous concrete bridge was constructed in 1967 and is reaching the end of its useful life.

The intent of this report is to provide a summary of the existing conditions and present a replacement option based on a one-dimensional hydraulic analysis. An opinion of costs has been provided for budgetary purposes.

SITE LOCATION & ROADWAY CLASSIFICATION

The structure is located in Minnehaha County, South Dakota on 487th Avenue (Co. Hwy. 103) over Beaver Creek. The structure is located in the northwest corner of Valley Springs, SD in accordance with the bridge inspection report. The bridge is 0.16 miles south of the intersection of Aspen Boulevard (Co. Hwy. 138) and 487th Avenue (Co. Hwy. 103)

487th Avenue is a two-lane, bi-directional, asphalt roadway with a functional classification of Rural Minor Collector. The SDDOT Traffic Data website indicates that ADT=725 0.2 miles south of the bridge. The bridge inspection report notes that the ADT in 2021 was 1,802. Overall, all available data provides confirmation that the ADT is greater than 100. The traffic data is inconclusive regarding if the traffic volume is less than 1,500.

MODELING APPROACH

The site topographic survey included taking cross-sections at predetermined locations. Cross-sections included the channel flowline, stream toes, and overbanks. The locations selected included the bounding cross-sections at the structure, 5 cross-sections downstream, and three cross-sections upstream. GeoHECRAS one-dimensional modeling software was utilized to complete an existing conditions model and to compare the results of a proposed structure option. The cross-sections used in the 1D model were placed where the surveyed topo data was available in order to provide the most accurate model utilizing minimal field data. The goal of the analysis was to approximate a replacement structure size needed to meet the design criteria from the SDDOT Drainage Manual and the Minnehaha County Highway Department Project Development & Operations Manual.

DESIGN ELEMENTS**ENVIRONMENTAL CONSIDERATIONS**

- a. Cultural Resource Survey & Categorical Exclusion if Federal Funding is utilized. It is assumed that a Categorical Exclusion would be appropriate but will be determined at a later date.
- b. Wetland delineation and USACE 404 Permit Application (Nationwide Permit No. 14 - Linear Transportation Project).
- c. Submit Notice of Intent to South Dakota Department of Agriculture and Natural Resources (SD DANR)

ROADWAY ELEMENTS

- a. Function Classification: Rural Minor Collector
- b. Horizontal Alignment: 0° Skew to match the existing channel

- c. Design Speed: 30-mph
- d. Vertical Alignment: Minimum Rate of Vertical Curve (K-Value) = 37
- e. Clear Zone: 15-ft or 20-ft depending on final traffic counts (SDDOT Road Design Manual Table 10-1)
- f. Typical Section: 2-12 ft lanes with asphalt widening to meet the new bridge structure; match existing roadway at project limits; asphalt crowned at 2%; 4:1 fill slopes or less through the clear zone.

GEOTECHNICAL CONSIDERATIONS

A geotechnical investigation would typically be completed following the Type, Size, & Location (TS&L) meeting and after a replacement structure type has been selected. Civil Design Inc will assist Minnehaha County as needed in determining the Geotechnical Subsurface Investigation requirements for the project prior to initiating final design.

ESTIMATING PEAK FLOW RATES

Peak flows were found in the effective Flood Insurance Study (FIS Number 46099CV000D, Revised: October 5, 2017 and reprinted with corrections on June 12, 2019). The drainage basin area indicated in the FIS was 106 square miles, and the subbasin area was found to be 104.26 square miles utilizing USGS online tool StreamStats Version 4.16.0 (<https://streamstats.usgs.gov/ss/>). The StreamStats map of the basin upstream of 50-330-183 is shown in Figure 1. A review of aerial imagery found that the watershed consists of mostly rural agricultural land typical of Minnesota and South Dakota. All of Beaver Creek, MN and half of the town of Valley Springs, SD are located in the drainage basin. Both towns are not expected to see significant growth.

As can be seen, a majority of the drainage area lies in Minnesota. Therefore, the regression equations for the State of South Dakota are not applicable. There is a stream gage located onsite. Stream gage 06482745 has only 17 stream flow readings, and there were only 11 readings at the time the peak flow calculations were completed. With the stream gage providing limited data, it was determined that the flows from the FIS are the most acceptable for this analysis.

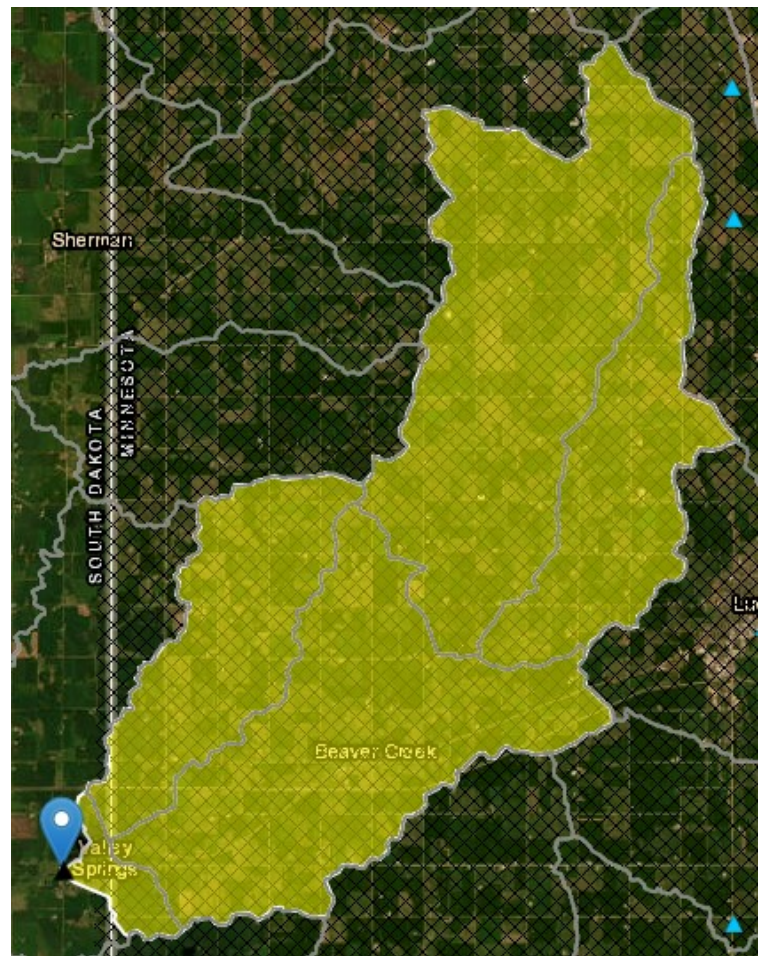


Figure 1: USGS StreamStats Drainage Basin at 50-330-183 (104.26 sq. mi.)

Table 1: Regression Equation Variables and Results (Subregion A)

Flow Return Period (Years)	Regression Equation	Contributing Area (Sq. Mi.)	PII	Calculated Peak Flow Q (cfs)	StreamStats Peak Flow
2	30.9 CA ^{0.513} PII ^{6.14}	104.26	1.20	1,027	1,030
5	85.5 CA ^{0.509} PII ^{5.45}	104.26	1.20	2,459	2,460
10	137 CA ^{0.510} PII ^{5.12}	104.26	1.20	3,727	3,730
25	218 CA ^{0.513} PII ^{4.80}	104.26	1.20	5,673	5,670
50	287 CA ^{0.517} PII ^{4.62}	104.26	1.20	7,363	7,360
100	362 CA ^{0.521} PII ^{4.47}	104.26	1.20	9,206	9,210
500	553 CA ^{0.531} PII ^{4.22}	104.26	1.20	14,076	14,100

Table 2: Peak Discharge Comparison

Flow Return Period (Years)	Regression Equations (cfs)	Stream Gage 06482745	FIS Flows (cfs)
2	1,030	650	*1,030
5	2,460	1,520	*2,460
10	3,730	2,300	3,149
25	5,670	3,510	**4,512
50	7,360	5,770	5,500
100	9,210	7,110	6,898
500	14,100	9,110	10,600

* The FIS did not provide the 2-yr and 5-yr peak discharges. The flows in the model were from regression equations.

**The FIS did not provide a 25-yr peak discharge. FIS flows reported were typically 75% of flows from regression equations for the 50-yr, 100-yr and 500-yr flood frequencies. Therefore, the 25-yr flow was calculated to be 75% of regression equations.

Design & Review Frequency: The design frequency, in accordance with Chapter 7.6.2 of the South Dakota Drainage Manual is the 25-year flood (Local Roads with ADT>100), and the review frequency is the 100-year event. The drainage manual indicates that the allowable design headwater elevation should not exceed 1-ft below the low subgrade shoulder at the lowest point of the roadway.

Section 14.2.3 of the drainage manual discusses freeboard requirements. The drainage manual recommends that replaced bridges have 2-ft of freeboard at the 100-year storm frequency or match the existing low chord at a minimum. The existing bridge has 2-ft of freeboard on the 100-yr. Therefore, the replacement structure should also have at least 2-ft of freeboard.

Minnehaha County No-Rise Certification: All proposed replacement structures shall not raise the flood elevation from the 100-yr storm event in accordance with the Minnehaha County Highway Department Project Development and Operations Manual. The following is an excerpt from the manual:

No replacement structure shall create a rise in the flood elevation produced by the 100-yr storm (1%-chance storm), or Base Flood Elevation (BFE). To this end, whenever a hydrologic and hydraulic (H&H) analysis is done, including a TS&L, the engineer of record shall certify that their design does not create rise in the BFE.

PROPOSED REPLACEMENT STRUCTURE

The contributing drainage area and peak discharges at this structure are not conducive to a box culvert option. Therefore, a berm type bridge option is being presented. Based on the overall length of the existing structure, a two-span is needed to allow for the use of 36" prestressed concrete girders and to minimize the required grade raise.

Hydraulic models were compiled for the existing conditions and proposed conditions. To appropriately prepare the opinion of costs, preliminary scour calculations were performed. Future structure replacement plans will include the removal of the existing abutments and other substructure components as needed for structure replacement.

132-FT 2-SPAN PRESTRESSED CONCRETE GIRDER BRIDGE

Based upon the preliminary hydraulic analysis performed, a 132-ft 2-span berm-type bridge with 36" prestressed girders and a composite cast-in-place concrete deck will meet the design criteria. The proposed berm-type bridge will include integral abutments with riprap at 2:1 slope. Steel piles would be driven for the abutments. The proposed bridge will have a concrete barrier railing with Midwest Guardrail System (MGS) approach guardrails.

The proposed centerline profile will be raised to allow for the increased depth in the superstructure. The proposed low chord elevation is 1364.75, which is approximately 9" higher than the roadway overtopping elevation, will minimize the possibility of pressure flow even during the most extreme flood events. A longitudinal slope of 0.5% across the bridge will assist with appropriate drainage. For improved rideability, the target rate for the vertical curves was set to 64, which is the recommended K-value for a 40-mph roadway.

The estimated length of roadway reconstruction to complete the project is 620 lineal feet. Roadway pavement markings and rumble strips will be replaced through the project limits.

Overtopping for the existing conditions and proposed option will occur at Sta 10+45 or approximately 600 feet north of the existing northern bridge abutment. The overtopping elevation is 1364.06.

The proposed 2-span structure will replace the existing 3-span bridge and reduce the number of piers. There was some consideration to a 3-span slab bridge. However, it was determined that the 2-span beam bridge would be more appropriate for avoidance of the existing substructures.

SCOUR COUNTERMEASURES:

Based on experience with similar projects, SDDOT Class B riprap at a thickness of 2'-3" is being used for estimating purposes. Preliminary scour estimates found that the 100-yr contraction scour was 3.3-ft. The SDDOT requires that scour countermeasures be buried in accordance with FHWA *TechBrief: Hydraulic Considerations for Shallow Abutment Foundations*. The layout of the riprap has been completed in accordance with this document, including burying the riprap to the calculated depth of the 100-yr contraction scour. There are no known factors that would contribute to long-term degradation at this site.

With a future detailed hydraulic analysis, there could be some consideration to review structure length versus the costs for scour countermeasures. However, a contraction scour calculation was performed on the existing 119-ft bridge, and the estimated 100-yr contraction scour depth was approximately 20-ft. It is anticipated that

reduction of the proposed structure length will result in increased costs for the required countermeasures and possible constructability concerns with the depth of bury.

Table 3: High Water Elevations of Existing and Proposed Option @ 50-330-183

Flow Return Period (Years)	*Peak Flow Q (cfs)	Existing Bridge	132-ft 2-Span, Berm-Type Bridge
2	1,030	1355.52	1355.13
5	2,460	1358.11	1357.59
10	3,149	1359.12	1358.47
25	4,512	1360.77	1359.49
50	5,500	1362.13	1359.92
100	6,898	1363.83	1360.42
500	10,600	1367.25	1361.41
Low Chord		1365.94	1364.75
**100-yr Freeboard		2.11 ft	4.33 ft
Overtopping Flow (cfs)		6,940	> 500 yr
Overtopping Elevation		1364.06	1364.06

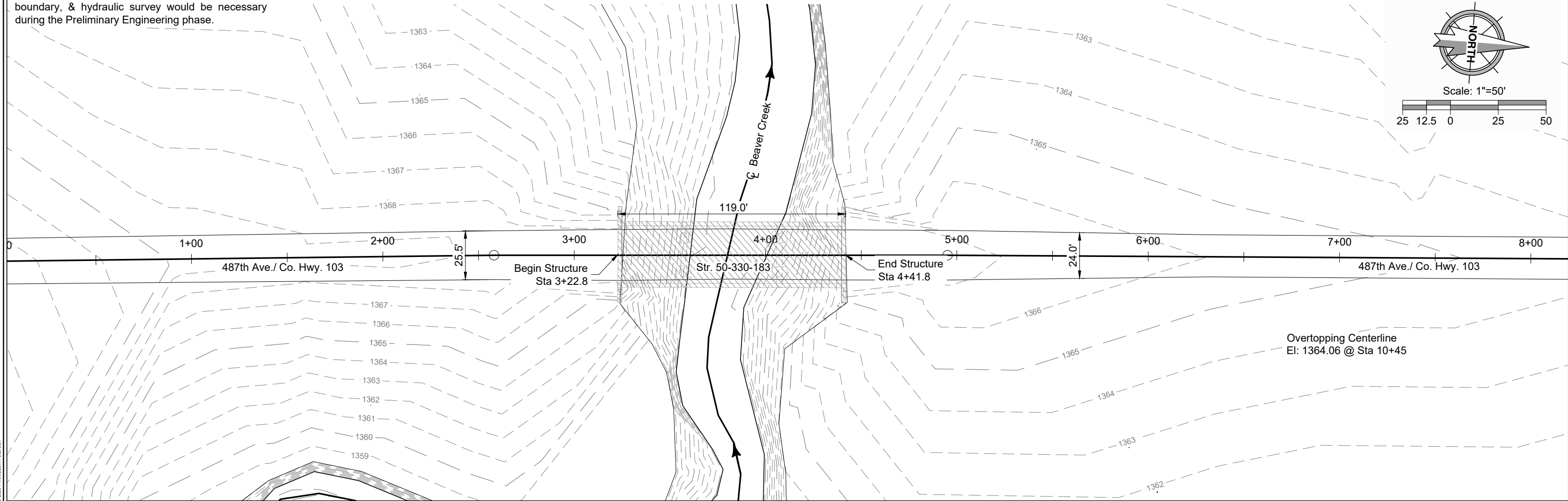
**Peak Flows at 50-330-183 are in accordance with the effective Flood Insurance Study. See Table 2.*

***Note: Existing and proposed bridges are slightly perched with the low chord being above the roadway overtopping elevation.*

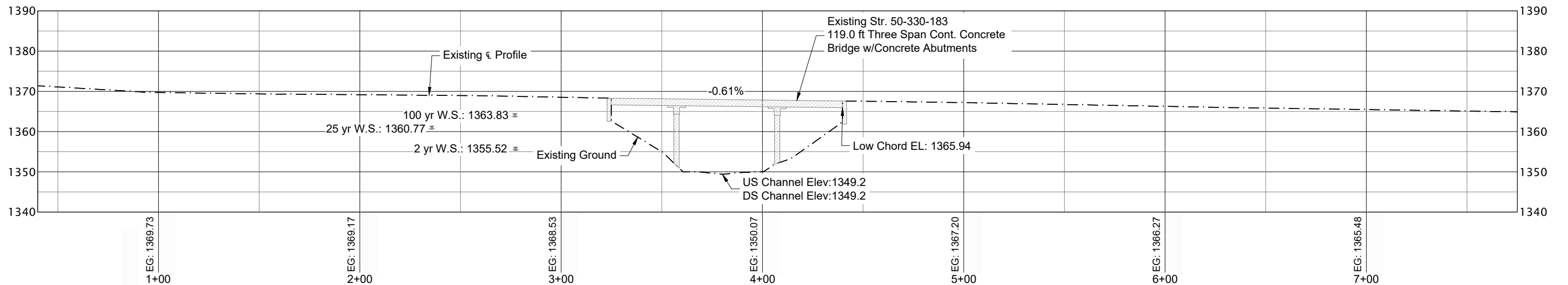
Vertical Datum Used: NAVD 1988

NOTE: Survey does not include all details of the site, but only enough information to perform a preliminary hydraulic analysis. A complete topographic, boundary, & hydraulic survey would be necessary during the Preliminary Engineering phase.

Existing Conditions



C.L. Road Profile

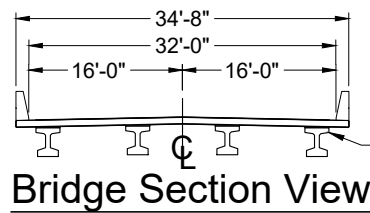
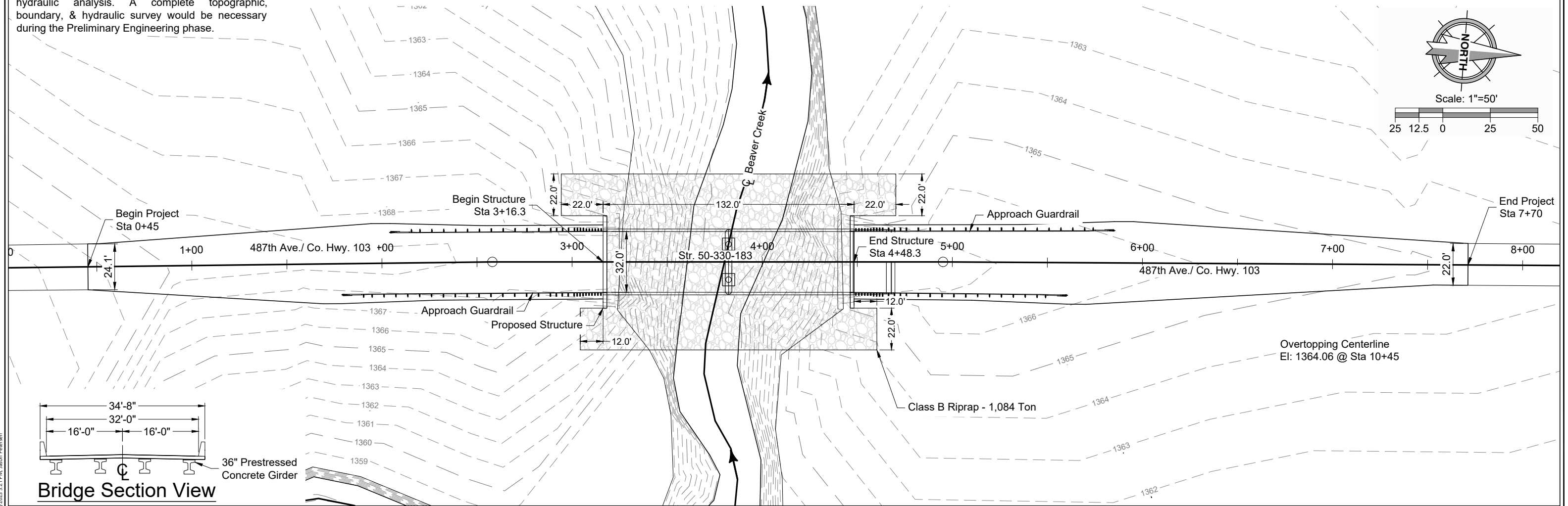
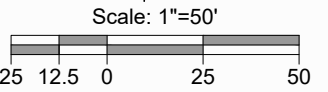
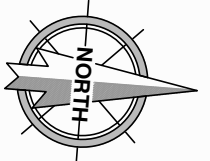


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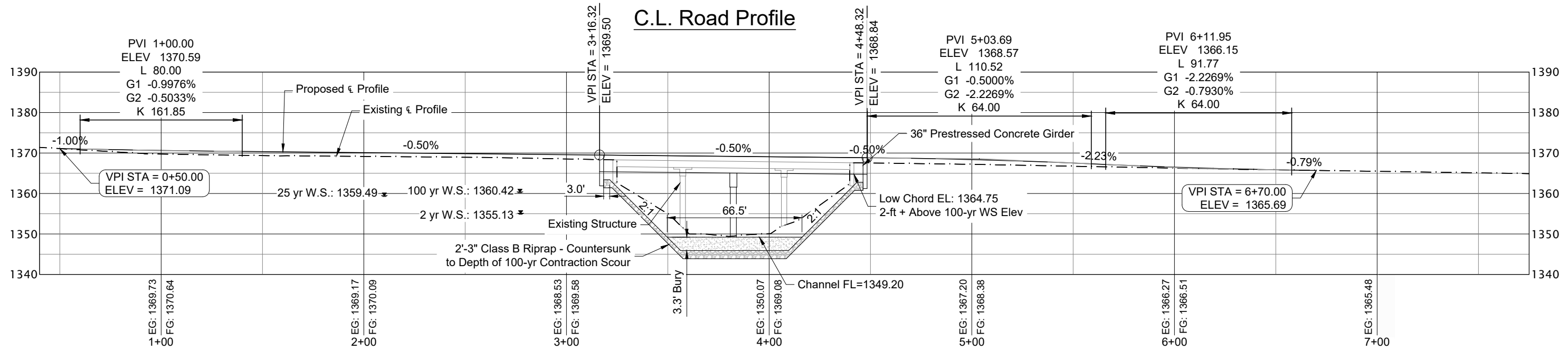
Vertical Datum Used: NAVD 1988

NOTE: Survey does not include all details of the site, but only enough information to perform a preliminary hydraulic analysis. A complete topographic, boundary, & hydraulic survey would be necessary during the Preliminary Engineering phase.

Proposed - 132-ft 2 Span 36" Girder Bridge



C.L. Road Profile



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MINNEHAHA COUNTY | ENGINEER'S OPINION OF PROBABLE COSTS
Structure No. 50-330-183
Proposed Structure: 132' 2-Span Prestressed Girder Bridge, No Skew

Updated: 8/22/2023



Inflation Percentage = 3.00%

GRADING

BID ITEM NUMBER	SDDOT ITEM NUMBER	DESCRIPTION	BASE BID QUANTITIES	UNIT	CURRENT YEAR 2023		FUTURE YEAR 2028	
					UNIT PRICE	TOTAL BID PRICE	UNIT PRICE	TOTAL BID PRICE
1	009E0010	Mobilization	1	Lump Sum	\$ 175,000.00	\$ 175,000.00	\$ 202,872.96	\$ 202,872.96
2	100E0100	Clearing	1	Lump Sum	\$ 25,000.00	\$ 25,000.00	\$ 28,981.85	\$ 28,981.85
3	110E0600	Remove Fence	500	Ft	\$ 1.50	\$ 750.00	\$ 1.74	\$ 869.46
4	110E1010	Remove Asphalt Concrete Pavement	1615	SqYd	\$ 8.00	\$ 12,920.00	\$ 9.27	\$ 14,977.82
5	110E5020	Salvage Traffic Sign	21	Each	\$ 25.00	\$ 525.00	\$ 28.98	\$ 608.62
6	110E5451	Salvage Riprap	160	Ton	\$ 30.00	\$ 4,800.00	\$ 34.78	\$ 5,564.52
7	120E0010	Unclassified Excavation	1700	CuYd	\$ 15.00	\$ 25,500.00	\$ 17.39	\$ 29,561.49
8	120E0600	Contractor Furnished Borrow Excavation	2000	CuYd	\$ 25.00	\$ 50,000.00	\$ 28.98	\$ 57,963.70
9	230E0010	Placing Topsoil	400	CuYd	\$ 15.00	\$ 6,000.00	\$ 17.39	\$ 6,955.64
10	260E1010	Base Course	1350	Ton	\$ 28.00	\$ 37,800.00	\$ 32.46	\$ 43,820.56
11	320E1200	Asphalt Concrete Composite	550	Ton	\$ 165.00	\$ 90,750.00	\$ 191.28	\$ 105,204.12
12	320E7008	Grind 8" Rumble Strip or Stripe in Asphalt Concrete	0.22	Mile	\$ 16,500.00	\$ 3,630.00	\$ 19,128.02	\$ 4,208.16
13	620E0020	Type 2 Right-of-Way Fence	500	Ft	\$ 12.00	\$ 6,000.00	\$ 13.91	\$ 6,955.64
14	630E0500	Type 1 MGS	100	Ft	\$ 55.00	\$ 5,500.00	\$ 63.76	\$ 6,376.01
15	630E1500	Type 1 Guardrail Transition	4	Each	\$ 4,000.00	\$ 16,000.00	\$ 4,637.10	\$ 18,548.39
16	630E2019	MGS Tangent End Terminal	4	Each	\$ 4,000.00	\$ 16,000.00	\$ 4,637.10	\$ 18,548.39
17	632E2220	Guardrail Delineator	16	Each	\$ 28.00	\$ 448.00	\$ 32.46	\$ 519.35
18	632E3500	Reset Sign	1	Each	\$ 200.00	\$ 200.00	\$ 231.85	\$ 231.85
19	633E1230	High Build Waterborne Pavement Marking Paint, 6" White	1450	Ft	\$ 1.00	\$ 1,450.00	\$ 1.16	\$ 1,680.95
20	633E1232	High Build Waterborne Pavement Marking Paint, 6" Yellow	2900	Ft	\$ 1.00	\$ 2,900.00	\$ 1.16	\$ 3,361.89
21	634E0110	Traffic Control Signs	300	SqFt	\$ 6.25	\$ 1,875.00	\$ 7.25	\$ 2,173.64
22	634E0120	Traffic Control, Miscellaneous	1	Lump Sum	\$ 5,000.00	\$ 5,000.00	\$ 5,796.37	\$ 5,796.37
23	634E0275	Type 3 Barricade	10	Each	\$ 150.00	\$ 1,500.00	\$ 173.89	\$ 1,738.91
24	734E0010	Erosion Control	1	Lump Sum	\$ 7,500.00	\$ 7,500.00	\$ 8,694.56	\$ 8,694.56
25	734E0103	Type 3 Erosion Control Blanket	500	SqYd	\$ 4.00	\$ 2,000.00	\$ 4.64	\$ 2,318.55
26	734E0154	12" Diameter Erosion Control Wattle	160	Ft	\$ 4.50	\$ 720.00	\$ 5.22	\$ 834.68
27	734E0604	High Flow Silt Fence	1600	Ft	\$ 4.50	\$ 7,200.00	\$ 5.22	\$ 8,346.77
28	734E0630	Floating Silt Curtain	320	Ft	\$ 20.00	\$ 6,400.00	\$ 23.19	\$ 7,419.35
29	900E1310	Concrete Washout Facility	1	Each	\$ 1,000.00	\$ 1,000.00	\$ 1,159.27	\$ 1,159.27
SUBTOTAL (GRADING) =					\$ 514,368.00		\$ 596,293.49	

STRUCTURE

BID ITEM NUMBER	SDDOT ITEM NUMBER	DESCRIPTION	BASE BID QUANTITIES	UNIT	CURRENT YEAR 2023		FUTURE YEAR 2028	
					UNIT PRICE	TOTAL BID PRICE	UNIT PRICE	TOTAL BID PRICE
30	009E5000	Concrete Penetrating Sealer	470	SqYd	\$ 8.50	\$ 3,995.00	\$ 9.85	\$ 4,631.30
31	250E0030	Incidental Work, Structure	1	Lump Sum	\$ 80,000.00	\$ 80,000.00	\$ 92,741.93	\$ 92,741.93
32	410E2600	Membrane Sealant Expansion Joint	68.0	Ft	\$ 130.00	\$ 8,840.00	\$ 150.71	\$ 10,247.98
33	410E0030	Structural Steel, Miscellaneous	1	Lump Sum	\$ 15,000.00	\$ 15,000.00	\$ 17,389.11	\$ 17,389.11
34	420E0100	Structure Excavation, Bridge	150.0	CuYd	\$ 450.00	\$ 67,500.00	\$ 521.67	\$ 78,251.00
35	430E0200	Bridge End Embankment	80.0	CuYd	\$ 40.00	\$ 3,200.00	\$ 46.37	\$ 3,709.68
36	430E0300	Granular Bridge End Backfill	150	CuYd	\$ 130.00	\$ 19,500.00	\$ 150.71	\$ 22,605.84
37	430E0510	Approach Slab Underdrain Excavation	3.0	CuYd	\$ 350.00	\$ 1,050.00	\$ 405.75	\$ 1,217.24
38	430E0700	Precast Concrete Headwall for Drain	4	Each	\$ 450.00	\$ 1,800.00	\$ 521.67	\$ 2,086.69
39	460E0300	Class A45 Concrete, Bridge Deck	175	CuYd	\$ 1,450.00	\$ 253,750.00	\$ 1,680.95	\$ 294,165.80
40	460E0050	Class A45 Concrete, Bridge	140	CuYd	\$ 1,250.00	\$ 175,000.00	\$ 1,449.09	\$ 202,872.96
41	460E0150	Concrete Approach Slab for Bridge	150.3	SqYd	\$ 450.00	\$ 67,635.00	\$ 521.67	\$ 78,407.50
42	460E0150	Concrete Approach Sleeper Slab for Bridge	33.9	SqYd	\$ 550.00	\$ 18,645.00	\$ 637.60	\$ 21,614.67
43	460E0500	Deck Drain, Girder Bridge	8	Each	\$ 1,100.00	\$ 8,800.00	\$ 1,275.20	\$ 10,201.61
44	464E0100	Controlled Density Fill	6.0	CuYd	\$ 1,000.00	\$ 6,000.00	\$ 1,159.27	\$ 6,955.64
45	480E0100	Reinforcing Steel	25,000	Lb	\$ 3.25	\$ 81,250.00	\$ 3.77	\$ 94,191.02
46	480E0200	Epoxy Coated Reinforcing Steel	37,000	Lb	\$ 3.75	\$ 138,750.00	\$ 4.35	\$ 160,849.28
47	510E0300	Preboring Pile	140	Ft	\$ 25.00	\$ 3,500.00	\$ 28.98	\$ 4,057.46
48	510E3130	HP 12 Pile Tip Reinforcement	30	Each	\$ 200.00	\$ 6,000.00	\$ 231.85	\$ 6,955.64
49	510E3401	HP 12x53 Steel Test Pile, Furnish and Drive	270	Ft	\$ 110.00	\$ 29,700.00	\$ 127.52	\$ 34,430.44
50	510E3405	HP 12x53 Steel Bearing Pile, Furnish and Drive	2,300	Ft	\$ 80.00	\$ 184,000.00	\$ 92.74	\$ 213,306.43
51	560E8036	36" Minnesota Shape Prestressed Concrete Beam	520	Ft	\$ 375.00	\$ 195,000.00	\$ 434.73	\$ 226,058.44
52	680E0040	4" Underdrain Pipe	252	Ft	\$ 20.00	\$ 5,040.00	\$ 23.19	\$ 5,842.74
53	680E2500	Porous Backfill	42	Ton	\$ 65.00	\$ 2,730.00	\$ 75.35	\$ 3,164.82
54	700E0210	Class B Riprap	1,400	Ton	\$ 55.00	\$ 77,000.00	\$ 63.76	\$ 89,264.10
55	700E1100	Overburden Excavation for Riprap	700	CuYd	\$ 85.00	\$ 59,500.00	\$ 98.54	\$ 68,976.81
56	831E0110	Type B Drainage Fabric	1,650	SqYd	\$ 5.00	\$ 8,250.00	\$ 5.80	\$ 9,564.01
SUBTOTAL (STRUCTURE) =					\$ 1,521,435.00		\$ 1,763,760.15	

SUBTOTAL (GRADING + STRUCTURE) = \$ 2,360,053.64

CONTINGENCY (10%) = \$ 236,005.00

CONSTRUCTION OPINION OF PROBABLE COST = \$ 2,596,058.64

ENVIRONMENTAL ENGINEERING, WETLAND DELINEATION, CULTURAL RESOURCE, & NEPA (CATEX) = \$ 35,000.00

WETLAND MITIGATION (POTENTIAL) = \$ 75,000.00

PRELIMINARY DESIGN ENGINEERING (HYDRAULICS) = \$ 45,000.00

GEOTECHNICAL SOIL BORINGS & RECOMMENDATIONS = \$ 12,000.00

FINAL DESIGN ENGINEERING (STRUCTURE + GRADING PLANS) + BIDDING = \$ 85,000.00

CONSTRUCTION ENGINEERING = \$ 85,000.00

FISH BIOLOGIST (TOPEKA SHINER REMOVAL) = \$ 4,000.00

QC/QA MATERIAL TESTING = \$ 15,000.00

ENVIRONMENTAL, ENGINEERING, & TESTING TOTAL = \$ 356,000.00

TOTAL ENGINEER'S OPINION OF PROBABLE PROJECT COST = \$ 2,952,058.64

Bridge Type Study

Structures 50-216-015, 50-219-015, 50-277-015 & 50-330-183

Minnehaha County Highway Department

September 2023

SUMMARY OF ENGINEER'S OPINION OF PROBABLE COSTS

MINNEHAHA COUNTY
SUMMARY OF ENGINEER'S OPINION OF PROBABLE COSTS



ALL 4 STRUCTURES

Structure No.	Structure Type	Construction with Contingency	Environmental, Engineering, & Testing	Total Cost
50-216-015	2 - 11'x9' CIP Box Culvert w/ 20° RHF Skew	\$ 890,441.10	\$ 220,000.00	\$ 1,110,441.10
50-219-015	3 - 12'x6' CIP Box Culvert w/ 45° LHF or 30° RHF Skew	\$ 1,082,862.77	\$ 285,500.00	\$ 1,368,362.77
50-277-015	4 - 11'x9' CIP Box Culvert w/ 0° Skew	\$ 1,243,958.86	\$ 245,500.00	\$ 1,489,458.86
50-330-183	132' 2-Span Prestressed Girder Bridge	\$ 2,596,058.64	\$ 356,000.00	\$ 2,952,058.64
TOTAL PROJECT COSTS =				\$ 6,920,321.37

3 STRUCTURES ON JASPER ST.

Structure No.	Structure Type	Construction with Contingency	Environmental, Engineering, & Testing	Total Cost
50-216-015	2 - 11'x9' CIP Box Culvert w/ 20° RHF Skew	\$ 890,441.10	\$ 220,000.00	\$ 1,110,441.10
50-219-015	3 - 12'x6' CIP Box Culvert w/ 45° LHF or 30° RHF Skew	\$ 1,082,862.77	\$ 285,500.00	\$ 1,368,362.77
50-277-015	4 - 11'x9' CIP Box Culvert w/ 0° Skew	\$ 1,243,958.86	\$ 245,500.00	\$ 1,489,458.86
TOTAL PROJECT COSTS =				\$ 3,968,262.73