

***Railroad Grade Raise Planning and Feasibility
Study***

***BNSF Mainline Track Raise
Between Devils Lake and Churchs Ferry, North
Dakota***

***Prepared for
BNSF Railway***

April 8, 2011



Railroad Grade Raise Planning and Feasibility Study

***BNSF Mainline Track Raise
Between Devils Lake and Churchs Ferry, North Dakota***

***Prepared for
BNSF Railway***

April 8, 2011



4700 West 77th Street
Minneapolis, MN 55435-4803
Phone: (952) 832-2600
Fax: (952) 832-2601



Railroad Grade Raise Planning and Feasibility Study

BNSF Mainline Track Raise Between Devils Lake and Churchs Ferry, North Dakota

Table of Contents

1.0	Executive Summary.....	1
2.0	Background Information and Purpose	3
2.1	Background Information	3
2.1.1	Level of Devils Lake.....	3
2.1.2	Vertical Datum	3
2.1.3	BNSF 2001 Mainline Track Study	4
2.1.4	U.S. Highway 2 Status	4
2.2	Purpose.....	4
3.0	Hydrologic Design Considerations.....	6
3.1	General.....	6
3.2	Background Hydrology Information.....	6
3.2.1	Existing Lake Elevations.....	6
3.2.2	Potential Future Lake Elevations.....	6
3.2.3	Lake Slope.....	8
3.2.4	Flows through BNSF Bridges.....	9
3.3	Background Structure Information	11
3.3.1	City of Devils Lake Levees and Embankments.....	11
3.3.2	Recently Rebuilt Highway Structures.....	12
3.3.2.1	Highway 2 Bridge at Mauvais Coulee.....	12
3.3.2.2	Highway 2 Bridge at Channel A	13
3.3.3	Existing BNSF Structures	14
3.3.3.1	BNSF Channel A Bridge – Mile-Post 92.2.....	14
3.3.3.2	BNSF Mauvais Coulee Bridge – Mile-Post 103.6	15
3.4	Freeboard/Wind Wave Impacts for Proposed BNSF Track Raise.....	15
3.5	Hydrologic Design Summary	18
3.6	Hydrologic Design Conclusions	19
3.7	References.....	22
4.0	Track Layout and Design.....	24
4.1	General.....	24
4.2	Preliminary Track Design	24
4.2.1	Data Collection.....	24
4.2.2	Inventory of Existing Track Materials	25
4.2.3	Design Criteria/Assumptions.....	25
4.2.3.1	Design Criteria for Track and Bridges	25
4.2.3.2	Assumptions.....	26

4.2.4	Track layout and Design	27
4.3	Existing Bridges	29
4.3.1	Channel A Bridge	29
4.3.2	Mauvais Coulee Bridge.....	29
4.3.3	Bridge Replacement.....	29
4.4	Utility and Adjacent Property Impacts	30
4.4.1	Utility Identification	30
4.4.2	Property Impacts.....	31
5.0	Permitting.....	32
5.1	Permit Review	32
5.2	Permit Summary	35
5.2.1	U.S. Army Corps of Engineers, permits under Section 404 of the CWA and Section 10 of the RHA	35
5.2.2	U.S. Army Corps of Engineers, Section 106 Consultations.....	36
5.2.3	Surface Transportation Board, environmental review under 49 CFR 1105	37
5.2.4	U.S. Fish and Wildlife Service, Consultations under Section 7 of the Endangered Species Act.....	37
5.2.5	National Park Service and North Dakota Department of Parks and Recreation.....	37
5.2.6	North Dakota Department of Health, Division of Water Quality, NPDES permits for temporary dewatering and storm water discharge; Section 401 Water Quality Certification.....	38
5.2.7	North Dakota State Water Commission, Sovereign Land Use Permit.....	38
5.2.8	Ramsey County and Coulee Township	38
5.2.9	City of Devils Lake.....	38
5.2.10	Benson County and Churchs Ferry	39
5.2.11	Resources	39
6.0	Opinion of Probable Project Cost.....	40
6.1	General.....	40
6.2	Resources	40
6.3	Assumptions	40
7.0	Preliminary Construction Schedule	45
7.1	General.....	45
7.2	Resources	45
7.3	Assumptions	45
8.0	Devils Lake Subdivision Rail Replacement.....	47
8.1	General.....	47

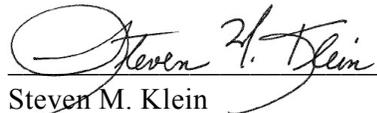
List of Tables

Table 1	Selected Historical Discharge Data.....	10
Table 2	Determination of Top of Levee/Embankment for the City of Devils Lake.....	12
Table 3	Preliminary Wave and Armor Parameters.....	17
Table 4	Summary of Key Elevations for BNSF Track Raise Study.....	21
Table 5	Summary of Existing Track Materials to be Removed.....	25
Table 6	Potential Environmental Permits and Approvals.....	32
Table 7	Opinion of Probable Project Costs.....	43

List of Appendices

Appendix A	Hydrology Figures	
Figure 1	Devils Lake Watershed	
Figure 2	Devils Lake Historical Lake Elevations	
Figure 3	Potential Water Surface Elevations of Devils Lake at Natural Outlet to Tolna Coulee	
Figure 4	U.S. Highway 2 Bridge at Mauvais Coulee	
Figure 5	U.S. Highway 2 Bridge at Channel A	
Figure 6-1	BNSF Bridge at Channel A (Mile-Post 92.2) Location Map and Hydraulic Data	
Figure 6-2	BNSF Bridge at Channel A (Mile-Post 92.2) General Plan and Elevation	
Figure 7-1	BNSF Bridge at Mauvais Coulee (Mile-Post 103.6) General Plan and Elevation	
Figure 7-2	BNSF Bridge at Mauvais Coulee (Mile-Post 103.6) Bridge Section Detail	
Figure 8	Devils Lake Depths and Fetch Locations at Design Elevation	
Figure 9	Elevation Comparisons of Existing and Proposed Structures near Devils Lake	
Figure 10	BNSF Mainline Track Raise Profile, Existing and Proposed Raise Conditions	
Figure 11	Devils Lake Outline at Design Lake Elevation and at Forecast 2011 Level	
Figure 12	2011 Probability Forecast for Level of Devils Lake, ND	
Figure 13	2011 Weekly Probability Forecast for Level of Devils Lake, ND	
Appendix B	Preliminary Track Design Drawings	
Appendix C	Preliminary Construction Schedule	

I hereby certify that this report was prepared by me or under by direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of North Dakota.


Steven M. Klein

Date: April 8, 2011 Reg. No. PE-5916

1.0 Executive Summary

The segment of Burlington Northern Santa Fe Railway (BNSF) mainline track known as the Devils Lake Subdivision between Devils Lake and Churchs Ferry, North Dakota has a significant potential for inundation due to the increasing elevation of Devils Lake. This year the U.S. Geological Survey indicated that there is a 10 percent chance that Devils Lake will reach or exceed its natural overflow elevation of 1,458 feet (NGVD 29) within the next twenty years. Based on the natural overflow elevation, the design peak lake level for the Inflow Design Event is 1462 feet (NGVD 29). The National Weather Service predicts an 85% chance that the lake will reach or exceed an elevation of 1454 feet (NGVD 29) during the summer of 2011. Continued rises in the lake level will render the BNSF mainline track inoperable between approximately Mile-Post 91.0 and Mile-Post 106.4, thus jeopardizing the ability to provide continued rail transport unless major construction work is undertaken to raise the track and bridges in this reach.

A raise of the mainline track to top of subgrade elevation 1,466 feet (NGVD 29) in non-critical reaches and 1467 feet (NGVD 29) in critical reaches between Mile-Post 91.0 and Mile-Post 106.4 is being evaluated to assure continuation of rail service if the level of Devils Lake continues to rise to its natural maximum lake level. Two bridges will also need to be raised in addition to raising the railroad embankment. These bridges extend across waterways known as Channel A and Mauvais Coulee.

The purpose of this planning and feasibility study and a 30-percent design was to identify and address the items of greatest significance associated with raising the track such that an opinion of probable project cost and construction schedule can be developed. Based on the information gathered to date, the opinion of probable project cost to raise the railroad track and two bridges along the existing alignment is approximately \$75,552,000. This cost includes engineering, construction administration, permitting, and a 20-percent contingency to account for variations in actual bid prices and items that will occur, but are not included in the project cost. An estimate on the timeline to complete the construction was also prepared. The construction is anticipated to take between six and seven months to complete.

NDDOT has requested relay of rail outside the proposed track raise limits be included in this report. These limits account for approximately 55.5 miles of bolted rail along the Devils Lake Subdivision per BNSF. This rail relay is a requirement for AMTRAK operations. BNSF estimated the cost for

replacing the existing rail with new rail relay is \$28,900,000. The salvage value of the existing rail and other track materials to be removed within the 55.5 miles is approximately \$7,010,000.

2.0 Background Information and Purpose

2.1 Background Information

2.1.1 Level of Devils Lake

Devils Lake, North Dakota is a closed basin lake with no outlet at its current level. Since 1993, Devils Lake has risen 30 feet and has over tripled in surface area. The lake level would have to rise another six feet before it reaches its natural outlet level. Many highways and several railroad tracks that cross Devils Lake or that are near the lake have been affected and have either been abandoned and are now flooded or have been raised to keep the transportation route in service. The rising water is now threatening portions of the BNSF mainline tracks between Devils Lake and Churchs Ferry.

The natural outlet elevation from Devils Lake to the Sheyenne River occurs at elevation 1,458 feet (NGVD 29), about 6.3 feet above the current lake elevation of 1,451.7 feet (NGVD 29) recorded on March 7, 2011. The maximum elevation of Devils Lake is expected to be about elevation 1,462 feet (NGVD 29), based on a probable maximum storm occurring when the lake is at its natural overflow elevation. For the BNSF tracks to remain operational during a period of maximum lake level for Devils Lake, a top-of-subgrade elevation of at least 1,466 feet (NGVD 29) is required, which will provide approximately four feet of freeboard. This freeboard is needed due to the predicted wave action when the lake reaches its maximum elevation.

2.1.2 Vertical Datum

There are two primary vertical elevation datums being used in the Devils Lake area at the U.S. Federal level, the National Geodetic Vertical Datum 1929 (NGVD 29) and the North American Vertical Datum 1988 (NAVD 88). The U.S. Geological Survey (USGS) and National Weather Service (NWS) use the NGVD 29 datum for mapping, lake level records, risk analysis, and for lake level projections. The U.S. Army Corps of Engineers (USACE) has used the NGVD 29 datum for past projects; however, the USACE is using the NAVD 88 datum for their current project construction plans and specifications. The North Dakota Department of Transportation (NDDOT) has also used the NAVD 88 datum for their construction plans for the Highway 2 bridges at Channel A and Mauvais Coulee. The conversion for the Devils Lake area is $\text{NAVD 88} = \text{NGVD 29} + 1.2 \text{ feet}$ (Reference 1, USACE 2009). In addition, BNSF has a vertical datum that is different from the two U.S. Federal vertical datums which is used on their Line Segment sheets that show track elevations. Unless otherwise noted, the elevations referenced in this report and in the drawings are based on the National Geodetic Vertical Datum 1929 adjustment (NGVD 29), as requested by BNSF.

2.1.3 BNSF 2001 Mainline Track Study

Surveys were done for BNSF in March 2001 to define potential locations between and in the vicinity of Devils Lake and Churchs Ferry, North Dakota where the BNSF track is subject to being flooded by the rising level of Devils Lake. Analysis of the survey data showed that several locations along the BNSF mainline track and passing track between Devils Lake and Churchs Ferry, between BNSF milepost 89 and 106, were below a desired elevation, with the most critical stretch at Churchs Ferry over the Mauvais Coulee with a top-of-rail elevation of only 1,453 feet (NGVD 29). This lowest segment of BNSF mainline and passing tracks at the Mauvais Coulee crossing at Churchs Ferry that was in imminent danger of being flooded was raised to a top-of-rail elevation of approximately 1,456 feet (NGVD 29) in the fall of 2001. That track raise to elevation 1456 feet will allow the BNSF mainline to remain operational for levels of Devils Lake as high as elevation 1,452 feet (NGVD 29), about five feet higher than the current lake level at that time. However, additional future raises of the BNSF mainline tracks will be required if the level of Devils Lake would continue to rise above elevation 1,452 feet (NGVD 29).

2.1.4 U.S. Highway 2 Status

From 2001 to 2005 the North Dakota Department of Transportation (NDDOT) has raised U.S. Highway 2 in the area between Devils Lake and Churchs Ferry. The roadway was raised to an approximate elevation of 1,456 feet, although the base was constructed the full width of the roadway section to accommodate the future raise of the roadway to the higher elevation of approximately 1,466 feet. The highway bridges spanning over the Mauvais Coulee and Channel A were raised to an approximate bridge deck elevation of 1,466 feet.

(Note: The NDDOT plans and specifications for the raising of U.S. Highway 2 use the NGVD (1988 adjustment) which differs in this location from the NGVD (1929 adjustment) by 1.2 feet. Thus the elevation information on the NDDOT plans and specifications will be listed as values 1.2 feet higher than the elevations listed in this report.)

2.2 Purpose

The reach of the BNSF mainline track between Devils Lake and Churchs Ferry, North Dakota has a significant potential for inundation due to the increasing elevation of Devils Lake. The U.S. Geological Survey indicated this year that there is a 10 percent chance that Devils Lake will reach or exceed its natural overflow elevation of 1,458 feet (NGVD 29) within the next ten years. Continued rises in the lake level will render the BNSF mainline track inoperable between approximately Milepost 91.0 and Milepost 106.4, thus jeopardizing the ability to provide continued rail transport

unless major construction work is undertaken to raise the track and bridges in this reach. The purpose of this analysis is to provide a planning and feasibility study and a 30-percent design for raising the BNSF mainline tracks between Devils Lake and Churchs Ferry, North Dakota to assure continuation of rail service if the level of Devils Lake continues to rise to its natural maximum lake level. A raise of the mainline track to top of subgrade elevation 1,466 feet (NGVD 29) in non-critical reaches and 1,467 feet (NGVD 29) in critical reaches is being evaluated. This study is intended to identify and address the items of greatest significance associated with raising the track such that an opinion of probable project cost and construction schedule can be developed. The balance of this report presents the results of this study.

3.0 Hydrologic Design Considerations

3.1 General

Devils Lake is a closed basin lake, meaning that the lake has no natural outlet at current water levels. The lake has a contributing watershed area of 3,810 square miles (Figure 1). Historically, Devils Lake has fluctuated from being dry to overflowing. Devils Lake reached its overflow elevation at least twice in the last 4,000 years and overflowed into the Sheyenne River. (Reference 2 – NDSWC, 2010). The Sheyenne River is a tributary to the Red River, which flows through Canada into Hudson Bay. The main objective of this study is to analyze the potential to decrease inundation due to rising lake levels by raising the Burlington Northern Santa Fe (BNSF) Railroad tracks from the City of Devils Lake to Churchs Ferry. This section discusses observed lake levels, predicted lake levels from a variety of previously completed studies, elevations of existing structures near Devils Lake, and existing sizes of bridge openings at the Devils Lake connecting channels of Mauvais Coulee and Channel A. Finally, preliminary conclusions are discussed relating to the top of railroad subgrade elevation and the size of bridge openings for the proposed raise of the BNSF track. As noted in Section 2.0, the elevations referenced in this report are based on the NGVD 29 vertical datum. The level of Devils Lake is recorded and measured on that datum and most of the benchmarks and topographic maps for the Devils Lake area also use that datum.

3.2 Background Hydrology Information

3.2.1 Existing Lake Elevations

In March 1993, Devils Lake had an elevation of 1,422.6 feet (NGVD 29) and a surface area of 44,230 acres. On June 27, 2010, Devils Lake reached its highest recorded elevation of 1,452.05 feet above sea level (NGVD 29) and covered 182,240 acres (Reference 2 – NDSWC, 2010). In just 17 years, lake levels rose by over 29 feet and inundated 138,010 acres, or 215 square miles. On March 7, 2011 the lake level was 1,451.7 feet (NGVD 29). Historical lake elevations are shown in Figure 2. The National Weather Service predicts an 85% chance that the lake will reach or exceed an elevation of 1454 feet (NGVD 29) during the summer of 2011

3.2.2 Potential Future Lake Elevations

The current natural overflow elevation from Devils Lake to the Sheyenne River is 1,458 feet (NGVD 29). The natural overflow outlet from Devils Lake is via Stump Lake into the Tolna Coulee, which flows into the Sheyenne River near Tolna, ND. Prior to 2009, the high point of the drainage divide at this location was elevation 1,459 feet (NGVD 29). However, in 2009, the City of Devils

Lake purchased the property at the drainage divide and received a permit from the North Dakota State Water Commission (NDSWC) to lower the high point of the drainage divide to elevation 1,458 feet (NGVD 29) (Reference 1 - USACE, 2009). The drainage divide was lowered in the winter of 2009/2010 to 1,458 feet (NGVD 29). At the October 2010 meeting of the NDSWC, the Commission directed the State Engineer to study and design a structure and associated necessary armoring of the Tolna Coulee outlet channel to prevent significant erosion of the outlet channel if the level of Devils Lake would reach the level to experience a natural overflow into the Sheyenne River. Although the results of this study could result in potential modification of the natural overflow elevation, it is most likely that the natural overflow elevation will remain at elevation 1,458 feet (NGVD 29).

The USGS has estimated the probability of the level of Devils Lake reaching elevation 1,458 feet (NGVD 29), the level of the natural overflow to the Sheyenne River. The most recent estimates made in 2010 indicate there is a 17 percent chance of reaching the natural overflow level in the next 10 years and a 20.5 percent chance in the next 20 years if no water were removed from Devils Lake via North Dakota's operated emergency outlet. If North Dakota's emergency outlet is operated, the chance of a natural overflow in the next 20 years drops to 6 to 10 percent, depending on the emergency outlet capacity. (Reference 16 – NDSWC, 2011). Currently the emergency outlet is being operated during the ice free season with a pumping capacity of 250 cubic feet per second (cfs), subject to downstream capacity and water quality restrictions. The NDSWC has plans to increase the capacity of the pumped outlet to 350 cfs in 2011 and the addition of a gravity flow outlet with a capacity of about 250 cfs is planned to be operational in 2011 or 2012 (Reference 16 – NDSWC, 2011). It should be noted that the lake has continued to rise well above the predicted levels during recent years. In January 2011, the National Weather Service (NWS) issued probability forecasts for the level of Devils Lake in 2011, and has been updating the forecasts about monthly. Based on conditions in the Devils Lake basin on February 27, 2011, on March 3, 2011 the NWS forecast indicated that there is an 85 percent chance that the lake level will reach or exceed an elevation of 1,454.0 feet (NGVD 29), about 2 feet above the previous record set in 2010 (Reference 17 – NWS, 2011). The NWS probability forecast for Devils Lake dated March 3, 2011 is shown in Figures 12 and 13.

The USACE design lake level elevation for the levees/embankments at the City of Devils Lake is 1462.9 feet (NGVD 29), not including freeboard for wave run-up or wind. Several floods were considered by the USACE in the design of the top of levees/embankments: the Probable Maximum Flood; the Inflow Design Flood (estimated at ½ of the Probable Maximum Flood); and the event with

1% probability of occurring in any year (100-year). These flood events were computed based on a starting lake elevation of 1,458 feet (NGVD 29), an assumed inflow duration of about 4 months as determined by the USACE based on review of major historical runoff events in the Devils Lake basin, the existing outlet configuration combined with no erosion along Tolna Coulee, an average outlet width of approximately 300 feet, and a lake slope of about 1 foot from the Devils Lake natural outlet at Tolna Coulee to the location of the levees/embankments at the City of Devils Lake. All of these events were considered in the analysis, with the Inflow Design Flood being the primary condition used in the design. (Reference 1 – USACE, 2009)

1. **Probable Maximum Flood:** Flood Volume = 2.9 million acre-feet; Peak lake level at the City of Devils Lake = 1,465.5 feet (NGVD 29) (including 1 foot lake slope); Assumed about 12 inches of Snow Water Equivalent runoff over the upstream watershed.
2. **Inflow Design Flood:** One-half the volume of the Probable Maximum Flood; Flood Volume = 1.4 million acre-feet; Peak lake level at the City of Devils Lake = 1,462.9 feet (NGVD 29) (including 1 foot lake slope)
3. **1% Event: Flood Volume** = 1.3 million acre-feet; Peak lake level at the City of Devils Lake = 1,462.5 feet (NGVD 29) (including 1 foot lake slope)

With the Inflow Design Flood, the elevation of Devils Lake would be at or near the peak elevation for around 30 days and would be within two feet of the peak elevation for over 4 months.

Computations by USACE (Reference 1 – USACE, 2009) were made for the duration of lake levels at the natural outlet during the Inflow Design Flood. The resultant lake level duration curves presented in Figure 3 (reproduced from Figure 6 in Reference 1 – USACE, 2009) show that one year after the start of the Inflow Design Event, the lake elevation would be about 1.5 feet above the natural outlet elevation. The Probable Maximum Flood and the 1% Event are also shown on Figure 3.

3.2.3 Lake Slope

The principal location of the USACE analysis of lake levels during the Probable Maximum Flood, the Inflow Design Flood, and the 1% Event was at the point of the natural overflow location at the Tolna Coulee. The levees/embankments at the City of Devils Lake are located about twenty-five miles west of this location. Although the water levels are fully connected over this distance, there are 4 distinct lake segments, 2 large connecting channels and several road/bridge crossings that can increase the upstream lake levels during a major inflow event. The BNSF's Channel A and Mauvais (Big) Coulee bridges are located 4 and 17 miles west of the City of Devils Lake, respectively, and are also separated by distinct lake segments, connecting channels and several road/bridge crossings.

By evaluating lake elevation data collected by the USGS at different locations in Devils Lake (Stump Lake, Devils Lake at Creel Bay, Dry Lake, and Lake Alice/Lake Irvine), it becomes apparent that the lake slope between these locations is flatter than one foot as lake levels rise. The differences in elevation at the upstream locations during the 2009 spring inflow event when Devils Lake was at an elevation of 1,449.39 feet (NGVD 29), was between 0.5 and 3.0 feet. The differences in elevation at the upstream locations during the 2010 spring inflow event when Devils Lake was at an elevation of 1,451.02 feet (NGVD 29), was between 0.2 and 0.7 feet.

The USACE assumed a lake slope of one foot from Devils Lake natural outlet at Tolna Coulee to the City of Devils Lake based on historical data collected in 2009 and prior years. Therefore in determining the design lake levels at the City of Devils Lake, it was assumed that the lake level at the city was one foot higher than the lake level at the outlet channel. The one foot slope was used for the Probable Maximum Flood, Inflow Design Flood, and 1% Event. This design criterion was assumed in December 2009. To evaluate if this assumption of a one foot slope was valid, the USACE provided funding to the USGS to complete a 2-dimensional lake slope model.

The USGS developed a 2-D model for Devils Lake to further evaluate the slope effect. The model and associated report are in the process of being reviewed so the following information is provisional. For the Inflow Design Flood with a starting water surface elevation of 1,458 feet (NGVD 29), the 2-D model did not show any measureable slope between the City of Devils Lake (Creel Bay) and the natural outlet at Tolna Coulee. The 2-D model was also used to simulate the 2009 inflow conditions and a slope similar to the observed data discussed above was predicted. It should be noted that the 2-D model did not extend far enough north to include the BNSF bridges at Channel A (Mile-Post 92.2) or Mauvais (Big) Coulee (Mile-Post 103.6); there are several road crossings between the lake and the BNSF bridges that could backup flow and increase the water level. Model results for Pelican Lake, which is just south of the Mauvais Coulee bridge, also indicate that for the Inflow Design Flood the slope is nearly flat (less than 0.1 feet) to the natural outlet at Tolna Coulee (Reference 6 – USGS, 2010).

3.2.4 Flows through BNSF Bridges

The USGS has measured discharges in Channel A near BNSF's Mile-Post 92.2 bridge and in Mauvais (Big) Coulee near BNSF's Mile-Post 103.6 bridge:

- USGS Gage 05056410 is located on Channel A on the right bank 200 feet upstream of U.S. Highway 2 and daily discharge data is available from 1983 to 1999. Occasional discharge measurements are available after 1999.

- USGS Gage 05056270 is located on Mauvais (Big) Coulee on the downstream side of the 65th Avenue NE bridge 1 mile south of Churchs Ferry and daily discharge data is available from 1998 to 1999. Occasional discharge measurements are available after 1999.

Table 1 presents selected peak annual streamflows in cubic feet per second (cfs) that were measured by the USGS. During the relatively short period of record, the largest flows measured in Channel A and Mauvais (Big) Coulee are approximately 2,000 cfs. Peak predicted inflows cannot be estimated for Mauvais Coulee using this historical data due to the short period of record. The discharge record at Channel A appears to be long enough to estimate peak predicted inflows.

Table 1 Selected Historical Discharge Data

05056410 – Channel A		05056270 – Mauvais (Big) Coulee	
Date	Peak Streamflow (cfs)	Date	Peak Streamflow (cfs)
20-April-1987	1,090		
15-August-1993	1,560		
18-April-1994	969		
14-April-1995	1,370		
9-May-1996	1,060		
30-April-1997	2,050		
14-April-1998	999	19-April-1998	1,270
19-April-1999	1,320	20-April-1999	1,280
16-April-2004	1,300	9-April-2004	1,180
22-April-2009	1,520*	22-April-2009	1,830*
1-April-2010	696*	1-April-2010	178*

* Streamflows in 2009 and 2010 do not necessarily represent the annual peak streamflows, but are presented to indicate the magnitude of historically high flows.

For their 2009 lake level predictions (prior to the actual spring runoff of 2009), the National Weather Service predicted discharges for both Channel A and Mauvais Coulee in their flood prediction model based on snow and soil conditions. Their 2009 peak discharge predictions of 3,215 cfs for Channel A and 2,797 cfs for Mauvais (Big) Coulee were substantially higher than the subsequent actual flows measured during the 2009 spring runoff event (Reference 7 – USGS, 2010).

Based on the somewhat limited data available and discussed above, it is our opinion that the best method to estimate peak flows and water levels upstream of BNSF bridges at Channel A and

Mauvais Coulee for the Inflow Design Event and/or other events would be through the development of a predictive model.

3.3 Background Structure Information

3.3.1 City of Devils Lake Levees and Embankments

The USACE is currently in the process of raising the levees at the City of Devils Lake to protect the city from future rises in the level of Devils Lake. The existing levees were designed for a maximum lake level of 1,455 feet (NGVD 29) and did not provide adequate protection to the city from higher lake levels. However, with the continued rise in the lake levels in 2009 and 2010, and the potential lake level increases in the future, the levees were in danger of becoming overtopped and raising the levees was required to address the higher lake levels. The levees are being raised to handle the likely maximum levels of Devils Lake. The USACE analysis of design lake levels for the construction of the raises to the levees/embankments protecting the City of Devils Lake used dam safety criteria. Since levees/embankments protecting the city are holding back water on a continuous basis, they are being considered to function more as dams than levees and therefore at all critical locations, the dam safety criteria are applied in the design.

As discussed in Section 3.2, the levees are designed to protect the city against the Inflow Design Flood with a peak lake level at the City of Devils Lake of 1462.9 feet (NGVD 29). An additional 3.0 to 3.8 feet of freeboard were added to the peak lake level. The top of levee/embankment elevations used for design at the City of Devils Lake is generally 1,466.0 feet (NGVD 29) except at the 2 locations with a freeboard requirement of greater than 3.0 feet (Reference 1 – USACE, 2009). A design freeboard of 3.0 feet was selected by USACE for all standard sections of the levee/embankment project. There were two locations where a non-standard section freeboard was used due to Wind Induced Wave Height analysis performed by the USACE that exceeded the 3.0 feet freeboard. The two locations had Wind Induced Wave Height calculations of 3.8 and 3.2 feet and these amounts were used in the design at those specific locations in lieu of the standard 3.0 feet (Reference 1 – USACE, 2009). Calculations for the top of levee/embankment elevation are presented in Table 2. All three events considered in the USACE Design Criteria Study are included in the table.

Table 2 Determination of Top of Levee/Embankment for the City of Devils Lake

	Elevation in Feet (NGVD 29)		
	1% Event	Inflow Design Flood	Probable Maximum Flood
Natural Outlet at Tolna Coulee			
Peak lake level (~120 days after start of event)	1,461.5	1,461.9	1,464.5
Lake level at 240 days (8 mo.) after start of event	1,460.2	1,460.3	1,461.1
Devils Lake at Creel Bay			
Peak lake level with USACE Design Assumptions of 1 foot slope on lake level between Tolna Coulee and the levees	1,462.5	1,462.9	1,465.5
Peak lake level with USACE Design Assumptions of 1 foot slope plus 3.0 feet of freeboard		1,465.9	
Peak lake level with USACE Design Assumptions of 1 foot slope plus 3.8 feet of freeboard		1,466.7	
USACE selected top of levee elevation		1,466-1,467	

3.3.2 Recently Rebuilt Highway Structures

After the level of Devils Lake rose over 20 feet in the 1990s, North Dakota Department of Transportation (NDDOT) raised the roadway and the bridges on U.S. Highway 2 during the period from 2001 to 2005. As noted in Section 2.1, the roadway was raised to an approximate elevation of 1,456 feet (NGVD 29), however the bridges over Channel A and Mauvais (Big) Coulee were raised to accommodate the expected ultimate level of Devils Lake. The bridge deck elevations were raised to an approximate elevation of 1,466 feet (NGVD 29).

3.3.2.1 Highway 2 Bridge at Mauvais Coulee

The NDDOT raised the U.S. Highway 2 bridge at Mauvais (Big) Coulee in 2001 to accommodate rising waters in Devils Lake. The bridge was designed for specific flow capacities and a targeted top of bridge deck elevation. The criteria used for the bridge design includes the following:

- 50-year event with a design discharge of 1,840 cfs
- Mean velocity through structure of 2.4 feet per second
- A high water elevation upstream of the bridge of 1,458.80 feet NGVD 29 (1,460.00 NAVD 88)

- A backwater elevation downstream of the bridge of 1,458.80 feet NGVD 29 (1,460.00 NAVD 88)
- Bridge waterway opening below design stage of 2,517 square feet

In 1999, during the planning process prior to the bridge raising, the NDDOT completed HEC-RAS modeling of the 10-year (677 cfs), 25-year (1,270 cfs), 50-year (1,840 cfs), 100-year (2,500 cfs), and 500-year (4,440 cfs) events at the bridge with a downstream backwater elevation of 1,458.8 feet NGVD 29 (1,460.00 NAVD 88) and all modeled events passed beneath the low beam elevation (1,462.32 feet NGVD 29) (1463.52 NAVD 88) of the bridge (Reference 13 – NDDOT, 1999). The plan sheet showing the existing NDDOT bridge at Mauvais Coulee is presented in Figure 4 of this report. Note that elevations in Figure 4 are in the NAVD 88 datum. The existing bridge is 200 feet long and 42.5 feet wide. The channel bottom elevation at the bridge is 1,436.5 feet NGVD 29 (1,437.7 NAVD 88). There is a 3:1 rip-rap protected slope extending from 7 feet away from the bridge abutment to the channel bottom. There are two piers located approximately 63 feet away from the bridge abutments. The elevation of the bridge deck ranges from approximately 1,466.3 feet NGVD 29 (1,467.5 NAVD 88) to 1,466.7 feet NGVD 29 (1,467.9 NAVD 88). The low beam elevation is 1,462.3 feet NGVD 29 (1,463.5 NAVD 88). The total flow area at the existing Highway 2 bridge at Mauvais Coulee below the low beam is approximately 3,050 square feet (Reference 12 - NDDOT, 2001).

3.3.2.2 Highway 2 Bridge at Channel A

The NDDOT raised the U.S. Highway 2 bridge at Channel A in 2005 to accommodate rising waters in Devils Lake. The bridge was designed for specific flow capacities and a targeted top of bridge deck elevation. The criteria used for the bridge design includes the following:

- 50-year event with a design discharge of 2,000 cfs
- Mean velocity through structure of 2.94 feet per second
- A high water elevation upstream of the bridge of 1,458.85 feet NGVD 29 (1,460.05 NAVD 88)
- A backwater elevation downstream of the bridge of 1,458.80 feet NGVD 29 (1,460.00 NAVD 88)
- Bridge waterway opening below design stage of 449 square feet

In 1999, during the planning process prior to the bridge raising, the NDDOT completed HEC-RAS modeling of the 8-year (500 cfs), 25-year (1,250 cfs), 50-year (2,000 cfs), and 100-year (2,700 cfs) events at the bridge with a downstream backwater elevation of 1,458.80 feet NGVD 29 (1,460.00 NAVD 88) and all modeled events passed beneath the low beam elevation (1,460.29 feet NGVD 29) of the bridge (Reference 11 – NDDOT, 1999). The plan sheet showing the existing NDDOT bridge at Channel A is presented in Figure 5. Note that elevations in Figure 5 are in the NAVD 88 datum. The existing bridge is 100 feet long and 42.5 feet wide. Currently, the triple 9-foot wide and 11-foot tall box culverts (invert elevation of 1,431.0 feet NGVD 29 (1,432.2 NAVD 88) and flow area of 297 square feet) are submerged. The road raise completed in 2005 added a bridge over the triple box culvert as illustrated in Figure 5. The channel bottom elevation at the bridge above the triple box culverts is 1,447.6 feet NGVD 29 (1,448.8 NAVD 88). There is a 2.5:1 rip-rap protected slope extending from 7 feet away from the bridge abutment to the channel bottom. The elevation of the bridge deck is 1,466.0 feet NGVD 29 (1,467.23 NAVD 88). The low beam elevation is 1,460.3 feet NGVD 29 (1,461.49 NAVD 88). The total flow area at the existing Highway 2 bridge at Channel A, below the low beam and including the triple box culvert, is approximately 1,170 square feet (Reference 10 – NDDOT, 2005).

3.3.3 Existing BNSF Structures

3.3.3.1 BNSF Channel A Bridge – Mile-Post 92.2

The existing BNSF Channel A Bridge at Mile-Post 92.2 was designed in 1980. Two plan sheets showing the existing BNSF bridge at Channel A (Mile-Post 92.2) are presented as Figure 6-1 and Figure 6-2. It should be noted that these plan sheets were obtained from BNSF and are not record drawings and elevations shown are in NGVD 29 datum. Actual bridge dimensions may differ from those shown in Figures 6-1 and 6-2. The existing BNSF bridge at Channel A (Mile-Post 92.2) was designed for:

- A 50-year event with a design discharge of 2,000 cfs
- Mean velocity through structure of 4.97 feet per second
- High water elevation of 1,448.2 feet (NGVD 29)
- Bridge waterway below normal depth of 402 square feet

The existing bridge is 97.3 feet long and 14 feet wide plus a 2.75-foot wide walkway. There is a 2:1 rip-rap slope extending from the bridge abutment to the two pier bents which are both located 31 feet from the abutment. Based on the information provided in Figure 6-2, the channel bottom elevation is approximately 1,438.6 feet (NGVD 29), the low beam elevation of the bridge ranges from

approximately 1,452.5 feet (NGVD 29) to 1,452.8 feet (NGVD 29). In addition, Figure 6-2 depicts a top of rail elevation ranging from approximately 1,458.1 feet (NGVD 29) to 1,458.3 feet (NGVD 29); however the survey completed by Land Surveying Service, Inc. in 2010 measured the top of rail ranging from 1,458.70 feet (NGVD 29) to 1,459.0 feet (NGVD 29). The total flow area at the existing BNSF bridge at Channel A (Mile-Post 92.2) below the low beam is approximately 935 square feet. Prior to 1980, there was a 10-foot diameter circular culvert under the BNSF track at Channel A (Reference 8 – BNSF, 1980).

3.3.3.2 BNSF Mauvais Coulee Bridge – Mile-Post 103.6

The BNSF Mauvais (Big) Coulee Bridge at Mile-Post 103.6 was raised in 2001 to accommodate rising water levels in Devils Lake. Two plan sheets showing the existing BNSF bridge at Mauvais Coulee (Mile-Post 103.6) are presented as Figure 7-1 and Figure 7-2. However, it should be noted that these plan sheets were obtained from BNSF, are not record drawings, and elevations shown are in NGVD 29 datum. The actual bridge dimensions may differ from those shown in Figures 7-1 and 7-2. Both figures indicate the bridge was raised on top of the previously existing piles and caps. The 2001 (existing) bridge is 103.8 feet long and 14 feet wide plus a 3.2-foot wide walkway on both sides of the bridge. There are three pier bents which are located 25.75 feet apart and 25.75 feet away from the abutments. The channel bottom elevation was presumably not modified during the bridge raise and is not specified on the plans; however it is likely that the channel bottom elevation at the BNSF bridge is approximately the same as the channel bottom elevation of 1,436.5 feet (NGVD 29) at the U.S. Highway 2 bridge. According to Figure 7-1, the low beam elevation is 1,450.3 feet (NGVD 29). According to Figure 7-1, the elevation of the top of railroad tie is 1,455.0 feet (NGVD 29), so the approximate top of rail is 1,455.6 feet (NGVD 29), however the survey completed by Land Surveying Service, Inc. in 2010 measured the top of rail at 1,455.7 feet (NGVD 29). The total flow area of the existing BNSF bridge at Mauvais Coulee (Mile-Post 103.6) is not specified on the plans, however assuming a channel bottom elevation and width similar to the U.S. Highway 2 bridge at Mauvais Coulee would yield a total flow area of approximately 1,000 square feet at the BNSF bridge (Reference 9 – BNSF, 2001). Detailed borings and surveys at the bridges was determined not to be necessary for this phase of design and cost estimating but would be obtained for the next phase of design.

3.4 Freeboard/Wind Wave Impacts for Proposed BNSF Track Raise

An analysis was completed of the potential wind wave impacts that would affect the proposed BNSF tracks, if the lake level were to reach the peak lake level for the Inflow Design Event of 1,462 feet (NGVD 29) (rounded up from 1,461.9 feet (NGVD 29)). Wind waves are a fetch dependent force, in

which the fetch is the length over which the wind imparts force on the water surface. The fetches studied can be seen in Figure 8. Wave development is also governed by the average water depth along the fetch length. Figure 8 also shows the projected water depths for the peak lake level of the Inflow Design Event (1,462 feet NGVD 29). The wind characteristics for each fetch direction were taken from the US Army Corps of Engineers (USACE) Devils Lake Flood Risk Management Project “Design Criteria and Project Considerations Report” (Reference 1 - USACE 2009).

Wave height was calculated using the Finite Water Depth Wind Wave Model, adapted from the JONSWAP model by Young and Verhagen (1996). Detailed explanation of the model can be found in Chapter 5 of “Introduction to Coastal Engineering and Management” (Reference 15 - Kamphuis 2010). The model inputs are water depth, fetch length, and wind speed. Outputs are the characteristic wave height and peak period. Wave height and peak period are then fed into the Automated Coastal Engineering System (ACES) computer model to compute the wave setup, wave run-up, and preliminary armor sizing. Wave setup is the change in water level at the shoreline due to the wind stress pushing the water toward the shore. The setup plus the wave height gives a minimum elevation required to resist overtopping. Once a wave breaks on the shore line, wave run up comes into play. A function of structure slope, structure material, and wave height, the wave run-up is the vertical distance up the structure from the still water level, which the water travels due to the wave impacting the structure. The structure slopes were assumed to be 1v:2h as taken from drawings provided by BNSF. ACES computer model also provided the average diameter, or d50, of material required to provide protection against the wave parameters calculated.

Ice action during spring thaw was not considered in the wave/wind analysis as 1) it is unlikely that critical ice breakup and movement would occur at the time the water surface would be at its highest point after the design inflow event and 2) there is less science available to compute such movement and buildup. However, ice movement and buildup can damage traditional riprap and filter shoreline protection because it can adhere to and pick up individual rocks or boulders and move them as the ice moves. But ice movement is far less damaging and perhaps even non-damaging when the shoreline protection consists of materials such as Cable Concrete, Armorflex or articulated block. Such materials create a type of shear plane that allows ice to move without picking up and moving the underlying slope protection material with it. Therefore it is recommended, at least in critical reaches that are not otherwise partially protected by roads, dams, or levees, that Cable Concrete, Armorflex or articulated concrete block be considered for the railroad embankment armor protection. This study considered traditional riprap for slope protection.

The project area was divided into two different reaches based on governing water depths surrounding the rail line. A critical reach was identified from Mile-Post 101 to Mile-Post 104.5, based on the significant fetch for north and easterly winds. This reach is identified on Figure 8, and includes the Mauvais Coulee crossing. Average water depths for the defining fetches in this critical reach were approximately 15 feet. The second reach analyzed is essentially the rest of the rail line in the project area. There are many geographical features in the non-critical second reach which act as breakwaters and protect the rail structure to some extent. The only fetch of significance in the non-critical second reach is the Channel A crossing, however it is a southerly fetch. Waves produced by winds from this direction will impact the Highway 2 Bridge prior to the BNSF bridge, thus the wave energy will be somewhat dissipated. Setup and run-up were not calculated for the non-critical reaches. Armor is not required on all reaches of the rail line, and not on both sides due to the protection offered by Highway 2. Thickness of riprap armor and average d50 values can be found in Table 3, as well as critical values for wave parameters.

Table 3 Preliminary Wave and Armor Parameters

Areas	Wave Height (feet)	Wave Setup (feet)	Wave Height + Wave Setup (feet)	Wave Run-up (feet)	Recommended Freeboard (feet)	Location of Required Armor	Average Diameter (d50) of Armor (feet)	Riprap Armor Thickness (feet)
Critical Reach (MP101-MP104.5)	3.2	0.8	4.0	4.0	5.0	North side of track only	1.0	3.0
Non-critical reaches	2.7	Not Calculated	Not Calculated	Not Calculated	4.0	North side of track only except on both sides at Channel A bridge	0.75	1.5

BNSF has recommended at least 4 feet of freeboard above the selected design peak lake level for the top of subgrade elevation. The actual freeboard required to prevent overtopping of the BNSF track subgrade is determined by comparing the wave height plus wave setup with the wave run-up, and designing to which value is larger. In the case of the critical reach, both are approximately equal and thus a proposed freeboard of 4 feet would not adequately protect against the given conditions. Providing 1 foot of additional freeboard above the larger value for the critical reach is therefore recommended. Thus the freeboard for the critical reach (Mile-Post 101 to Mile-Post 104.5) should be 5 feet. In the non-critical reach, wave heights are much lower and the structure is somewhat protected

by natural breakwaters and the Highway 2 embankment. Thus the freeboard for non-critical reach appears to be adequate at 4 feet. Based on the peak lake level of the Inflow Design Event 1,462 feet (NGVD 29), a top of subgrade for the critical reach (Mile-Post 101 to 104.5) of 1,467 feet (NGVD 29) and for the remaining portion of the project area of 1,466 feet (NGVD 29) appear appropriate.

3.5 Hydrologic Design Summary

Following is an overview of key elevations and bridge openings for structures near Devils Lake. The information is also provided in Figure 9.

- The peak lake level for the Inflow Design Event (1/2 Probable Maximum Flood) is 1,462 feet (rounded up from 1461.9 feet) (NGVD 29) at the natural outlet at Tolna Coulee (assuming no lake slope).
- The existing Highway 2 bridge at Channel A has a bridge deck elevation of 1,466.0 feet (NGVD 29) and a low beam elevation of 1,460.3 feet (NGVD 29). The total flow area at the existing Highway 2 bridge at Channel A, including the triple box culvert, is approximately 1,170 square feet.
- The existing Highway 2 bridge at Mauvais Coulee has a bridge deck elevation of 1,466.34 to 1,466.7 feet (NGVD 29) and a low beam elevation of 1,462.3 feet (NGVD 29). The total flow area at the existing Highway 2 bridge at Mauvais Coulee is approximately 3,050 square feet.
- The top of levee/embankment elevation generally used for design around the City of Devils Lake is 1,466.0 feet (NGVD 29) except at the 2 locations with a freeboard requirement of greater than 3.0 feet for which a top elevation of 1,467.0 feet (NGVD 29) was used. A lake slope of one foot was assumed from the natural outlet at Tolna Coulee to the city.
- According to Figure 6-2, the existing BNSF bridge at Channel A (Mile-Post 92.2) has a top of rail elevation of 1,458.0 to 1,458.3 feet (NGVD 29) and a low beam elevation of 1,452.5 to 1,452.8 feet (NGVD 29). The survey completed in 2010 measured the top of rail at 1,459.1 feet (NGVD 29). The total flow area at the existing BNSF bridge at Channel A is approximately 935 square feet. Based on March 2011 lake levels the water level in Channel A is approximately one foot away from reaching the low beam elevation.
- According to Figure 7-1, the existing BNSF bridge at Mauvais Coulee (Mile-Post 103.6) has a top of rail elevation of approximately 1,455.5 feet (NGVD 29) and a low beam elevation of 1,450.31 feet (NGVD 29). The survey completed in 2010 measured the top of rail at 1,455.9 feet (NGVD 29). The total flow area at the existing BNSF bridge at Mauvais Coulee is not specified on the BNSF plan sheets, however assuming a channel bottom elevation and width similar to the U.S. Highway 2 bridge at Mauvais Coulee would yield a total flow area of approximately 1,000 square feet at the BNSF bridge. Based on March 2011 lake levels the

water level in Mauvais Coulee is over the low beam elevation, indicating that the beams are partially submerged.

3.6 Hydrologic Design Conclusions

The list below summarizes the key conclusions of this analysis.

- **Design Peak Lake Level: 1,462 feet (NGVD 29).** It appears to be appropriate to use a peak lake level of 1,462 feet (NGVD 29) (rounded up from 1,461.9 feet (NGVD 29)) to design the proposed raise to the BNSF track between the City of Devils Lake and Churchs Ferry, ND and the BNSF bridges at Channel A and Mauvais Coulee. This elevation corresponds to the peak lake level associated with the Inflow Design Event at the natural outlet to Tolna Coulee that was used for the USACE design of the levees/embankments at the City of Devils Lake. The USGS 2-D model predicted a negligible lake slope for the Inflow Design Event from the natural outlet at Tolna Coulee to the City of Devils Lake and to Pelican Lake. The current USGS 2-D model does not extend far enough north to include the BNSF bridges at Channel A and Mauvais Coulee. Although there are several road crossings between the lake and the BNSF bridges that could backup flow and increase water level, we have assumed in this preliminary analysis that the lake slope between the natural outlet at Tolna Coulee to the BNSF bridges is negligible at the very high lake elevation of the design peak lake level of 1,462 feet (NGVD 29) which is about ten feet higher than the existing lake level.
- **Freeboard for Proposed BNSF Subgrade: 4 to 5 feet.** BNSF has recommended at least 4 feet of freeboard above the selected design peak lake level for the top of subgrade elevation. The wind wave analysis has demonstrated that four feet of freeboard is adequate for most of the project area. However, the analysis indicates a freeboard of more than four feet is required for a critical reach from Mile-Post 101 to Mile-Post 104.5. A freeboard of five feet was selected for this critical reach.
- **Top of Subgrade Elevation of Proposed BNSF Track: 1,466 to 1,467 feet (NGVD 29) Depending on Location.** Based on the preliminary information presented in this report, a top of subgrade of 1,467 feet (NGVD 29) for the reach from Mile-Post 101 to Mile-Post 104.5 (including the Mauvais Coulee crossing) and a top of subgrade of 1,466 feet (NGVD 29) for the remaining reaches in the project area (including Channel A crossing) appear appropriate based on the wind wave analysis and are used in this study. Based on further study, more detailed surveys and the bridge and track design in the later stages of design, these elevations may change.
- **Probability of Devils Lake Overflow to Sheyenne River in the Next 20 Years: 6 to 10 percent.** The probability of the level of Devils Lake to reach the natural overflow elevation of 1,458 feet (NGVD 29) from Devils Lake into the Sheyenne River in the next 20 years is 10

percent if North Dakota's emergency outlet is operated at the current 250 cfs capacity. However, the State of North Dakota is currently undertaking additional strategies to lower the probability even further. The North Dakota State Water Commission is increasing the capacity of the west end outlet from 250 cfs to 350 cfs. The State is also pursuing additional increases in the current outflow from Devils Lake via changes to the water quality standards in the Sheyenne River and the construction of an additional outlet at the east end of Devils Lake with a capacity of 250 cfs. With these additional increases in outflow capacity, the probability of the lake level reaching 1,458 feet (NGVD 29) drops to 6 percent.

- **Low Beam Elevation of Proposed BNSF Bridges: 1,462.5 to 1,463 feet (NGVD 29).** Discussions with the BNSF have indicated that their design goal for the Channel A and Mauvais Coulee bridges is to have the low beam elevations above the design lake level. Selection of a design peak lake level of 1,462 feet (NGVD 29) and given the relatively rare likelihood of that occurring, a minimum low beam elevation of 1,462.5 to 1,463 feet (NGVD 29) for the BNSF bridges at Channel A (Mile-Post 92.2) and Mauvais Coulee (Mile-Post 103.6) appears reasonable. If an event larger than the Inflow Design Event was to occur and a low beam elevation of 1,462.5 to 1,463 feet (NGVD 29) were to be used in the bridge design, it is possible that the bridge beams would be partially submerged for a period of time. As shown in Figure 3, if a Probable Maximum Flood were to occur, the lake would be at an elevation greater than 1,462.5 feet for about 120 days (4 months).
- **Proposed BNSF Channel A Bridge (Mile-Post 92.2) Design Flow Area and Design Flow: 1,170 square feet and 2,000 cfs.** Without a complete hydrologic and hydraulic model of Channel A, the best estimates for a reasonable design flow area and design discharge for the proposed BNSF bridge can be based on comparing the existing Highway 2 and BNSF bridges. The Highway 2 bridge at Channel A was designed with a total flow area of 1,170 square feet and to pass a design flow of 2,000 cfs. The existing BNSF bridge at Channel A was designed with a total flow area of 935 square feet and to pass a design flow of 2,000 cfs. Hence, a flow area of 1,170 square feet designed to pass at least 2,000 cfs for the proposed BNSF bridge at Mile-Post 92.2 appears reasonable. This is based on the assumption that the NDDOT bridge will not be replaced and the plan sheets presented in Figures 5 and 6 accurately portray what actually exists. Under this assumption, the flow restriction from the NDDOT Highway 2 bridge will control the upstream water level and therefore a BNSF bridge of similar capacity will result in similar upstream water levels. If the BNSF bridge were built with a smaller capacity, it would be the more restricting structure and control the upstream water level. Similarly, if the NDDOT bridge were to be replaced with a larger opening and/or a raised low bridge chord, the BNSF bridge would then be the restricting factor and a larger BNSF opening would be necessary to reduce the possibility of the BNSF bridge affecting upstream lake levels for higher flow events. Additional hydrologic and hydraulic analyses would be required to define the potential flood reduction impact of these

scenarios. It is advisable to obtain the HEC-RAS model used by NDDOT to size the U.S. Highway 2 bridge, for further design of the proposed BNSF bridge.

- Proposed BNSF Mauvais Coulee Bridge (Mile-Post 103.6) Design Flow Area and Design Flow: 3,050 square feet and 1,840 cfs.** The assumptions and recommendations described under the Channel A bridge description above also apply to the Mauvais Coulee bridge. The Highway 2 bridge at Mauvais Coulee was designed with a total flow area of 3,050 square feet and to pass a design flow of 1,840 cfs. Based on the plan sheets obtained from BNSF for the 2001 track raise, the exact design flow area and design discharge were not specified. However assuming a channel bottom elevation and width similar to the U.S. Highway 2 bridge at Mauvais Coulee would yield a total flow area of approximately 1,000 square feet at the existing BNSF bridge. Based on the information presented above and in the absence of a complete hydrologic and hydraulic model, a flow area of 3,050 square feet designed to pass at least 1,840 cfs for the proposed BNSF bridge at Mile-Post 103.6 appears reasonable.
- Recommendations for Future Design Stages:** More Detailed Survey of Existing Highway 2 and BNSF Bridges, Analysis of Ice Action, and Extending USGS 2-D Model. For detailed design of the two BNSF bridges in the next phase, a more detailed survey of the existing Highway 2 and BNSF bridges and channels at Channel A and Mauvais Coulee are recommended to obtain a more accurate flow area and low beam elevations. Consideration of potential ice action at the critical reach (Mile-Post 101 to Mile-Post 104.5) should be further evaluated during the final design phase to confirm the proposed structure side slope and armor type are adequate to accommodate the effects of ice break-up during a major wind event. In its existing state, the USGS 2-D lake slope model does not extend to Highway 2 or the BNSF tracks. Extending the USGS 2-D model to include areas north of these major transportation corridors would confirm the lack of lake slope effect at the design peak lake level of 1,462 feet (NGVD 29).
- Summary of Key Elevations:** A summary of key elevations used in this study are listed in Table 4 and are illustrated in Figure 10.

Table 4 Summary of Key Elevations for BNSF Track Raise Study

	Elevation (feet, NGVD 29)
Lake Level in February/March 2011	1,451.7
Natural Lake Overflow at Tolna Coulee	1,458.0
Peak Lake Level for Inflow Design Event (1/2 Probable Maximum Flood)	1,462
Proposed Low Beam Elevation at Channel A Bridge (Mile-Post 92.2) and Mauvais Coulee Bridge (Mile-Post 103.6)	1,462.5 – 1,463

	Elevation (feet, NGVD 29)
Proposed Top of Subgrade for Remaining Reaches of Project Area (Non-Critical Reach)	1,466
Proposed Top of Subgrade from Mile-Post 101 to 104.5 (Critical Reach)	1,467

3.7 References

1. Design Criteria and Project Considerations Report, Devils Lake Flood Risk Management Project, U.S. Army Corps of Engineers, St. Paul District. 21 December 2009.
2. Devils Lake Flood Facts, North Dakota State Water Commission. October 2010.
3. Testimony by Todd Sando, North Dakota State Engineer, to the Senate Budget Committee Devils Lake Hearing “Devils Lake Flooding Disaster: How Should the Federal Government Respond?”, 8 July 2010.
4. Climate Simulation and Flood Risk Analysis for 2008-40 for Devils Lake, North Dakota, Scientific Investigations Report 2008-5011, US Geological Survey, February 2008.
5. USGS National Water Information System, <http://nwis.waterdata.usgs.gov/nwis/>
6. Rachel Nustad, USGS, email communication, 1 December 2010.
7. Rachel Nustad, USGS, email communication, 2 December 2010.
8. Burlington Northern, Inc. Bridge No. 92.2 Over Channel “A” at Grand Harbor in Ramsey County, North Dakota, plan set, Bakke Kopp Ballou and McFarlin, 29 July 1980.
9. Burlington Northern Santa Fe Railway. Bridge 103.6 Over Mauvais Coulee near Churchs Ferry, ND, plan set, Burlington Northern Santa Fe Railway Bridge Engineering, Kansas City, MO, August 2001.
10. North Dakota Department of Transportation. Plans for the Improvement of US Highway 2 – Eastbound & Westbound in Ramsey County, Federal Aid Project No. SER-3-002(088)262, plan set, Kadrmas, Lee and Jackson, Inc., 2 February 2005.
11. North Dakota Department of Transportation. Hydraulic Analysis and Structure Selection, Bridge No. 2-262.330, Project No. NH-3-002(064)248, Ramsey County, prepared by Cliff Scott & Michael Rivinius, November 1999.

12. North Dakota Department of Transportation. Plans for the Improvement of US Highway 2 – Eastbound & Westbound in Ramsey and Benson Counties, Federal Aid Project No. NH-SER-3-002(074)249, plan set, Kadrmass, Lee and Jackson, Inc., 7 March 2001.
13. North Dakota Department of Transportation. Hydraulic Analysis and Structure Selection, Bridge No. 2-250.546 L & R, Project No. NH-3-002(064)248, Ramsey County, prepared by Cliff Scott, October 1999.
14. Report of the Federal Interagency Devils Lake Working Group, December 2010.
15. Kamphuis, J. William. Introduction to Coastal Engineering and Management. 2010.
16. North Dakota State Water Commission. The Oxbow. January 2011.
17. National Weather Service River Forecast Office: North Central River Forecast Center, <http://www.crh.noaa.gov/ncrfc/>

4.0 Track Layout and Design

4.1 General

The feasibility study focused mainly on the Devils Lake Subdivision track from approximately Milepost 91.0 to 106.4 between the City of Devils Lake and Churchs Ferry. A short segment of track on the Rolla Subdivision near Churchs Ferry was incorporated in the evaluation to account for transitioning from the Devils Lake Sub to the Rolla Sub. The study also included an evaluation of removing and replacing existing BNSF bridges at Mauvais Coulee (Mile-Post 103.6) and Channel A (Mile-Post 92.2). The purpose of this analysis is to provide a planning and feasibility study and a 30-percent design for raising the BNSF mainline tracks to assure continuation of rail service if the level of Devils Lake continues to rise to its natural maximum lake level. A raise of the mainline track along its current alignment to top of subgrade elevation 1,466 feet (NGVD 29) in non-critical reaches and 1,467 feet (NGVD) in critical reaches is being evaluated. The non-critical reach extends from Mile-Post 91.0 to Mile-Post 101.0 and from Mile-Post 104.5 to Mile-Post 106.4. The critical reach near Mauvais Coulee extends from Mile-Post 101.0 to Mile-Post 104.5. Figure 10 shows the pertinent elevations for the existing and proposed raise conditions in profile view. Figure 11 shows the outline of Devils Lake and the location of the sections of BNSF mainline track proposed to be raised. A set of 30-percent preliminary drawings can be found in Appendix B.

4.2 Preliminary Track Design

4.2.1 Data Collection

A topographic survey of the BNSF mainline and associated infrastructure from Milepost 90 to Milepost 107 was completed in the fall of 2010 by Land Surveying Services, a sub-consultant to Barr Engineering Co. The work included a profile survey of the track centerline, cross-sectional survey every 500 feet along the track (locating top of rail, centerline of track, shoulders and slope break points, water's edge) and all visible features such as exposed culverts, railroad signals, switches, bridge structures, crude oil pipeline markers, edges of obvious wetlands, buried or overhead utilities, roads and other notable visible features. In addition to and to supplement the topographic survey, digital photos were taken every one-tenth of a mile along the track alignment. Visible culverts were documented for size and type.

Light Detection and Ranging (LIDAR) information generated in 2009 as part of the Red River Basin Mapping Initiative was used to supplement the topographic survey data outside of the railroad

corridor. This data was integrated with the topographic survey to develop an overall basemap for design purposes.

4.2.2 Inventory of Existing Track Materials

An inventory of existing BNSF track materials within the project area was approximated as part of this study. This includes the Devils Lake Sub from approximately Mile-Post 91.03 to Mile-Post 106.06, existing siding track located in Penn, siding tracks located in Churchs Ferry and connecting tracks from the Devils Lake Sub to the Rolla Sub. Materials inventoried include rail, joint bars and accessories, tie plates, rail anchors, spikes, ties, turnouts, derails and signals. Data collected during the topographic survey in conjunction with information provided in BNSF’s Mainline Design Guidelines for Track Projects, BNSF’s Engineering Instructions document and from BNSF personnel was used to estimate the track materials. Quantity Table 5 below provides a summary of the materials inventoried. The values provided are approximate and final quantities may vary.

Table 5 Summary of Existing Track Materials to be Removed

Item	Unit	Quantity
Wood Ties ²	EA	58,350
Rail	Lineal feet	189,600
Tie Plates	EA	116,700
Rail Anchors ¹	EA	116,700
Spikes	Pounds	191,300
Joint Bars ²	EA	4,900
Derail	EA	4
Turnouts	EA	10
Signals	EA	7
Signals with arms	EA	2

¹ Rail anchor quantity shown in table above is based on BNSF track specifications. Actual quantity is expected to be less based on documentation gathered during field survey.

² Estimation of wood ties and joint bars was based on assumed 39-foot lengths of jointed rail and 19.5-inch tie spacing.

4.2.3 Design Criteria/Assumptions

The following design criteria and assumptions were used to prepare 30-percent design drawings.

4.2.3.1 Design Criteria for Track and Bridges

- The vertical datum used for the study shall be NGVD (1929 adjustment), which is also used for the lake level data provided by the USGS.

- Wherever the BNSF mainline top-of-subgrade elevation is lower than 1,466 feet (NGVD 29) and the projected wave height is less than 4 feet (non-critical reach), the track shall be raised to provide a top-of-subgrade elevation of 1,466 feet (NGVD 29).
- In the critical reach (MP 101.0 to MP 104.5) where the projected wave height is 4 feet, the top-of-subgrade will be raised an additional 1-foot to elevation 1,467 feet (NGVD 29).
- Cross-section template for new single mainline track with 13-foot access roadway was applied per BNSF Appendix A “BNSF Engineering Standard Plans” reference Drawing No. 1000, Sheet No. 2, Rev. No. 3 for 30-percent engineering design of track raise from Mile-Post 91.08 to Mile-Post 93.36 and from Mile-Post 93.90 to Mile-Post 103.62.
- Cross-section template for new single mainline track on tangent sections was applied per BNSF Appendix A “BNSF Engineering Standard Plans” reference Drawing No. 1000, Sheet No. 1, Rev. No. 4 for 30-percent engineering design of track raise from Mile-Post 103.62 to Mile-Post 106.07 and for connection to Rolla Sub near Churchs Ferry.
- Passenger train speed of 79 mile per hour was used for design of super elevation. Freight train speed of 50 miles per hour was evaluated, but not used as the passenger train speed governed.
- Existing horizontal curvature was duplicated.
- A rate of change not exceeding 0.1 ft/ft in summits and 0.05 ft/ft in sags was applied for vertical curvature as outlined in BNSF Mainline Design Guidelines for Track Projects, revised September, 2010.
- A 10-degree horizontal curve was used for connection to Rolla Sub at Mile-Post 104.68 per BNSF.
- Riprap (assuming 4” or smaller crushed stone) will be used as railroad embankment material in areas where embankment is expected to be constructed in water. Elevation 1,455 feet (NGVD 29) is assumed as target elevation based on National Weather Service January 2011 forecast of 95-percent probability of lake level reaching Elevation 1,454 feet (NGVD 29).
- Riprap will be used for slope protection.

4.2.3.2 Assumptions

- All mainline track below the proposed design subgrade elevation in critical and non-critical reaches will be removed. The subgrade will be raised to new design elevation and new track will be installed following the exiting track alignment.
- Mainline track will remain out of service during construction period.

- Potential crossings of the BNSF track that would be abandoned with the track raise are based on the assumption that the lake elevation would rise to 1462 feet (NGVD 29) or higher affecting adjacent farmland to the north of BNSF mainline. Evaluation was based on topographic information, aerial photos, and personal judgment and is subject to change.

4.2.4 Track layout and Design

The segment of mainline track along the BNSF Devils Lake Subdivision that would require a raise stretches from approximately Mile-Post 91.03 to Mile-Post 106.06. As previously discussed, areas along this segment were identified as non-critical and critical reaches based on the wave analysis discussed in Section 3.0 of this report. In the non-critical reaches the proposed track subgrade would be raised to elevation 1,466 feet (NGVD 29) and in critical reaches the proposed track subgrade would be raised to elevation 1,467 feet (NGVD 29). The track raise would commence at approximately Mile-Post 91.08 and extend about 12,300 lineal feet to a point where the existing track subgrade is above the proposed design elevation near Mile-Post 93.35. An average of approximately 10 feet of fill would be needed to raise the track within this reach to achieve a top of rail elevation of 1,469.10 feet (NGVD 29). At Mile-Post 93.35 the new track would match the existing track profile to about Mile-Post 93.9. No embankment construction would be required within this segment of track. The existing track would be removed and replaced with new track.

The existing track profile varies in elevation from Mile-Post 93.9 to Mile-Post 101.0, resulting in embankment construction ranging from only a few feet to as much as nine feet. The new track profile would maintain a top of rail elevation of 1,469.10 feet (NGVD 29) to Mile-Post 100.80 where it then transitions at a 0.10 percent grade over 1,000 feet to a top of rail elevation of 1,470.10 feet (NGVD 29) at Mile-Post 101.00. The top of rail elevation would remain at this height through the critical section for 17,700 lineal feet where it then descends at a -0.10 percent grade over 1,000 feet to transition from top of rail elevation 1,470.10 feet (NGVD 29) to top of rail elevation 1,469.10 feet (NGVD 29). The remaining length of track to be raised would maintain a top of rail elevation of 1,469.10 feet (NGVD 29) to a point where it would match the existing top of rail at about Mile-Post 106.06. A significant amount of fill will be required within the critical reach as this area has the lowest existing top of rail elevation. Fill heights in excess of 14 feet are required in some reaches.

It should be noted that the existing track under the Highway 281 overpass will need to be raised approximately three feet. The vertical clearance from the existing top of rail to the underside of the bridge beam is about 22'-3" based on field survey. Raising the track three feet will reduce this height to approximately 19'-3". Section 5.2 "Overhead Structures" located in Appendix Y of BNSF Standard Construction Specifications for Mainline Track outlines a minimum vertical clearance of

23'-4" from top of rail to the lowest obstruction under the structure. BNSF Drawing number 2509, Sheet 2, Rev. 1 located in Appendix G of BNSF's Mainline Design Guidelines provides clearance requirements by State and recommended by BNSF. This document notes a recommended vertical clearance of 21'-0" for highway bridges located in North Dakota. Based on these two references, raising the track to the proposed top of rail elevation will result in a vertical clearance less than recommended. The track raise in this section should be reviewed during the next phase of design.

Two short segments of track approximately 1,500 feet in length connect the Devils Lake Subdivision to the Rolla Subdivision in Churchs Ferry. Raising the Devils Lake Subdivision will also require a raise to these two segments of track in order to maintain a connection to the Rolla Subdivision. The design of these two connections mirrors the existing alignment to the extent possible. An adjustment in the horizontal curvature to the west side connection was required as the existing curvature appears to not follow any standard horizontal curvature. A 10 degree curve approximates the existing alignment and was used for this segment per BNSF. The existing turnout on the Rolla Subdivision where these two tracks converge will need to be removed and a new turnout installed approximately 100 feet north to allow the new tracks to tie into the existing track. Relocation of this turnout is a result of a change in the curvature of the west connecting track. A 1.0 percent vertical grade was applied to both tracks to transition from the Devils Lake Subdivision to a point where the new track ties into the existing Rolla Subdivision.

Several culverts exist along the Devils Lake Subdivision where the existing track is proposed to be raised to a higher elevation. Culverts that were visible and accessible were identified during the field survey. Culverts that were unable to be located in the field were identified based on BNSF documents. Existing culverts range in size and type. For this level of design it was assumed that the existing culverts would be abandoned or removed and new corrugated metal pipe culverts would be installed in close proximity to the existing. Where existing culvert diameters are 36-inches or less, a new 36-inch pipe culvert would be installed. Where multiple culverts exist with diameters of 36-inch or greater, new 36-inch diameter culverts would be installed of the same number as existing or greater. All existing culverts below elevation 1,455 feet (NGVD 29) would be replaced with a new culvert at an invert elevation of 1,455 feet (NGVD 29). This elevation was chosen based on the most recent lake level prediction after snowmelt this year. Culverts at this elevation will essentially act as equalizer pipes as the water level would be the same elevation on either side of the track. Culvert(s) located with invert elevations above 1,455 feet (NGVD 29) would be replaced with new pipe culvert(s) at an invert elevation where the toe of the new embankment would intersect the existing

ground at that location. Additional review and analysis should be considered as part of the final design.

4.3 Existing Bridges

4.3.1 Channel A Bridge

The existing bridge at Channel A is a three span bridge with a total length of 97.33 feet. The superstructure cross-section is 14 foot wide and consists of four simply supported W33 X 118 steel beams with a composite cast-in-place (C-I-P) concrete deck. The piers are pile bents made up of a 6 HP 14 x 89 piles in a single row. The piles are embedded into a concrete pier cap which supports the superstructure. A reinforced concrete strut is poured at the flow line and diagonal channels help brace the piles above the strut. The abutments are a parapet style and are supported on 2 rows of HP 12 x 53 piles. A 6.5 foot long wing is supported off the abutment foundation. The abutment piles are designed for a maximum load of 39.7 tons and the pier piles have a maximum load of 54.2 tons.

4.3.2 Mauvais Coulee Bridge

The existing Mauvais Coulee bridge is a four span bridge with a total length of 103.78 feet. The original construction plans were not available so plans from a 2001 repair to raise the superstructure were used for evaluation purposes. The superstructure cross-section is 14 foot wide and consists of 7-foot wide x 1.67-foot deep, precast/pre-stressed panels with special concrete curbs cast into the panels. The curbs retain the ballast fill under the track and ties. The piers appear to be pile bents made up of H-piles in a single row. The piles are most likely embedded into a concrete pier cap which supports the superstructure. The abutments are a parapet style and appear to be supported on 2 rows of H- piles. A 22.5-foot long wing supported by HP 14 x 89 soldier piles was added to the abutments during the 2001 repairs.

4.3.3 Bridge Replacement

For the new replacement bridge estimate, it was assumed that the bridges would be similar to the existing Channel A bridge described earlier. The total bridge length for the Channel A bridge is assumed to be 127-feet long and 145-feet long for the Mauvais Coulee bridge. The super structure would be unchanged except for a slight increase in quantities to reflect the longer length. The existing top of rail elevation at the Channel A bridge is approximately 1,459.10 feet (NGVD 29) and would be raised 10 feet to top of rail elevation 1,469.10 feet (NGVD 29). The existing top of rail elevation at the Mauvais Coulee bridge is approximately 1,455.90 feet (NGVD) and would be raised about 14 feet to a top of rail elevation of 1,470.10 feet. For the piers it was assumed that the pile bents would be 10 feet and 14 feet higher than existing and that the cap and strut used in the original

design would be used for quantity purposes. The abutments for the cost estimate were assumed to be 10 feet and 14 feet higher than the original abutments. This caused a significant increase in the lateral loads and required a wider footing and additional piles. The increase in height also required the addition of longer wing walls. A 24-foot long reinforced wing wall supported on piles was used in the cost estimate.

4.4 Utility and Adjacent Property Impacts

4.4.1 Utility Identification

Research was completed to identify potential utilities that may exist along the mainline corridor. Ground and air photos, field survey, BNSF drawings, and drawings received from Enbridge Pipeline were used to identify utility type and approximate location. An assessment was completed to determine the potential impact to each utility with the proposed railroad grade raise. Several utilities were noted and are identified on the 30-percent preliminary design drawings located in Appendix B. Existing utilities include overhead and underground electrical lines, fiber optic, telephone, cable TV and a 16-inch crude oil pipeline.

Most of the utilities were found to parallel the existing railroad centerline and are located outside the proposed limits of construction with the exception of a couple locations. An Enbridge crude oil pipeline extends under the existing Devils Lake Subdivision at approximately Mile-Post 92.3. The pipeline is currently encased in a 20-inch diameter casing which extends 75 feet under the railroad grade based on Enbridge Pipeline Drawings number B-81-5.7-10145-13-40. The railroad grade is proposed to be raised 12 feet higher in this location which will result in extending the toe of the embankment outward on both sides of the track. BNSF guidelines for encasement of utilities under railroad tracks state that the greater of the following distances measured at right angles to the track centerline shall apply:

1. Two feet beyond toe of slope
2. Three feet beyond ditch line
3. Twenty-five feet from centerline of outside track when casing is sealed at both ends
4. Forty-five feet from centerline of outside track when casing is open at both ends
5. If additional track is planned for future construction, casing must extend far enough to meet above distances given the additional track requirements.

Based on this information and the extent of construction proposed in this area, additional encasement will be needed to protect the pipeline.

Overhead power lines cross the BNSF Devils Lake Subdivision at three locations and at one location on the connecting track to the Rolla Subdivision near Churchs Ferry. The first location is at approximately Mile-Post 93.75. The proposed railroad grade in this location mirrors the existing grade; therefore it is assumed that there will be no impact to the existing power line at this location. The second location is near the town of Penn at Mile-Post 98.34. The railroad grade at this location is proposed to be raised nearly two feet which may require a raise to the overhead power line. Additional research is recommended to determine if the power line needs to be raised. The third and fourth location where overhead power crosses BNSF track is near Churchs Ferry. A power line extends in the north-south direction just west of Walker Street crossing the Devils Lake Subdivision at Mile-Post 104.4 and connecting track to the Rolla Subdivision. The railroad grade at these two locations is proposed to be raised eight to nine feet. Based on this information, it is assumed the power line crossing the BNSF track at both locations will need to be raised.

4.4.2 Property Impacts

Raising the Devils Lake Subdivision and connecting tracks to the Rolla Subdivision will require widening of the existing railroad embankment thus impacting adjacent properties. Research of property ownership and easements along the project corridor is still underway. Information shown on the 30-percent preliminary design drawings includes right-of-way data from BNSF drawings. Given the information currently available, it is difficult to complete a full assessment of the impacts to adjacent properties and associated costs of these impacts. Additional information such as utility mapping/lease agreements and permit information was not obtainable within the timeframe of this study; therefore it is recommended that further evaluation is necessary to identify potential impacts and associated costs. At present this information is being compiled and will be included on future plan sheets once it becomes available. Potential impacts and associated costs will be addressed and included in a future submittal.

5.0 Permitting

5.1 Permit Review

Research of the BNSF right-of-way that would be impacted by raising the mainline track on the Devils Lake Subdivision was performed in order to provide an opinion regarding necessary construction and environmental permits that may be required. The scope of this work did not include wetland delineation or other detailed environmental studies.

Table 6 identifies the potential construction and environmental permits that may be needed for the project including the agency, permit or authority, agency action, time for completion of permit or approval, and likelihood that the permit or approval will be required. Requirements for these permits or approvals are further described in Section 5.2 of this report. Resources that were consulted for this analysis are listed at the end of Section 5.2.

Table 6 Potential Environmental Permits and Approvals

Agency	Permit or Authority	Agency Action	Time to Complete
U.S. Army Corps of Engineers (COE), Omaha District	Section 404 of the Clean Water Act (CWA); Section 10 of the Rivers and Harbors Act (RHA) Likelihood: UNKNOWN	Consider issuance of permit for placement of dredge or fill material into waters of the United States, including in wetlands, and for work in wetlands and establishing compensatory mitigation.	3 to 18 months depending on type of 404 permit required
	Section 106 of the National Historic Preservation Act (NHPA) Likelihood: LOW	Consultation with local tribes and other Native American groups concerning potential impacts of the proposed activity on cultural resources.	3 to 12 months depending on likelihood for adverse effects or controversy
Surface Transportation Board (STB), U.S. Department of Transportation	Environmental Review under the National Environmental Policy Act (NEPA) and the NHPA Likelihood: LOW	Determine whether the proposed action requires environmental review or qualifies for a categorical exclusion.	2 months to 2 years depending on qualification for a categorical exclusion
U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS)	Section 7 of the Endangered Species Act (ESA) Likelihood: LOW	Consultation to determine potential effects on endangered and threatened species and migratory birds.	3 months to 2 years depending on impacts to listed species

Agency	Permit or Authority	Agency Action	Time to Complete
U.S. Department of the Interior, National Park Service (NPS)	Activities on Federal Lands Likelihood: LOW	Consultation regarding potential impacts to the Silver Lake National Wildlife Refuge and similar uses in the project area.	2 months to 2 years depending on presence of federal lands
State Historical Society of North Dakota, State Historic Preservation Office (SHPO)	Section 106 of the National Historic Preservation Act (NHPA) and North Dakota Century Code 55-02-07 Likelihood: HIGH	Consultation with local tribes and other Native American groups concerning potential impacts of the proposed activity on cultural resources.	3 to 12 months depending on likelihood for adverse effects or controversy
North Dakota Department of Health (NDDH), Division of Water Quality	NDDH Rules, Chapters 33-16-01 and 61-28; Section 401 Water Quality Certification Likelihood: HIGH	Consider issuance of NPDES Permits for temporary dewatering and construction storm water discharge (NDR10-000) and certification of the Corps permit under Section 401 of the CWA.	4 to 6 months
North Dakota State Water Commission	Permit to Construct within Islands and Beds of Navigable Streams and Waters Likelihood: UNKNOWN	Consider issuance of Sovereign Land Use Permit for activities in and near Devils Lake.	3 to 4 months
North Dakota Department of Parks and Recreation	Oversight of activities on Department lands Likelihood: LOW	Consultation regarding activities on or near Department lands that could temporarily impact use of park lands.	6 to 12 months depending on presence of Department lands
Ramsey County	County land use and other permits, if applicable Likelihood: LOW	Consultation regarding the need for a conditional use permit, water resource district drainage permit, or floodplain development permit.	2 to 4 months
Benson County (if applicable)	County land use and other permits, if applicable Likelihood: LOW	Consultation regarding the need for a conditional use permit, water resource district drainage permit, or floodplain development permit.	2 to 4 months

Agency	Permit or Authority	Agency Action	Time to Complete
City of Devils Lake (if applicable)	Building Permit, Excavating Permit, Floodplain Development Permit Likelihood: UNKNOWN	Permits may be required for construction activities within the city limits.	2 to 4 months
City of Churchs Ferry (if applicable)	Floodplain Development Permit Likelihood: LOW	Permits may be required for construction activities within the city limits.	2 to 4 months
Coulee Township	Floodplain Development Permit Likelihood: LOW	Consultation regarding the need for a floodplain development permit.	2 to 4 months

The project area has been a railroad corridor for many years. The historical rail operations and certain activities on adjacent properties may present a potential risk for the release of hazardous substances or petroleum to the soil or groundwater in the project area. In general, the concern with rail corridors increases at rail yards, fueling operations, and rail sidings where materials are stored, handled, and transferred. Rail sidings are present at Churchs Ferry and Penn in the project area.

A cursory review of the site was conducted to preliminarily assess the above concerns within the rail corridor by conducting an internet search for information regarding the presence of contaminated sites near the project area and assessing if pipelines were present near the rail corridor. The internet search did not identify any federal Superfund or state brownfield sites located near the project area. Information was not readily available for other potential release sites (e.g., petroleum leaks, old farm dumps, train derailments, agricultural chemical spills, etc.).

The National Pipeline Mapping System (NPMS) web site identified an Enbridge crude oil pipeline, which parallels the rail corridor for approximately 12 miles. A natural gas pipeline operated by Williston Basin Interstate Pipeline Company also crosses the rail corridor just outside of the Devils Lake city limits. No other pipelines were identified by the internet search.

In addition to the internet search, a BNSF employee with 28 years of experience in the project area was interviewed for this analysis. The BNSF employee, Mike Woolridge, had conducted his own analysis and determined that no historical environmental concerns are likely in the project area. Mr. Woolridge's determination was based on his years of experience with maintenance of the railroad in the Devils Lake area as well as his investigation of BNSF incident files, which turned up no incident reports for the stretch between Devils Lake and Churchs Ferry. Mr. Woolridge had also spoken with

Chris Roberts of the North Dakota Department of Health, who also had no records of any spills or other incidents involving hazardous materials or other pollutants along the subject stretch of railroad. Mr. Woolridge's conclusion that no environmental concerns are likely to be found in the project area is supported by the supplemental research discussed above.

The historical rail operations and the presence of the petroleum pipeline present a risk for subsurface contamination in the project corridor. However the planned project to raise the railroad embankment will involve limited excavations areas, which reduces concerns for the project to encounter potential subsurface contamination.

If it is determined that the risks for potential subsurface contamination need to be assessed further, then a Phase I Environmental Site Assessment following the provisions of ASTM 1527-05 could be completed for the project corridor. The Phase I could involve additional efforts such as:

- Conducting interviews with current and former railroad employees, property owners, and city and county officials with historical knowledge of the project area
- Ordering and reviewing an environmental regulatory database report for the project area.
- Ordering and reviewing historical aerial photos, maps, railroad records, etc for the project area.
- Conducting site reconnaissance of the project area by an environmental professional

If additional assessment is deemed necessary after completing the Phase I, then a Phase II investigation (soil borings with sampling and analyses) could be completed at areas of concern where project excavations are planned that might encounter potential subsurface impacts. If a Phase II investigation is completed, the drilling work could be coordinated with geotechnical investigations conducted in support of the project.

5.2 Permit Summary

The following summarizes the necessary permits, federal, state, city, and local; their conditions and requirements; and their effects on the application and review process schedule.

5.2.1 U.S. Army Corps of Engineers, permits under Section 404 of the CWA and Section 10 of the RHA

Activities to raise (and therefore presumably to widen) the railroad bed will have permanent impacts (drain or fill) to water features currently adjacent to the railroad right-of-way. In addition, construction activities are likely to have temporary impacts to adjacent wetlands. Wetland

delineations should be conducted within the construction corridor to determine the extent to which such waters could be considered “Waters of the U.S.” and therefore jurisdictional to the Corps of Engineers. Based on a recent determination by the COE for a proposed North Dakota Department of Transportation project to raise the bed of portions of U.S. Highway 2 in Ramsey County, the wetlands along the BNSF right-of-way are likely to be non-jurisdictional, in which case no 404 permit would be required. However, if any wetlands or waterbodies are determined to be jurisdictional to the COE, the wetland delineations will aid in determining the acres of impacts and to confirm the project’s eligibility under a Nationwide Permit (NWP). Assuming qualification under a NWP 3 or 14 (less than .5 acre of permanent fill or loss of waters of the U.S.) and few additional regulated impacts (e.g. no takings of threatened or endangered species, no adverse effects to eligible historic properties), the environmental review process will be well-defined and of short duration as defined by the applicable NWP and COE guidelines. Wetland delineations may be performed in May or June at the earliest and the permitting process could take approximately three months from the time of application, including the wetland delineation report. If the permanent jurisdictional wetland impacts will be greater than 0.5 acre, the project will likely require an Individual Permit under Section 404 and the permitting process could take as long as 18 months.

5.2.2 U.S. Army Corps of Engineers, Section 106 Consultations

As part of the federal government’s trust responsibility and procedural requirements under both NEPA and the NHPA, the COE must consult with local Indian Tribes and Native American groups and the North Dakota SHPO regarding the proposed project, and must make a determination on the likelihood that the project will cause adverse effects to cultural resources. The project will engage a cultural resources consultant to determine whether field surveys are necessary, and to develop a report outlining the known resources in the project area and making a recommendation as to the project’s likely impacts on those resources. The COE, in consultation with the North Dakota SHPO, will either concur in the findings of the report or will recommend further avoidance, minimization, or mitigation of impacts. The chances that field surveys will be required are minimal because the area is already a highly-disturbed transportation corridor, and the proposed project presents a de minimis incremental visual impact on the surrounding area. The COE must decide when it has satisfied its responsibility for consultation, but there is no statutory timeline for such consultations.

Disagreements on the part of any tribe or group have the potential to delay the issuance of a permit from the COE; however, given the nature of the proposed project, such delays are not likely.

Expected time for the COE to complete these consultations is 3 to 18 months.

5.2.3 Surface Transportation Board, environmental review under 49 CFR 1105

The STB is an economic regulatory agency charged with resolving freight railroad rate and service disputes, reviewing proposed rail mergers, rail line purchases, constructions and abandonments. The STB may have jurisdiction over the proposed action because the BNSF line is an interstate railroad. Under NEPA and the NHPA, the Office of Environmental Analysis within the STB must conduct an environmental analysis for actions that come before the STB and make a recommendation to the STB (the STB's environmental rules are found at 49 CFR 1105). Given the nature of the proposed action, and assuming that no significant impacts are likely (such as to endangered species or historical properties), it is likely that the proposed action would qualify for a categorical exclusion. The STB would need enough project information, including a summary environmental review, with which to make this determination.

5.2.4 U.S. Fish and Wildlife Service, Consultations under Section 7 of the Endangered Species Act

In concert with any proposed federal action (COE permit or STB approval), such federal agencies must consult with the USFWS to determine whether the proposed action could have adverse effects on federally listed species. Available information shows that there are several listed bird species with breeding ranges in and around the project area. Often the project proponent is allowed to consult directly with the USFWS, which can expedite the process of determining whether there are particular species of concern in the project area and what, if any, avoidance, minimization, and mitigation measures the USFWS is likely to recommend. Such early consultations are a good way to avoid project delays later in the permitting and environmental review process. The time to complete the USFWS consultation process can be 3 months to 2 years depending on impacts to listed species.

5.2.5 National Park Service and North Dakota Department of Parks and Recreation

Several state and federal recreational facilities exist in the area, including the Silver Lake National Wildlife Refuge near the City of Church's Ferry. Consultations and investigations will confirm whether state or federal lands are crossed by the existing railroad grade or would be impacted by the proposed project. The time to complete consultations with the Park Service and ND Parks and Recreation can be 2 months to 2 years depending on presence of federal or state lands.

5.2.6 North Dakota Department of Health, Division of Water Quality, NPDES permits for temporary dewatering and storm water discharge; Section 401 Water Quality Certification

North Dakota NPDES general permits are relatively straight forward to secure (1 to 2 months), provided that the applicant can adequately characterize the project impacts and areas of discharge. The NDDH also requires quarterly discharge monitoring reports (DMRs) for activities under the permit. In addition, the NDDH has water quality certification authority under Section 401 of the CWA and will coordinate with the COE to certify the 404 permit, if required. This process is rolled into the COE's NWP process and is largely pro forma.

5.2.7 North Dakota State Water Commission, Sovereign Land Use Permit

The State Engineer at the SWC determines the eligibility of rivers and lakes as 'navigable' under this permit authority. The SWC maintains Devils Lake basin maps and will determine whether any proposed actions would occur within North Dakota sovereign lands, thus requiring a sovereign land use permit. The process does not require additional environmental review and the time to acquire a permit is typically 3 to 4 months.

5.2.8 Ramsey County and Coulee Township

Most if not all of the project is within Ramsey County and Coulee Township. County ordinances were not readily available and the county does not appear to have a zoning ordinance or conditional use permit process, but county and township officials should be contacted to determine whether the proposed activity would require a conditional use permit, a variance from the zoning code, a floodplain development permit, or similar approval. If required, such a process typically takes 2 to 4 months and requires minimal effort and project information. Because all work would occur within the existing railroad right-of-way, it is unlikely that any such approvals would be required.

5.2.9 City of Devils Lake

If any portion of the project is within the Devils Lake city limits, the city may require a building permit, excavating permit, or floodplain development permit for the proposed activities. Both building and excavating permits appear to require minimal time and effort to complete. In addition, based on the City of Devils Lake zoning map, the existing railroad grade is within an area that is zoned for such activity and therefore a variance from the code is not likely to be required. If required, these permits could take from 2 to 4 months to secure.

5.2.10 Benson County and Church's Ferry

If a portion of the project would extend into Benson County and the city limits of Church's Ferry, similar inquiries should be made as mentioned above for Ramsey County and Devils Lake. Benson County also does not appear to have a zoning ordinance or conditional use permit process, and because all work would occur within the existing railroad right-of-way, it is unlikely that any such approvals would be required. If required, any permits could take from 2 to 4 months to secure.

5.2.11 Resources

The following resources were consulted for the preceding analysis of potential versus likely environmental permits and issues and time to complete.

- Project Concept Report, NH-3-002 (064) 248, U.S. Highway 2 – Draft; Kadrmas, Lee & Jackson, Consulting Engineers and Surveyors; September, 2000
- Project Concept Report, MER-3-002 (130) 256, RP 256 to RP 258 PERM GRADE RAISE EB/WB (U.S. Highway 2); North Dakota Department of Transportation, Derek D. Pfeifer, P.E., Principal Author; October, 2010 (provided in December, 2010 by Matt Linneman, P.E., NDDOT Support Center)
- NDDOT Solicitation of Views (agency consultation letters), Project Number MER-3-002 (130) 256, PCN 18295 – Ramsey County, U.S. Highway 2 EB/WB from RP 256 to RP 258; August, 2010 (provided in December, 2010 by Chad M. Orn, Environmental and Transportation Services Division, NDDOT)
- NDDOT Staff: Telephone conversations and e-mail responses from NDDOT staff were helpful in providing likely permits, time estimates for said permits, and other resources discussed above. Staff who responded to requests for information were:
 - Derek Pfeiffer, P.E., NDDOT Support Center
 - Matt Linneman, P.E., NDDOT Support Center
 - Chad Orn, Environmental and Transportation Services Division
 - Greg Semenko, Assistant District Engineer, Devils Lake District

6.0 Opinion of Probable Project Cost

6.1 General

An opinion of probable project cost was developed for raising BNSF mainline between Devils Lake and Churchs Ferry, North Dakota including a short section of the Rolla Subdivision to account for run-off due to raising the Devils Lake Subdivision. The cost reflects raising the track subgrade to elevation 1,466 feet (NGVD 29) in non-critical areas and subgrade elevation 1,467 feet (NGVD 29) in a critical reach as determined from Barr's wave analysis. Non-critical reaches extend from Mile-Post 91.0 to Mile-Post 101.0 and from Mile-Post 104.5 to Mile-Post 106.4. Critical reach is from Mile-Post 101.0 to Mile-Post 104.5.

6.2 Resources

Several resources were used to develop the opinion of probable project cost presented in this section of the report. Resources include 2010 bid tabulations from North Dakota Department of Transportation projects within the Devils Lake area, recent U.S. Corps of Engineers bid tabulations for levee raises around Devils Lake, and consultation with a representative of Park Construction and Railworks Track Systems, Inc.

6.3 Assumptions

The following assumptions were used to prepare the project cost.

- All mainline track below the proposed design subgrade elevation of 1,466 feet (NGVD 29) in non-critical reaches and elevation 1467 feet (NGVD 29) in critical reaches will be removed, subgrade will be raised to new design elevation, and new track will be installed following the exiting track alignment.
- Mainline track between approximately Mile-Post 93.0 and Mile-Post 94.0 where subgrade elevation is at or above proposed subgrade elevation 1,466 feet (NGVD 29) would be removed and replaced with new track.
- Bridge crossing at Mauvais Coulee and Channel A will be removed. The new bridge will be installed at the proposed bridge deck design elevation as shown on Figure 9 at its existing location. Bridge would be same type of structure (concrete) as existing.
- Mainline track will remain out of service during construction period.
- All construction would be completed by earthwork and rail contractors.
- Construction would be completed in 2011.

- All track materials removed would remain property of owner.
- New rail will consist of 136 pound continuous welded rail per BNSF.
- Wood ties will be used per BNSF.
- All crossings to remain will be concrete panel crossings per BNSF.
- All track signaling and crossing signals with arms will be new. Power to new signaling is included in the cost.
- Track removal and installation is based on a forty man crew working 6 days per week.
- Existing pipe culverts would remain and new pipe culverts would be installed adjacent to existing.
- Rock will be used as railroad embankment material in areas where embankment is expected to be constructed in water. Rock embankment material would likely consists of 4-inch (or smaller) crushed stone.
- Riprap used for slope protection would consist of size and thickness identified in Table 3.
- Embankment material placed above elevation 1,455 feet (NGVD 29) will consist of a granular material.
- Earthwork and bridge construction is based on working 2-10 hour shifts 5 days per week.
- Encasement of Enbridge crude oil pipeline will be needed at one location.
- Existing power line will need to be raised at two locations where it crosses the existing railroad grade near Churchs Ferry.
- Impacts to adjacent property are unknown at this time. An estimated cost was included in the opinion of probable project costs as a placeholder. This value will need to be updated once more information becomes available. Cost shown in table is based on an estimate of property outside of BNSF right-of-way that will be affected by the track raise. A \$2,500 per acre price was used which includes current land prices and miscellaneous fees.
- Environmental impacts are unknown at this time. A lump sum of \$500,000 was included for environmental impacts that may be required as part of permitting or construction. Specific tasks have not been identified, but could include issues related to potential wetland mitigation, cultural resources, threatened and endangered species, hazardous toxic radioactive waste (HTRW) cleanup, or other environmental concerns.

- Item 21 “Signals and Accessories” estimate was provided by BNSF and includes installation of 7 intermediate signals; installation of 1 crossing warning location with gates/flashers (complete); installation of 2 HT cases; and installation of new meter service at 10 locations. It was assumed that each new wayside location will be installed PTC ready.
- Item 28 “Existing Rail and OTM Salvage Value (Deduct)” estimate was provided by BNSF which represents the salvage value of the rail and other track materials that would be removed and salvaged as part of the track raise between approximately Mile-Post 91.0 and Mile-Post 106.4 along the Devils Lake Subdivision .

Table 7 below summarizes the project costs based on the assumptions outlined above and information gathered during our evaluation and preliminary design efforts.

Table 7 Opinion of Probable Project Costs

Opinion of Probable Project Costs
BNSF Mainline Track Between Devils Lake and Churchs Ferry, North Dakota
Devils Lake Subdivision from Approximately Mile-Post 91.0 to Mile-Post 106.4 and Rolla SubDivision Run-off
Subgrade Elevation 1466 Feet in Non-Critical Area and Subgrade Elevation 1467 Feet in Critical Area
March 29, 2011

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Amount
1	Mobilization, 5%	LS	1	\$2,800,000.00	\$2,800,000.00
2	Erosion Control	LS	1	\$250,000.00	\$250,000.00
3	Embankment Foundation Prep.	LS	1	\$56,000.00	\$56,000.00
4	R.R. Granular Embankment (> Elev. 1455)	CY	756,000	\$10.00	\$7,560,000.00
5	R.R. Embankment (< Elev. 1455)	TON	634,500	\$30.00	\$19,035,000.00
6	Sub-ballast	CY	108,300	\$26.00	\$2,815,800.00
7	Aggregate Base for Road Crossings	CY	3,600	\$16.00	\$57,600.00
8	Culverts	LF	2,705	\$50.00	\$135,250.00
9	Riprap for Slope Protection	TON	166,500	\$40.00	\$6,660,000.00
10	Traffic Control	LS	1	\$20,000.00	\$20,000.00
11	Quality Control/Quality Assurance Testing	LS	1	\$20,000.00	\$20,000.00
12	Bridge Construction (Mauvais Coulee and Channel A)	EA	2	\$975,000.00	\$1,950,000.00
13	Remove Track	TF	94,800	\$9.00	\$853,200.00
14	Remove Turnouts	EA	10	\$5,000.00	\$50,000.00
15	Remove Crossing Signals with Arms	EA	2	\$3,000.00	\$6,000.00
16	Remove Signals	EA	7	\$2,700.00	\$18,900.00
17	Remove Concrete Crossings	EA	1	\$2,700.00	\$2,700.00
18	Remove Timber Crossings	EA	19	\$2,600.00	\$49,400.00
19	F&I Track and Accessories	TF	82,800	\$175.00	\$14,490,000.00
20	F&I Turnouts	EA	4	\$190,000.00	\$760,000.00
21	F&I Signals and Accessories	LS	1	\$1,610,000.00	\$1,610,000.00
22	F&I Concrete Crossings	TF	400	\$475.00	\$190,000.00
23	20-inch Pipeline Encasement	LF	60	\$1,600.00	\$96,000.00
24	Overhead Power Line Raise	LS	1	\$10,000.00	\$10,000.00
25	Turf Establishment	Acre	22	\$3,000.00	\$66,000.00
26	Environmental Impacts	LS	1	\$500,000.00	\$500,000.00
27	Easements/Land Acquisition	Acre	14	\$2,500.00	\$35,000.00
28	Existing Rail and OTM Salvage Value (Deduct)	LS	1	-\$1,980,000.00	-\$1,980,000.00
	Subtotal: (Items 1-28)				\$58,116,850.00
29	Contingency, 20%	LS	1	---	\$11,623,000.00
30	Engineering/Construction Admin., 10%	LS	1	---	\$5,812,000.00
	Total: (Items 1-30)				\$75,552,000.00

The opinion of probable project cost provided in this feasibility study report is made on the basis of Barr's experience and qualifications and represents our best judgment as experienced and qualified professionals familiar with the project. The cost opinion is based on project-related information available to Barr at this time and includes a 30-percent preliminary design of the project. The opinion of cost may change as more information becomes available and further design is completed. In addition, since we have no control over the cost of labor, fuel, materials, equipment, or services furnished by others, or over the contractor's methods of determining prices, or over competitive bidding or market conditions, Barr cannot and does not guarantee that proposals, bids, or actual project costs will not vary from the opinion of probable project cost.

7.0 Preliminary Construction Schedule

7.1 General

A preliminary construction schedule was developed for raising BNSF mainline between Devils Lake and Churchs Ferry, North Dakota including a short section of the Rolla Subdivision to account for run-off due to raising the Devils Lake Subdivision. The construction schedule encompasses all removal of track and accessories, earthwork for embankment construction, bridge construction, and installation of new track and accessories from approximately Mile-Post 91.0 to Mile-Post 106.4 on the Devils Lake Subdivision including connections to the Rolla Subdivision near Churchs Ferry. The estimated construction schedule can be found in Appendix C.

7.2 Resources

Contractors who are familiar with the items of work to be completed and the project site conditions were consulted to aid in developing the preliminary construction schedule. A representative from Park Construction, who has completed several earthwork projects within the area around Devils Lake, assisted in developing the timeline to complete the earthwork related items. Likewise a representative from Railworks Track Systems, Inc., a railroad contractor who has constructed track for many years, provided assistance with the timeline to remove the existing track and install new track.

7.3 Assumptions

The following assumptions were used to prepare the construction schedule.

- All mainline track below the proposed design subgrade elevation of 1,466 feet (NGVD 29) in non-critical reaches and elevation 1467 feet (NGVD 29) in critical reaches will be removed, subgrade will be raised to new design elevation, and new track will be installed following the exiting track alignment.
- Mainline track between approximately Mile-Post 93.0 and Mile-Post 94.0 where subgrade elevation is at or above proposed subgrade elevation 1,466 feet (NGVD 29) would be removed and replaced with new track.
- Bridge crossing at Mauvais Coulee and Channel A will be removed. The new bridge will be installed at the proposed bridge deck design elevation as shown on Figure 9 at its existing location. Bridge would be same type of structure (concrete) as existing. Precast concrete structures would be used instead of cast in place.
- Mainline track will remain out of service during construction period.

- All construction would be completed by earthwork and rail contractors.
- Track removal and installation is based on a forty man crew working 6 days per week.
- Earthwork and bridge construction is based on working 2-10 hour shifts 5 days per week.
- Embankment material will be hauled to project site via on-road trucks with belly dump or side dump trailers.
- Procurement of construction materials is not included in construction schedule.

8.0 Devils Lake Subdivision Rail Replacement

8.1 General

The values provided in Table 7 represent an opinion of probable project costs for raising the Devils Lake Subdivision from approximately Mile-Post 91.0 to Mile-Post 106.4 and the Rolla Subdivision run-off. NDDOT has requested relay of rail outside the proposed track raise limits be included in this report. These limits account for approximately 55.5 miles of bolted rail along the Devils Lake Subdivision per BNSF. This rail relay is a requirement for AMTRAK operations. BNSF has estimated the cost at \$28,900,000 for new rail relay. They have estimated the salvage value of the existing 55.5 miles of bolted rail and other track materials to be approximately \$7,010,000.

Appendices

Appendix A
Hydrology Figures

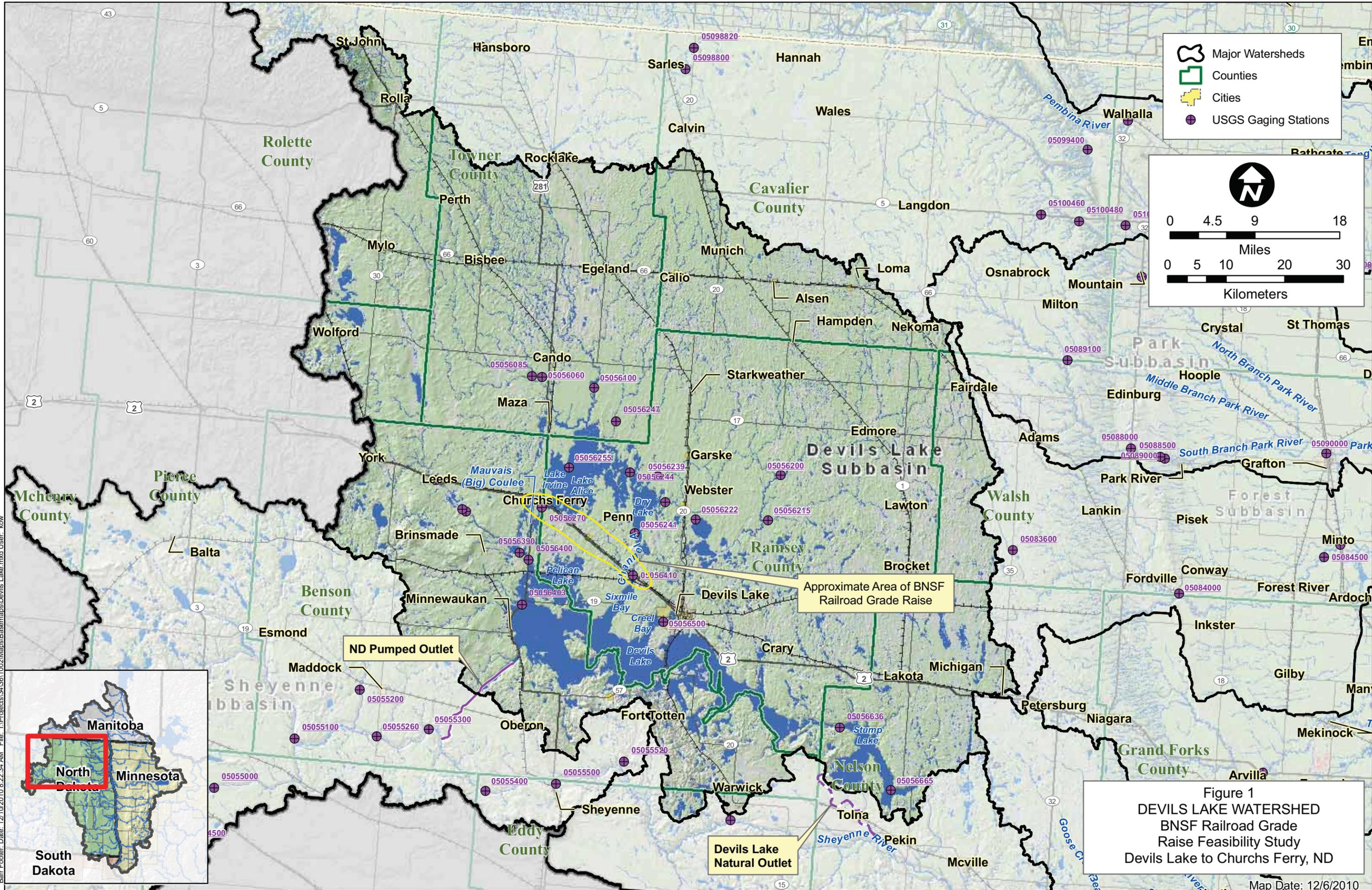


Figure 1
 DEVILS LAKE WATERSHED
 BNSF Railroad Grade
 Raise Feasibility Study
 Devils Lake to Church's Ferry, ND

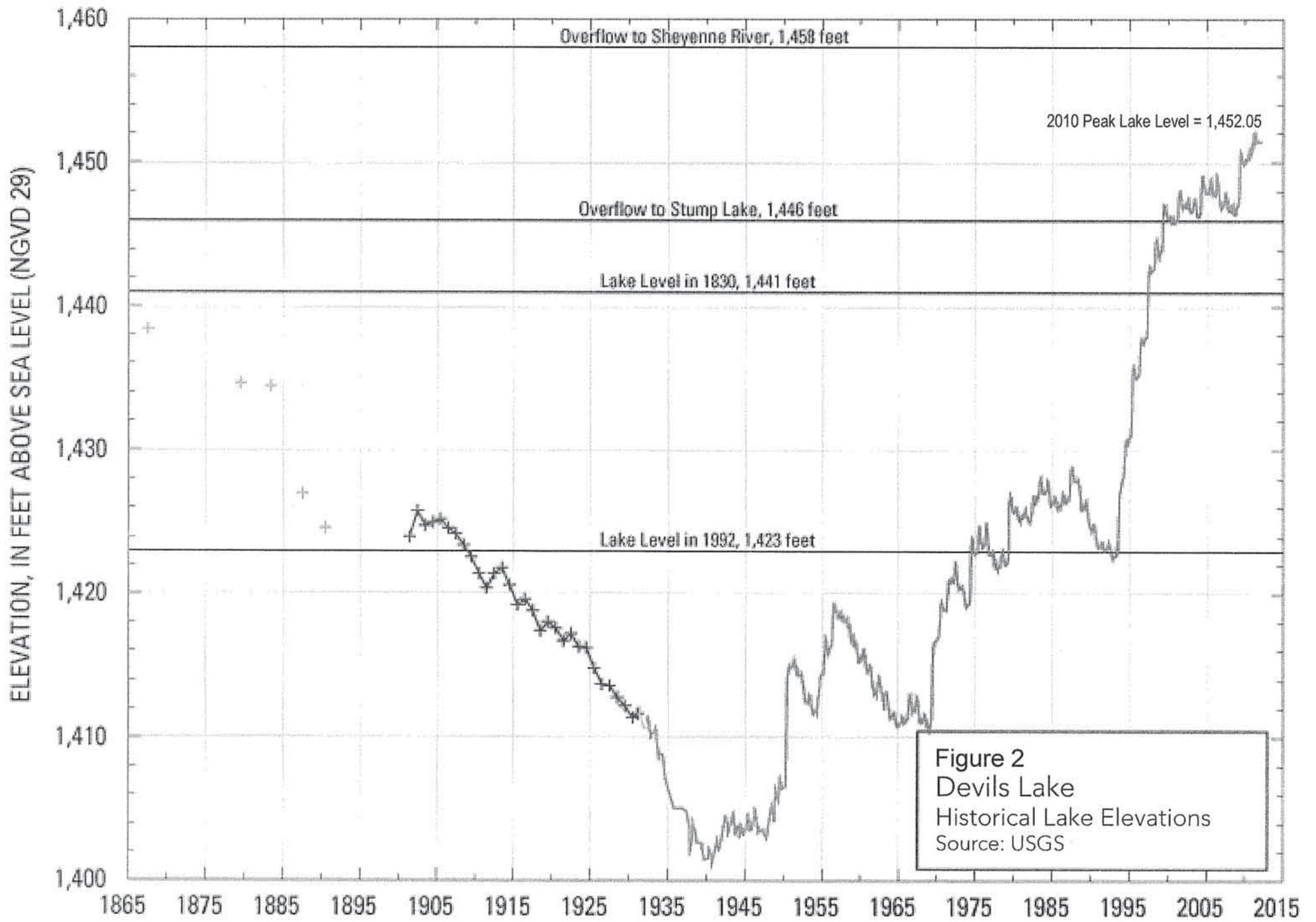
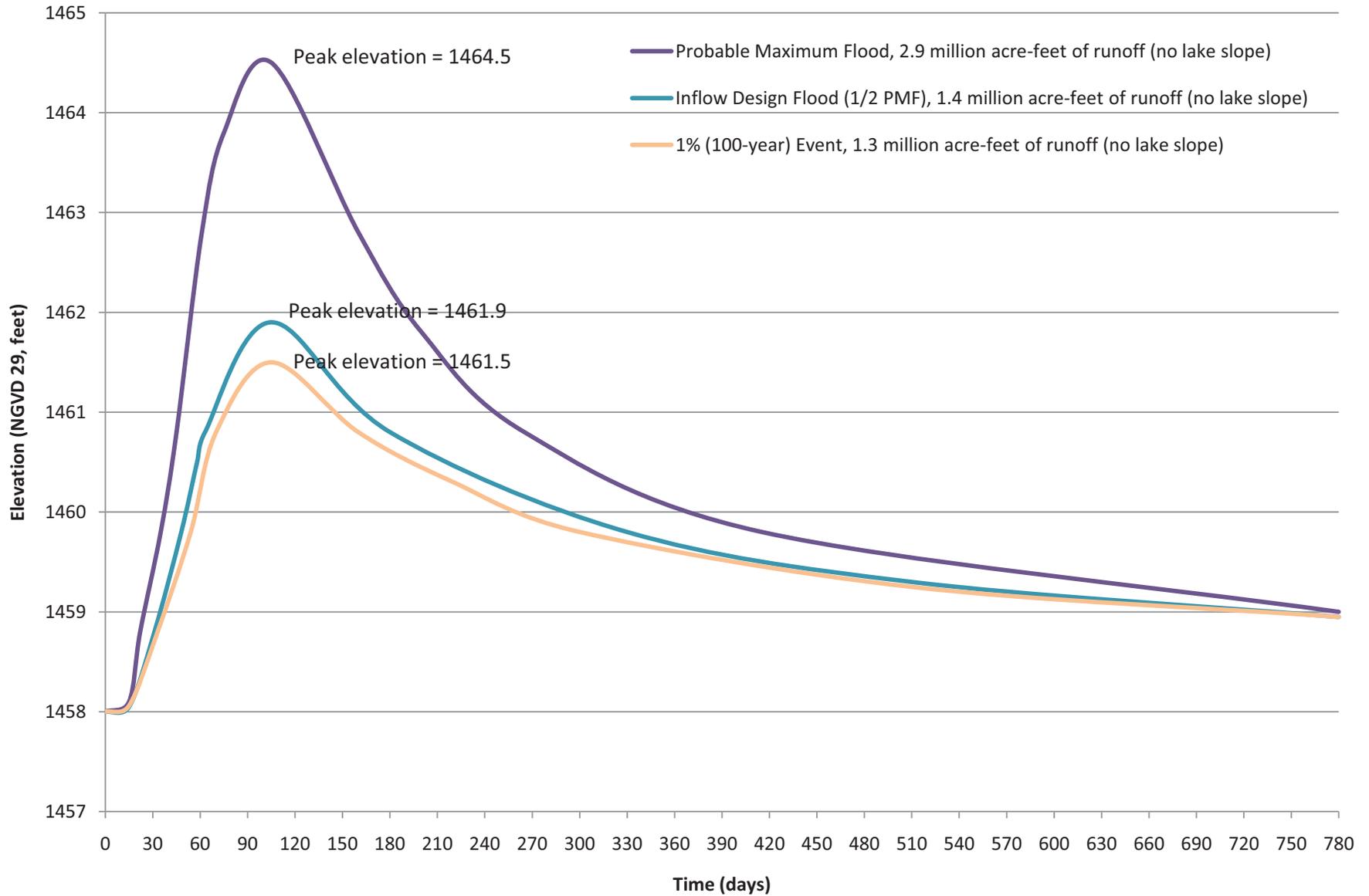
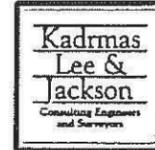


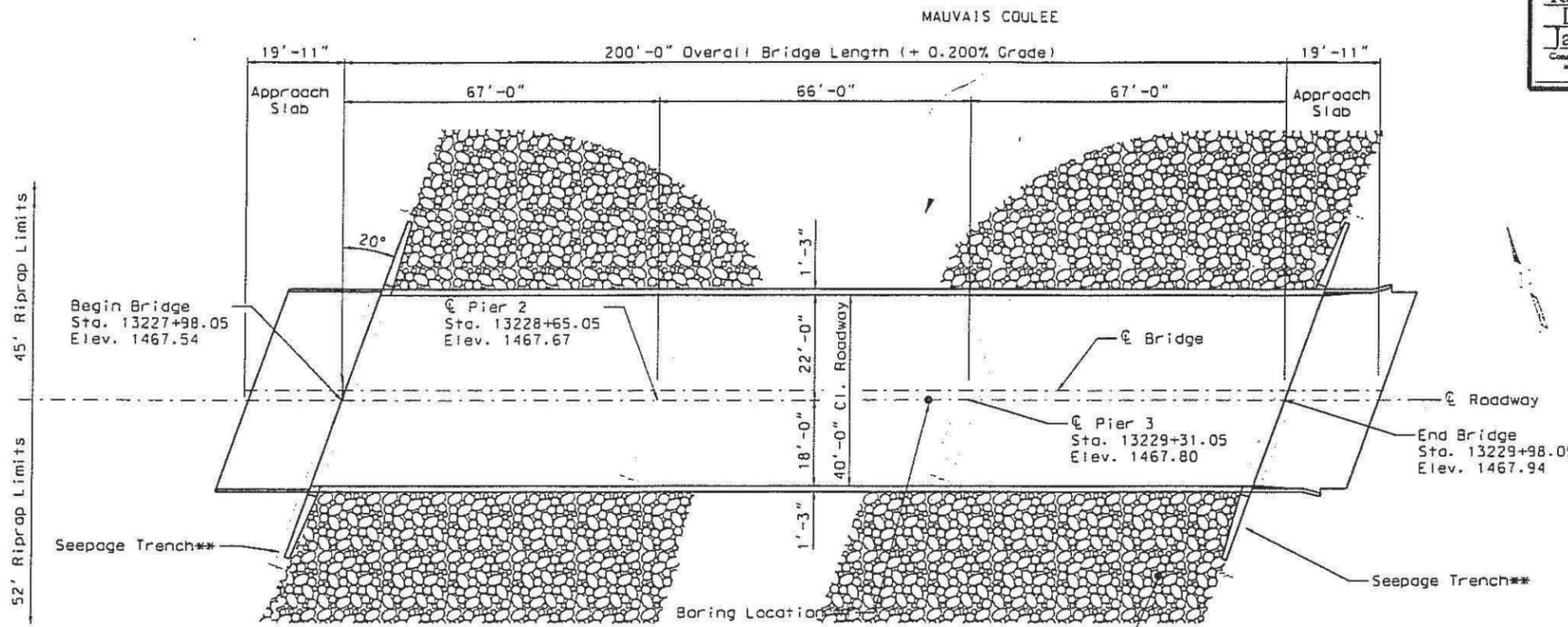
Figure 2
 Devils Lake
 Historical Lake Elevations
 Source: USGS

Figure 3: Potential Water Surface Elevations of Devils Lake at Natural Outlet to Tolna Coulee
(assumes starting water surface elevation of 1458 feet (NGVD 29) and 4-month inflow trianulized)





BRIDGE CODE	STATE	PROJECT NO.	SHEET NO.
X-081	ND	NH-SER-3-002(074)249	106



DESIGN STRENGTHS:

$f'_c = 3,000 \text{ PSI} \sim \text{C1}$

$f'_c = 4,000 \text{ PSI} \sim \text{C2}$

$f'_c = 5,000 \text{ PSI} \sim \text{P1}$

$f_y = 60,000 \text{ PSI} \sim \text{R1}$

LOAD FACTOR DESIGN

HYDRAULIC DATA:

EXISTING LAKE LEVEL (JAN 2001) 1447.3

CLEARANCE ELEVATION 1463.4

100 YR FREQUENCY STAGE* 1462.2

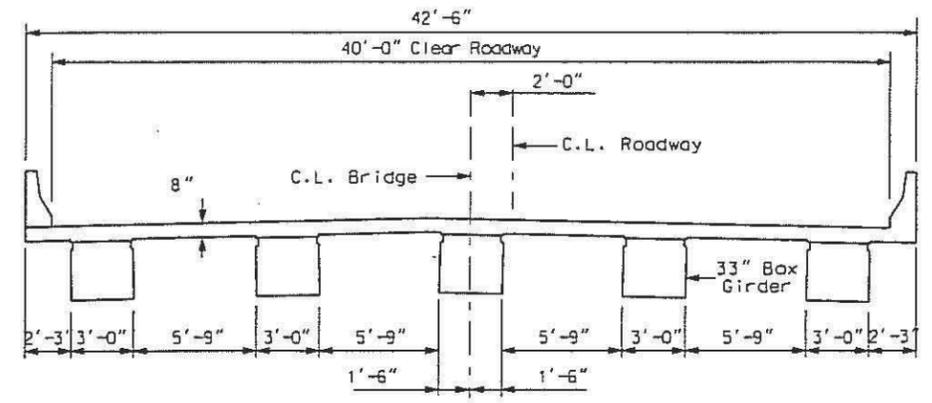
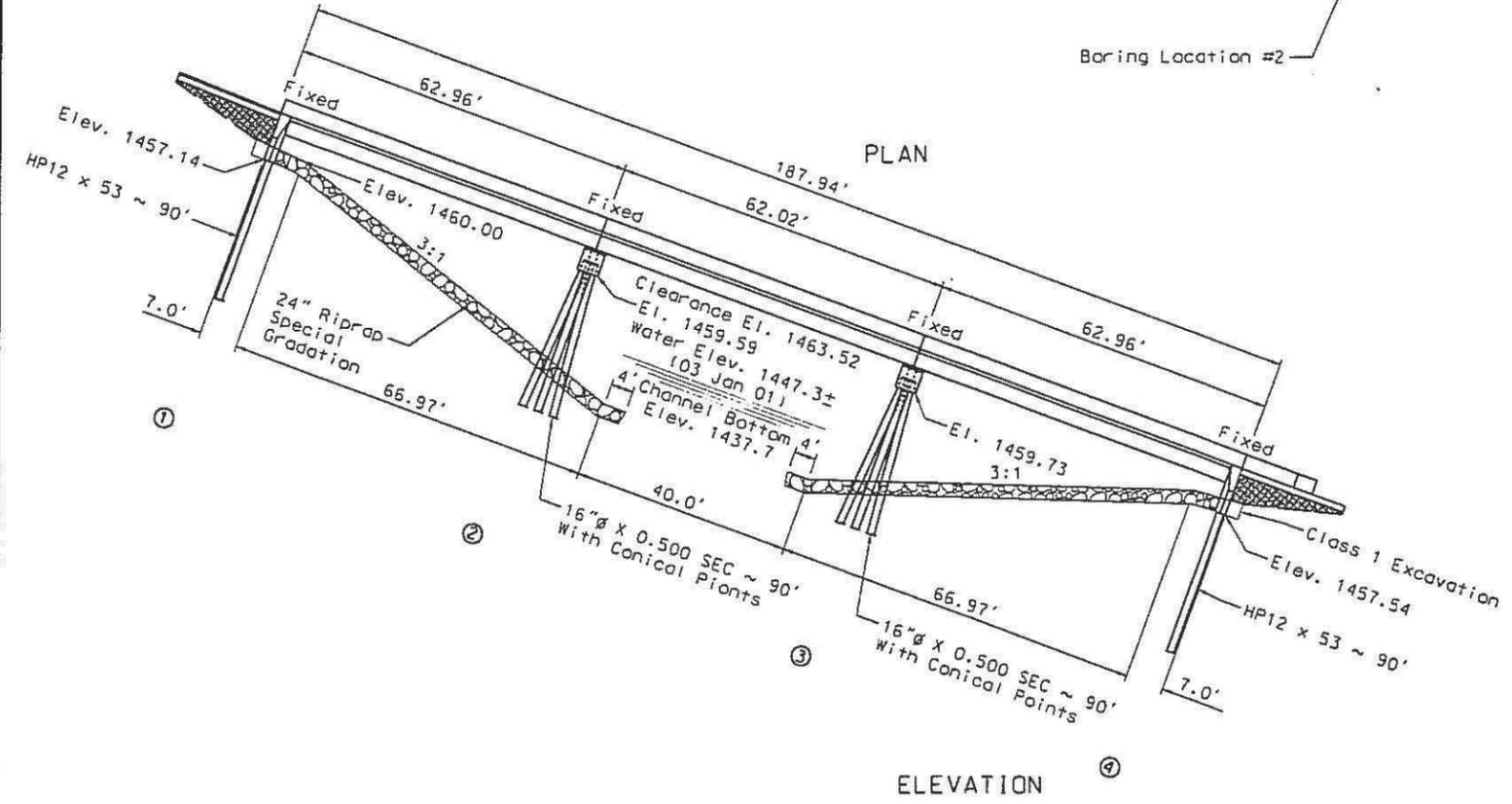
OUTLET ELEVATION TO STUMP LAKE 1448.2

OUTLET ELEVATION TO SHEYENNE RIVER 1460.3

* BASED ON AN ASSUMED LAKE ELEVATION OF 1462.2

All Elevations Based on NAVD-88 DATUM

** Fill bottom 2'-0" with select backfill (granular). Fill remainder with excavated material. Extend seepage trench until it daylight.

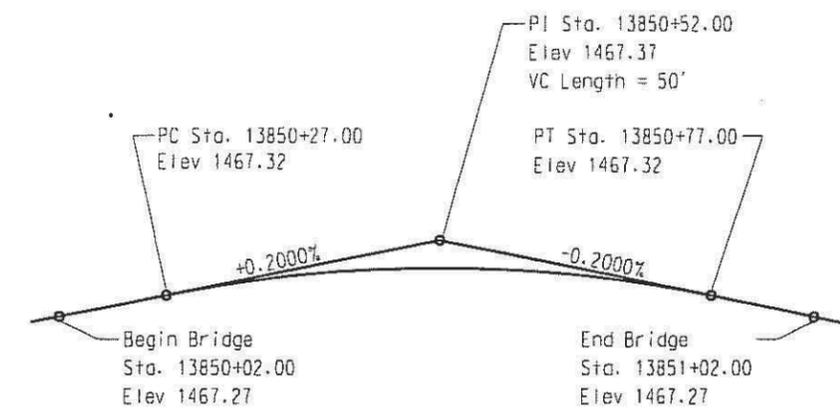
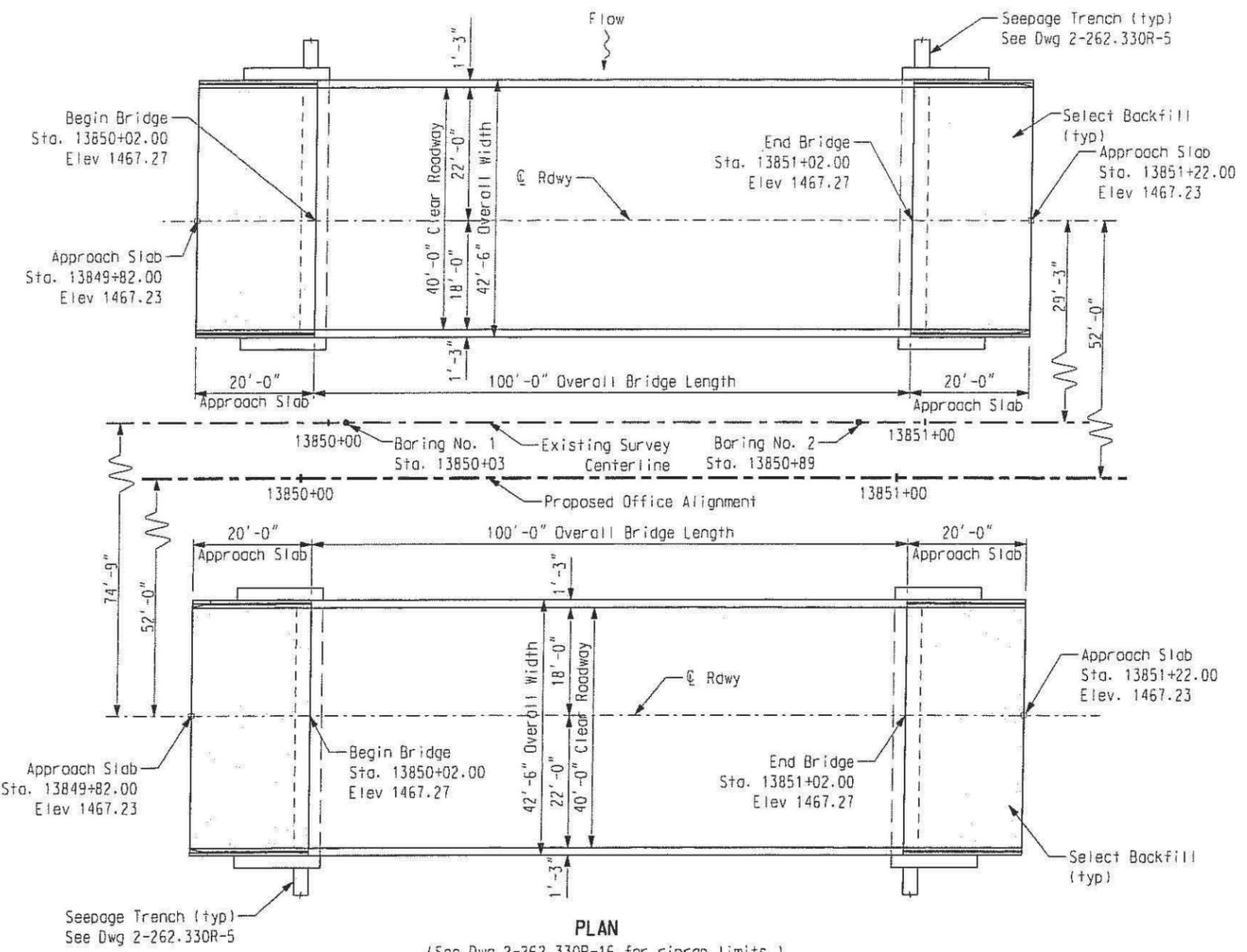


TYPICAL SLAB SECTIONS



STANDARD DRAWINGS
D-604-3, D-622-1, D-900-1
F.W.S. 15 PSF
HS 25 DESIGN LOADING
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION U.S. HIGHWAY 2 AT MAUVAIS COULEE (WESTBOUND)
BRIDGE LAYOUT
PROJECT: NH-3-002(074)249 STATION 13228+98.05 RAMSEY COUNTY
3-6-01 DATE
<i>Seamus Holland</i> BRIDGE ENGINEER

BRIDGE CODE	STATE	PROJECT NUMBER	SECTION NO.	SHEET NO.
X-081	ND	SER-3-002(088)262	170	1



VERTICAL CURVE DATA @ C ROADWAY

Figure 5
U.S. Highway 2 Bridge
at Channel A

DESIGN STRENGTHS:
 f'c = 3.000 psi ~ Class AE-3 Concrete
 f'c = 4.000 psi ~ Class AAE-3 Concrete
 f'c = 6.500 psi ~ Prestressed Girder Concrete
 fy = 60.000 psi ~ Reinforcing Steel

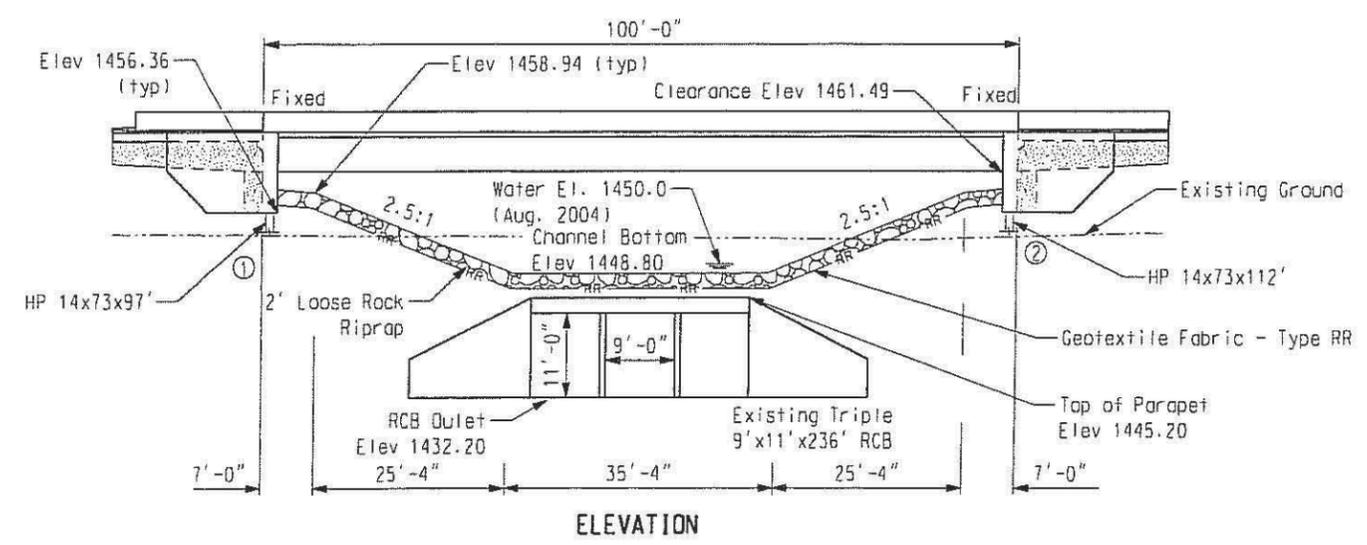
Load Factor Design

HYDRAULIC DATA:

Existing Lake Level (Aug 2004)	1450.0 Ft
Clearance Elevation	1461.8 Ft
Outlet to Stump Lake	1448.2 Ft
Outlet to Shyanne River	1460.3 Ft

*All elevations are based on NAVD-88 Datum.

PLAN
(See Dwg 2-262.330R-16 for riprap limits.)



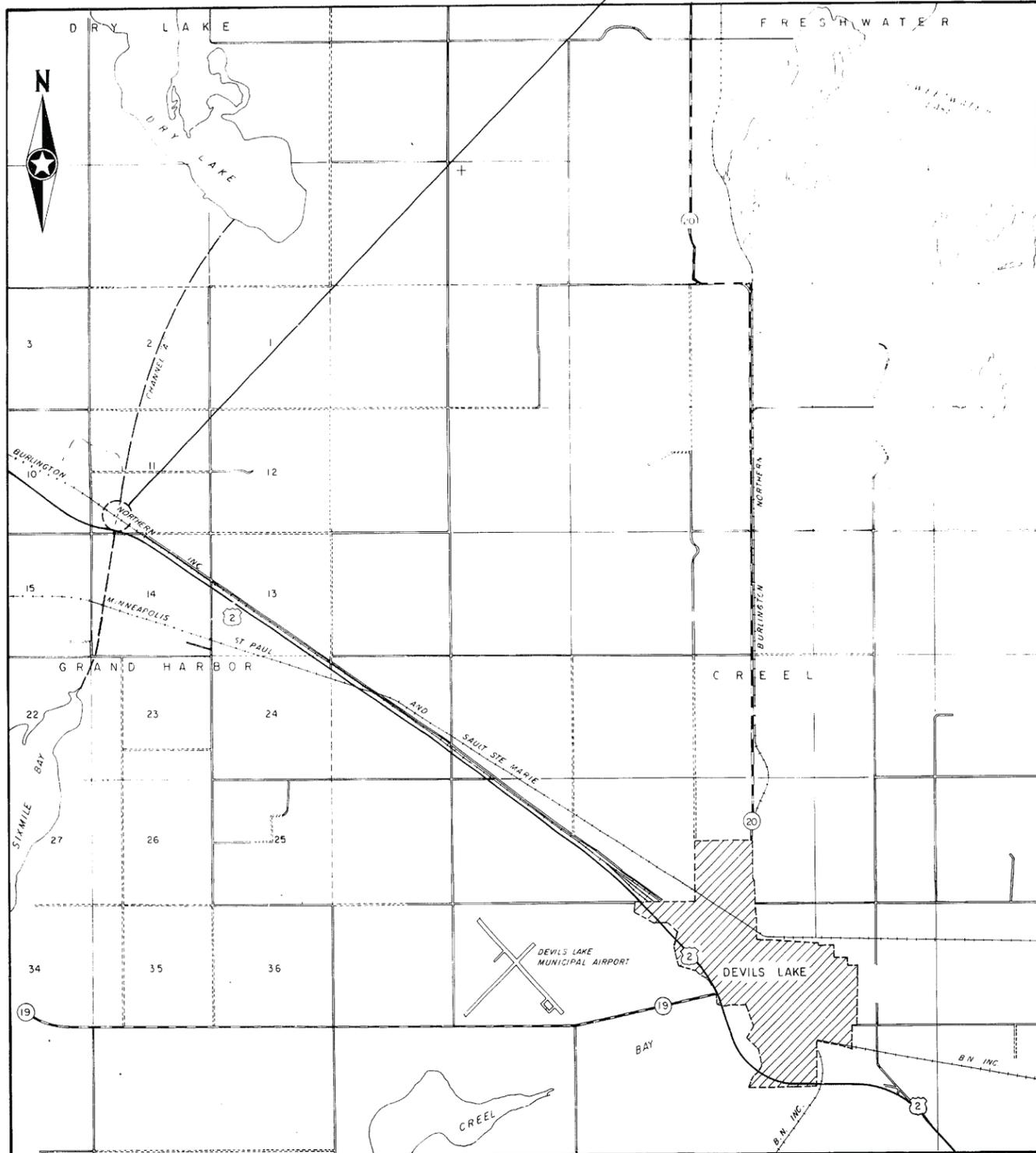
ELEVATION



STANDARD DRAWINGS
D-622-1, D-900-1
F.W.S. 15 PSF
HS 25 DESIGN LOADING
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
U.S. HIGHWAY 2 - CHANNEL A
BRIDGE LAYOUT
PROJECT: SER-3-002(088)262 STATION 13850+52.00
RAMSEY COUNTY
2-23-05 <i>James R. Valland</i> DATE BRIDGE ENGINEER

J:\state\106\5204106\30002262.088\br\ldg\170br_001_brla.dgn 2/14/2005 2:02:06 PM

**PROPOSED BRIDGE
BURLINGTON NORTHERN, INC.
BRIDGE NO. 92.2**



VICINITY MAP

SCALE: 0 0.5 1.0 1.5 2.0 MILES

CONSTRUCTION SPECIFICATIONS

THE NORTH DAKOTA STATE HIGHWAY DEPARTMENT "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" ADOPTED OCTOBER, 1976 SHALL GOVERN.

CONSTRUCTION NOTE :

ALL APPLICABLE FEDERAL, STATE, AND LOCAL LAWS AND ORDINANCES WILL BE COMPLIED WITH, IN THE CONSTRUCTION OF THIS PROJECT.

HYDRAULIC DATA :

STREAM: CHANNEL "A", STARK-WEATHER WATERSHED
 DRAINAGE AREA: 774 SQ MILES
 STREAM GRADIENT: 0.00025 FT./FT.
 DESIGN DISCHARGE: 2,000 C.F.S.
 DESIGN FREQUENCY: 50 YEARS
 STAGE ELEVATION: 1448.2
 STAGE INCREASE: 0.54 FT.
 MEAN VELOCITY THRU STRUCTURE: 4.97 F.P.S.
 BRIDGE WATERWAY BELOW NORMAL DEPTH: 402 SQ FT.
 AVERAGE VELOCITY IN NATURAL CHANNEL: 2.36 F.P.S.

LIST OF SPECIAL PROVISIONS

ITEM	DESCRIPTION

Fed. Proj. No.

FDAA-581-DR-071-91001

DESIGN DATA :

DESIGN SPECIFICATIONS: 1980 AMERICAN RAILWAY ENGINEERING ASSOCIATION (A.R.E.A.) DESIGN SPECIFICATIONS.

LOADING: COOPER'S E-80 WITH DIESEL IMPACT.

MAXIMUM ALLOWABLE DESIGN STRESSES:

STRUCTURAL STEEL:	CONCRETE:	REINFORCING STEEL:
F _y = 27,500 PSI, HIGH STRENGTH LOW ALLOY STEEL	F _c ' = 4,000 PSI, (N=8)	F _s = 24,000 PSI (GRADE 60)
F _y = 20,000 PSI, STRUCTURAL CARBON STEEL	F _c ' = 1,600 PSI	
	F _c ' = 4,000 PSI, (N=8)	CLASS AE-4
	F _c ' = 1,600 PSI	

SHEET INDEX

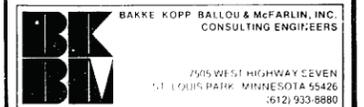
SHEET NO.	TITLE
1	TITLE SHEET
2	GENERAL PLAN AND ELEVATION
3	RAILROAD SHO-O-FLY AND BRIDGE SITE PLAN
4	BRIDGE LAYOUT AND GENERAL NOTES
5	BORING LOGS AND PILE LAYOUT
6	ABUTMENTS 1 & 4
7	BENTS 2 & 3
8	FRAMING PLAN AND BEAM ELEVATION
9	BEARING ASSEMBLY DETAILS
10	DECK REINFORCEMENT
11	JOINT DETAILS
12	RAILING DETAILS
13	WATERPROOFING AND DRAINAGE DETAILS
14	PRECAST DECK SLAB ALTERNATE

**Figure 6-1
BNSF Bridge at
Channel A**

FOR THE NORTH DAKOTA DISASTER EMERGENCY SERVICES AGENCY
 APPROVED BY: _____ DIRECTOR _____ DATE: _____

FOR THE RAMSEY COUNTY WATER MANAGEMENT BOARD
 RECOMMENDED FOR APPROVAL: _____ CHAIRMAN _____ DATE: _____

CONSULTING ENGINEERS
BAKKE KOPP BALLOU & McFARLIN, INC.
 MINNEAPOLIS, MINNESOTA

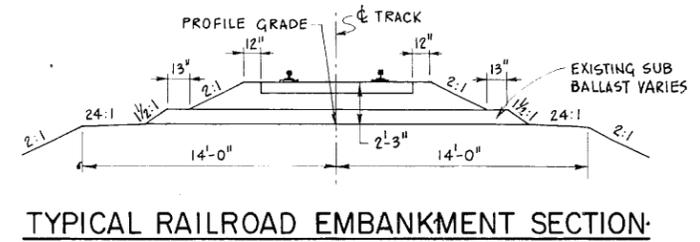
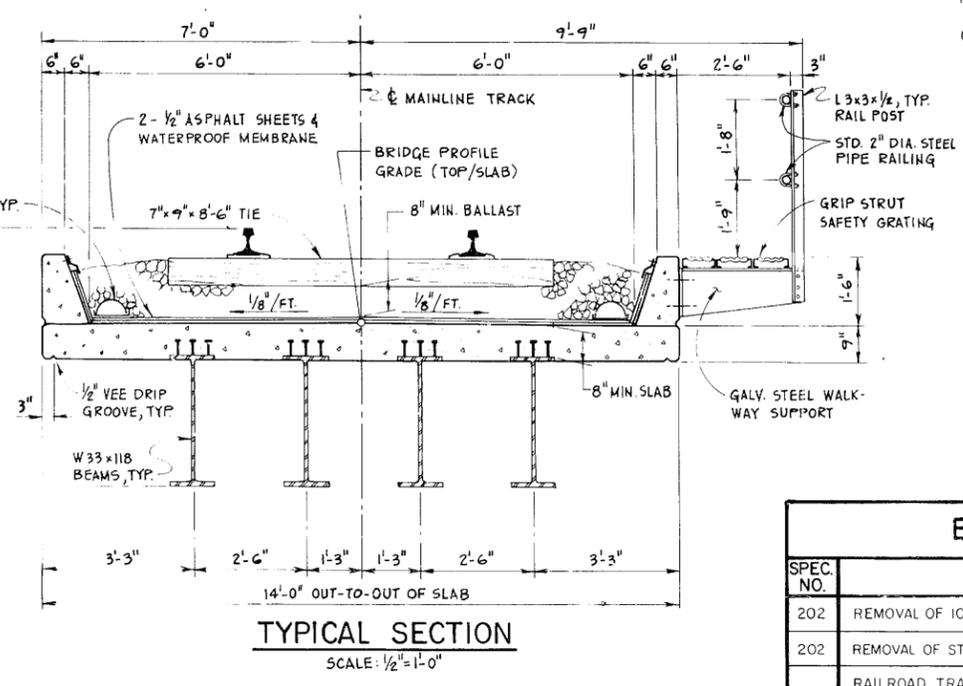
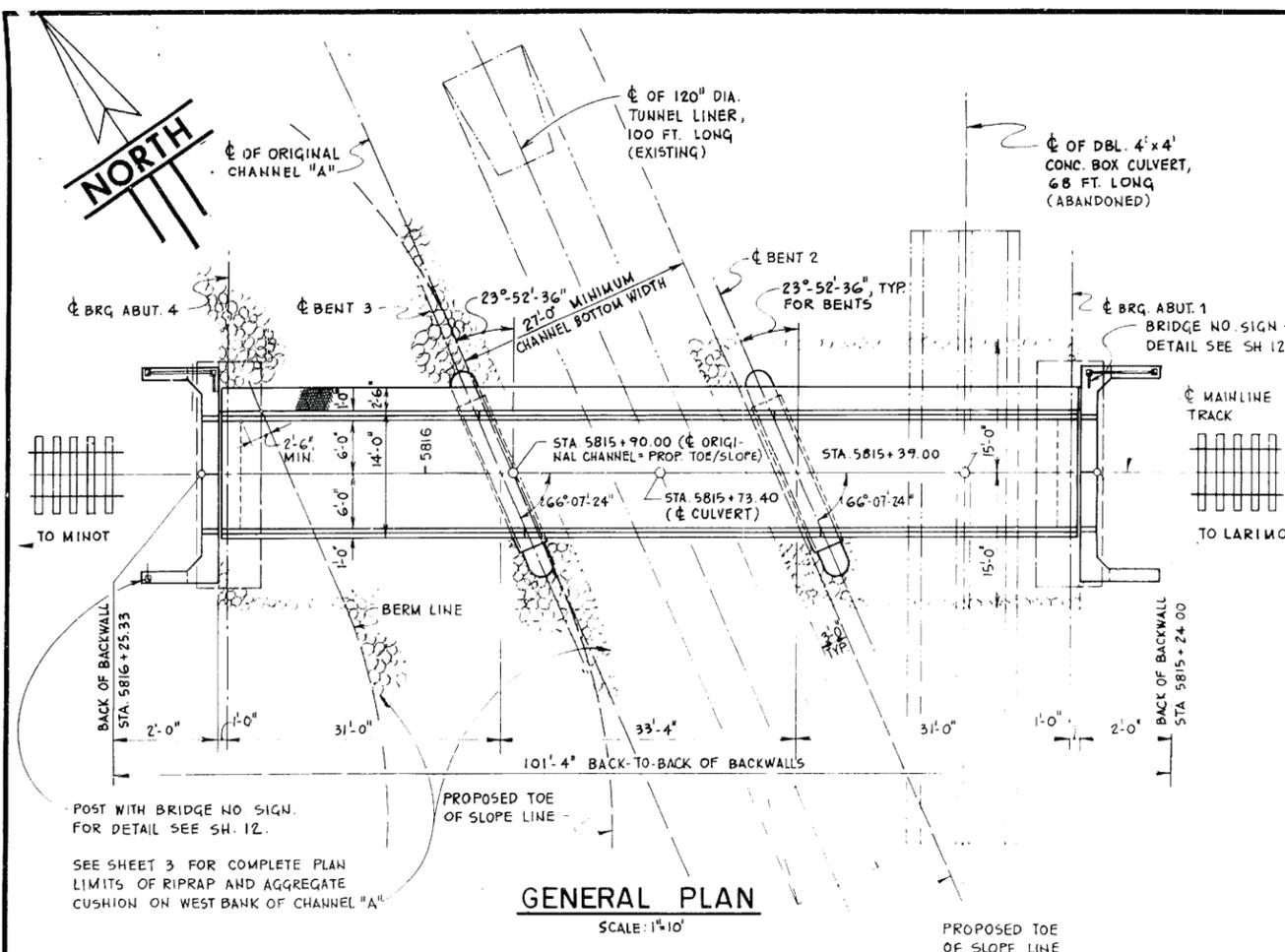


PROFESSIONAL RESPONSIBILITY:
 I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF NORTH DAKOTA.
Robert J. McFarlin DATE: 7/29/80 REG NO. 488

BURLINGTON NORTHERN, INC.
 TWIN CITIES REGION DAKOTA DIVISION
 LARIMORE TO MINOT
BRIDGE NO. 92.2
 OVER CHANNEL "A" AT GRAND HARBOR IN
RAMSEY COUNTY, NORTH DAKOTA

APPROVED: _____
 ASST. VICE PRESIDENT, ENGR. DIRECTOR, BRIDGE ENGINEERING

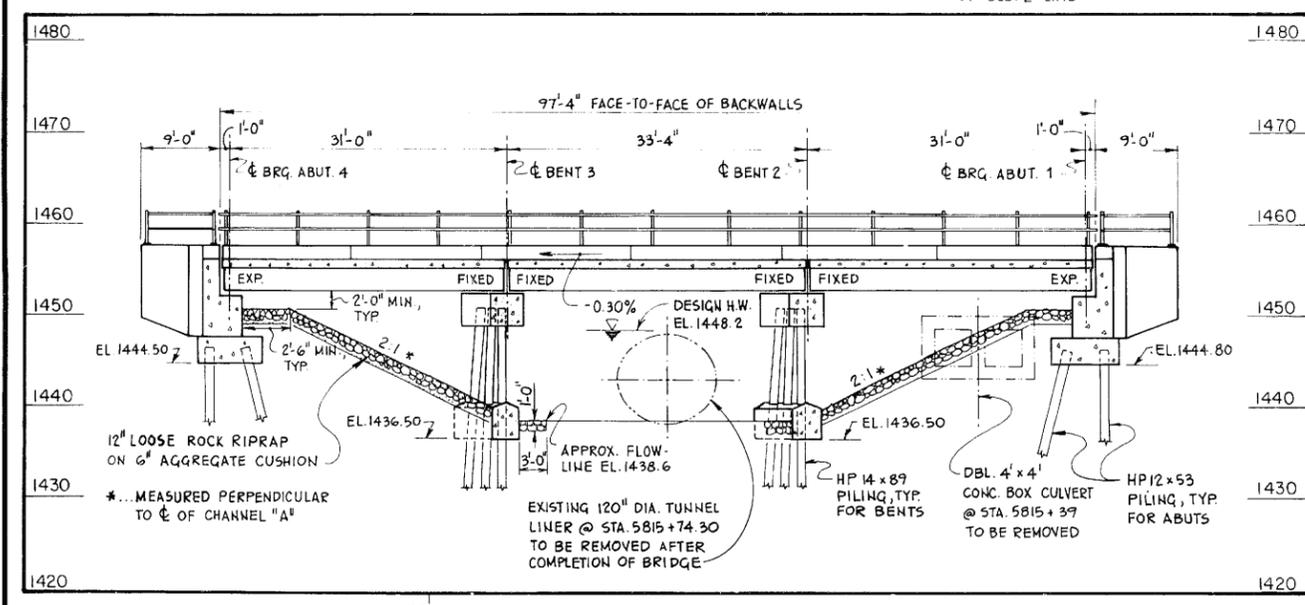
DATE: AUGUST 1980 FILE NO. 384-8334-1



NOTES:
 6" BALLAST TO BE FURNISHED BY RAILROAD AND TO BE PLACED BY CONTRACTOR. TRACK, TIES AND REMAINING BALLAST TO BE FURNISHED AND PLACED BY RAILROAD. SEE SPECIAL PROVISIONS.
 SHOO-FLY CONSTRUCTION BY OTHERS PRIOR TO BRIDGE CONSTRUCTION.

Figure 6-2
BNSF Bridge at
Channel A

ESTIMATE OF QUANTITIES		
SPEC. NO.	BID ITEM	
202	REMOVAL OF 10'-0" DIA PIPE CULVERT	1 LUMP SUM
202	REMOVAL OF STRUCTURES AND OBSTRUCTIONS (DBL BOX CULV)	1 LUMP SUM
	RAILROAD TRACK BALLAST	22 CU YD.
208	STRUCTURE EXCAVATION	1 LUMP SUM
228	SELECT BACKFILL	90 CU YD.
610	CLASS AE-3 CONCRETE	140 CU YD.
610	CLASS AE-4 CONCRETE	48 CU YD.
612	REINFORCING STEEL	20,350 POUND
612	REINFORCING STEEL (EPOXY-COATED)	790 POUND
	LOOSE ROCK RIPRAP	171 CU YD.
703	AGGREGATE CUSHION	77 CU YD.
622	STEEL PILING (HP 12x53)	1,920 LIN. FT.
622	STEEL PILING (HP 14x89)	1,500 LIN. FT.
616	STRUCTURAL CARBON STEEL (AASHTO M-183)	7,140 POUND
616	HIGH STRENGTH LOW ALLOY STRUCTURAL STEEL(AASHTO M-222)	59,250 POUND
	FIXED BEARING ASSEMBLY	16 EACH
	EXPANSION BEARING ASSEMBLY	8 EACH
	DRAINAGE SYSTEM	1 LUMP SUM
	MEMBRANE WATERPROOFING	1,528 SQ.FT.
	WALKWAY GRATING	97 LIN.FT.
	DAMPPOOFING	68 SQ. YD.
	TESTING SERVICES	1 LUMP SUM



STRESS TABLE

DESIGN DATA FOR BEAMS:
 LIVE LOAD: COOPER'S E-80 WITH DIESEL IMPACT.
 TOTAL DEAD LOAD:
 BEAM AND DETAILS 0.136 K/FT.
 CONCRETE DECK 0.416 K/FT.
 SUB-TOTAL, NON-COMPOSITE 0.552 K/FT.
 BALLAST, TIES & TRACK 0.630 K/FT.
 SUB-TOTAL, COMPOSITE 0.630 K/FT.
 TOTAL DEAD LOAD (4 BEAMS) 1.182 K/FT.

PROPERTIES OF BEAM: ① (SEE STRESS TABLE NOTE)

NON-COMPOSITE:	COMPOSITE (LONG-TERM):	COMPOSITE (SHORT-TERM):
A = 31.19 IN. ²	A = 40.19 IN. ² EQUIV.	A = 58.19 IN. ² EQUIV.
A _w = 22.25 IN. ²	A _w = 22.25 IN. ²	A _w = 22.25 IN. ²
Y _T = 16.21 IN.	Y _T = 11.73 IN.	Y _T = 7.58 IN.
Y _B = 16.56 IN.	Y _B = 21.04 IN.	Y _B = 25.19 IN.
S _T = 330 IN. ³	S _T = 699 IN. ³	S _T = 1633 IN. ³
S _B = 305 IN. ³	S _B = 370 IN. ³	S _B = 423 IN. ³

TABULATION OF FORCES AND MOMENTS:

	MAX. SHEAR	MAX. MOMENT
D.L. (NON-COMPOSITE)	8.8 K	71 K.FT.
D.L. (COMPOSITE, LONG TERM)	10.1 K	81 K.FT.
L.L.+I (COMPOSITE, SHORT TERM)	99.9 K	692 K.FT.
	118.8 K	844 K.FT.

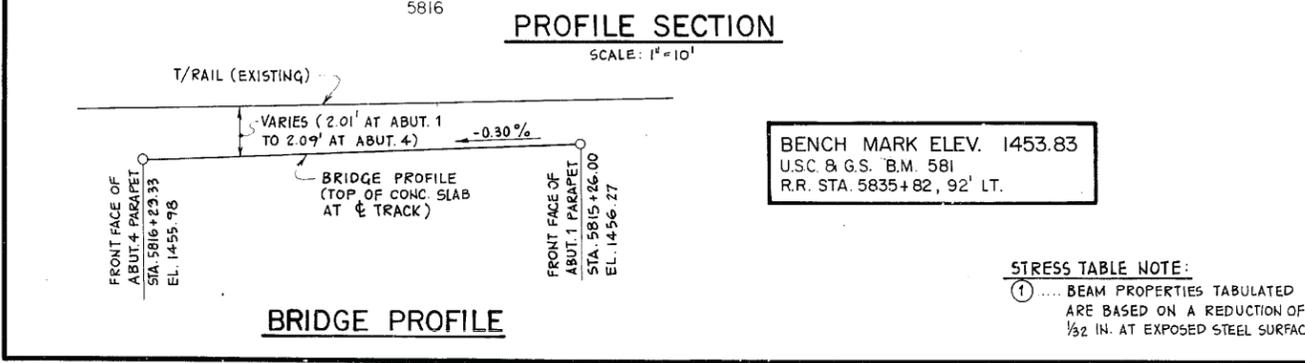
TABULATION OF STRESSES:

	MAX. SHEAR STRESS	MAX. BENDING STRESS (STL)	MAX. BENDING STRESS (CONC.)
D.L. (N. COMP)	0.55 K.S.I.	2.79 K.S.I.	
D.L. (COMP. L.T.)	0.63 K.S.I.	2.63 K.S.I.	0.131 K.S.I.
L.L.+I (COMP. ST)	6.24 K.S.I.	19.63 K.S.I.	1.117 K.S.I.
TOTAL	7.42 K.S.I.	25.05 K.S.I.	1.248 K.S.I.

TABULATION OF LIVE LOAD DEFLECTIONS:

Δ (L.L.+I) =	0.60 IN. PERMITTED
Δ (L.L.+I) =	0.36 IN. COMPUTED

STRESS TABLE NOTE:
 ① BEAM PROPERTIES TABULATED ARE BASED ON A REDUCTION OF 1/2 IN. AT EXPOSED STEEL SURFACES.

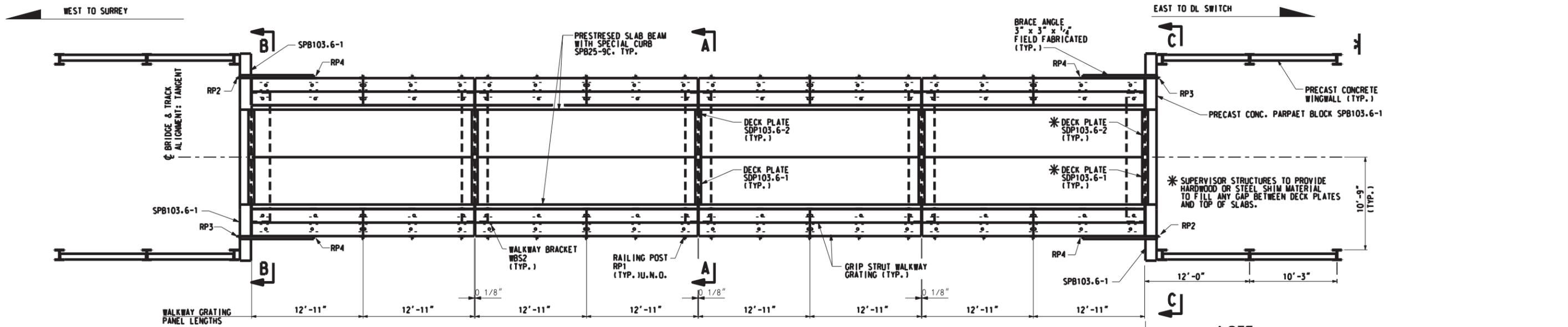


RAMSEY COUNTY WATER MANAGEMENT BOARD

BURLINGTON NORTHERN, INC.
BRIDGE NO. 92-2
 OVER CHANNEL "A" AT GRAND HARBOR, NORTH DAKOTA
 TWIN CITIES REGION DAKOTA DIVISION
 LARIMORE TO MINOT
GENERAL PLAN AND ELEVATION
 SEC. II T154N R65W
 GRAND HARBOR TOWNSHIP RAMSEY COUNTY

DES: G.M. DR: G.M. APPROVED:
 CHK: R.O.C. CHK: R.O.C.

Sheet No. 2 of 14 Sheets



NOTE:
FOR SECTIONS A-A, B-B & C-C
SEE PLAN NO. 0033-103.6-2

PLAN

NOTE:
FILL GAP BETWEEN ENDS OF BEAMS AND BETWEEN ENDS OF BEAMS & FACE OF PARAPET WALL WITH 8'-1/2" x 18" x 6'-10" PLIES OF PREMOULDED JOINT FILLER.

FACE OF EXISTING PARAPET STA. 10+00.00

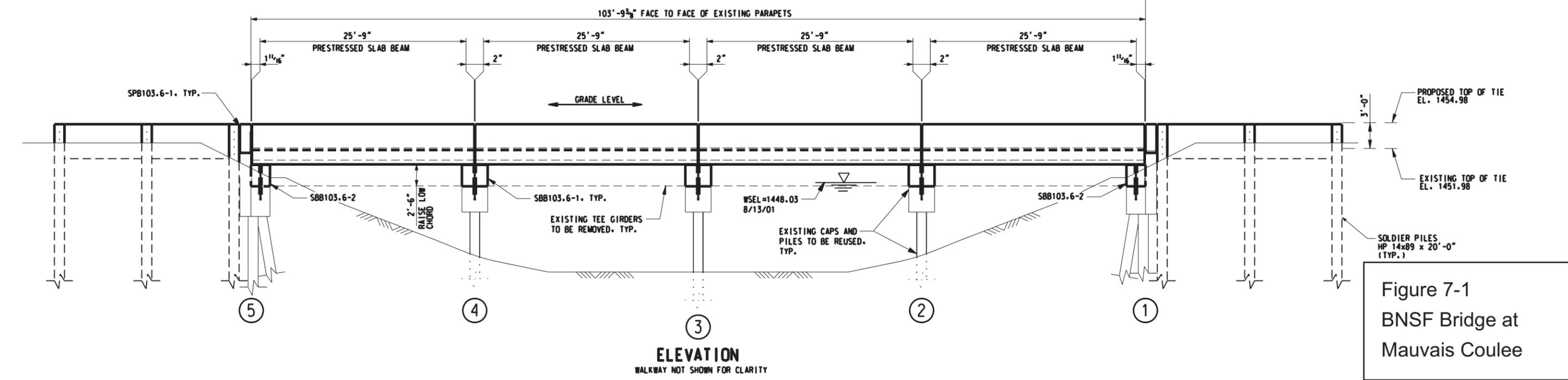


Figure 7-1
BNSF Bridge at
Mauvais Coulee

TABLE OF ELEVATIONS			
LOCATION	STATION	TOP/TIE	TOP/BRC. BLK
ABUT. 1	10+00.00	1454.98	1450.21
☉ BENT 2	10+25.95	1454.98	1450.21
☉ BENT 3	10+51.89	1454.98	1450.21
☉ BENT 4	10+77.83	1454.98	1450.21
ABUT. 5	11+03.78	1454.98	1450.21

TABLE OF LIFTING WEIGHTS		
DESCRIPTION	EST. WT. (LBS.)	
EXISTING 25'-11" SOLID TEE GIRDER	44,000	
BEARING BLOCK, SBB103.6-1	17,200	
BEARING BLOCK, SBB103.6-2	14,300	
PARAPET BLOCK, SPB103.6-1	3,200	
25'-10" SPECIAL P/S SLAB BEAM	53,000	
PRECAST CONCRETE WINGWALLS	4,000	

GENERAL NOTES:
DESIGN LOADING: COOPER'S E-75 WITH DIESEL IMPACT FOR NEW SUPERSTRUCTURE ONLY. NEW CONSTRUCTION SHOWN IN HEAVY SOLID LINES. EXISTING STRUCTURE TO BE REMOVED SHOWN IN LIGHT DASHED LINES. EXISTING STRUCTURE TO REMAIN SHOWN IN LIGHT SOLID LINES.
STATIONING AND ELEVATIONS ARE BASED ON SITUATION SURVEY OF BRIDGE 103.6 DATED AUGUST 13, 2001 BY LAND SURVEYING SERVICES OF DEVILS LAKE, ND. ELEVATIONS SHOWN ARE RELATIVE TO NAVD 29 DATUM.
TEMP. BENCH MARK #1:
REFERENCES:
EXIST. GENERAL PLAN & DETAILS BNRR PLAN NO'S. 33-8103.6-1 TO 5
EXIST. 25'-11" P/S CONC. "I" GDR. BNRR STD. PLAN NO. 116-8143-17

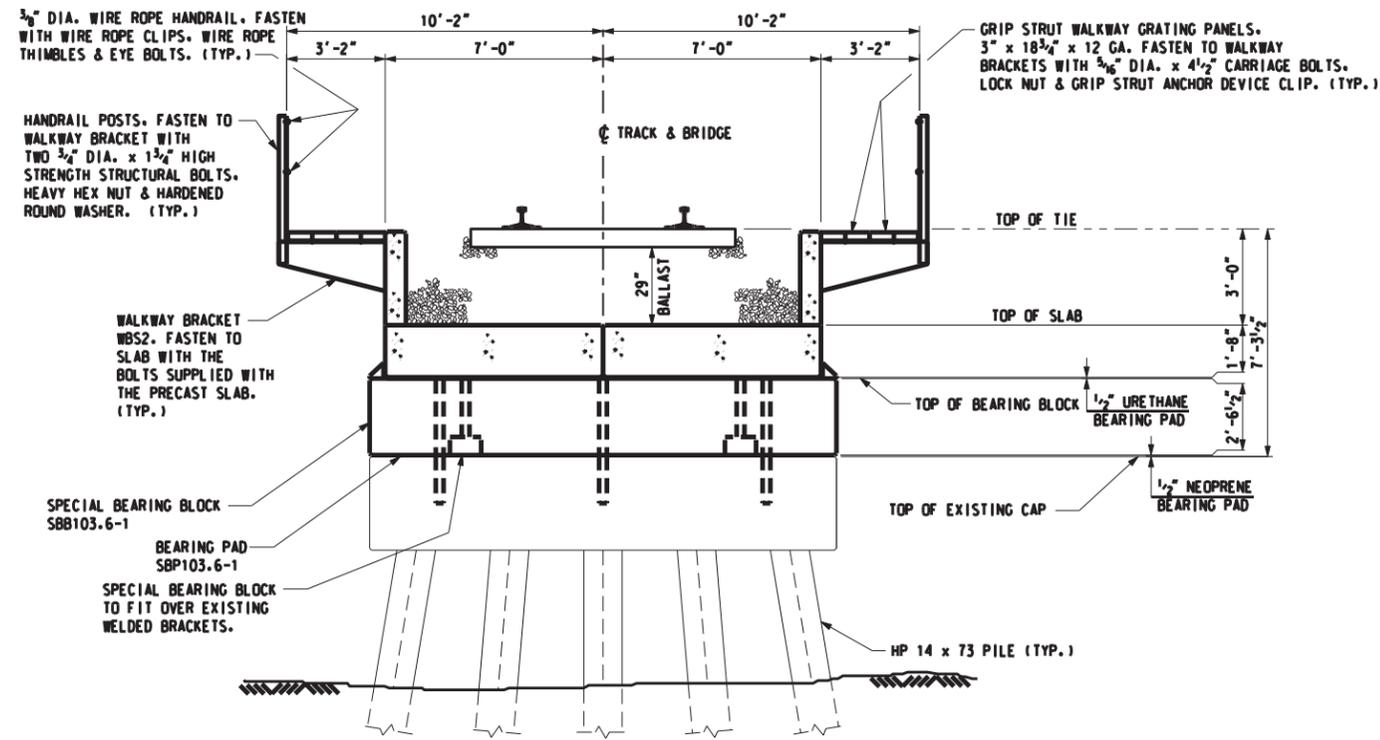
ATTENTION!
INFORMATION SHOWN ON THESE PLANS CONCERNING TYPE AND LOCATION OF UNDERGROUND OR ABOVE GROUND UTILITIES IS NOT GUARANTEED TO BE ACCURATE OR ALL INCLUSIVE.
SUPERVISOR STRUCTURES OR FOREMAN IN CHARGE WILL VERIFY THE LOCATION OF UNDERGROUND AND OVERHEAD UTILITIES BEFORE BEGINNING CONSTRUCTION.

LIST OF DRAWINGS	
PLAN NO.	TITLE
0033-103.6-01	GENERAL PLAN - RAISE BRIDGE
0033-103.6-02	TYPICAL SECTIONS
0033-103.6-03	PRESTRESSED SLAB BEAM w/ SPECIAL CURB
0033-103.6-04	PRECAST CONCRETE DETAILS
0033-103.6-05	PRECAST CONCRETE DETAILS
0033-103.6-06	BILL OF MATERIAL AND MISC. DETAILS

DES: RGB DRW: GLW CHK: RGB
DATE: AUG. 2001 AUTH: 7822501 LINE SEG: 0033
BRIDGE ENGINEERING KANSAS CITY, KS
APPROVED: *K.H. Jennison*
ASSISTANT DIRECTOR STRUCTURES DESIGN

DEVILS LAKE SWITCH TO SURREY
BRIDGE 103.6
OVER MAUVAIS COULEE
NEAR CHURCHES FERRY, ND
GENERAL PLAN - RAISE BRIDGE
PLAN NO.: 0033-103.6-01 SHEET: 1 OF 6

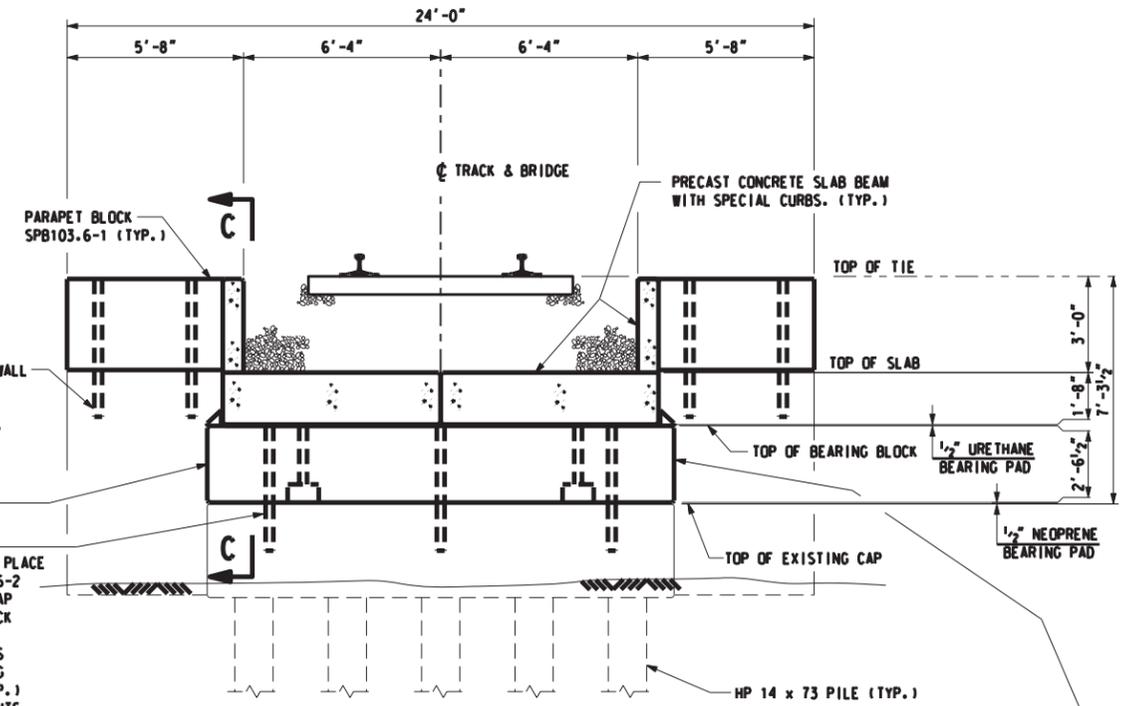




SECTION A-A
FROM SHEET 1

PLACE 1/2" OF LEVELING GROUT AND PLACE PARAPET BLOCK SPB103.6-1 INTO PLACE. DRILL 16" INTO EXISTING PARAPET WALL USING THE PARAPET BLOCK SPB103.6-1 AS TEMPLATE. GROUT NO. 8 x 4'-0" DOWELS INTO BLOCKS. (TYP.)

PLACE BEARING PAD SBP106.3-2 ON THE EXISTING ABUTMENT CAP. PLACE SPECIAL BEARING BLOCK SBB103.6-2 AND DRILL 16" INTO EXISTING CAP USING THE SPECIAL BEARING BLOCK SBB103.6-2 AS TEMPLATE. GROUT NO. 8 x 3'-6" DOWELS INTO CAPS AND FILL VOIDS AROUND EXISTING B100 BRACKETS WITH GROUT. (TYP.) INSTALLATION IS SIMILAR AT BENTS.



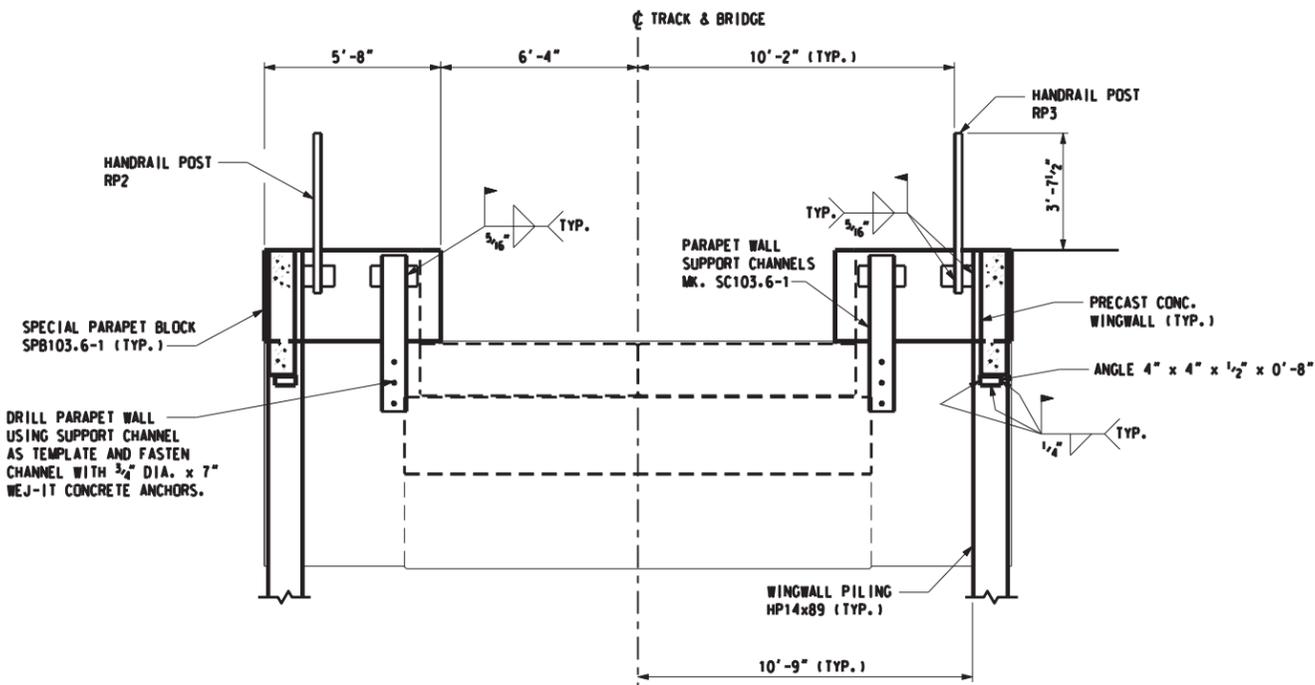
SECTION B-B

FROM SHEET 1
WALKWAY NOT SHOWN FOR CLARITY

PLACE 1/2" x 29 1/2" x 14'-10" PREMOLDED JOINT FILLER BETWEEN BEARING BLOCK & FACE/PARAPET. SEAL TOP & SIDES WITH POLY. JOINT SEALANT.

NOTE:

ONLY 3 DOWELS REQ'D. TO ANCHOR EACH BEARING BLOCK. SIX HOLES PROVIDED IN CASE INTERFERENCE OCCURS WHILE DRILLING IN ONE OR MORE LOCATIONS. PLACE NO. 8 x 2'-3" DOWEL IN HOLE WHERE BEARING BLOCK IS TO FIT OVER EXISTING WELDMENTS.

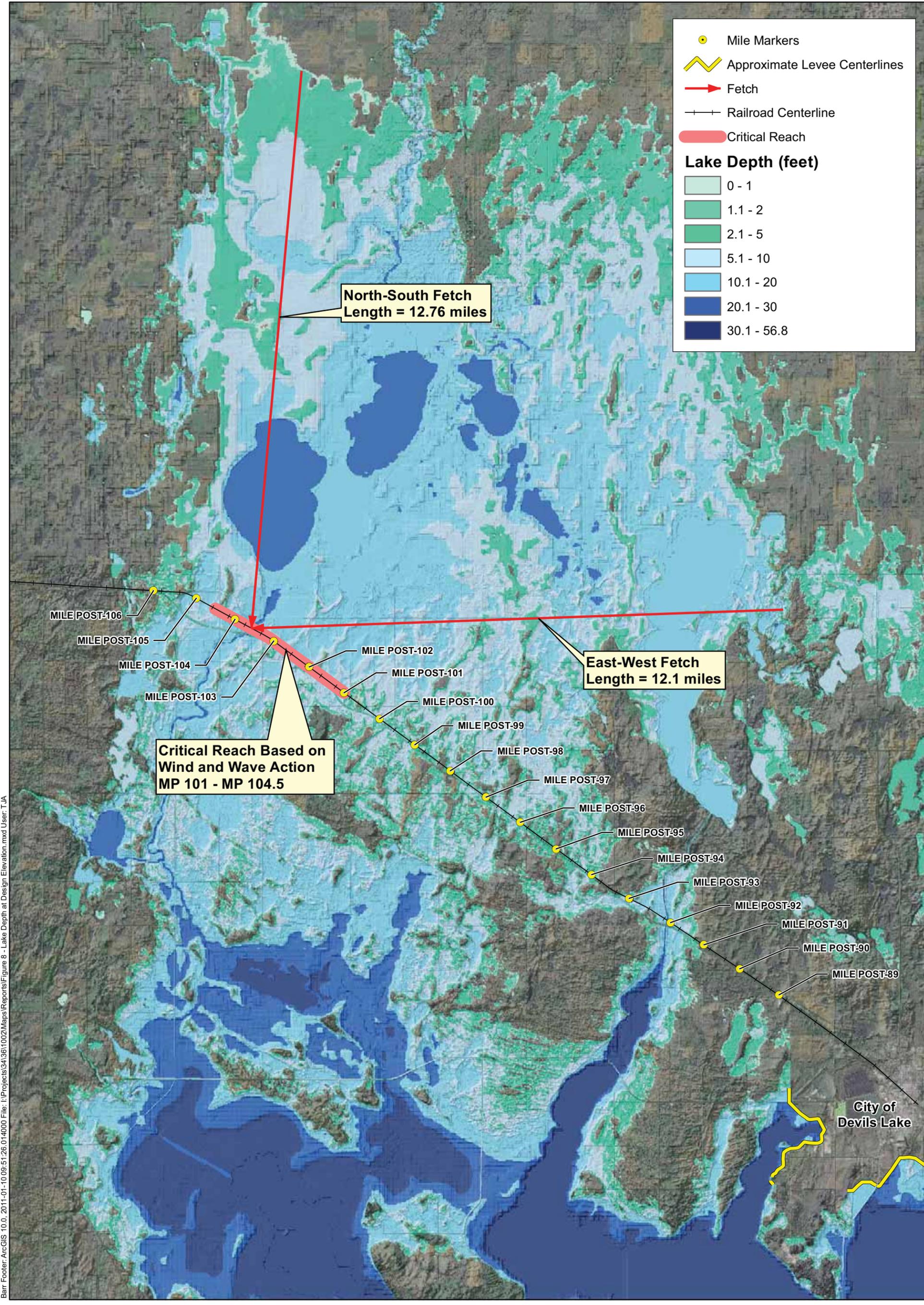


SECTION C-C
FROM SHEET 1

Figure 7-2
BNSF Bridge at
Mauvais Coulee

DES: RGB	DRW: GLW	CHK: RGB
DATE: AUG., 2001	AUTH: 7822501	LINE SEG: 0033
BRIDGE ENGINEERING		KANSAS CITY, KS
APPROVED:		
<i>K.H. Jennison</i>		
ASSISTANT DIRECTOR STRUCTURES DESIGN		

DEVILS LAKE SWITCH TO SURREY	
BRIDGE 103.6	
OVER MAUVAIS COULEE NEAR CHURCHES FERRY, ND	
TYPICAL SECTIONS	
PLAN NO.: 0033-103.6-02	SHEET: 2 OF 6



Barr Footer: ArcGIS 10.0, 2011-01-10 09:51:26.014000 File: I:\Projects\341361002\Maps\Reports\Figure 8 - Lake Depth at Design Elevation.mxd User: TJA

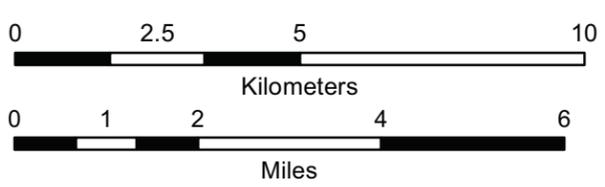
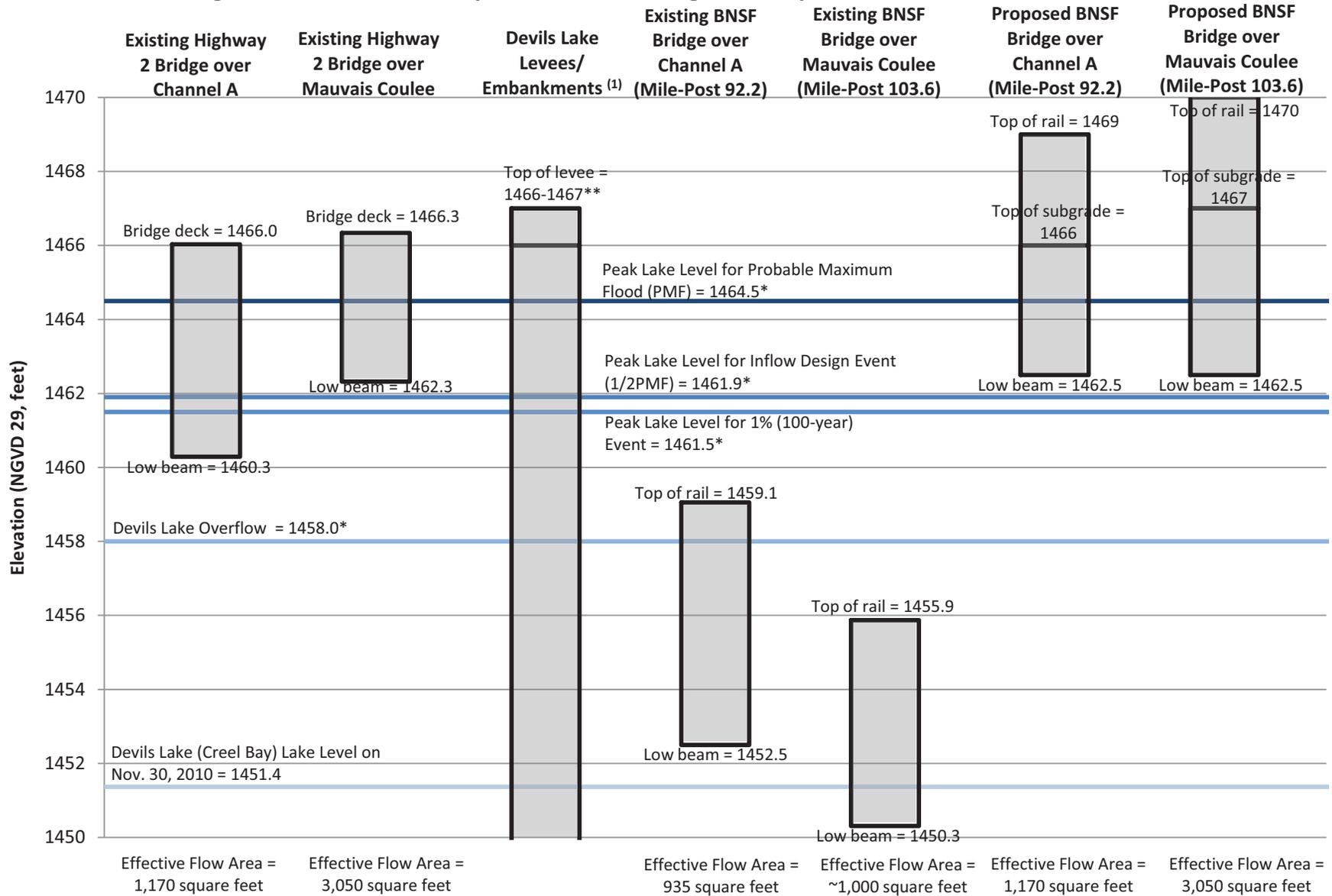


Figure 8
DEVILS LAKE DEPTHS AND
FETCH LOCATIONS AT
DESIGN ELEVATION*
BNSF Railroad Grade
Raise Feasibility Study
Devils Lake to Churchs Ferry, ND

*Design Elevation of 1462 (NGVD29) [1463.2 (NAVD 1988)].
Data Source: Lidar data and USGS 1/3 Arcsecond NED

Figure 9: Elevation Comparisons of Existing and Proposed Structures near Devils Lake



⁽¹⁾ Under construction in 2010. Expected completion in 2011-2012.

* Elevation at natural outlet at Tolna Coulee. Lake slope is assumed to be negligible.

** Design for City of Devils Lake top of levee/embankment assumed a one foot lake slope.

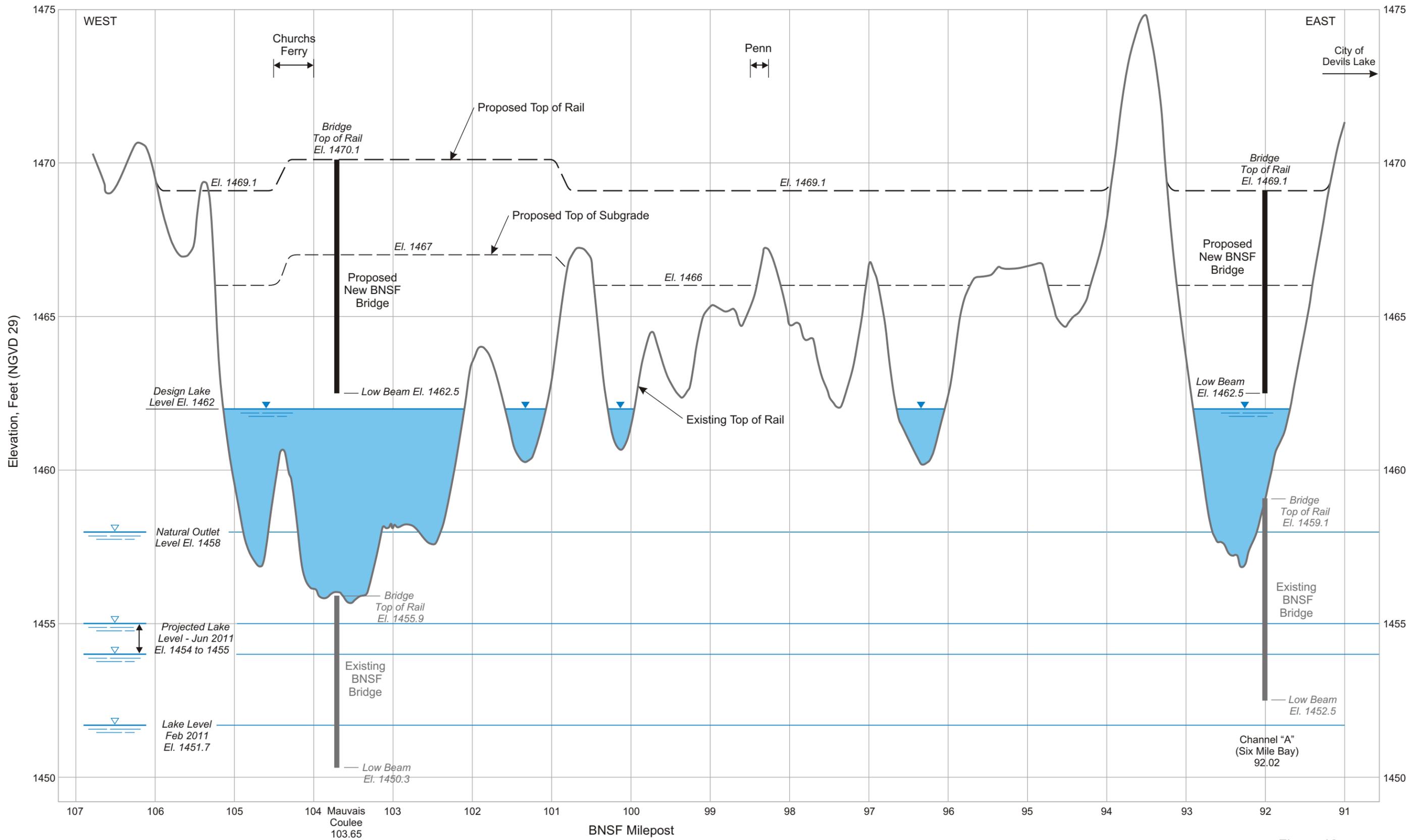
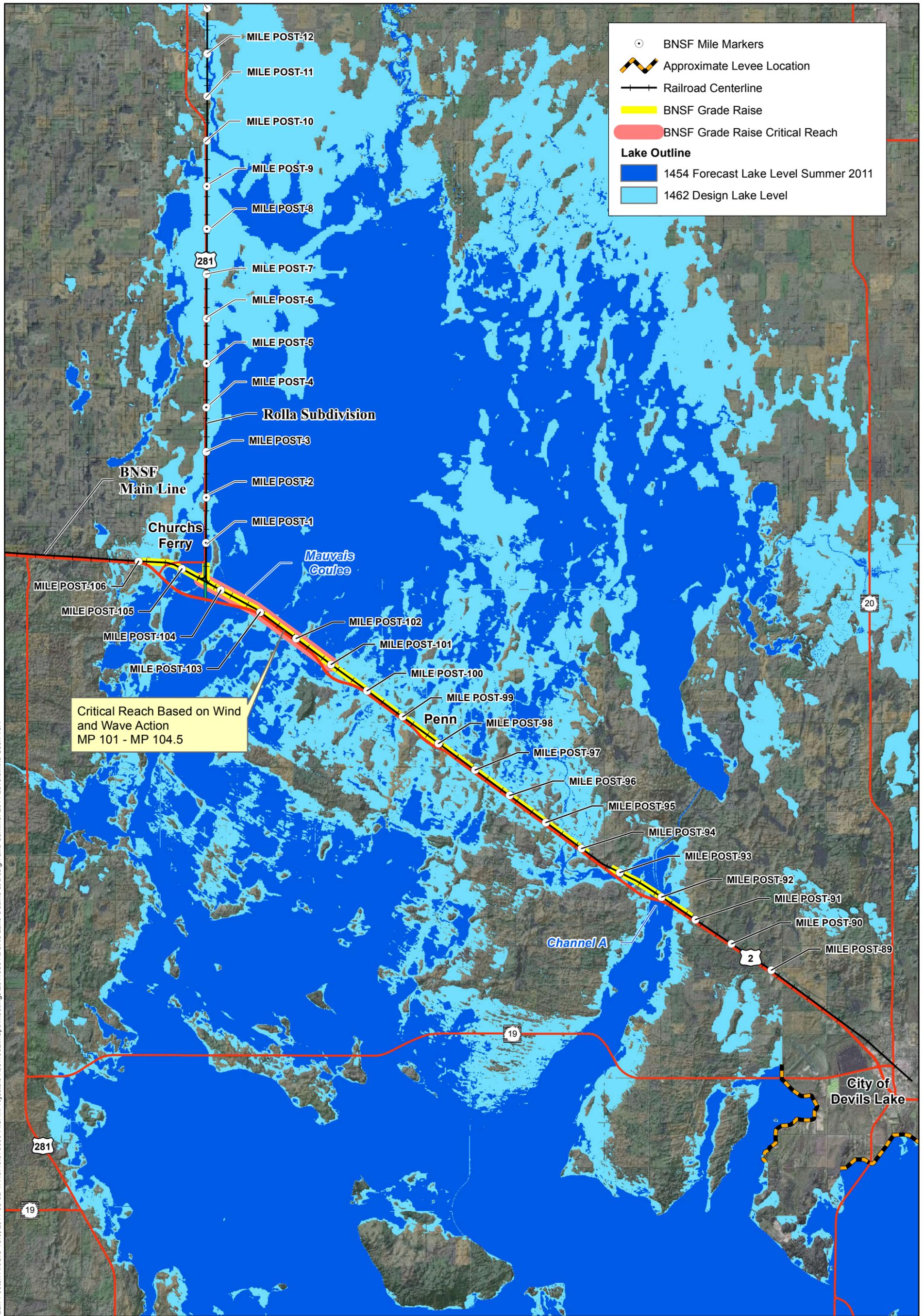


Figure 10

BNSF MAINLINE TRACK PROFILE
 EXISTING AND PROPOSED RAISE CONDITIONS
 Devils Lake Subdivision - Line Segment 33
 DEVILS LAKE TO CHURCH'S FERRY, ND



Barr Footer: ArcGIS 10.0, 2011-03-02 17:45:45.578000 File: I:\Projects\34361\1002\Maps\Meetings\20110304\Devils Lake Outline at Design and Summer 2011 Levels.mxd User: TJA

Figure 11

DEVILS LAKE OUTLINE
 AT DESIGN LAKE ELEVATION AND AT
 FORECAST 2011 LEVEL
 BNSF Railroad Grade
 Raise Feasibility Study
 Devils Lake to Church's Ferry, ND

*Design Elevation of 1462 (NGVD29) [1463.2 (NAVD 1988)].
 Data Source: Lidar data and USGS 1/3 Arcsecond NED

Devils Lake at Creel Bay, ND
Latitude: 48.1 Longitude: 99.3
Forecast for the period 2/27/2011 - 9/30/2011
This is a conditional simulation based on the current conditions as of 2/27/2011

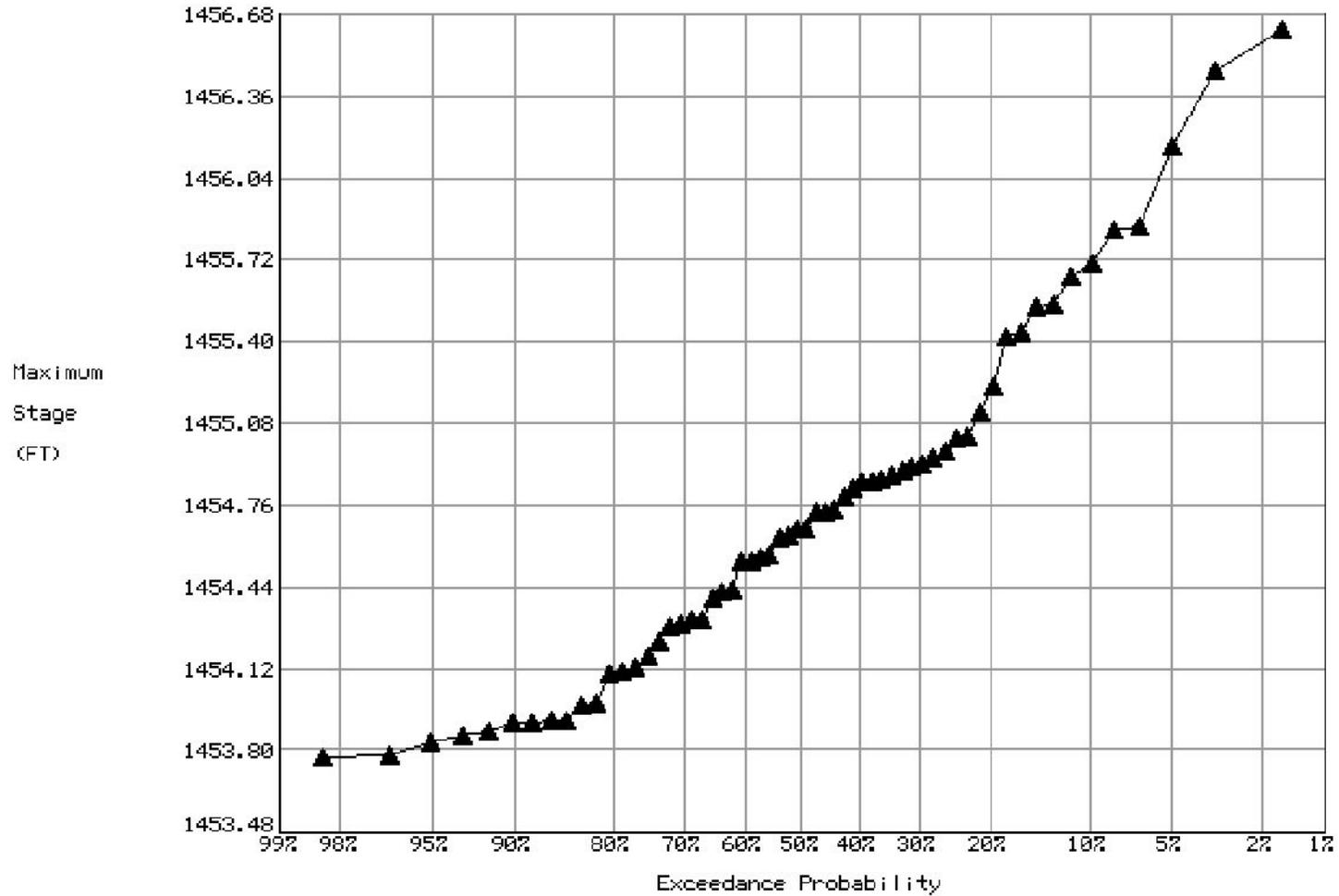
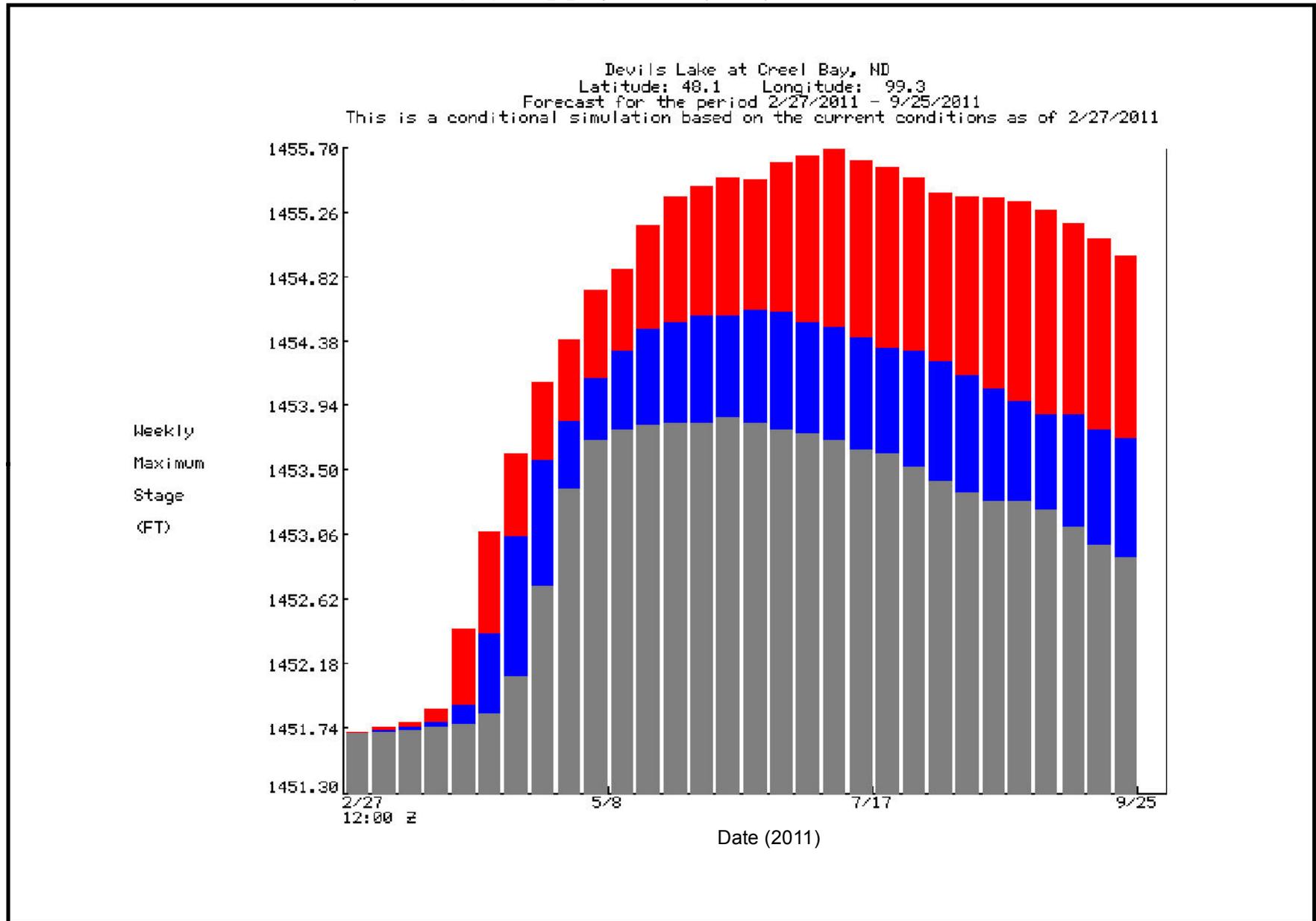


Figure 12

2011 PROBABILITY FORECAST FOR
LEVEL OF DEVILS LAKE, ND
Published 3 March 2011 by National Weather Service
BNSF Railroad Grade Raise Feasibility Study
Devils Lake to Churchs Ferry, ND



Exceedance
Probability

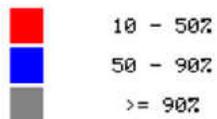


Figure 13

2011 WEEKLY PROBABILITY FORECAST for
 LEVEL of DEVILS LAKE, ND
 Published 3 March 2011 by National Weather Service
 BNSF Railroad Grade Raise Feasibility Study

Appendix B

Preliminary Track Design Drawings

CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\TS-002.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 4:04 PM
 BARR M:\outlook\2008\templates\barr_2008_template.dwt Plot at 0 07/21/2007 08:18:39



30% DRAFT
 NOT FOR CONSTRUCTION

NO.	BY	CHK	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11								
BID									
CONSTRUCTION									
RELEASED TO/FOR	A	B	C	0	1	2	3		
DATE RELEASED									

BARR
 Project Office:
 BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Ph: 1-800-225-1966
 Fax: (218) 262-3460
 www.barr.com
 Corporate Headquarters:
 Minneapolis, Minnesota
 Ph: 1-800-632-2277

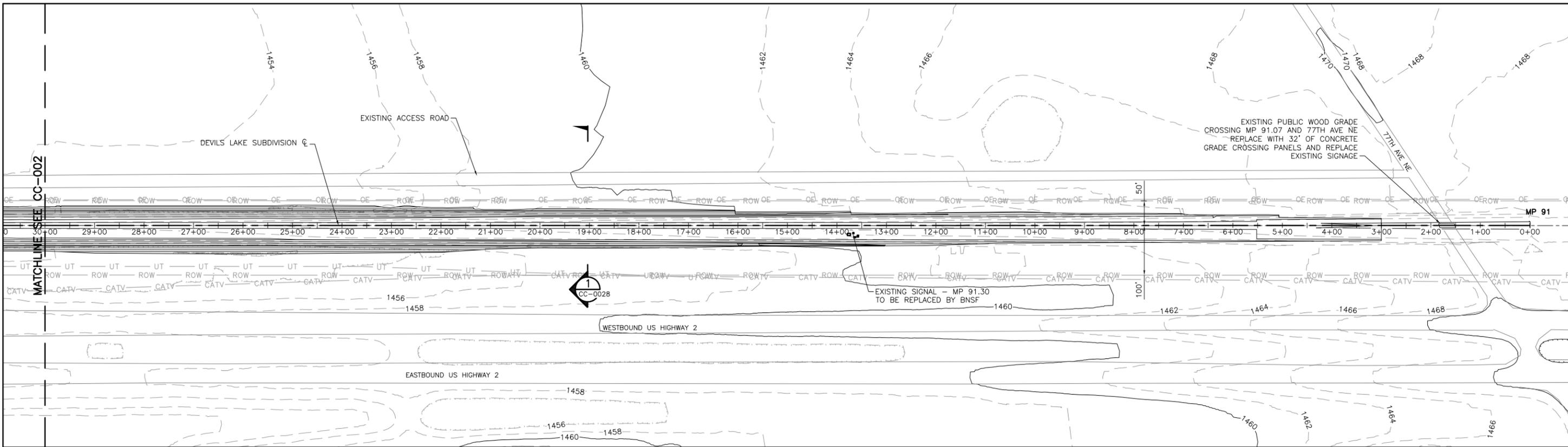
Scale	NO SCALE
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
 MINNEAPOLIS, MINNESOTA

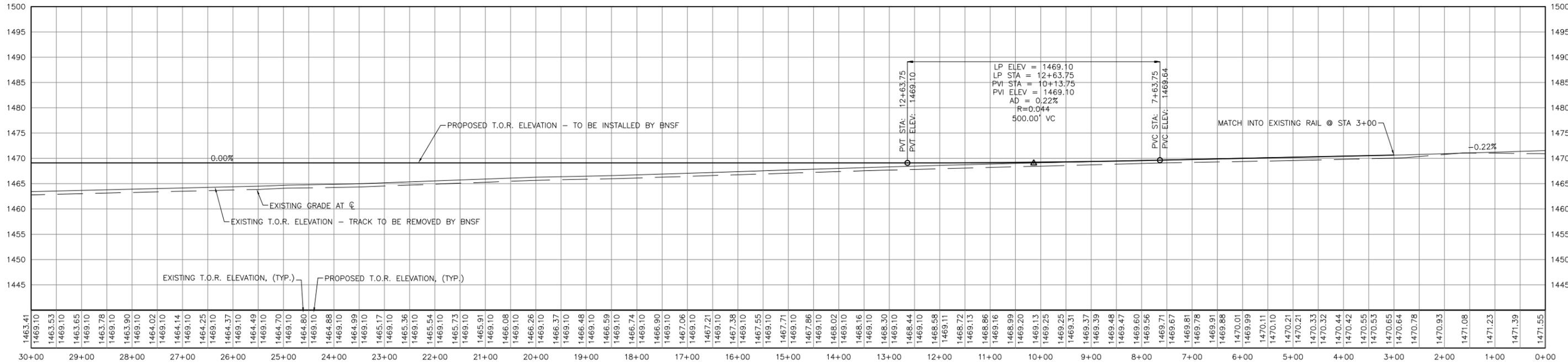
RAILROAD GRADE RAISE PLANNING
 DEVILS LAKE, NORTH DAKOTA
DEVILS LAKE SUBDIVISION
 OVERALL SITE PLAN

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	TS-002
REV. No.	A

CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-001.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 10:17 AM



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



- NOTES:
- EXISTING T.O.R. ELEVATIONS AS SHOWN FROM COMPILATION OF AVAILABLE SURVEY INFORMATION, (TYPICAL FOR ALL DRAWINGS)
 - KNOWN UTILITY LOCATIONS SHOWN ARE APPROXIMATE, (TYPICAL FOR ALL DRAWINGS). ADDITIONAL UTILITY INFORMATION WAS NOT MADE AVAILABLE.

30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11						
BID							
CONSTRUCTION							
RELEASED TO/FOR	A	B	C	0	1	2	3
DATE RELEASED							

BARR Engineering Co.
3128 14TH AVENUE EAST
HIBBING, MN 55746
Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

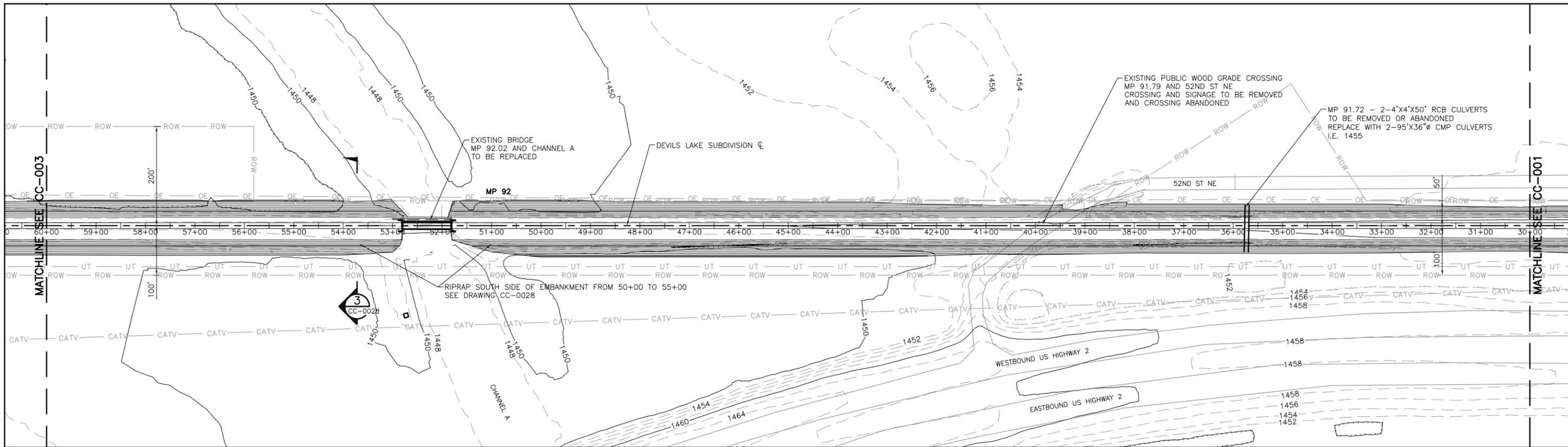
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

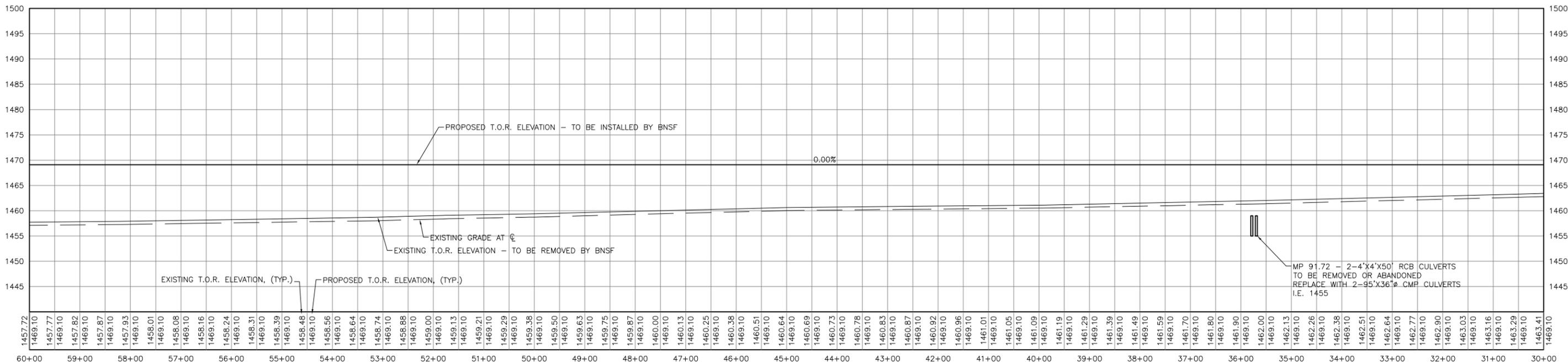
RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA
DEVILS LAKE SUBDIVISION - PLAN & PROFILE
STA 0+00 TO 30+00 (MP 91.03 TO 91.60)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-001
REV. No.	A

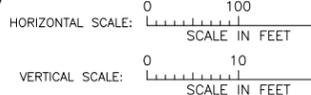
CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-002.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 10:23 AM
 BARR MA Autocad 2006 template\Barr_2006_template.dwt Plt at 0 07/27/2007 08:19:39



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	0	1
DATE RELEASED					

Project Office:
BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746

Corporate Headquarters:
 Minneapolis, Minnesota
 Ph: 1-800-632-2277

Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

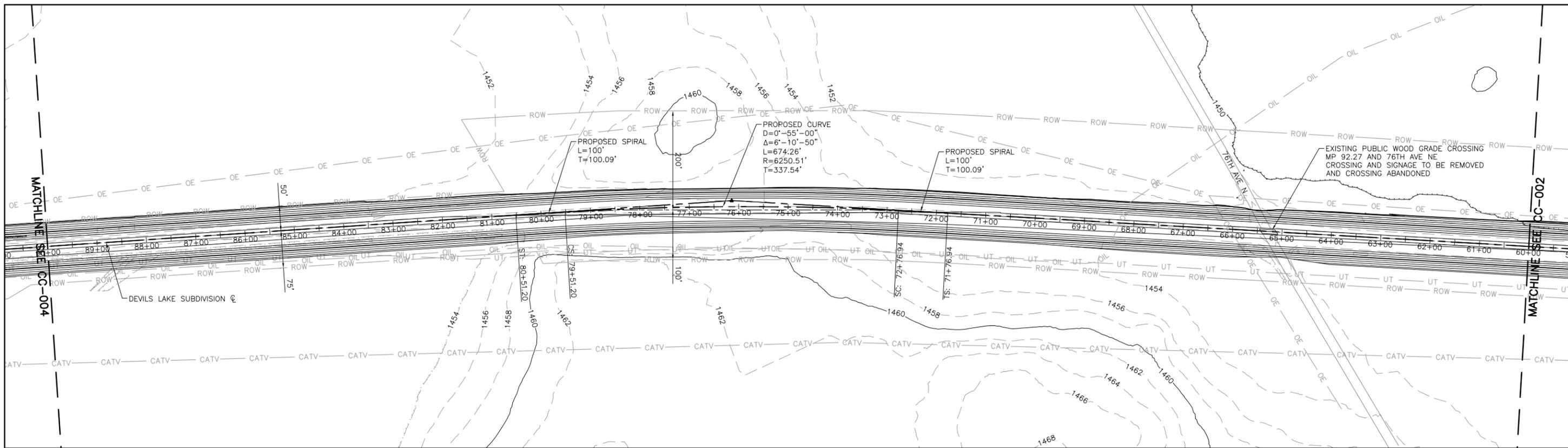
BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA

DEVILS LAKE SUBDIVISION - PLAN & PROFILE
STA 30+00 TO 60+00 (MP 91.60 TO 92.17)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-002
REV. No.	A

CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-003.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 10:28 AM
 BARR M:\outcad\2006\template\Barr_2006_template.dwt Plot at 0 07/27/2007 09:19:39



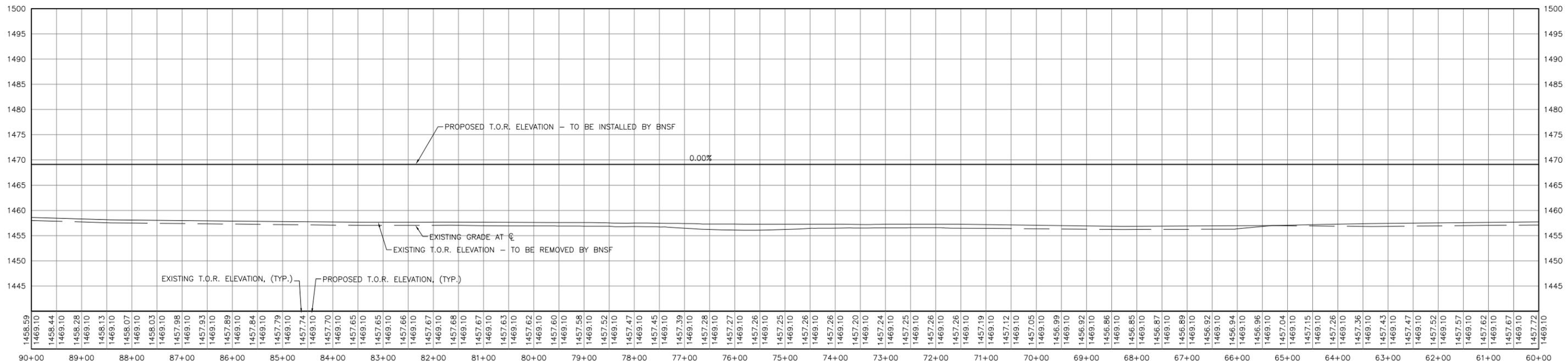
1 PLAN: DEVILS LAKE SUBDIVISION



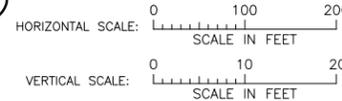
CURVE SUPERELEVATION

DEGREE OF CURVE	DESIGN SPEED	SUPERELEVATION
0°-55'-00"	79 MPH	1-1/8"

NOTE: SUPERELEVATION TO BE DEVELOPED OVER SPIRAL PASSENGER TRAIN DESIGN CRITERIA USED



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
 NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	0	1
DATE RELEASED					

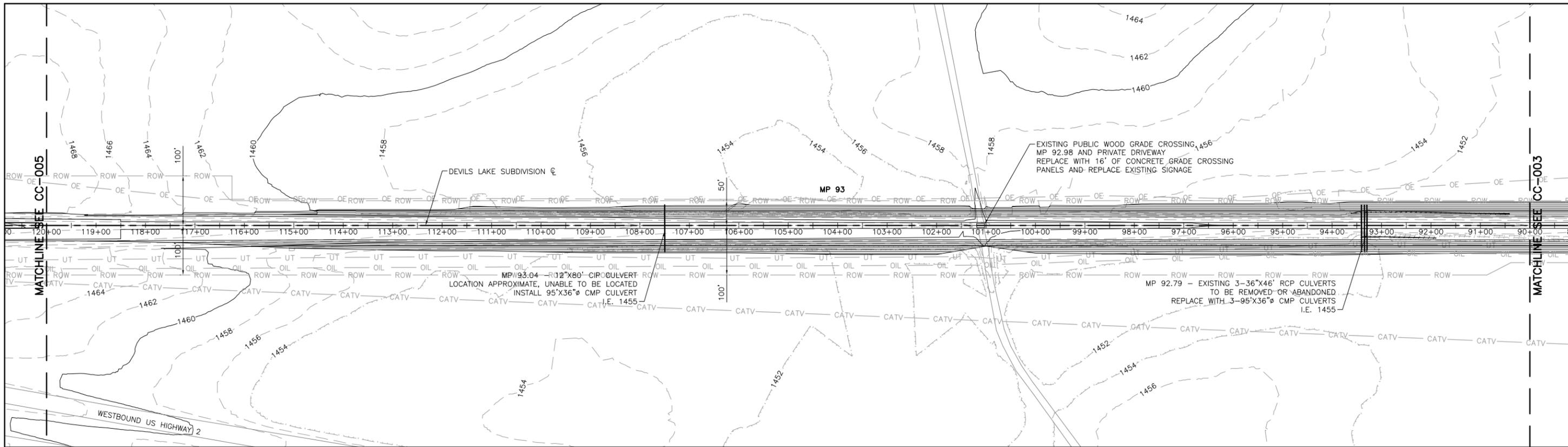
BARR Engineering Co.
 Project Office:
 BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Corporate Headquarters:
 Minneapolis, Minnesota
 Ph: 1-800-225-1966
 Fax: (218) 262-3460
 www.barr.com

Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

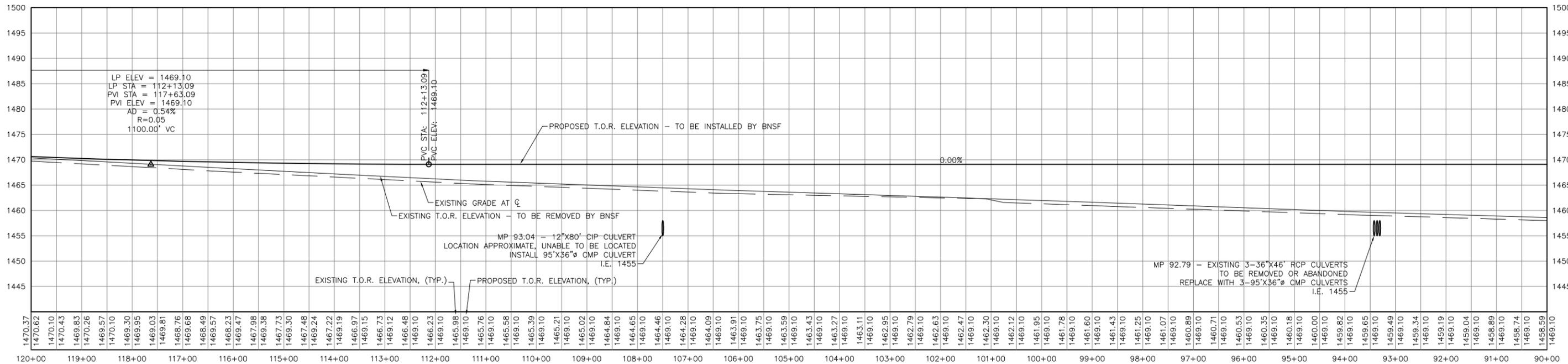
BNSF RAILWAY
 MINNEAPOLIS, MINNESOTA

RAILROAD GRADE RAISE PLANNING
 DEVILS LAKE, NORTH DAKOTA
 DEVILS LAKE SUBDIVISION - PLAN & PROFILE
 STA 60+00 TO 90+00 (MP 92.17 TO 92.73)

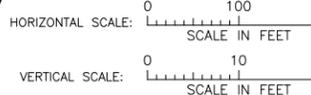
BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-003
REV. No.	A



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-004.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 10:32 AM

BARR - MA\outcad_2006\template\barrr_2006_template.dwt Plot at 0 07/27/2007 08:19:39

30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	0	1
DATE RELEASED					

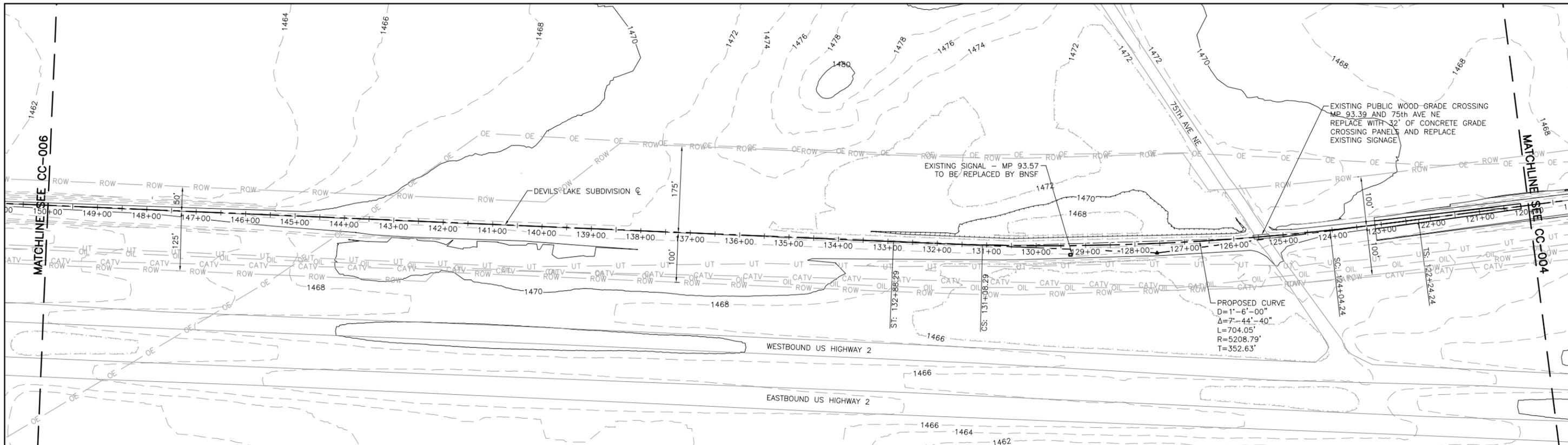
BARR Project Office:
BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Corporate Headquarters:
 Minneapolis, Minnesota
 Ph: 1-800-225-1966
 Fax: (218) 262-3460
 www.barr.com

Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
 MINNEAPOLIS, MINNESOTA

RAILROAD GRADE RAISE PLANNING
 DEVILS LAKE, NORTH DAKOTA
 DEVILS LAKE SUBDIVISION - PLAN & PROFILE
 STA 90+00 TO 120+00 (MP 92.73 TO 93.30)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-004
REV. No.	A



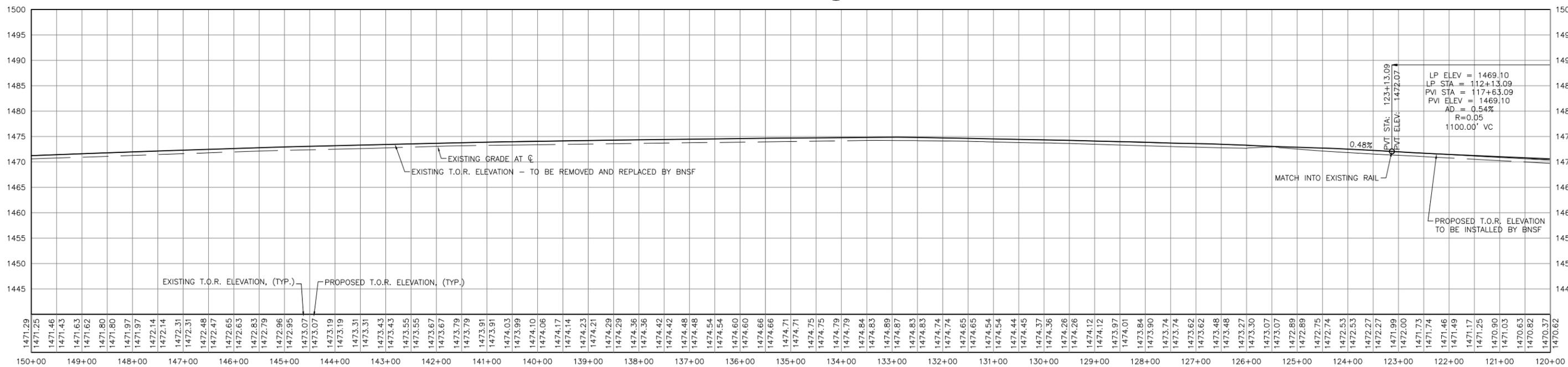
1 PLAN: DEVILS LAKE SUBDIVISION



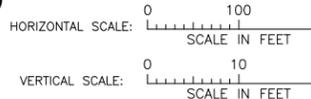
CURVE SUPERELEVATION

DEGREE OF CURVE	DESIGN SPEED	SUPERELEVATION
1'-06"-00"	78 MPH	2"

NOTE: SUPERELEVATION TO BE DEVELOPED OVER SPIRAL PASSENGER TRAIN DESIGN CRITERIA USED



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11
BID	
CONSTRUCTION	
RELEASED TO/FOR	
DATE RELEASED	A B C 0 1 2 3

BARR Engineering Co.
3128 14TH AVENUE EAST
HIBBING, MN 55746
Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

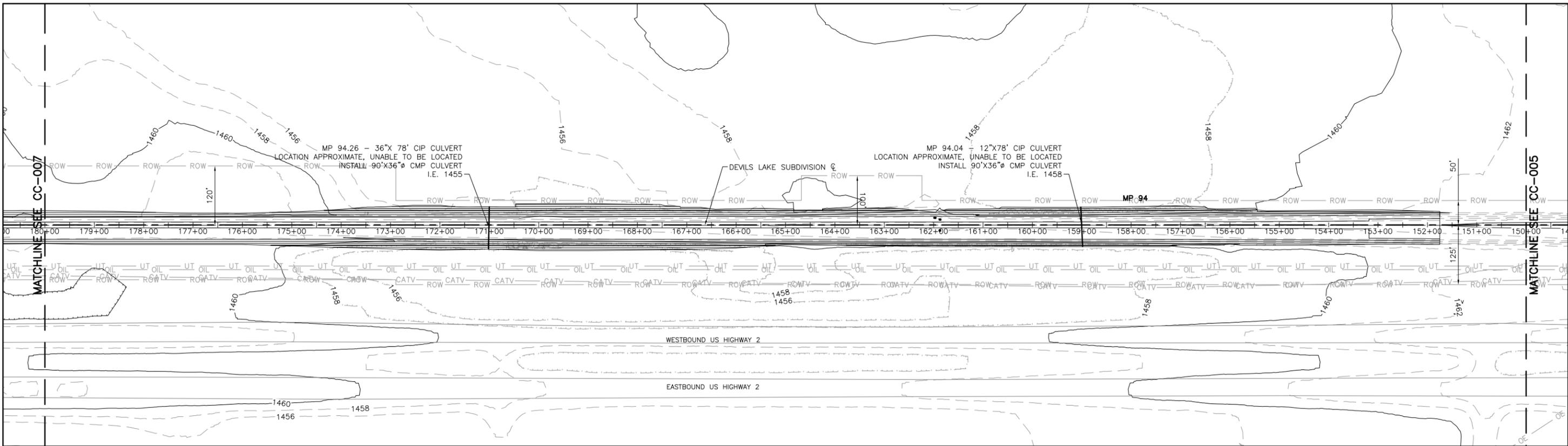
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

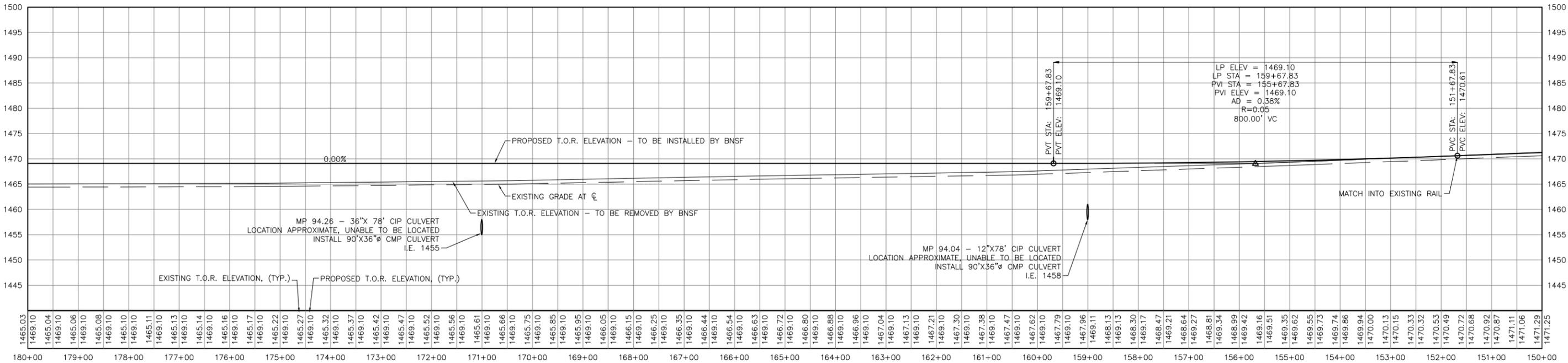
RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA
DEVILS LAKE SUBDIVISION - PLAN & PROFILE
STA 120+00 TO 150+00 (MP 93.30 TO 93.87)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-005
REV. No.	A

CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-006.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 10:47 AM



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	0	1
DATE RELEASED					

BARR Engineering Co.
3128 14TH AVENUE EAST
HIBBING, MN 55746
Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

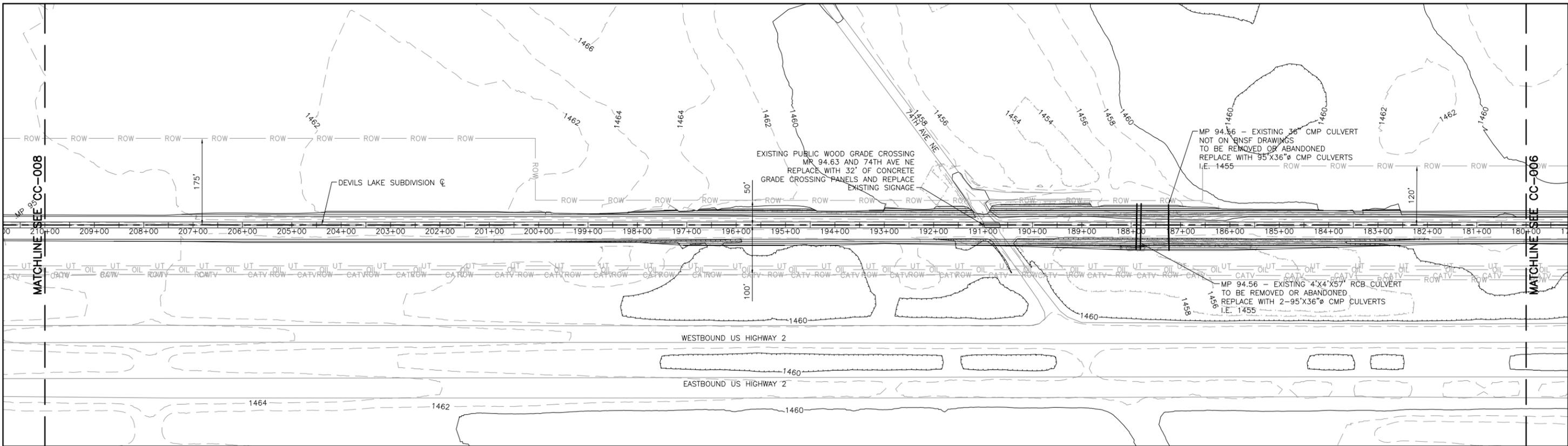
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

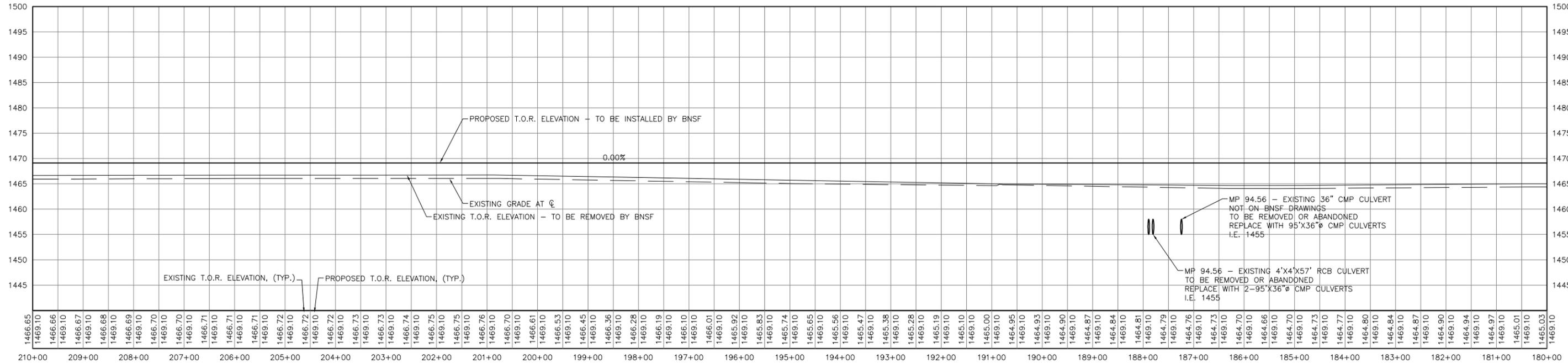
RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA
DEVILS LAKE SUBDIVISION - PLAN & PROFILE
STA 150+00 TO 180+00 (MP 93.87 TO 94.44)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-006
REV. No.	A

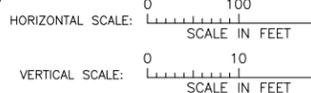
CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-007.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 10:53 AM



1 PLAN: DEVILO LAKE SUBDIVISION



1 PROFILE: DEVILO LAKE SUBDIVISION



NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	O	1
DATE RELEASED					

BARR Engineering Co.
3128 14TH AVENUE EAST
HIBBING, MN 55746
Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

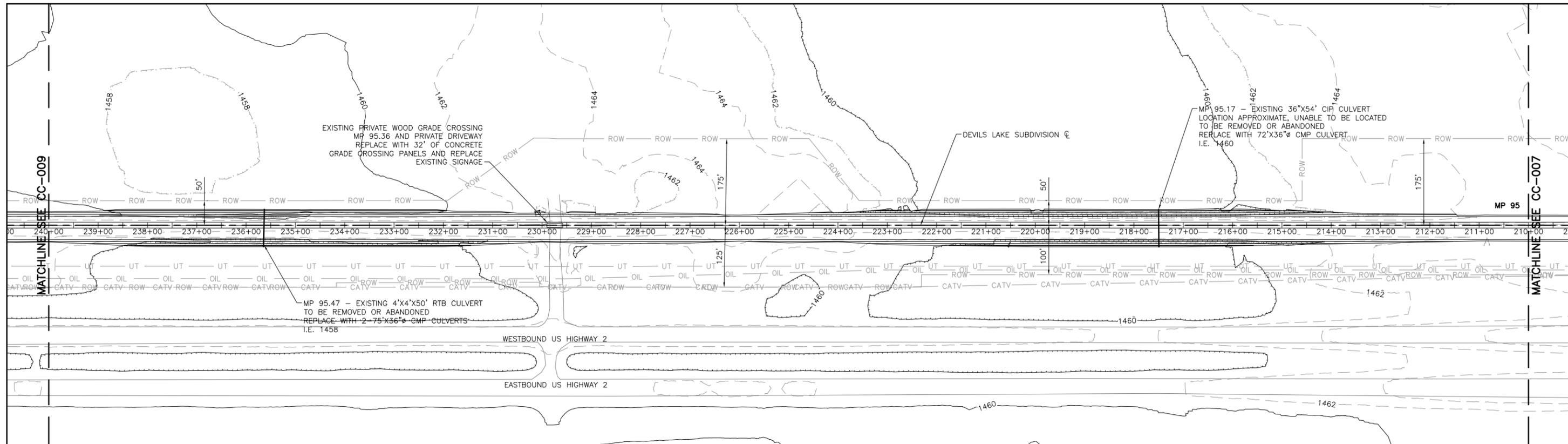
BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

RAILROAD GRADE RAISE PLANNING
DEVILO LAKE, NORTH DAKOTA
DEVILO LAKE SUBDIVISION - PLAN & PROFILE
STA 180+00 TO 210+00 (MP 94.44 TO 94.99)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-007
REV. No.	A

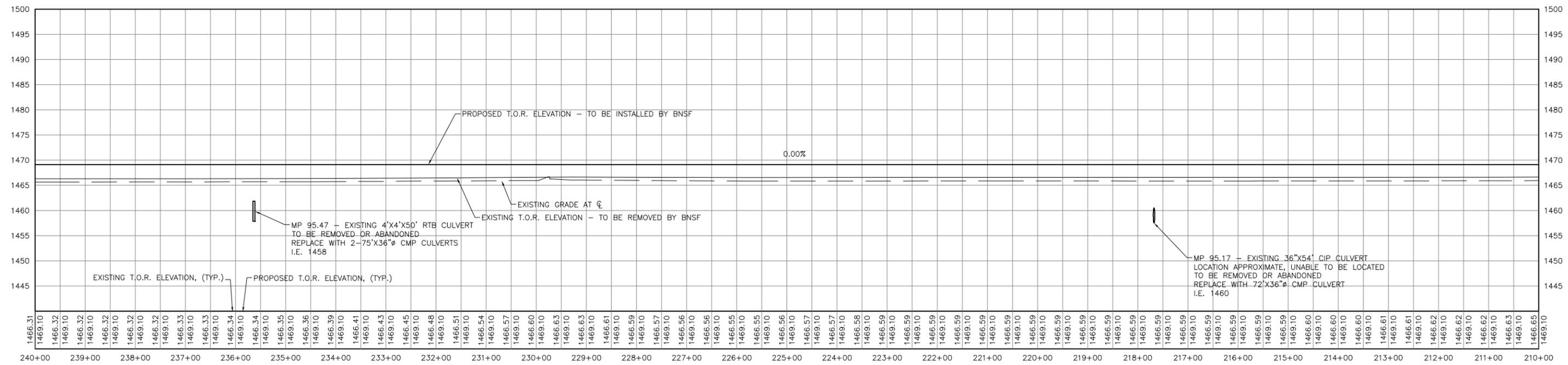
30% DRAFT
NOT FOR CONSTRUCTION

CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-008.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 3:40 PM



1 PLAN: DEVILS LAKE SUBDIVISION

0 100 200 SCALE IN FEET



1 PROFILE: DEVILS LAKE SUBDIVISION

HORIZONTAL SCALE: 0 100 200 SCALE IN FEET

VERTICAL SCALE: 0 10 20 SCALE IN FEET

30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11
BID	
CONSTRUCTION	
RELEASED TO/FOR	
DATE RELEASED	A B C 0 1 2 3

BARR Engineering Co.
3128 14TH AVENUE EAST
HIBBING, MN 55746

Project Office:
BARR ENGINEERING CO.
3128 14TH AVENUE EAST
HIBBING, MN 55746

Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-225-1966
Ph: 1-800-632-2277

Scale AS SHOWN
Date 1/03/11
Drawn GSJ
Checked MJZ
Designed LCH2
Approved MJZ

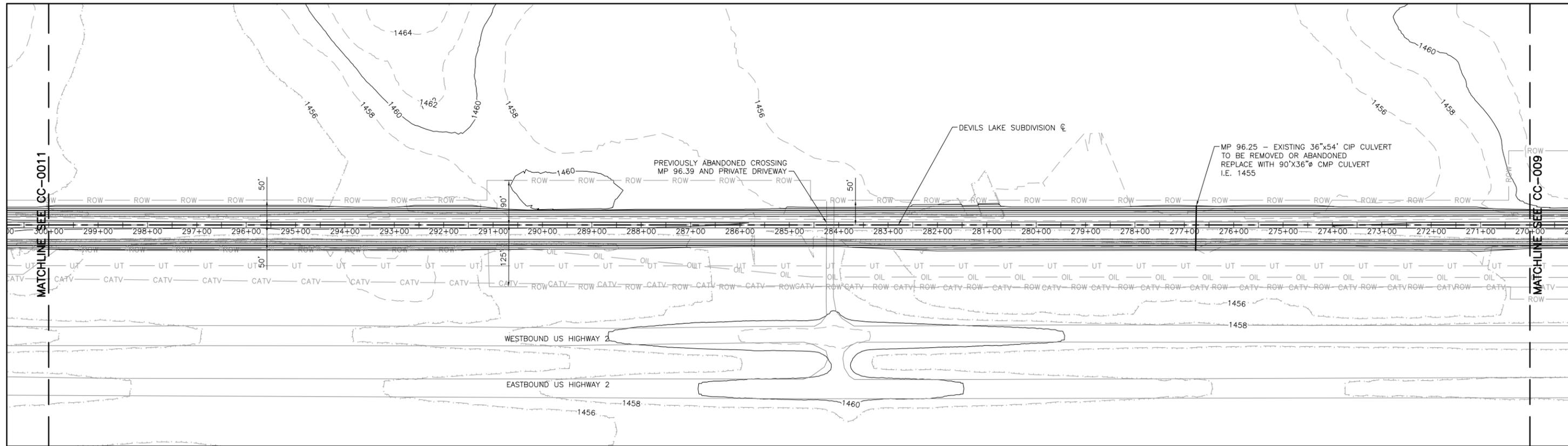
BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA

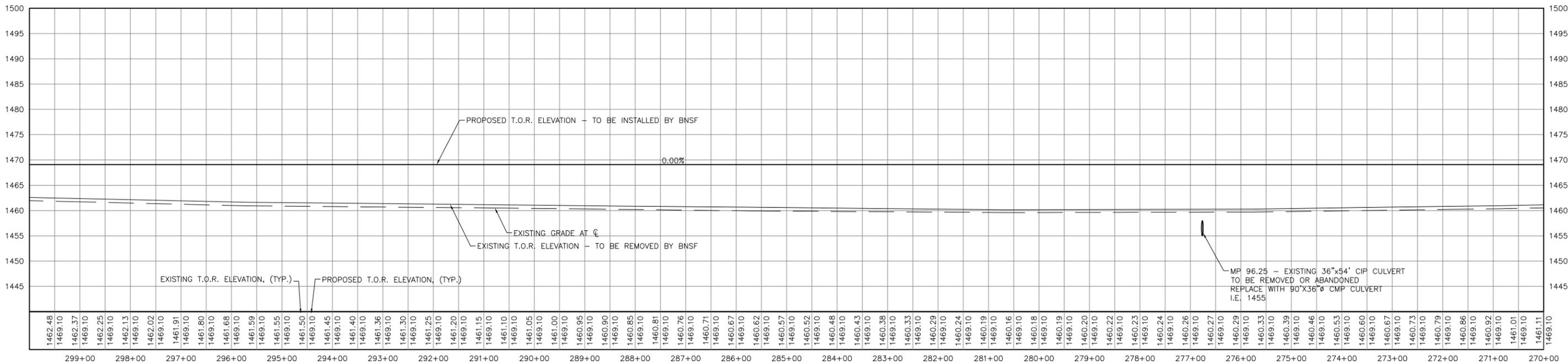
DEVILS LAKE SUBDIVISION - PLAN & PROFILE
STA 210+00 TO 240+00 (MP 94.99 TO 95.56)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-008
REV. No.	A

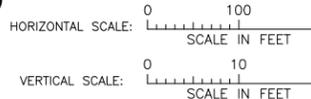
CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-0010.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 11:09 AM



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	O	1
DATE RELEASED					

BARR
Project Office:
BARR ENGINEERING CO.
3128 14TH AVENUE EAST
HIBBING, MN 55746
Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

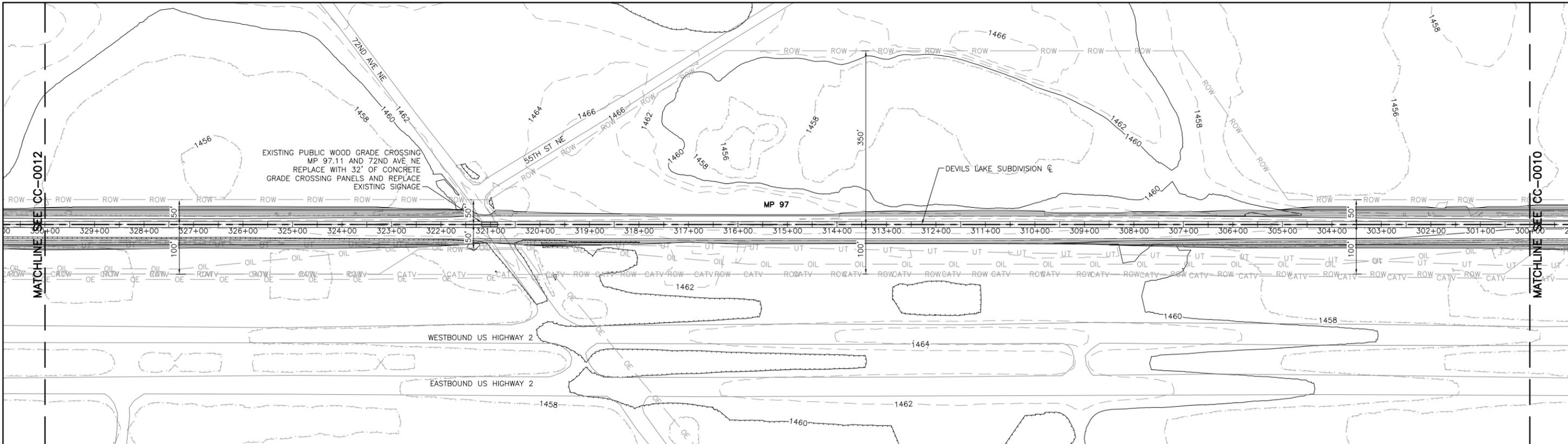
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

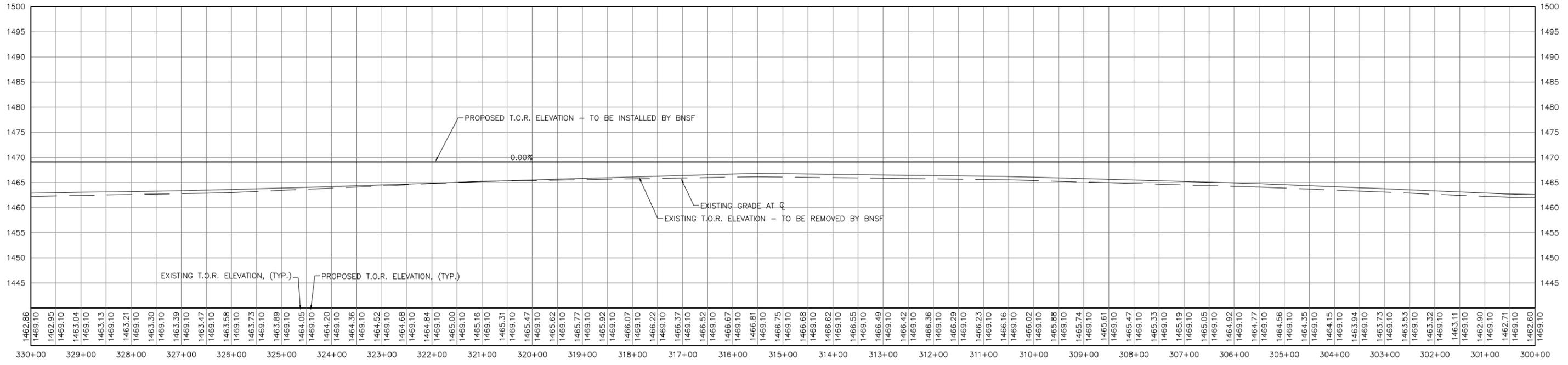
RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA
DEVILS LAKE SUBDIVISION - PLAN & PROFILE
STA 270+00 TO 300+00 (MP 96.13 TO 96.70)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0010
REV. No.	A

CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF6 - BNSF-PROPOSED - CC-0011.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 10:16 AM



1 PLAN: DEVILS LAKE SUBDIVISION
 0 100 200
 SCALE IN FEET



1 PROFILE: DEVILS LAKE SUBDIVISION
 HORIZONTAL SCALE: 0 100 200
 SCALE IN FEET
 VERTICAL SCALE: 0 10 20
 SCALE IN FEET

30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	O	1
DATE RELEASED					

BARR Engineering Co.
 Project Office:
 BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Ph: 1-800-225-1966
 Fax: (218) 262-3460
 www.barr.com

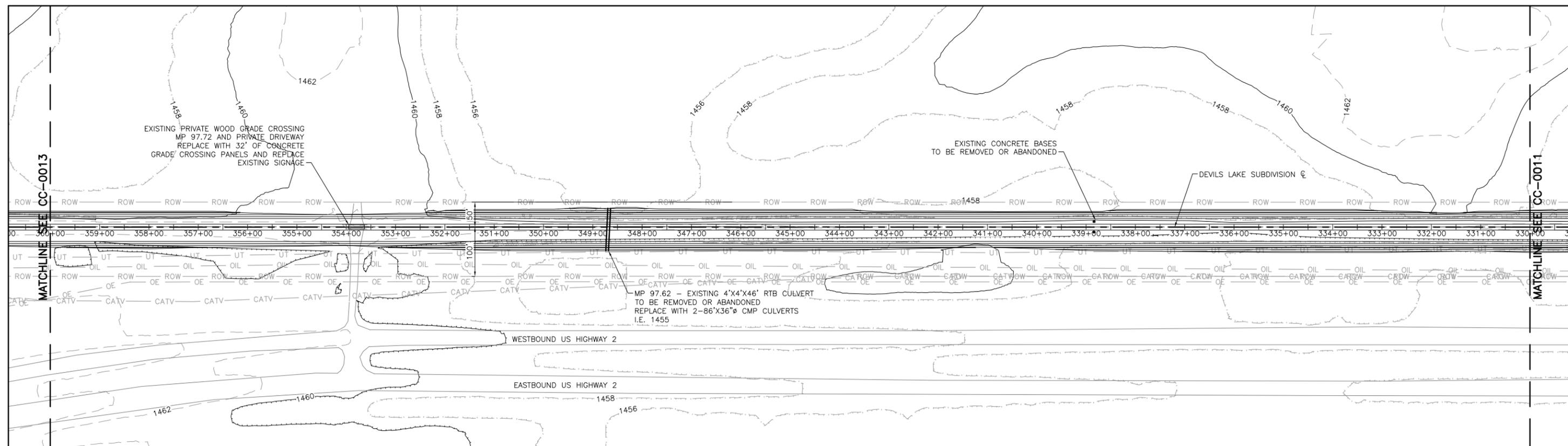
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
 MINNEAPOLIS, MINNESOTA

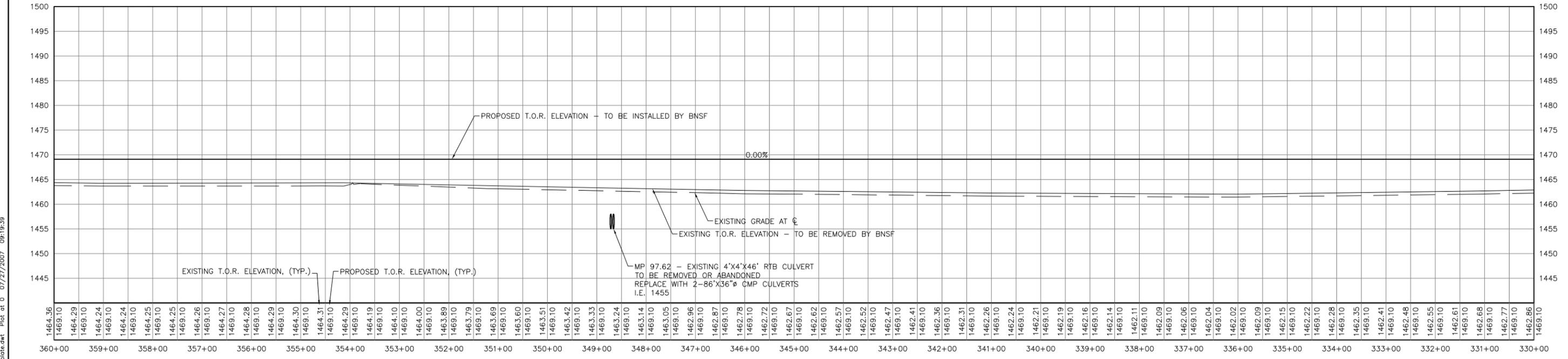
RAILROAD GRADE RAISE PLANNING
 DEVILS LAKE, NORTH DAKOTA
 DEVILS LAKE SUBDIVISION - PLAN & PROFILE
 STA 300+00 TO 330+00 (MP 96.70 TO 97.27)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0011
REV. No.	A

CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF6 - BNSF-PROPOSED - CC-0012.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 10:23 AM
 BARR - M:\outcad_2006\template\barrr_2006_template.dwt Plot at 0 07/27/2007 09:19:39



1 PLAN: DEVILS LAKE SUBDIVISION
 0 100 200
 SCALE IN FEET

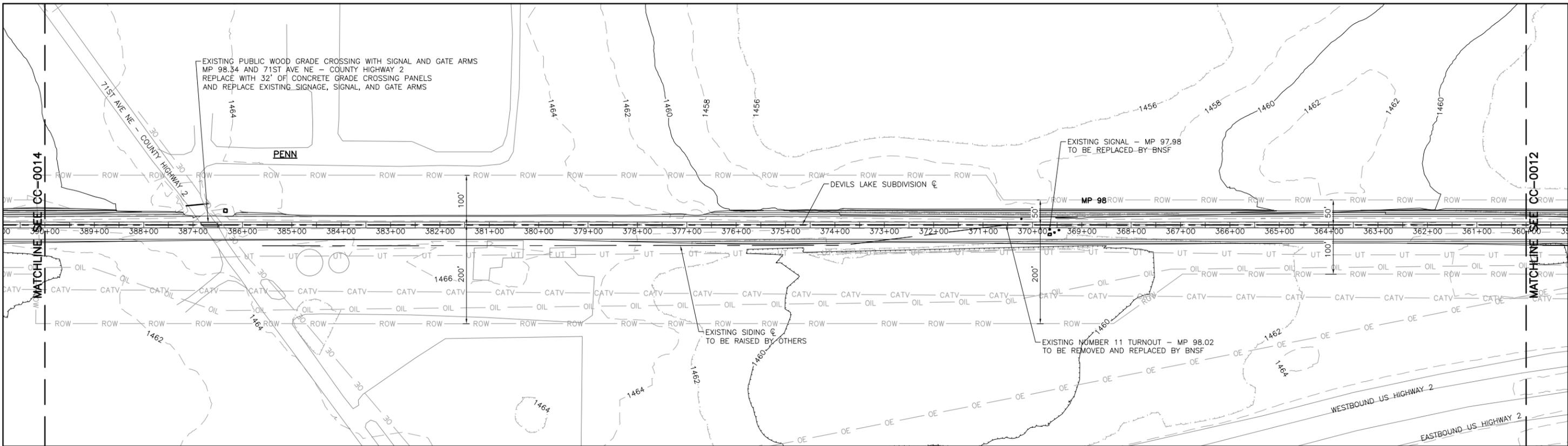


1 PROFILE: DEVILS LAKE SUBDIVISION
 HORIZONTAL SCALE: 0 100 200 SCALE IN FEET
 VERTICAL SCALE: 0 10 20 SCALE IN FEET

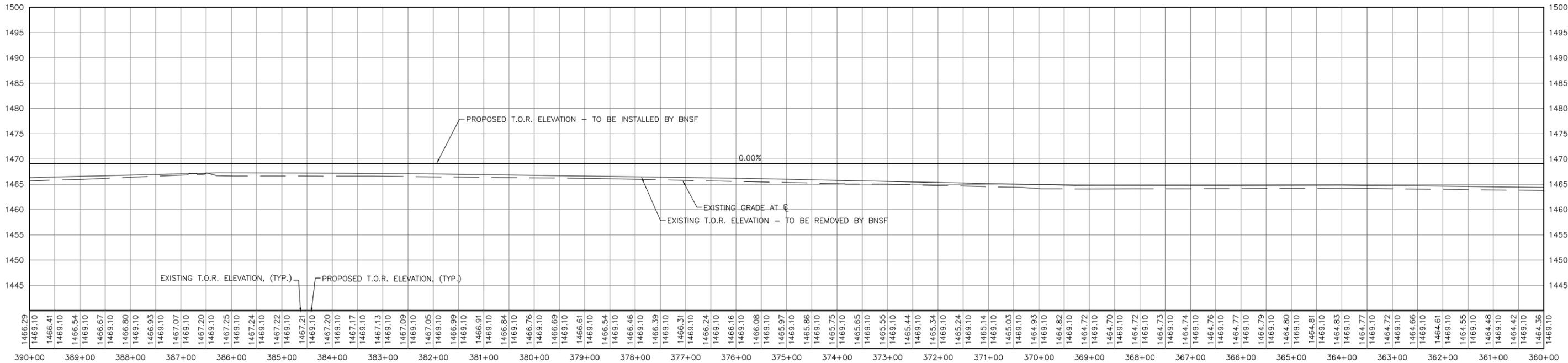
30% DRAFT
 NOT FOR CONSTRUCTION

<table border="1"> <tr><td>CLIENT</td><td>2/11</td></tr> <tr><td>BID</td><td></td></tr> <tr><td>CONSTRUCTION</td><td></td></tr> </table>		CLIENT	2/11	BID		CONSTRUCTION		<table border="1"> <tr><td>A</td><td>B</td><td>C</td><td>0</td><td>1</td><td>2</td><td>3</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>		A	B	C	0	1	2	3								<table border="1"> <tr><td>RELEASED TO/FOR</td><td></td></tr> <tr><td>DATE RELEASED</td><td></td></tr> </table>		RELEASED TO/FOR		DATE RELEASED		<table border="1"> <tr><td>Scale</td><td>AS SHOWN</td></tr> <tr><td>Date</td><td>1/03/11</td></tr> <tr><td>Drawn</td><td>GSJ</td></tr> <tr><td>Checked</td><td>MJZ</td></tr> <tr><td>Designed</td><td>LCH2</td></tr> <tr><td>Approved</td><td>MJZ</td></tr> </table>		Scale	AS SHOWN	Date	1/03/11	Drawn	GSJ	Checked	MJZ	Designed	LCH2	Approved	MJZ	<table border="1"> <tr><td colspan="2">Project Office:</td></tr> <tr><td colspan="2">BARR ENGINEERING CO.</td></tr> <tr><td colspan="2">3128 14TH AVENUE EAST</td></tr> <tr><td colspan="2">HIBBING, MN 55746</td></tr> <tr><td colspan="2">Ph: 1-800-225-1966</td></tr> <tr><td colspan="2">Fax: (218) 262-3460</td></tr> <tr><td colspan="2">www.barr.com</td></tr> </table>		Project Office:		BARR ENGINEERING CO.		3128 14TH AVENUE EAST		HIBBING, MN 55746		Ph: 1-800-225-1966		Fax: (218) 262-3460		www.barr.com		<table border="1"> <tr><td colspan="2">BNSF RAILWAY</td></tr> <tr><td colspan="2">MINNEAPOLIS, MINNESOTA</td></tr> </table>		BNSF RAILWAY		MINNEAPOLIS, MINNESOTA		<table border="1"> <tr><td colspan="2">RAILROAD GRADE RAISE PLANNING</td></tr> <tr><td colspan="2">DEVILS LAKE, NORTH DAKOTA</td></tr> <tr><td colspan="2">DEVILS LAKE SUBDIVISION - PLAN & PROFILE</td></tr> <tr><td colspan="2">STA 330+00 TO 360+00 (MP 97.27 TO 97.84)</td></tr> </table>		RAILROAD GRADE RAISE PLANNING		DEVILS LAKE, NORTH DAKOTA		DEVILS LAKE SUBDIVISION - PLAN & PROFILE		STA 330+00 TO 360+00 (MP 97.27 TO 97.84)		<table border="1"> <tr><td colspan="2">BARR PROJECT No.</td></tr> <tr><td colspan="2">34/36-1002</td></tr> <tr><td colspan="2">CLIENT PROJECT No.</td></tr> <tr><td colspan="2"></td></tr> <tr><td>DWG. No.</td><td>REV. No.</td></tr> <tr><td>CC-0012</td><td>A</td></tr> </table>		BARR PROJECT No.		34/36-1002		CLIENT PROJECT No.				DWG. No.	REV. No.	CC-0012	A
CLIENT	2/11																																																																																								
BID																																																																																									
CONSTRUCTION																																																																																									
A	B	C	0	1	2	3																																																																																			
RELEASED TO/FOR																																																																																									
DATE RELEASED																																																																																									
Scale	AS SHOWN																																																																																								
Date	1/03/11																																																																																								
Drawn	GSJ																																																																																								
Checked	MJZ																																																																																								
Designed	LCH2																																																																																								
Approved	MJZ																																																																																								
Project Office:																																																																																									
BARR ENGINEERING CO.																																																																																									
3128 14TH AVENUE EAST																																																																																									
HIBBING, MN 55746																																																																																									
Ph: 1-800-225-1966																																																																																									
Fax: (218) 262-3460																																																																																									
www.barr.com																																																																																									
BNSF RAILWAY																																																																																									
MINNEAPOLIS, MINNESOTA																																																																																									
RAILROAD GRADE RAISE PLANNING																																																																																									
DEVILS LAKE, NORTH DAKOTA																																																																																									
DEVILS LAKE SUBDIVISION - PLAN & PROFILE																																																																																									
STA 330+00 TO 360+00 (MP 97.27 TO 97.84)																																																																																									
BARR PROJECT No.																																																																																									
34/36-1002																																																																																									
CLIENT PROJECT No.																																																																																									
DWG. No.	REV. No.																																																																																								
CC-0012	A																																																																																								
<table border="1"> <tr><th>NO.</th><th>BY</th><th>CHK.</th><th>APP.</th><th>DATE</th><th>REVISION DESCRIPTION</th></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>		NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION																																																																																		
NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION																																																																																				

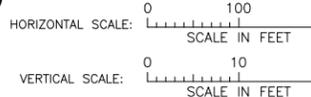
CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF8 - BNSF-PROPOSED - CC-0013.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 10:46 AM
 BARR MA\outcad_2006\template\template.dwg Plot at 0 07/27/2007 09:19:39



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
 NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11					
BID						
CONSTRUCTION						
RELEASED TO/FOR						
DATE RELEASED						
A	B	C	0	1	2	3

BARR Project Office:
 BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Ph: 1-800-225-1966
 Fax: (218) 262-3460
 www.barr.com

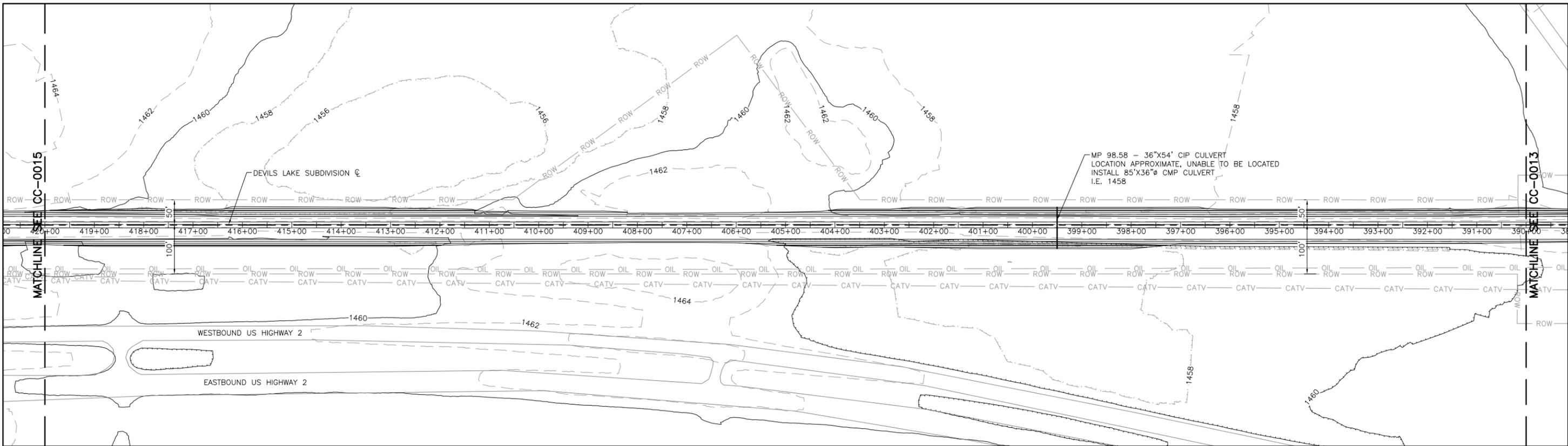
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
 MINNEAPOLIS, MINNESOTA

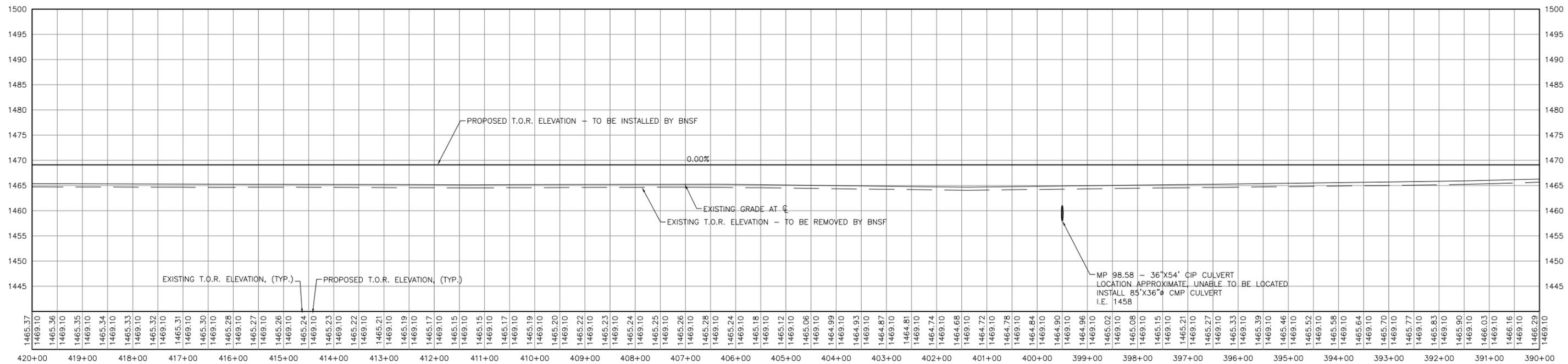
RAILROAD GRADE RAISE PLANNING
 DEVILS LAKE, NORTH DAKOTA
 DEVILS LAKE SUBDIVISION - PLAN & PROFILE
 STA 360+00 TO 390+00 (MP 97.84 TO 98.41)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0013
REV. No.	A

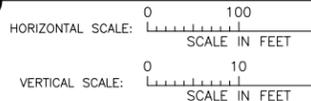
CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF6 - BNSF-PROPOSED - CC-0014.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 11:18 AM
 BARR MA\outocad_2006\template\barrr_2006_template.dwt Plt at 0 07/27/2007 08:19:39



1 PLAN: DEVI'S LAKE SUBDIVISION



1 PROFILE: DEVI'S LAKE SUBDIVISION



30% DRAFT
 NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11						
BID							
CONSTRUCTION							
RELEASED TO/FOR	A	B	C	0	1	2	3
DATE RELEASED							

Project Office:
BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746

Corporate Headquarters:
 Minneapolis, Minnesota
 Ph: 1-800-632-2277

Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

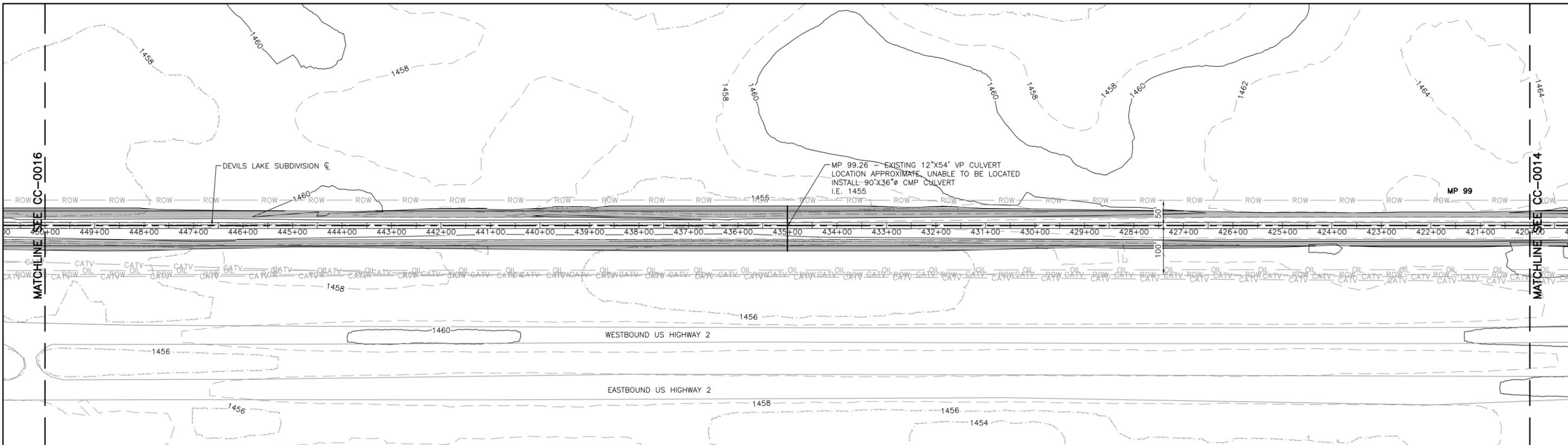
BNSF RAILWAY
 MINNEAPOLIS, MINNESOTA

RAILROAD GRADE RAISE PLANNING
 DEVI'S LAKE, NORTH DAKOTA

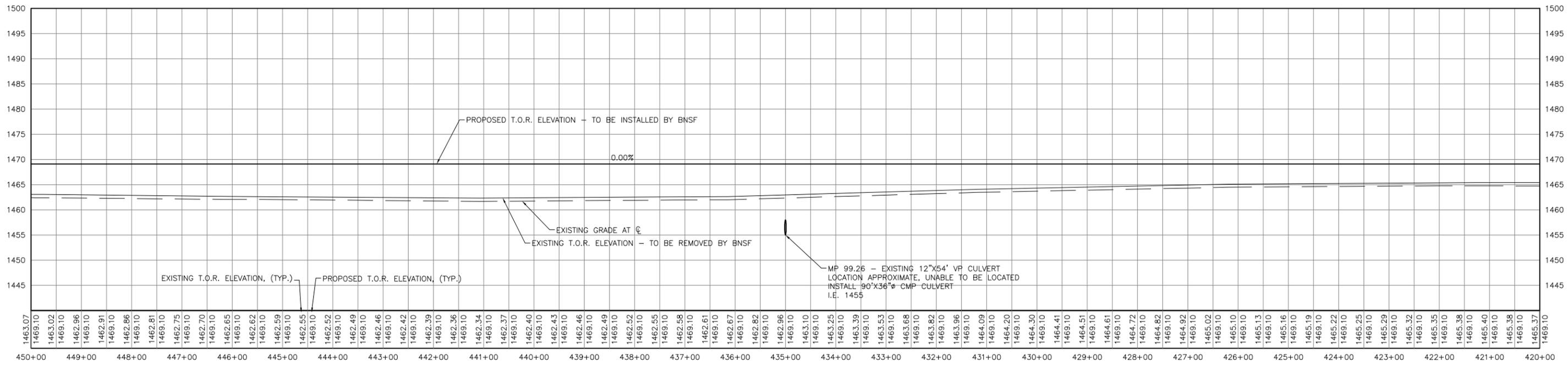
DEVI'S LAKE SUBDIVISION - PLAN & PROFILE
 STA 390+00 TO 420+00 (MP 98.41 TO 98.98)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0014
REV. No.	A

CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF6 - BNSF-PROPOSED - CC-0015.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 11:24 AM
 BARR MA autocad 2006 template\Barr_2006_template.dwt Plot at 0 07/27/2007 09:19:39



1 PLAN: DEVILS LAKE SUBDIVISION
 0 100 200
 SCALE IN FEET



1 PROFILE: DEVILS LAKE SUBDIVISION
 HORIZONTAL SCALE: 0 100 200 SCALE IN FEET
 VERTICAL SCALE: 0 10 20 SCALE IN FEET

30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11
BID	
CONSTRUCTION	
RELEASED TO/FOR	
DATE RELEASED	A B C 0 1 2 3

BARR
 Project Office:
BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Ph: 1-800-225-1966
 Fax: (218) 262-3460
 www.barr.com

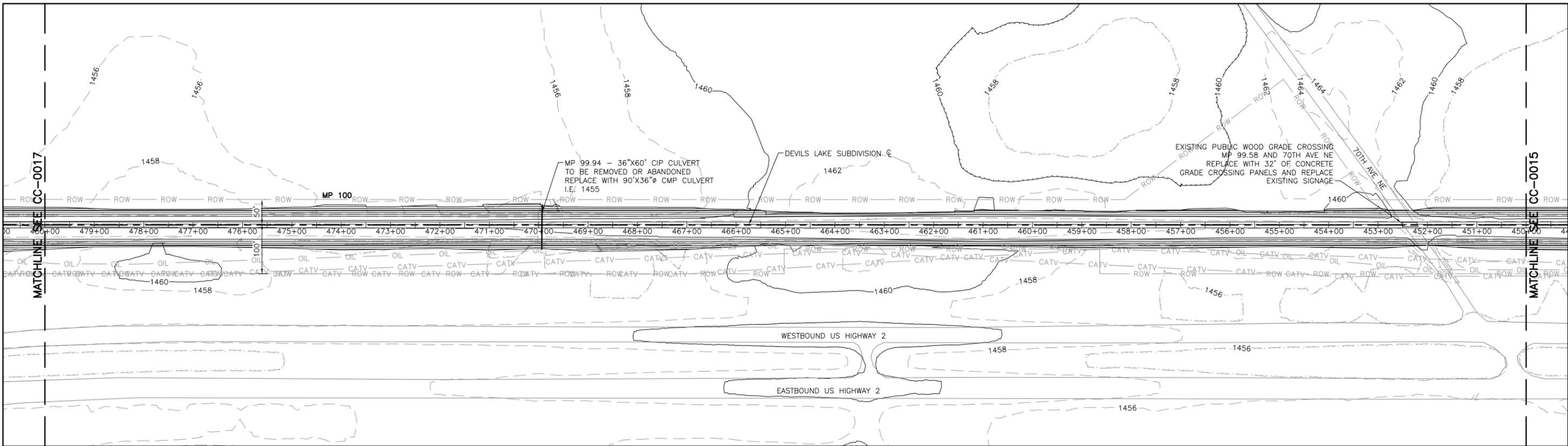
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
 MINNEAPOLIS, MINNESOTA

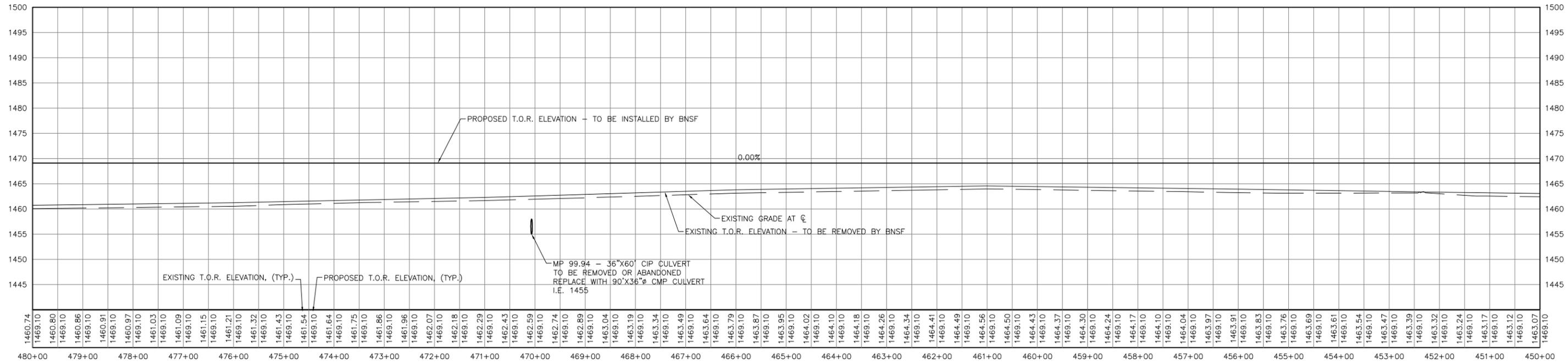
RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA
DEVILS LAKE SUBDIVISION - PLAN & PROFILE
 STA 420+00 TO 450+00 (MP 98.98 TO 99.55)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0015
REV. No.	A

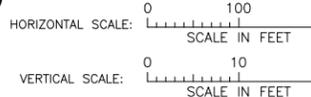
CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-0016.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 11:41 AM



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11						
BID							
CONSTRUCTION							
RELEASED TO/FOR	A	B	C	0	1	2	3
DATE RELEASED							

Project Office:
BARR ENGINEERING CO.
3128 14TH AVENUE EAST
HIBBING, MN 55746

Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

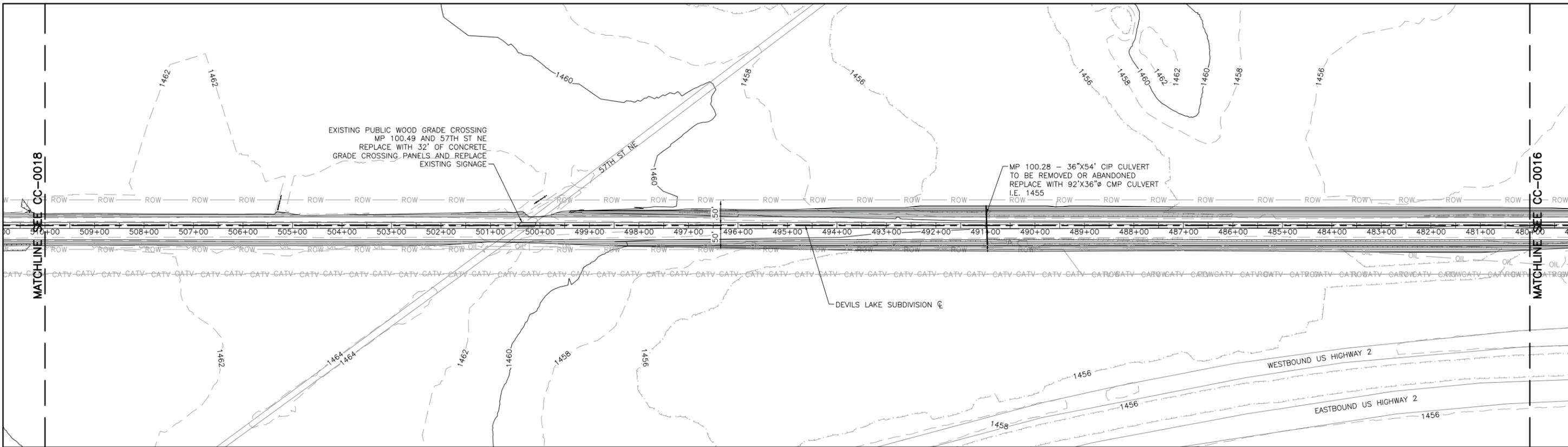
BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA

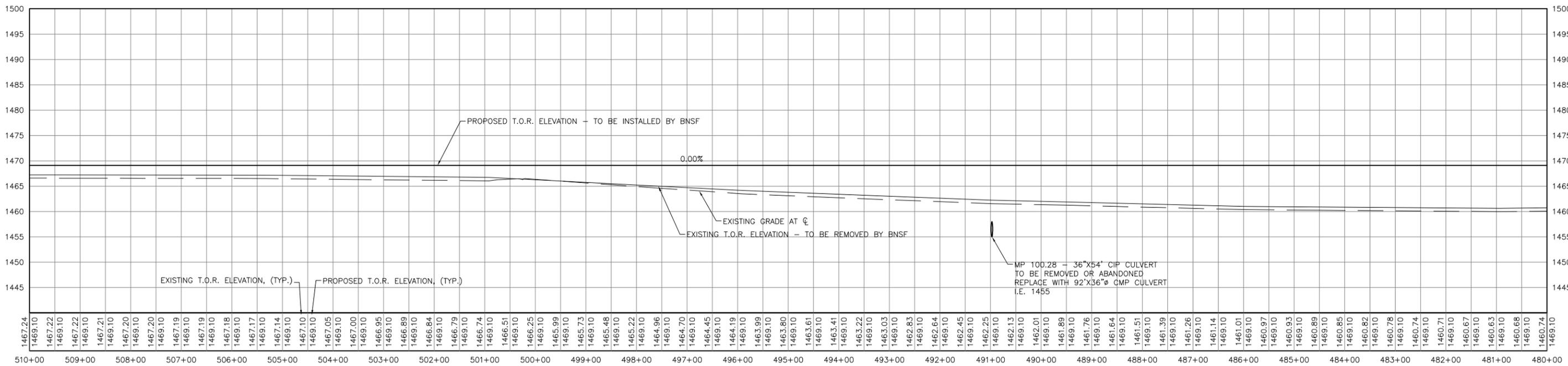
DEVILS LAKE SUBDIVISION - PLAN & PROFILE
STA 450+00 TO 480+00 (MP 99.55 TO 100.12)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0016
REV. No.	A

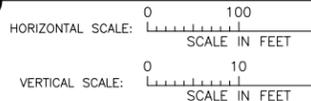
CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF6 - BNSF-PROPOSED - CC-0017.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 11:46 AM
 BARR MA\outocad_2006\template\barrr_2006_template.dwt Plt at 0 07/27/2007 09:19:39



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
 NOT FOR CONSTRUCTION

NO.	BY	CHK	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	0	1
DATE RELEASED					

BARR Engineering Co.
 Project Office:
 BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Corporate Headquarters:
 Minneapolis, Minnesota
 Ph: 1-800-225-1966
 Fax: (218) 262-3460
 www.barr.com

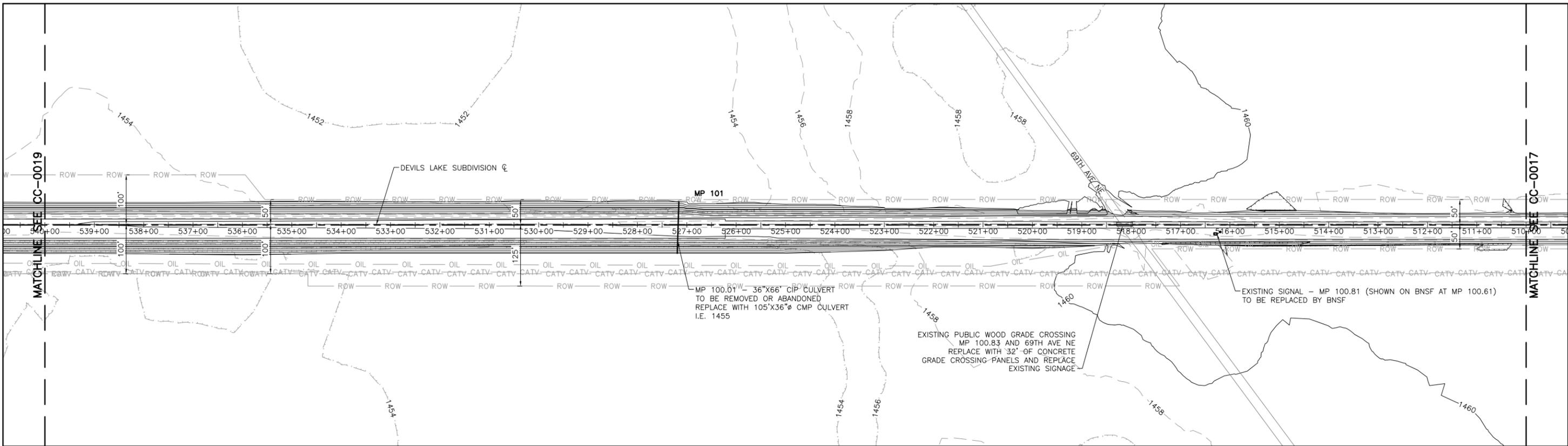
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
 MINNEAPOLIS, MINNESOTA

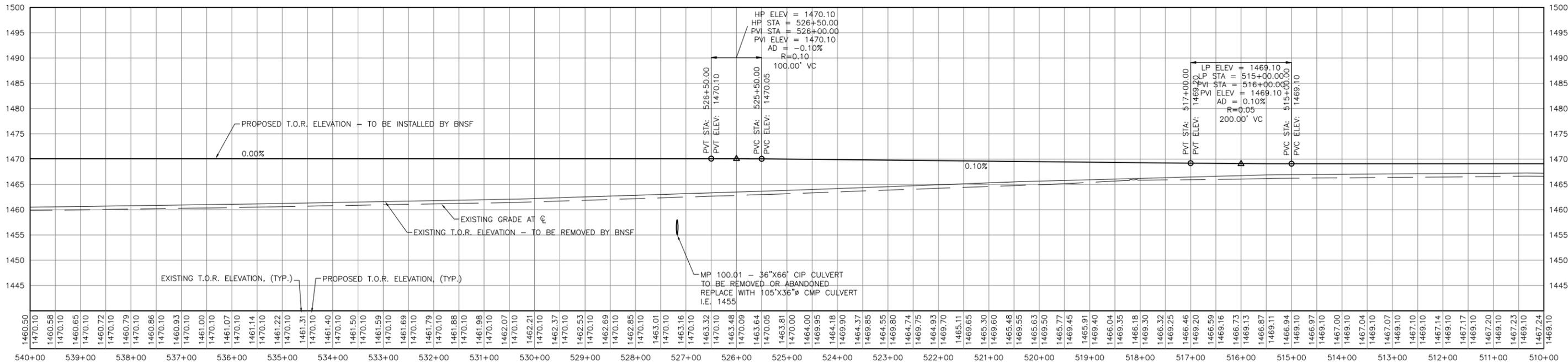
RAILROAD GRADE RAISE PLANNING
 DEVILS LAKE, NORTH DAKOTA
 DEVILS LAKE SUBDIVISION - PLAN & PROFILE
 STA 480+00 TO 510+00 (MP 100.12 TO 100.69)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0017
REV. No.	A

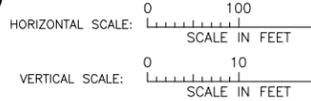
CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF6 - BNSF-PROPOSED - CC-0018.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 11:55 AM
 BARR M:\outcad\2006\template\barr_2006_template.dwt Plot at 0 07/27/2007 09:19:39



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
 NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	O	1
DATE RELEASED					

BARR Engineering Co.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Project Office:
 BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Ph: 1-800-225-1966
 Fax: (218) 262-3460
 www.barr.com
 Corporate Headquarters:
 Minneapolis, Minnesota
 Ph: 1-800-632-2277

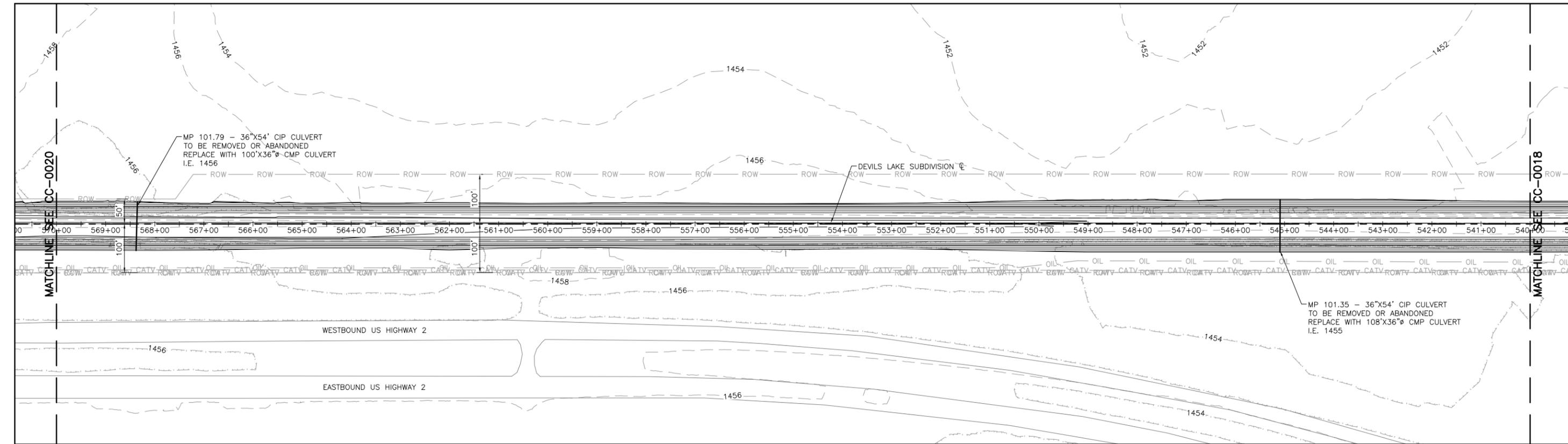
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
 MINNEAPOLIS, MINNESOTA

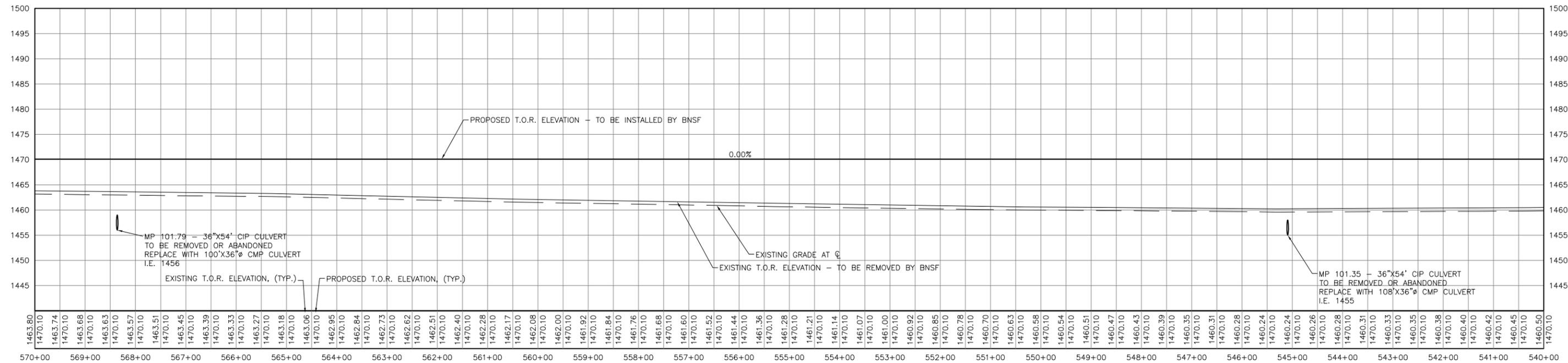
RAILROAD GRADE RAISE PLANNING
 DEVILS LAKE, NORTH DAKOTA
 DEVILS LAKE SUBDIVISION - PLAN & PROFILE
 STA 510+00 TO 540+00 (MP 100.69 TO 101.26)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0018
REV. No.	A

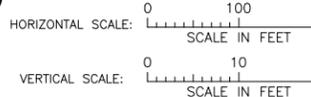
CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF8 - BNSF-PROPOSED - CC-0019.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 1:15 PM



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	O	1
DATE RELEASED					

Project Office:
BARR ENGINEERING CO.
3128 14TH AVENUE EAST
HIBBING, MN 55746

Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277

Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

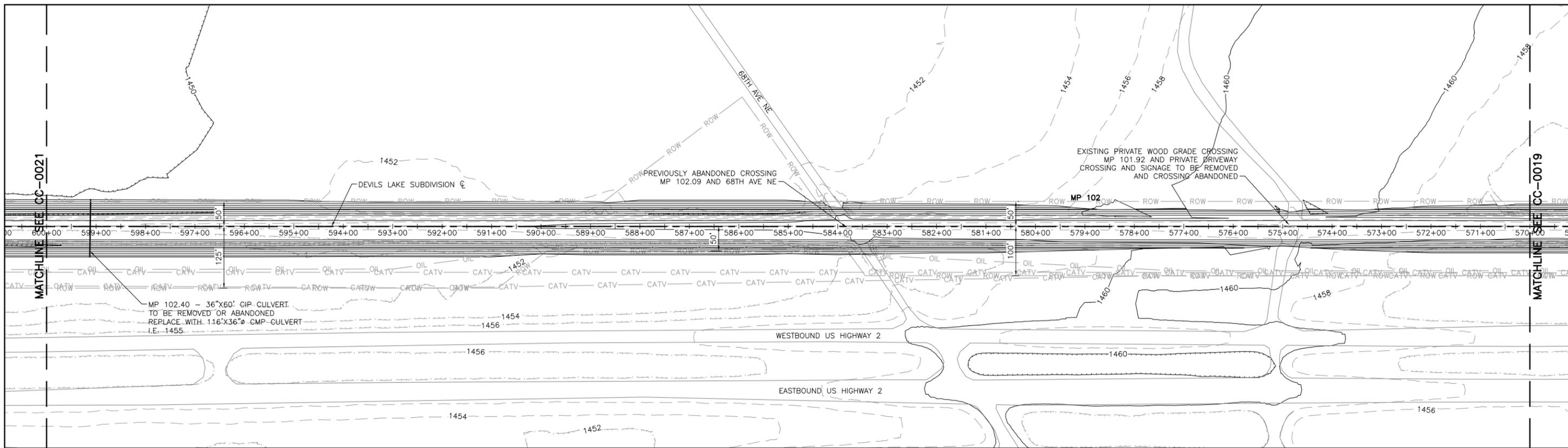
BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA

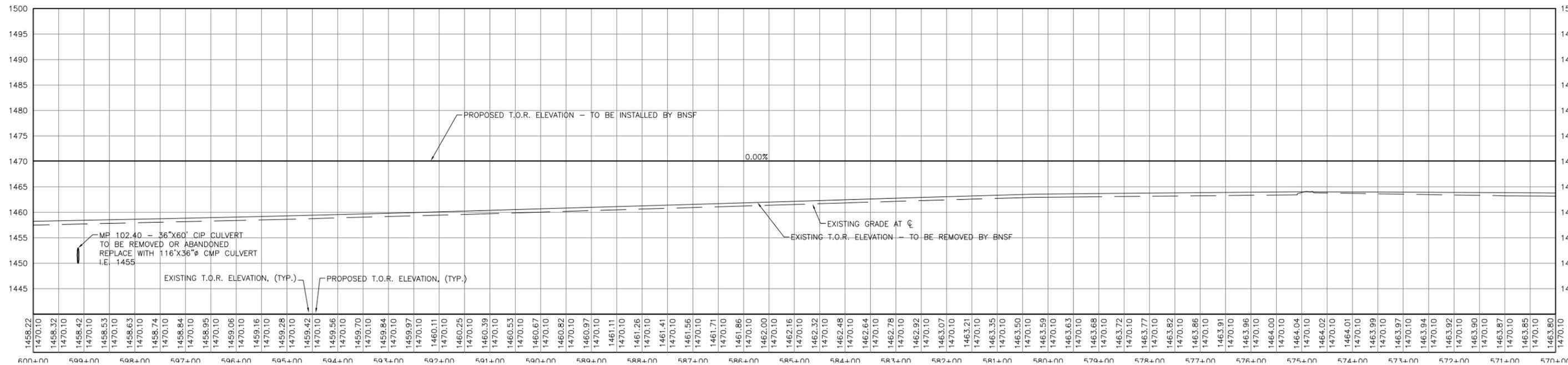
DEVILS LAKE SUBDIVISION - PLAN & PROFILE
STA 540+00 TO 570+00 (MP 101.26 TO 101.83)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0019
REV. No.	A

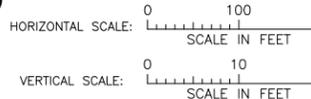
CADD USER: Kevin Miller FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-0020.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 1:40 PM
 BARR M:\outcad\2006\template\barr_2006_template.dwt Plot at 0 07/27/2007 08:19:39



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
 NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	O	1
DATE RELEASED					

BARR Engineering Co.
 Project Office:
 BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Corporate Headquarters:
 Minneapolis, Minnesota
 Ph: 1-800-225-1966
 Fax: (218) 262-3460
 www.barr.com

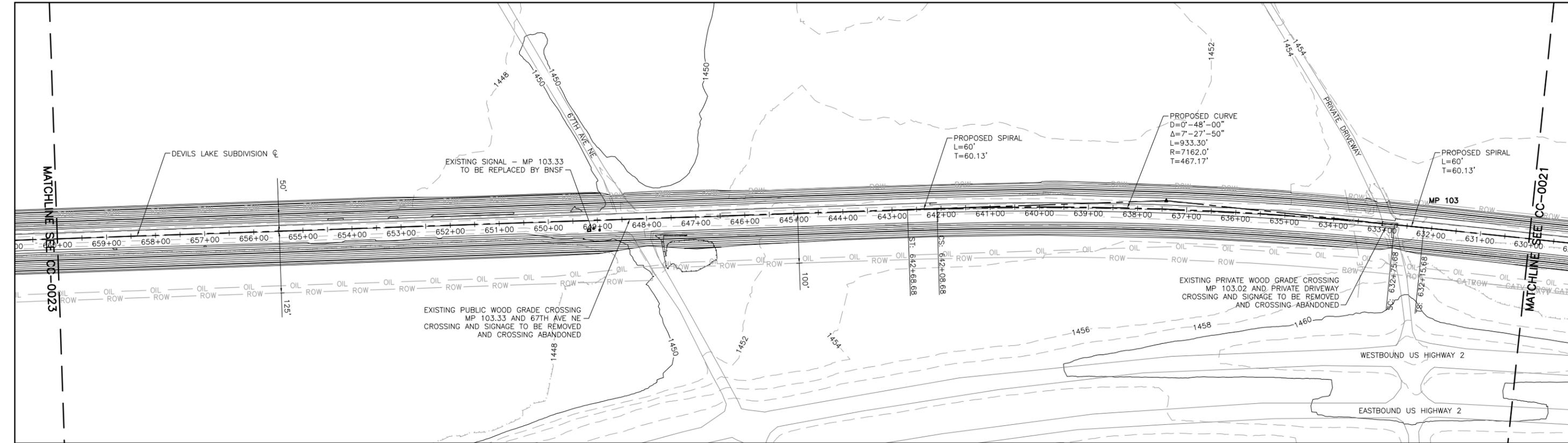
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
 MINNEAPOLIS, MINNESOTA

RAILROAD GRADE RAISE PLANNING
 DEVILS LAKE, NORTH DAKOTA
 DEVILS LAKE SUBDIVISION - PLAN & PROFILE
 STA 570+00 TO 600+00 (MP 101.83 TO 102.40)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0020
REV. No.	A

CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-0022.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 11:55 AM



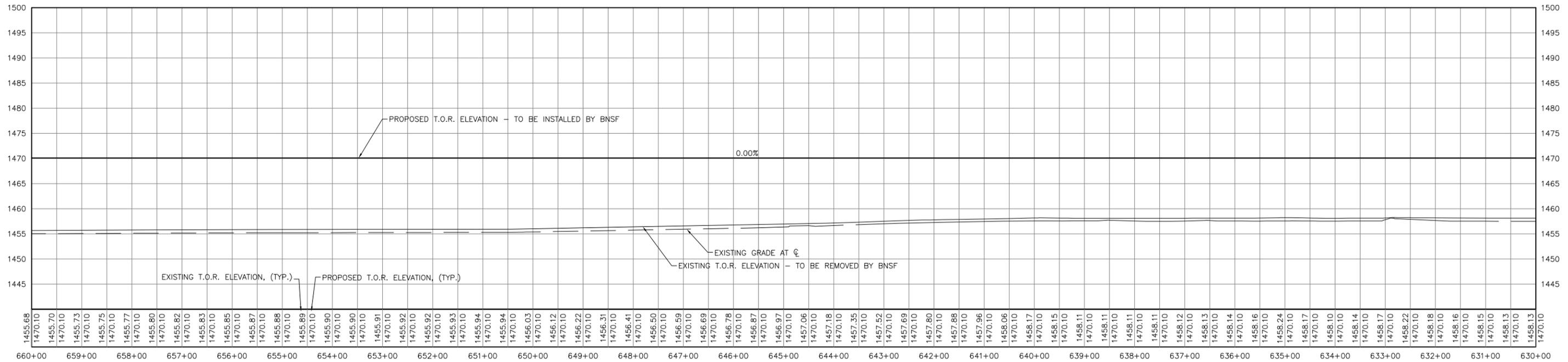
1 PLAN: DEVILS LAKE SUBDIVISION



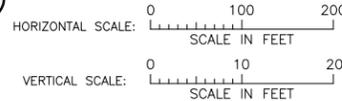
CURVE SUPERELEVATION

DEGREE OF CURVE	DESIGN SPEED	SUPERELEVATION
0°-48'-00"	79 MPH	3/4"

NOTE: SUPERELEVATION TO BE DEVELOPED OVER SPIRAL PASSENGER TRAIN DESIGN CRITERIA USED



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11				
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	0	1
DATE RELEASED					

BARR Project Office:
BARR ENGINEERING CO.
3128 14TH AVENUE EAST
HIBBING, MN 55746
Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

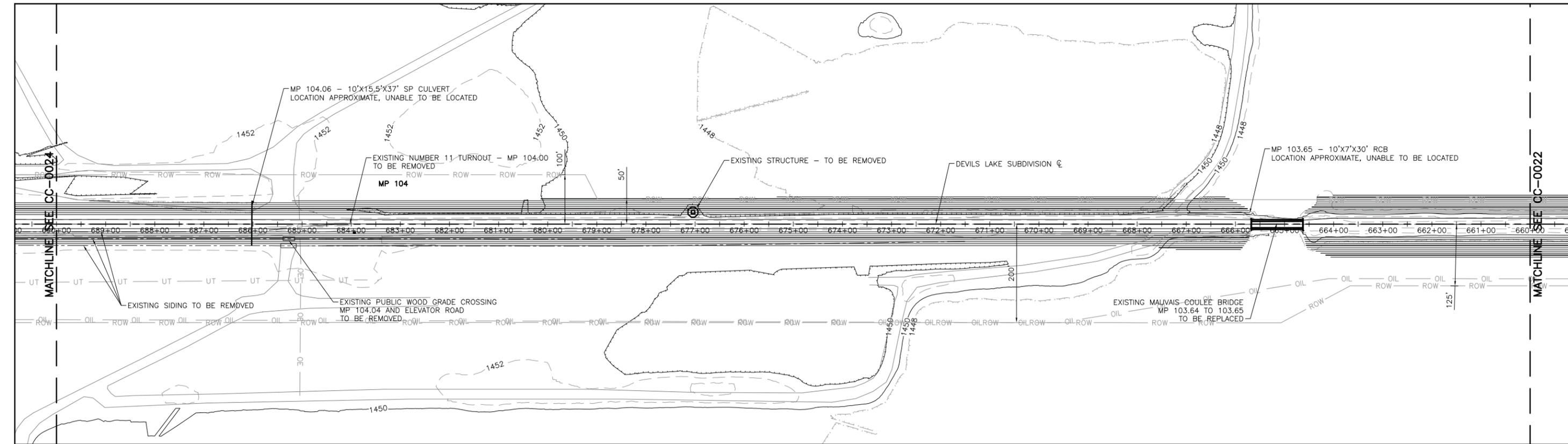
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

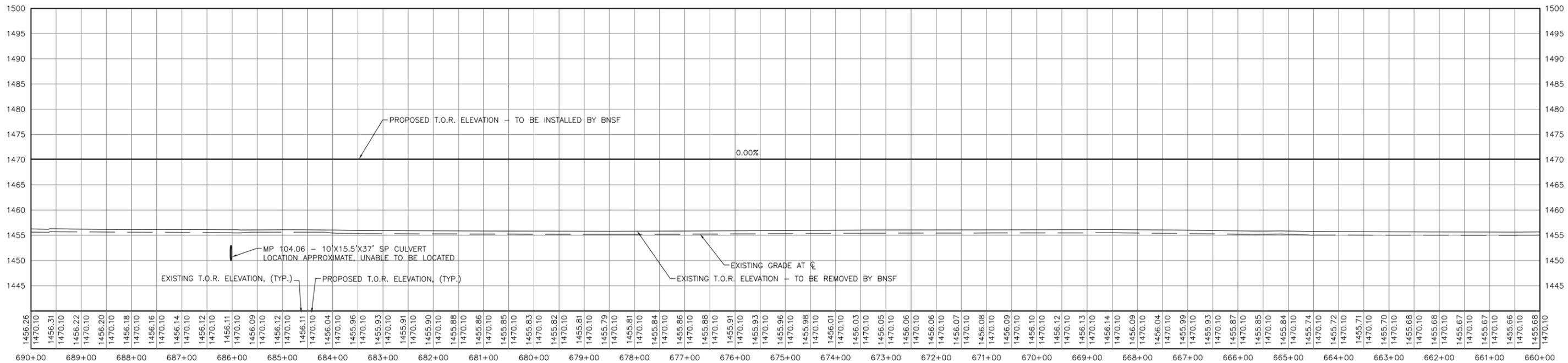
RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA
DEVILS LAKE SUBDIVISION - PLAN & PROFILE
STA 630+00 TO 660+00 (MP 102.97 TO 103.54)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0022
REV. No.	A

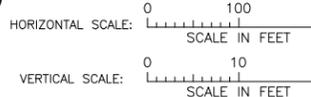
CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-0023.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 12:02 PM



1 PLAN: DEVILS LAKE SUBDIVISION



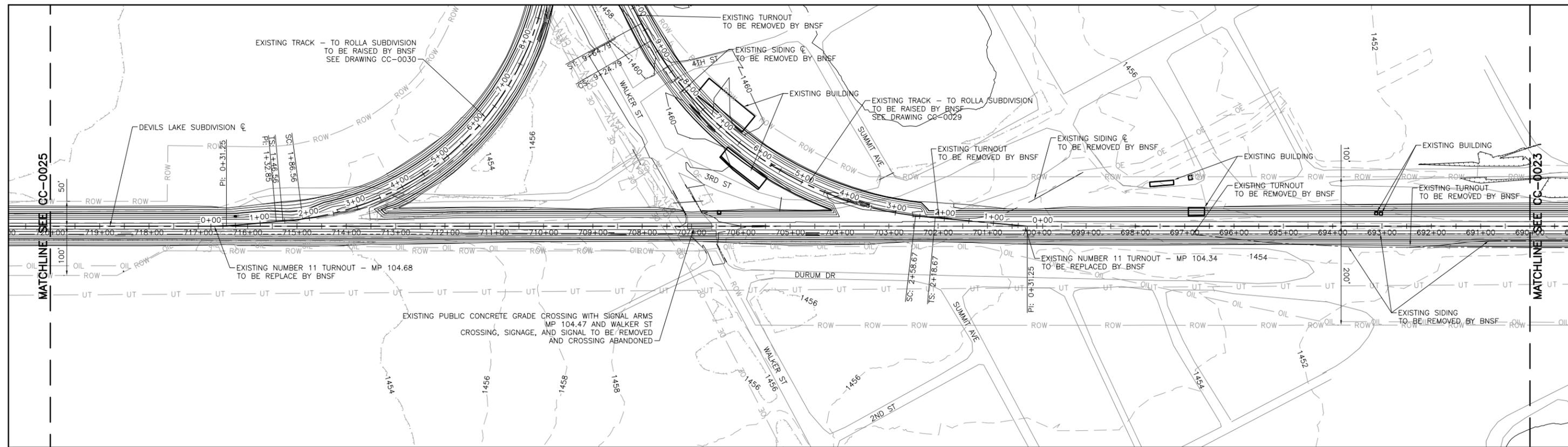
1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

<table border="1"> <tr><td>CLIENT</td><td>2/11</td></tr> <tr><td>BID</td><td></td></tr> <tr><td>CONSTRUCTION</td><td></td></tr> </table>				CLIENT	2/11	BID		CONSTRUCTION		<table border="1"> <tr><td>A</td><td>B</td><td>C</td><td>0</td><td>1</td><td>2</td><td>3</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>				A	B	C	0	1	2	3								<p>Project Office: BARR ENGINEERING CO. 3128 14TH AVENUE EAST HIBBING, MN 55746</p> <p>Ph: 1-800-225-1966 Fax: (218) 262-3460 www.barr.com</p>		<table border="1"> <tr><td>Scale</td><td>AS SHOWN</td></tr> <tr><td>Date</td><td>1/03/11</td></tr> <tr><td>Drawn</td><td>GSJ</td></tr> <tr><td>Checked</td><td>MJZ</td></tr> <tr><td>Designed</td><td>LCH2</td></tr> <tr><td>Approved</td><td>MJZ</td></tr> </table>		Scale	AS SHOWN	Date	1/03/11	Drawn	GSJ	Checked	MJZ	Designed	LCH2	Approved	MJZ	<p>BNSF RAILWAY MINNEAPOLIS, MINNESOTA</p>		<p>RAILROAD GRADE RAISE PLANNING DEVILS LAKE, NORTH DAKOTA</p>		<p>BARR PROJECT No. 34/36-1002</p>	
CLIENT	2/11																																																
BID																																																	
CONSTRUCTION																																																	
A	B	C	0	1	2	3																																											
Scale	AS SHOWN																																																
Date	1/03/11																																																
Drawn	GSJ																																																
Checked	MJZ																																																
Designed	LCH2																																																
Approved	MJZ																																																
<table border="1"> <tr><th>NO.</th><th>BY</th><th>CHK.</th><th>APP.</th><th>DATE</th><th>REVISION DESCRIPTION</th></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>				NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION							<p>RELEASED TO/FOR</p>				<p>Corporate Headquarters: Minneapolis, Minnesota Ph: 1-800-632-2277</p>		<p>DEVILS LAKE SUBDIVISION - PLAN & PROFILE STA 660+00 TO 690+00 (MP 103.54 TO 104.11)</p>		<p>CLIENT PROJECT No. CC-0023</p>		<p>DWG. No. REV. No. A</p>																							
NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION																																												

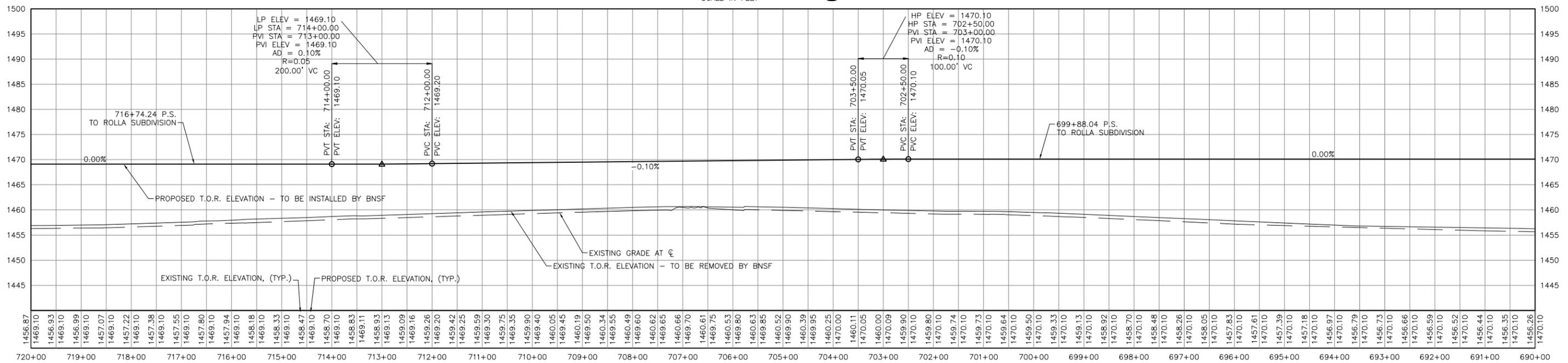
CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-0024.DWG PLOT SCALE: 1:2 PLOT DATE: 3/29/2011 12:45 PM



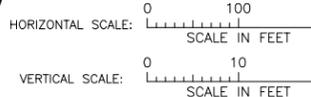
1 PLAN: DEVILS LAKE SUBDIVISION



NOTE: RIGHT OF WAY INFORMATION IN CHURCHS FERRY AREA NOT PROVIDED AND IS NOT SHOWN



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11	3/29			
BID					
CONSTRUCTION					
RELEASED TO/FOR	A	B	C	0	1
DATE RELEASED					

Project Office:
BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Ph: 1-800-225-1966
 Fax: (218) 262-3460
 www.barr.com

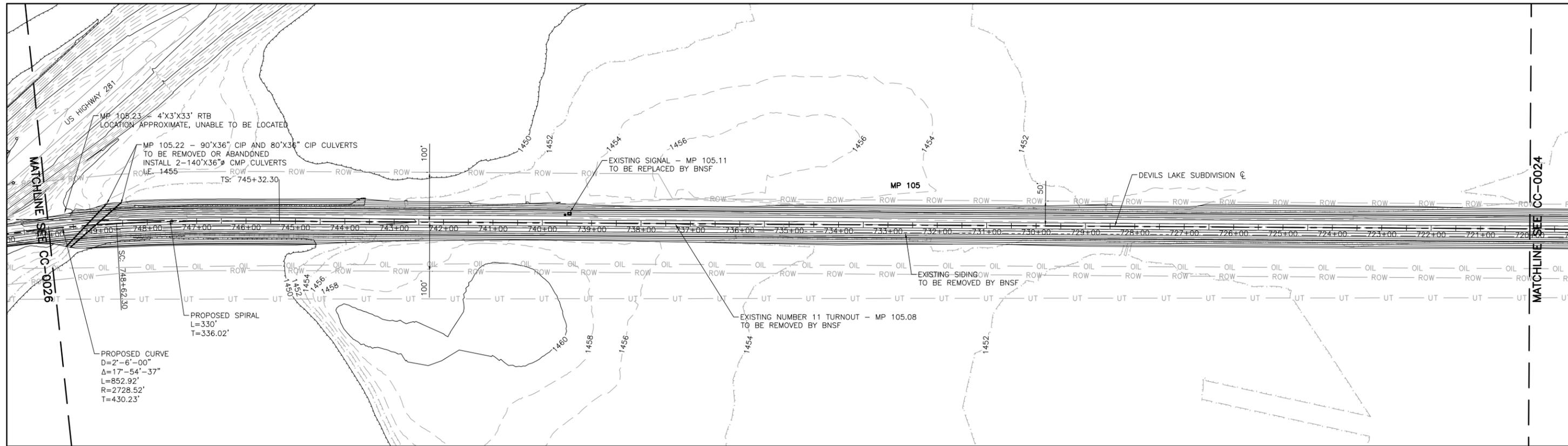
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA
 DEVILS LAKE SUBDIVISION - PLAN & PROFILE
 STA 690+00 TO 720+00 (MP 104.11 TO 104.68)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0024
REV. No.	B

CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-0025.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 12:50 PM

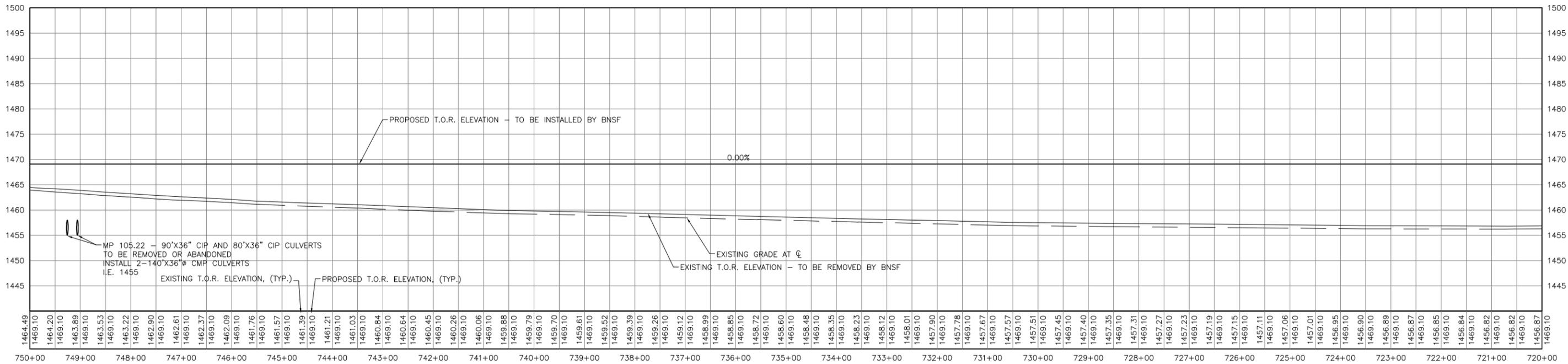


CURVE SUPERELEVATION

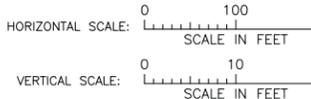
DEGREE OF CURVE	DESIGN SPEED	SUPERELEVATION
2'-06"-00"	70 MPH	4-1/4"

NOTE: SUPERELEVATION TO BE DEVELOPED OVER SPIRAL PASSENGER TRAIN DESIGN CRITERIA USED

1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11					
BID						
CONSTRUCTION						
RELEASED TO/FOR						
DATE RELEASED						
A	B	C	0	1	2	3

BARR Engineering Co.
3128 14TH AVENUE EAST
HIBBING, MN 55746
Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

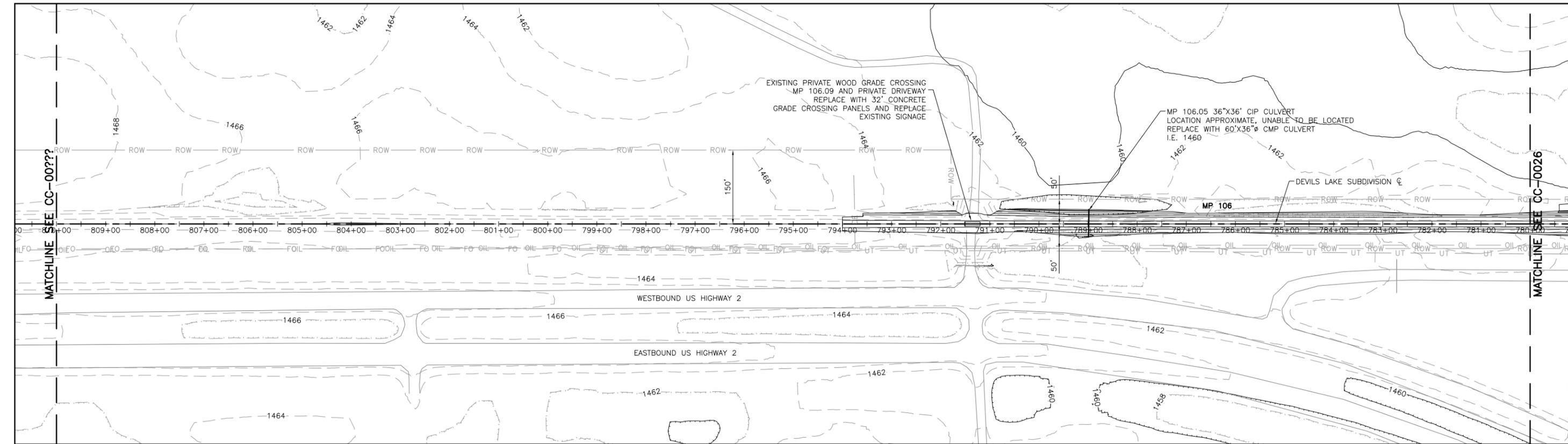
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

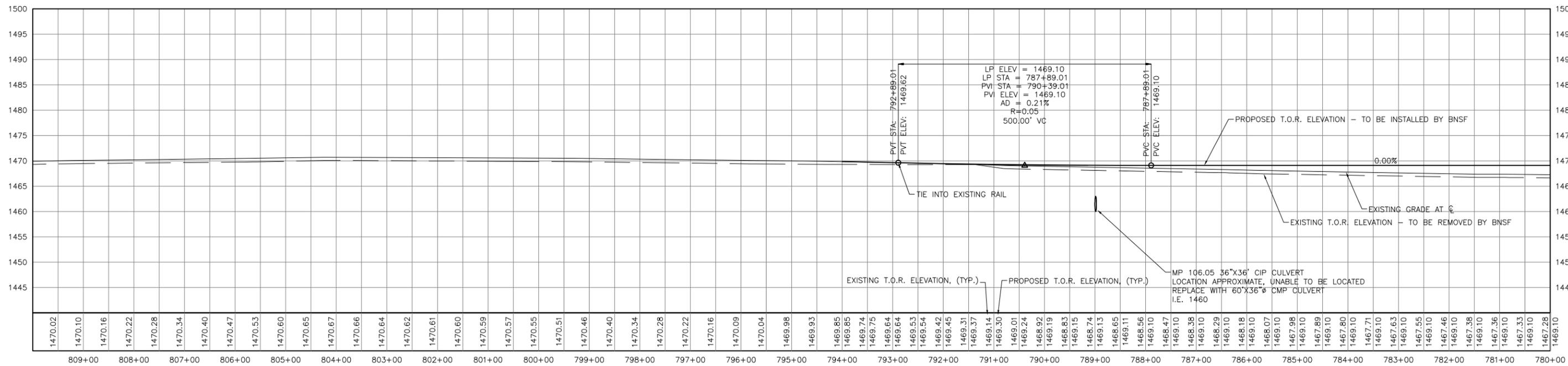
RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA
DEVILS LAKE SUBDIVISION - PLAN & PROFILE
STA 720+00 TO 750+00 (MP 104.68 TO 105.25)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0025
REV. No.	A

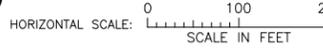
CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\PLAN-PROFILE SHEETS\VF - BNSF-PROPOSED - CC-0027.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 1:16 PM



1 PLAN: DEVILS LAKE SUBDIVISION



1 PROFILE: DEVILS LAKE SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11
BID	
CONSTRUCTION	
RELEASED TO/FOR	
DATE RELEASED	

Project Office:
BARR ENGINEERING CO.
3128 14TH AVENUE EAST
HIBBING, MN 55746

Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

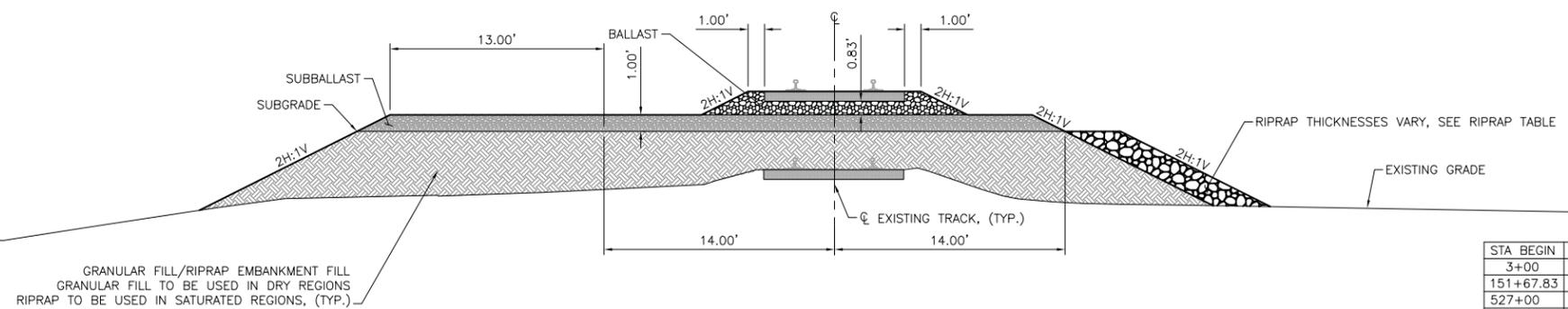
Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

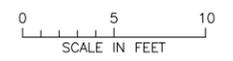
RAILROAD GRADE RAISE PLANNING
DEVILS LAKE, NORTH DAKOTA

DEVILS LAKE SUBDIVISION - PLAN & PROFILE
STA 780+00 TO 810+00 (MP 105.82 TO 106.39)

BARR PROJECT No. 34/36-1002
CLIENT PROJECT No.
DWG. No. CC-0027
REV. No. A



1 TYPICAL SECTION: SINGLE TRACK TANGENT WITH 13' ACCESS ROAD



- NOTE:
- SECTION TYPICAL FOR TANGENT SECTIONS. SEE SUPERELEVATION TABLE FOR CURVES FOR TYPICAL SECTIONS ON CURVES.
 - SECTION APPLIES FROM STA 3+00 TO 123+13 (MP 91.08 TO 93.36) AND FROM STA 151+68 TO 664+62 (MP 93.90 TO 103.62).

RIPRAP TABLE - NORTH SIDE

STA BEGIN	STA END	RIPRAP THICKNESS	RIPRAP D50 SIZE	RIPRAP TOP ELEVATION
3+00	123+13.09	1.5'	0.75	1466
151+67.83	527+00	1.5'	0.75	1466
527+00	702+50	3'	1.0	1467
702+50	794+00	1.5'	0.75	1466

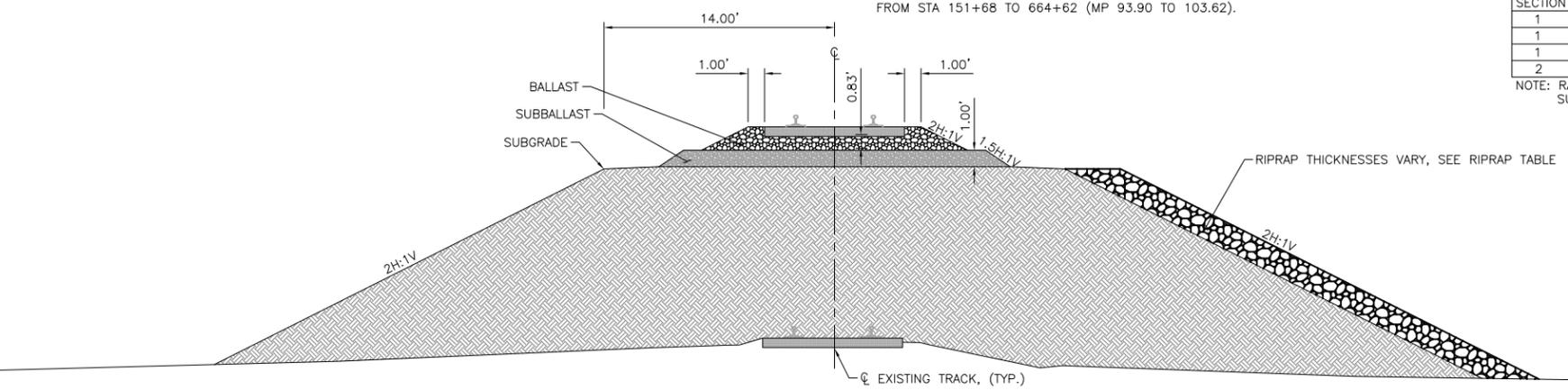
RIPRAP TABLE - SOUTH SIDE

STA BEGIN	STA END	RIPRAP THICKNESS	RIPRAP D50 SIZE	RIPRAP TOP ELEVATION
50+00	55+00	1.5'	0.75	1466

SUPERELEVATION TABLE FOR CURVES

SECTION	STA BEGIN	STA END	DEGREE OF CURVE	TRACK SUPERELEVATION
1	72+76.94	79+51.20	0°-55'-00"	1-1/8"
1	122+24.24	132+88.29	1°-06'-00"	2"
1	632+75.68	642+08.68	0°-48'-00"	3/4"
2	757+15.13	748+62.30	2°-06'-00"	4-1/4"

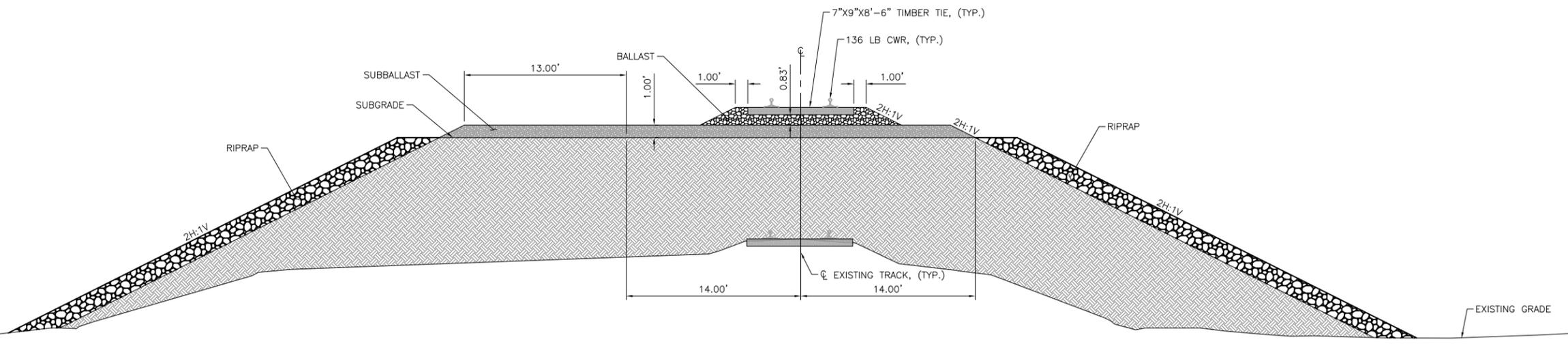
NOTE: RAISE OUTER RAIL ON CURVES BY MEASUREMENT SHOWN TO CREATE SUPERELEVATION



2 TYPICAL SECTION: SINGLE TRACK TANGENT



- NOTE:
- SECTION TYPICAL FOR TANGENT SECTIONS. SEE SUPERELEVATION TABLE FOR CURVES FOR TYPICAL SECTIONS ON CURVES.
 - SECTION APPLIES FROM STA 665+00 TO 794+00 (MP 103.62 TO 106.07)



3 TYPICAL SECTION: SINGLE TRACK TANGENT WITH 13' ACCESS ROAD, BY CHANNEL A



- NOTE:
- SECTION APPLIES FROM STA 50+00 TO 55+00 (MP 91.98 TO 92.07)

30% DRAFT
NOT FOR CONSTRUCTION

CADD USER: Greg Johnson FILE: M:\CAD\BNSF\3436_1002\CC-0028.DWG PLOT SCALE: 1:2 PLOT DATE: 2/11/2011 2:06 PM
 BARR - M:\outcad_2006\template\Barr_2006_template.dwt Plot at 0 07/27/2007 09:19:39

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11
BID	
CONSTRUCTION	
RELEASED TO/FOR	A B C 0 1 2 3
DATE RELEASED	

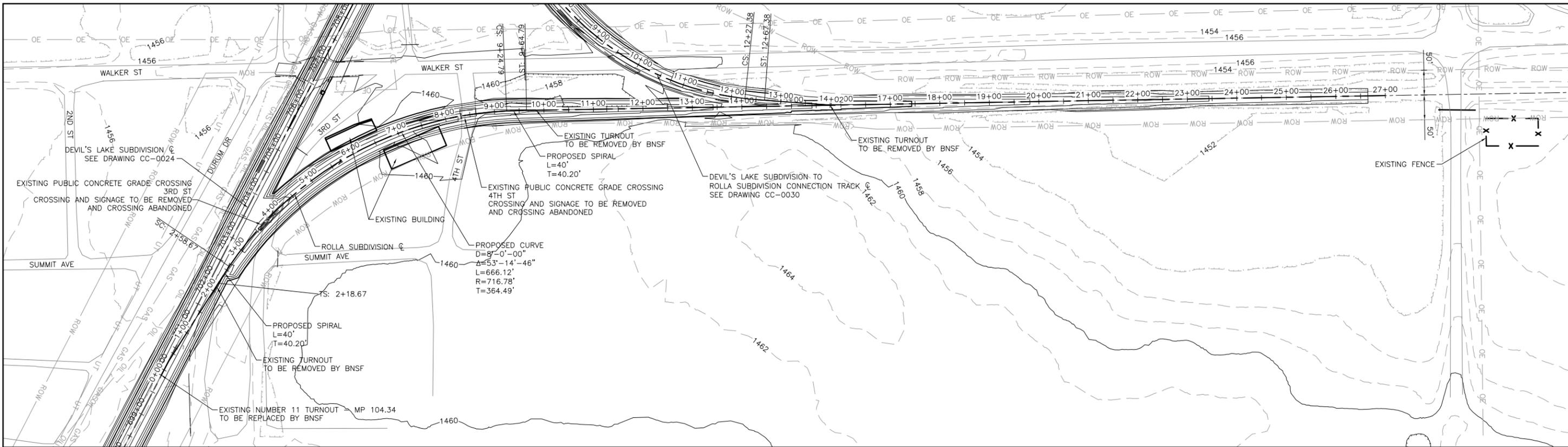
Project Office:
BARR ENGINEERING CO.
 3128 14TH AVENUE EAST
 HIBBING, MN 55746
 Corporate Headquarters:
 Minneapolis, Minnesota
 Ph: 1-800-225-1966
 Fax: (218) 262-3460
 www.barr.com

Scale	AS SHOWN
Date	1/18/2011
Drawn	GSJ
Checked	LCH2
Designed	BARR
Approved	MJZ

BNSF RAILWAY
 MINNEAPOLIS, MINNESOTA

RAILROAD GRADE RAISE PLANNING
 DEVILS LAKE, NORTH DAKOTA
 DEVILS LAKE SUBDIVISION
 TYPICAL SECTIONS

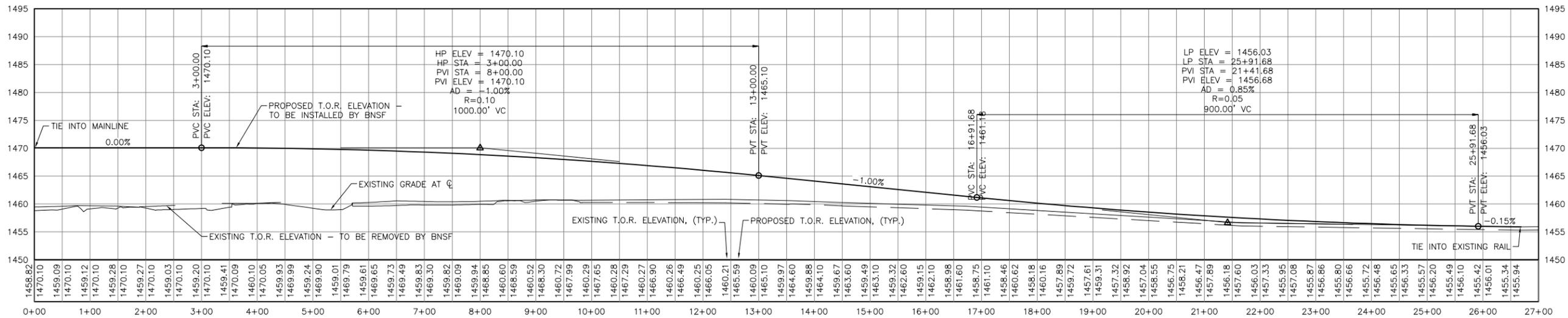
BARR PROJECT No.	34/34-1002
CLIENT PROJECT No.	
DWG. No.	CC-0028
REV. No.	A



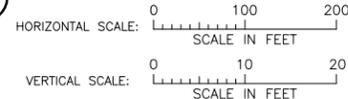
1 PLAN: ROLLA SUBDIVISION



NOTE: RIGHT OF WAY INFORMATION IN CHURCHS FERRY AREA NOT PROVIDED AND IS NOT SHOWN



1 PROFILE: ROLLA SUBDIVISION



30% DRAFT
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	2/11	3/29							
BID									
CONSTRUCTION									
RELEASED TO/FOR	A	B	C	0	1	2	3		
DATE RELEASED									

BARR Engineering Co.
3128 14TH AVENUE EAST
HIBBING, MN 55746
Project Office:
BARR ENGINEERING CO.
3128 14TH AVENUE EAST
HIBBING, MN 55746
Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

Scale	AS SHOWN
Date	1/03/11
Drawn	GSJ
Checked	MJZ
Designed	LCH2
Approved	MJZ

BNSF RAILWAY
MINNEAPOLIS, MINNESOTA

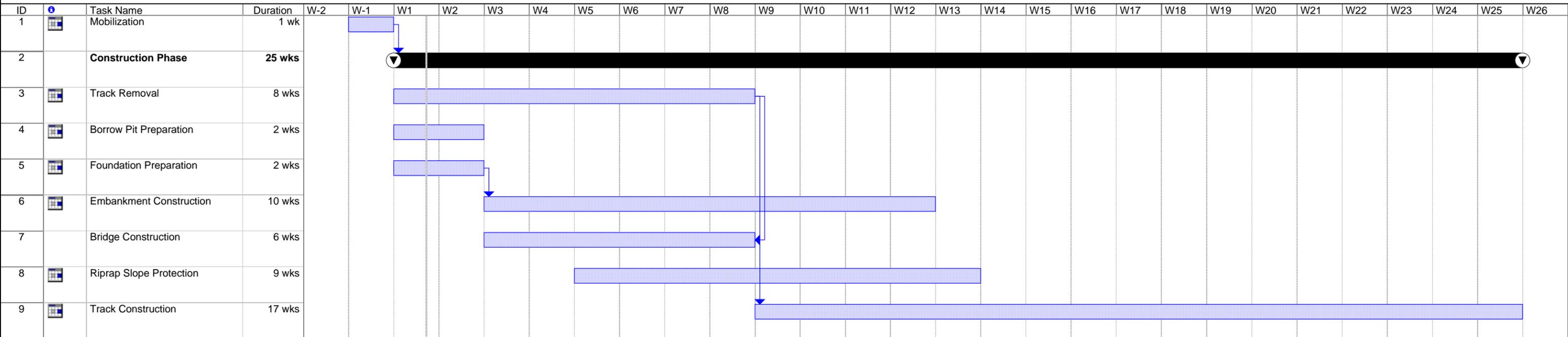
RAILROAD GRADE RAISE PLANNING
DEVIL'S LAKE, NORTH DAKOTA
ROLLA SUBDIVISION - PLAN & PROFILE
STA 0+00 TO 27+00 (MP 0.00 TO 0.51)

BARR PROJECT No.	34/36-1002
CLIENT PROJECT No.	
DWG. No.	CC-0029
REV. No.	B

Appendix C

Preliminary Construction Schedule

Appendix C: Preliminary Construction Schedule



Devils Lake RR Grade Feasibility Study

W1 = Week 1

Task		Progress		Summary		External Tasks		Deadline	
Split		Milestone		Project Summary		External Milestone			