

October 7, 2022

Contents of folder with information on the Mississippi River streambank restoration project at the Weyerhaeuser Museum

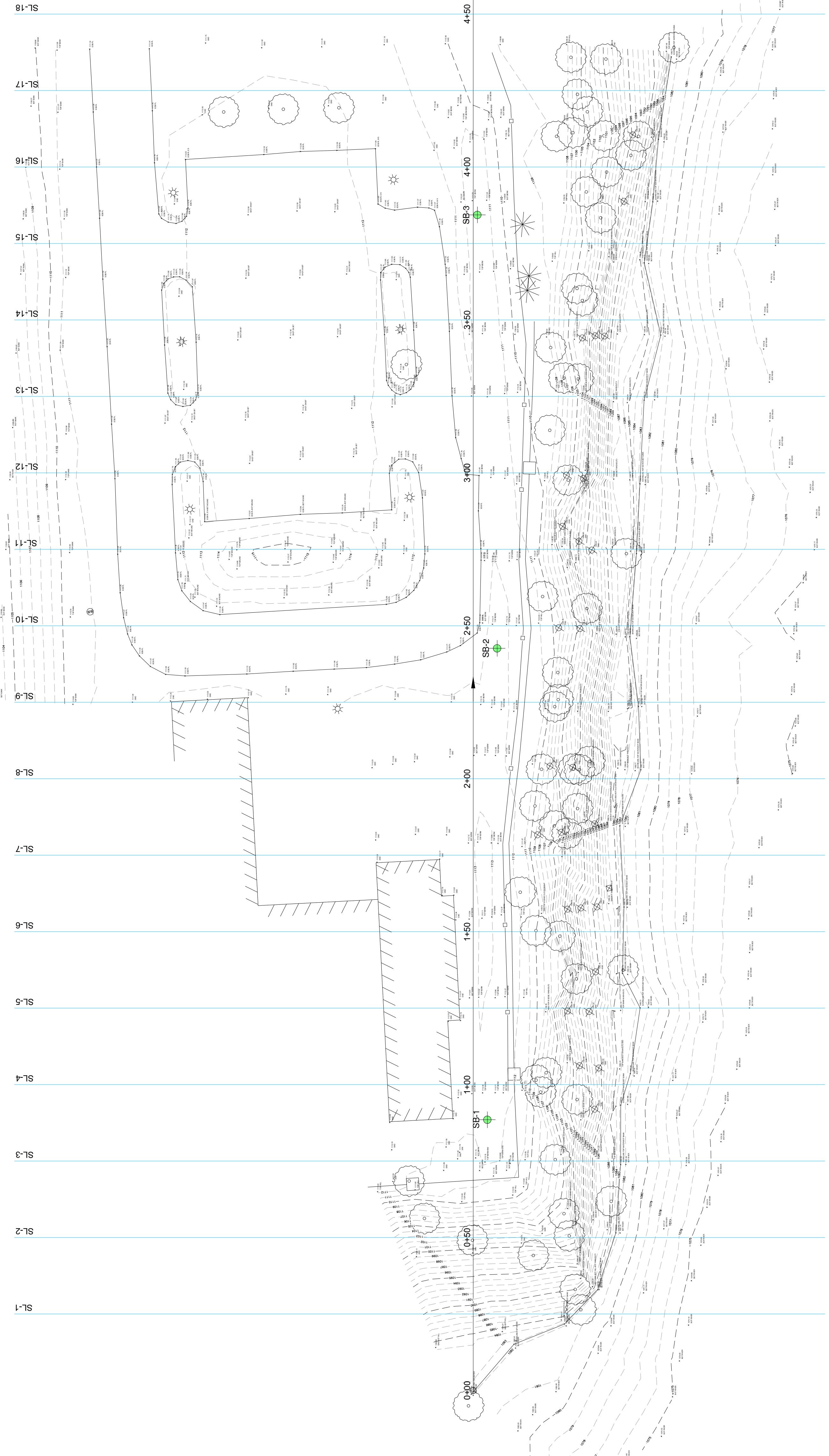
| File | Contents |
|--|---|
| Existing riverbank topo & cross sections.pdf | Topography of the riverbank at the Weyerhaeuser Museum. The stream banks are 25 to 30-ft high. |
| B2206910-Draft Boring Logs.pdf | Soil boring logs for the 3 soil borings obtained in August 2022 at the Weyerhaeuser Museum. Boring log locations are shown on the Existing river bank topo pdf file (SB-1 ect). |
| Geoslope.pdf | Results of geotechnical engineering analysis for what is needed to create a stable slope at two representative cross sections. Factor of safety values are provided adjacent to green dot in center. Factor of safety of at least 1.5 is required where there is a building. |
| Sta 1+25 – Proposed Layout at Museum.pdf | Proposed cross section at station 1+25 at the museum. Stationing is provided along the baseline found in the Existing river bank topo pdf file. |
| Sta 2+75 – Proposed Layout at Museum.pdf | Proposed cross section at station 2+75 at the parking lot. |
| There are 3 *.jpg files | Pictures of bank failures below the museum. |
| Warzaala_Riverbank_Stabilization_2020.pdf | Information on recent Mississippi River streambank restoration project in Anoka County constructed with support from the Clean Water Fund. The lower right hand photo shows riprap at the toe and the reinforced soil geogrid used to hold topsoil for planning with native vegetation. |

Riverbank Erosion Images - 5 July 2022

(Taken by Mike Worcester)



| | | |
|-----------------|--------------|-----------|
| DOT PROJECT NO. | REVISION NO. | SHEET NO. |
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This document
is preliminary
and not for
construction or
implementation
purposes.

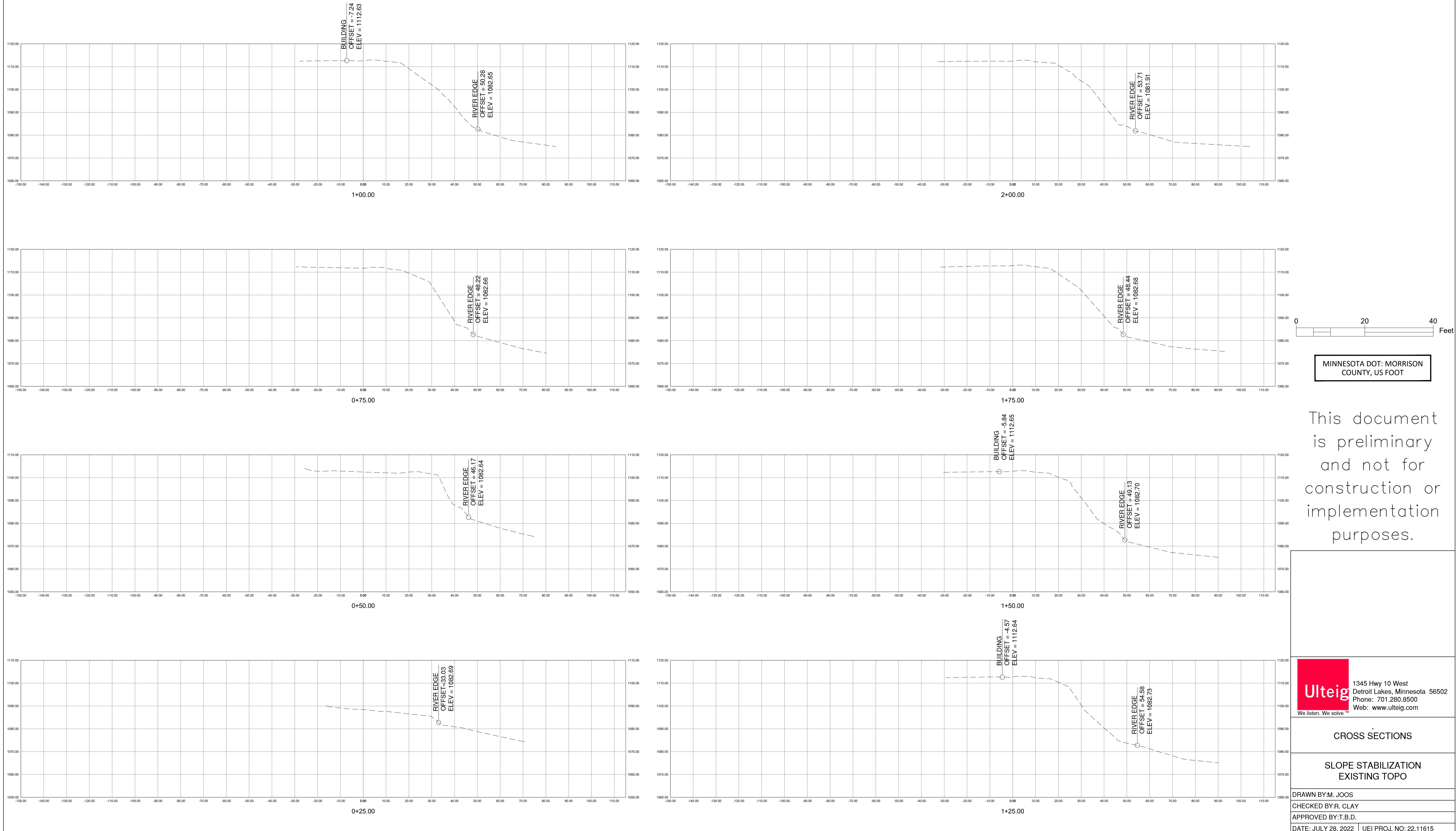
MINNESOTA DOT: MORRISON
COUNTY, US FOOT

Ulteig
1345 Hwy 10 West
Detroit Lakes, Minnesota 58602
Phone: 701-286-8500
Web: www.ulteig.com

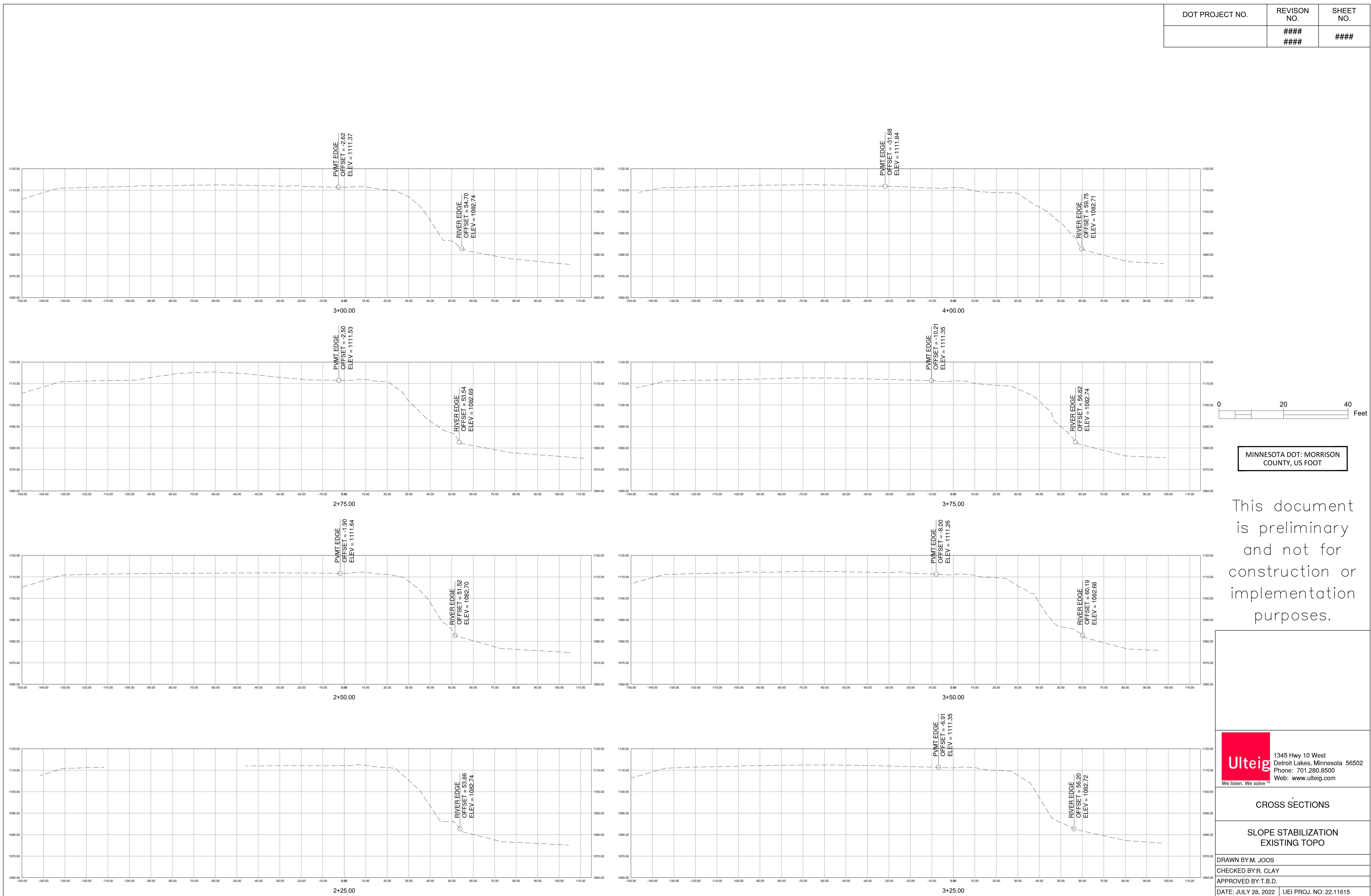
EXISTING CONDITIONS
SLOPE STABILIZATION
EXISTING TOPO

DRAWN BY M. JOOS
CHECKED BY R. CLAY
APPROVED BY T.B.D.
We listen. We solve.TM
DATE: JULY 28, 2022 | UEPROJ NO: 22-11615 | Existing Topo.dwg Layout1 8/29/2022 3:21 PM

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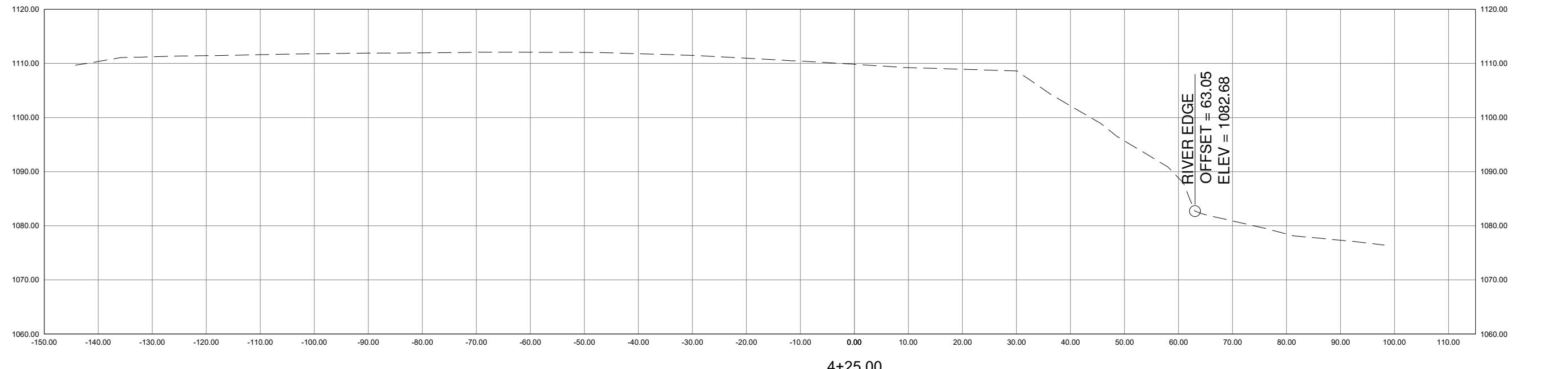
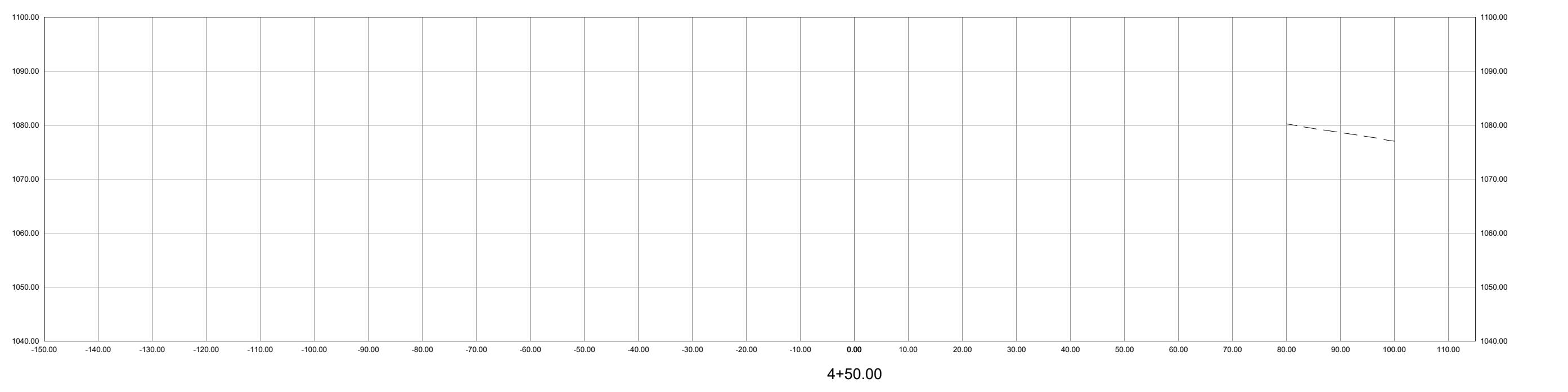


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| | #### | #### |

0 20 40 Feet

MINNESOTA DOT: MORRISON COUNTY, US FOOT

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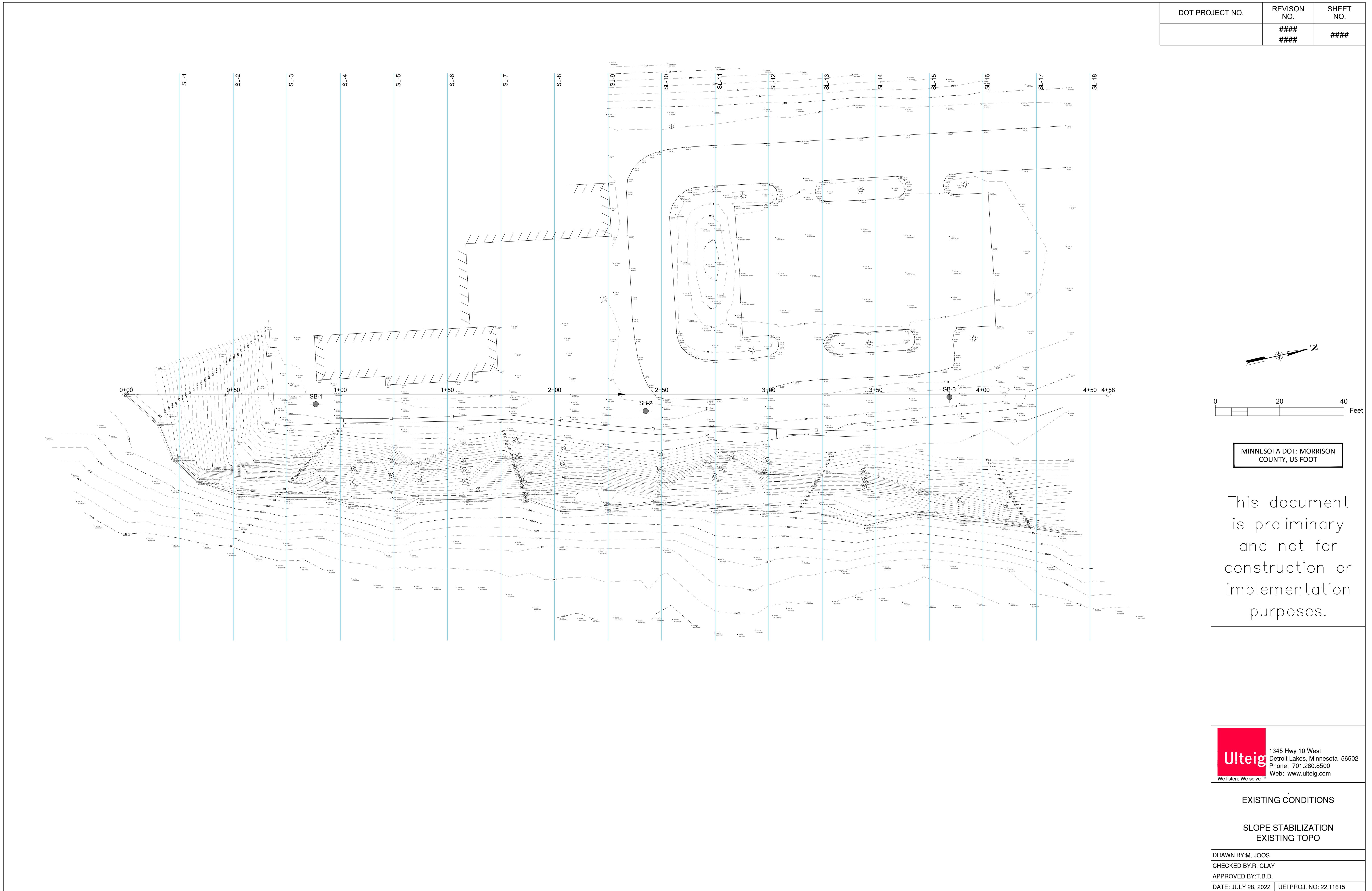
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Detroit Lakes, Minnesota 56502
Phone: 701.280.8500
Web: www.ulteig.com
We listen. We solve™

CROSS SECTIONS

SLOPE STABILIZATION
EXISTING TOPO

DRAWN BY:M. JOOS
CHECKED BY:R. CLAY
APPROVED BY:T.B.D.
DATE: JULY 28, 2022 | UEI PROJ. NO: 22.11615

| | | |
|-----------------|--------------|-----------|
| DOT PROJECT NO. | REVISION NO. | SHEET NO. |
| #### | #### | #### |



LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

| Project Number B2206910 Geotechnical Evaluation Charles Weyerhauser Memorial Museum 2151 Lindbergh Drive South Little Falls, Minnesota | | | | BORING: | ST-1 | |
|---|------------------------------|--|---------|--|---------------------|--------------------|
| | | | | LOCATION: | See attached sketch | |
| | | | | DATUM: | | |
| | | | | NORTHING: | EASTING: | |
| DRILLER: | B. Kammermeier/N. Swanson | LOGGED BY: | R. Bipp | START DATE: | 08/17/22 | END DATE: 08/17/22 |
| SURFACE ELEVATION: | RIG: 7506 | METHOD: 3 1/4" HSA | | SURFACING: | Soil | WEATHER: Clear |
| Elev./ Depth ft | Water level | Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908) | Sample | Blows (N-Value) Recovery | q _p tsf | MC % |
| 2.0 | | SILTY CLAY (CL-ML), dark brown, moist (TOPSOIL FILL) | | 4-5-6 (11) 13" | | |
| 6.5 | | SILTY CLAY (CL-ML), with Gravel, brown, moist, medium (GLACIOFLUVIUM) | 5 | 4-6-14 (20) 13" | | 3 |
| 11.7 | | SILTY, CLAYEY SAND (SC-SM), with Gravel, brown, moist, dense (GLACIOFLUVIUM) | 10 | 12-13-21 (34) 15" | | 8 P200=44% |
| | | SILTY, CLAYEY SAND (SC-SM), with Gravel, brown, moist, dense to very dense (GLACIOFLUVIUM) | 15 | TW 13-25-41 (66) 4" 31-50/5" (REF) 12" | | 7 |
| | | | 20 | 24-50/4" (REF) 4" | | 7 |
| | | | 25 | 50/3" (REF) 0" | | |
| | | | 30 | 50/2" (REF) 0" | | |

Continued on next page

See Descriptive Terminology sheet for explanation of abbreviations

| Project Number B2206910 Geotechnical Evaluation Charles Weyerhauser Memorial Museum 2151 Lindbergh Drive South Little Falls, Minnesota | | | | BORING: | ST-1 | |
|---|------------------------------|--|---------|--------------------------|---------------------|----------------------|
| | | | | LOCATION: | See attached sketch | |
| | | | | DATUM: | | |
| | | | | NORTHING: | EASTING: | |
| DRILLER: | B. Kammermeier/N. Swanson | LOGGED BY: | R. Bipp | START DATE: | 08/17/22 | END DATE: 08/17/22 |
| SURFACE ELEVATION: | RIG: 7506 | METHOD: 3 1/4" HSA | | SURFACING: | Soil | WEATHER: Clear |
| Elev./ Depth ft | Water level | Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908) | Sample | Blows (N-Value) Recovery | q _p tsf | MC % |
| 38.0 | | SILTY, CLAYEY SAND (SC-SM), with Gravel, brown, moist, dense to very dense (GLACIOFLUVIUM) | 35 | 34-50/5" (REF) 1" | | |
| 41.0 | | SILTY CLAY (CL-ML), gray, moist, hard (GLACIAL TILL) | 40 | 40-15-27 (42) 10" | | 9 LL=18, PL=12, PI=6 |
| END OF BORING | | | | | | |

See Descriptive Terminology sheet for explanation of abbreviations

| Project Number B2206910 Geotechnical Evaluation Charles Weyerhauser Memorial Museum 2151 Lindbergh Drive South Little Falls, Minnesota | | | | BORING: | ST-2 | |
|---|------------------------------|--|---------|-----------------------------------|---------------------|--------------------|
| | | | | LOCATION: | See attached sketch | |
| | | | | DATUM: | | |
| | | | | NORTHING: | EASTING: | |
| DRILLER: | B. Kammermeier/N. Swanson | LOGGED BY: | R. Bipp | START DATE: | 08/17/22 | END DATE: 08/17/22 |
| SURFACE ELEVATION: | RIG: 7506 | METHOD: 3 1/4" HSA | | SURFACING: | Soil | WEATHER: Clear |
| Elev./ Depth ft | Water level | Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908) | Sample | Blows (N-Value) Recovery | q _p tsf | MC % |
| 2.0 | | SILTY CLAY (CL-ML), dark brown, moist (TOPSOIL FILL) | 5 | 10-18-17 (35) 11" | | 0 |
| 6.5 | | SILTY CLAY (CL-ML), with Gravel, brown, moist, medium to hard (GLACIOFLUVIUM) | 10 | 12-12-20 (32) 10" | | |
| 17.5 | | SILTY, CLAYEY SAND (SC-SM), with Gravel, brown, moist, dense to very dense (GLACIOFLUVIUM) | 15 | 50 1" 16-22-50/4" (REF) 13" | 9 | |
| | | | 20 | 21-26-42 (68) 13" | 7 | |
| | | | 25 | 11-19-20 (39) 14" | 8 | |
| | | | 30 | 13-21-28 (49) 16" | | |
| | | | | 18-22-30 (52) 14" | | |

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See Descriptive Terminology sheet for explanation of abbreviations

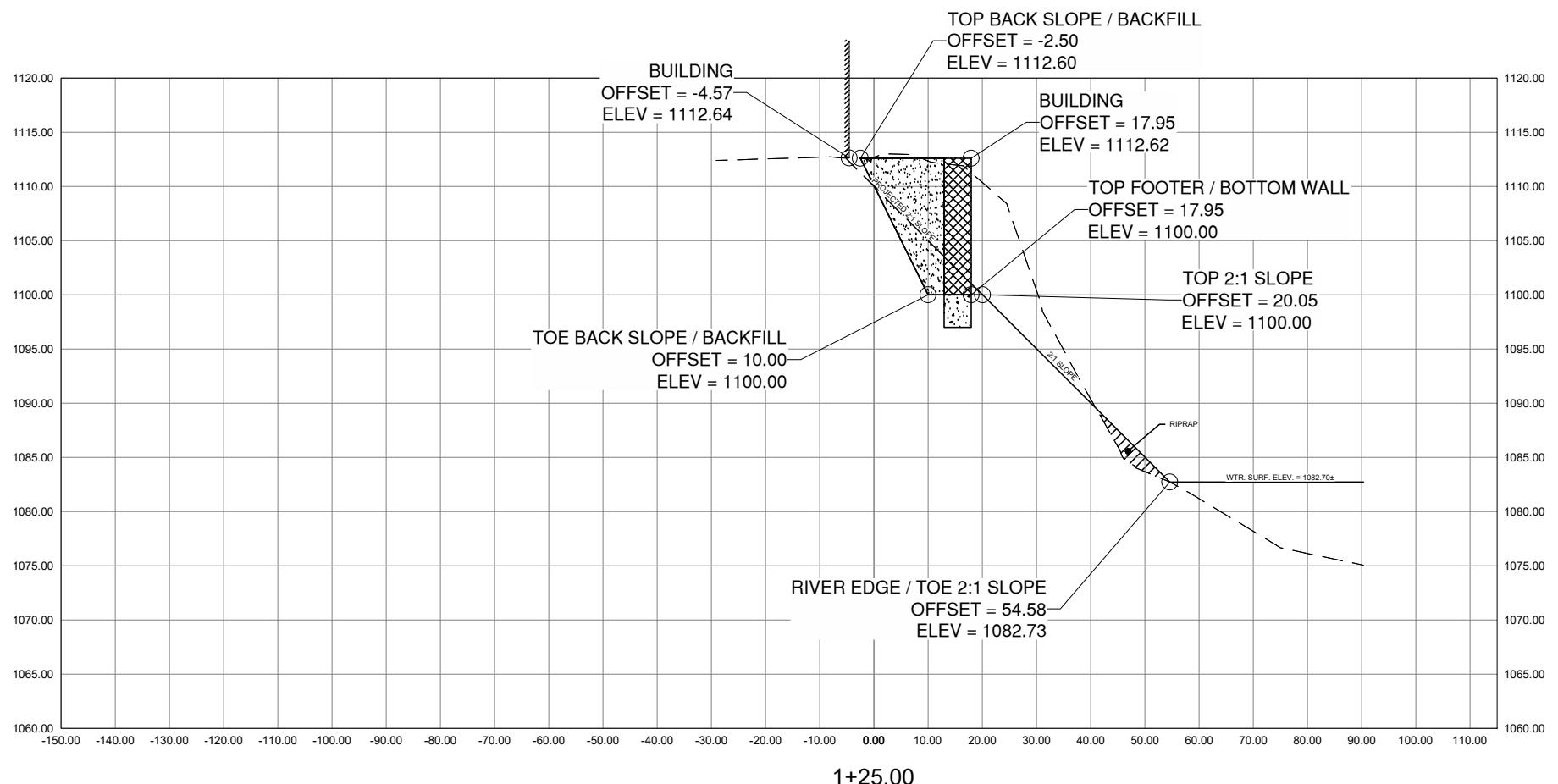
| | | | | | | | | | |
|---|------------------------------|---|------------|-------------------------------|--------|--------------------------|-----------|--|--|
| Project Number B2206910 Geotechnical Evaluation Charles Weyerhauser Memorial Museum 2151 Lindbergh Drive South Little Falls, Minnesota | | | | BORING: | | ST-2 | | | |
| | | | | LOCATION: See attached sketch | | | | | |
| | | | | DATUM: | | | | | |
| | | | | NORTHING: | | EASTING: | | | |
| DRILLER: | B. Kammermeier/N. Swanson | | LOGGED BY: | R. Bipp | | START DATE: | 08/17/22 | | |
| SURFACE ELEVATION: | RIG: 7506 | | METHOD: | 3 1/4" HSA | | SURFACING: | Soil | | |
| Elev./ Depth ft | Water level | Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908) | | | Sample | Blows (N-Value) Recovery | q_p tsf | | |
| 41.0 | | SILTY, CLAYEY SAND (SC-SM), with Gravel, gray, moist, dense to very dense (GLACIOFLUVIUM) | | | 35 | 15-27-42 (69) 18" | 7 | | |
| | | END OF BORING | | | 40 | 12-18-34 (52) 14" | | | |
| | | | | | 45 | | | | |
| | | | | | 50 | | | | |
| | | | | | 55 | | | | |
| | | | | | 60 | | | | |

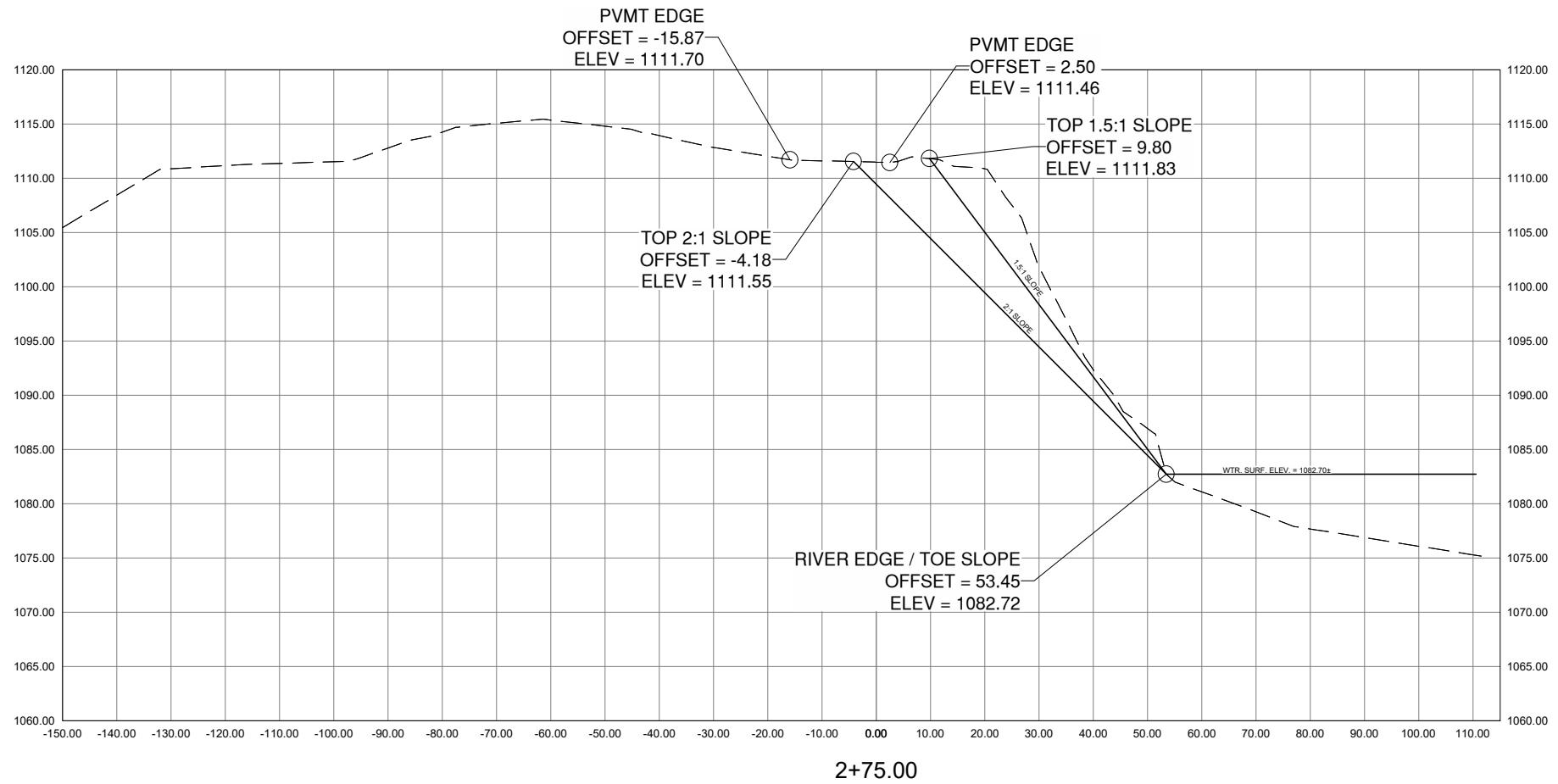
See Descriptive Terminology sheet for explanation of abbreviations

| | | | | | |
|---|------------------------------|--|-----------|--------------------------|--------------------|
| Project Number B2206910 Geotechnical Evaluation Charles Weyerhauser Memorial Museum 2151 Lindbergh Drive South Little Falls, Minnesota | | | BORING: | ST-3 | |
| | | | LOCATION: | See attached sketch | |
| | | | DATUM: | | |
| | | | NORTHING: | EASTING: | |
| DRILLER: | B. Kammermeier/N. Swanson | LOGGED BY: | R. Bipp | START DATE: | 08/18/22 |
| SURFACE ELEVATION: | | RIG: | 7506 | METHOD: | 3 1/4" HSA |
| Surfacing: | | | | Soil | WEATHER: |
| Elev./ Depth ft | Water level | Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908) | Sample | Blows (N-Value) Recovery | q _p tsf |
| 1.5 | | SILTY CLAY (CL-ML), dark brown, moist (TOPSOIL FILL) | | 2-2-2 (4) 13" | |
| | | SILTY, CLAYEY SAND (SC-SM), with Gravel, brown, moist, loose to medium dense (GLACIOFLUVIUM) | 5 | 5-5-9 (14) 10" | |
| | | | 10 | 7-10-14 (24) 11" | |
| | | | 13 | 13-19-30 (49) 15" | 12 P200=29% |
| | | | 15 | 12-20-39 (59) 14" | 7 |
| | | | 20 | 13-29-50/2" (REF) 14" | 9 |
| | | | 25 | 12-20-28 (48) 18" | |
| | | | 30 | 14-18-23 (41) 18" | |
| | | | | 50/1" (REF) 11" | |
| Becomes brown and gray below 19 feet | | | | | |
| Continued on next page | | | | | |

See Descriptive Terminology sheet for explanation of abbreviations

| Project Number B2206910 Geotechnical Evaluation Charles Weyerhauser Memorial Museum 2151 Lindbergh Drive South Little Falls, Minnesota | | | | BORING: | ST-3 | | |
|---|------------------------------|--|---------|--------------------------|---------------------|--------------------|------------------|
| | | | | LOCATION: | See attached sketch | | |
| | | | | DATUM: | | | |
| | | | | NORTHING: | EASTING: | | |
| DRILLER: | B. Kammermeier/N. Swanson | LOGGED BY: | R. Bipp | START DATE: | 08/18/22 | END DATE: 08/18/22 | |
| SURFACE ELEVATION: | RIG: 7506 | METHOD: 3 1/4" HSA | | SURFACING: | Soil | WEATHER: Clear | |
| Elev./ Depth ft | Water level | Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908) | Sample | Blows (N-Value) Recovery | q _p tsf | MC % | Tests or Remarks |
| 32.5 | | SILTY, CLAYEY SAND (SC-SM), with Gravel, gray, moist, dense (GLACIOFLUVIUM) LEAN CLAY (CL), with Gravel, gray, wet, hard (GLACIAL TILL) | | 26-27-43 (70) 18" | | 10 | |
| 41.0 | | END OF BORING | | 13-22-30 (52) 18" | | | |





WARZALA RESIDENCE BANK STABILIZATION RAMSEY, MN



Riverbank
Stabilization



Project Summary

Anoka Conservation District (ACD) partnered with a private landowner in Ramsey to stabilize 100 linear feet of severely eroding Mississippi riverbank. The bank was approximately 25 feet tall and nearly vertical. The site was identified as a high priority in a riverbank erosion inventory completed by ACD. Final site selection included targeted outreach to high priority property owners and prioritization of erosion severity at interested properties. The stabilization approach included riprap at the bottom of the slope, significant regrading, a reinforced soil slope using a geogrid with anchors to preserve as many mature trees at the top of the slope as possible, and native seed and plants across the entire slope. Stabilization of the bank will prevent 112 tons of sediment and 112 pounds of phosphorus from entering the Mississippi River annually. Funding was provided by a Clean Water Fund Projects and Practices grant, Metro Conservation Districts Enhanced Technical Assistance funds, and the landowner.



Riverbank conditions before (left) and after (right) the project.

Project Specifications

Date Installed September 2020

Project Length.....100 feet

Bank Height~25 feet

TSS Reduction (lbs/yr) 224,109

TP Reduction (lbs/yr).....112

Project Cost

Administration, Outreach, Site Prioritization, Design, and Construction Oversight.....\$62,218.56

Riverbank Stabilization.. \$113,440.28

Total Project Cost \$175,658.84

Project Funding

CWF Grant\$127,534.42

MCD ETA \$14,092.34

Landowner Funds \$34,032.08

Total Project Funding\$175,658.84

Project Details



Pre-project conditions consisted of a nearly vertical bare bank with severe vegetative overhang, many exposed tree roots, fallen trees, and slumps or slips. Therefore, the lateral recession rate was estimated to be 0.7 ft/yr.

Significant grading was necessary to establish slopes that could be stabilized using the reinforced soil slope geogrid. Final slopes above the riprap were ~1.5:1 (horizontal : vertical).

Riprap at the toe of the slope within the zone of frequent water level fluctuation, a reinforced soil slope geogrid, seeding with native vegetation, and installation of an erosion control blanket stabilized the eroding bank.