Confederated Tribes of the Umatilla Indian Reservation

Section 408 #FY19-NO46

100 Percent Submittal

UmaBirch In-Stream Design and Construction Oversight Project

July 2025

TETRA TECH

TETRA TECH

July 1, 2025

Sally Bird-Gauvin
Program Manager, 408 / IIS / FERC
US Army Corps of Engineers
Portland District

Subject: Section 408 Request #FY19-NO46 UmaBirch Environmental Restoration (NWP-2019-489/408-FY19-NO46)

Dear Ms. Bird-Gauvin:

This cover letter, including the enclosed Attachment 1 below, and the supplemental materials described in Section 4 of Attachment 1, are being provided by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Tetra Tech, Inc. (Tetra Tech) to the U.S. Army Corps of Engineers (USACE). They are intended to be a continuance of the USACE Section 408 process and review of UmaBirch In-Stream Design and Construction Oversight Project (the Project). The Project has been identified by the USACE as request #FY19-NO46 and is linked to the nationwide permit NWP-2019-489. The enclosed Attachment 1 describes the information being submitted by the CTUIR and Tetra Tech in support of the 408 process and includes the following sections:

- Section 1: Project Location and Background
- Section 2: Description of the USACE Pendleton 2a Levee
- Section 3: USACE Section 408 Coordination
- Section 4: Section 408 Supporting Materials
- Section 5: Summary of Changes Incorporated into the 90 Percent
- Section 6: References

Please reach out to Jude Love with the CTUIR at judelove@ctuir.org or by phone at (541) 429-7283, or me directly at chris.james@tetratech.com or by phone at (503) 358-7079 with any questions regarding this submittal.

Sincerely,

Chris James, CWM, CERP
Project Manager/Hydrologist
Tetra Tech, Inc.
Enclosure:
Attachment 1

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ATTACHMENT 1

1. PROJECT LOCATION AND BACKGROUND

The Project is located on the Umatilla River from river mile (RM) 48.7 to RM 49.7 and Birch Creek from RM 0.0 to RM 0.3. It encompasses the associated floodplains on both sides of the Umatilla River and Birch Creek, and the confluence of Birch Creek with the Umatilla River (see Figure 1). The Project is part of a larger series of project's being proposed by the CTUIR and Bonneville Power Administration (BPA) located downstream on the Umatilla River and upstream on Birch Creek. To provide a phased construction approach based on funding, hydrology and geomorphology, and anticipated environmental permitting requirements, all project actions being proposed by the CTUIR and BPA, have been separated into four distinct project areas. Of these project areas, the USACE Pendleton 2a Levee is located within Project Area 2 (PA 2) (see Figure 1). In this Attachment 1 and supplemental materials described in Section 4 below, the Project and its location are commonly referred to as PA 2.

The purpose of the Project is to restore floodplain connectivity and natural riverine processes, while maintaining the function of the Pendleton 2a Levee. The need for the Project arose from the constraints that the levee, flood berms, past agricultural activities, and other anthropogenic actions continue to have on the Umatilla River and its confluence with Birch Creek. These constraints have contributed to decreased floodplain connectivity and degraded instream processes. The goal of the Project is to reestablish floodplain connectivity, channel morphology and instream processes, improve instream habitat for Endangered Species Act (ESA)-listed and non-listed fish, and protect existing infrastructure on the Umatilla River and Birch Creek. The USACE Section 408 review is requested because the Project proposes to setback a portion of the Pendleton 2a Levee downstream of Birch Creek Road (see Figure 1 for the portion of the Pendleton 2a Levee proposed for setback located inside the PA 2 Boundary).

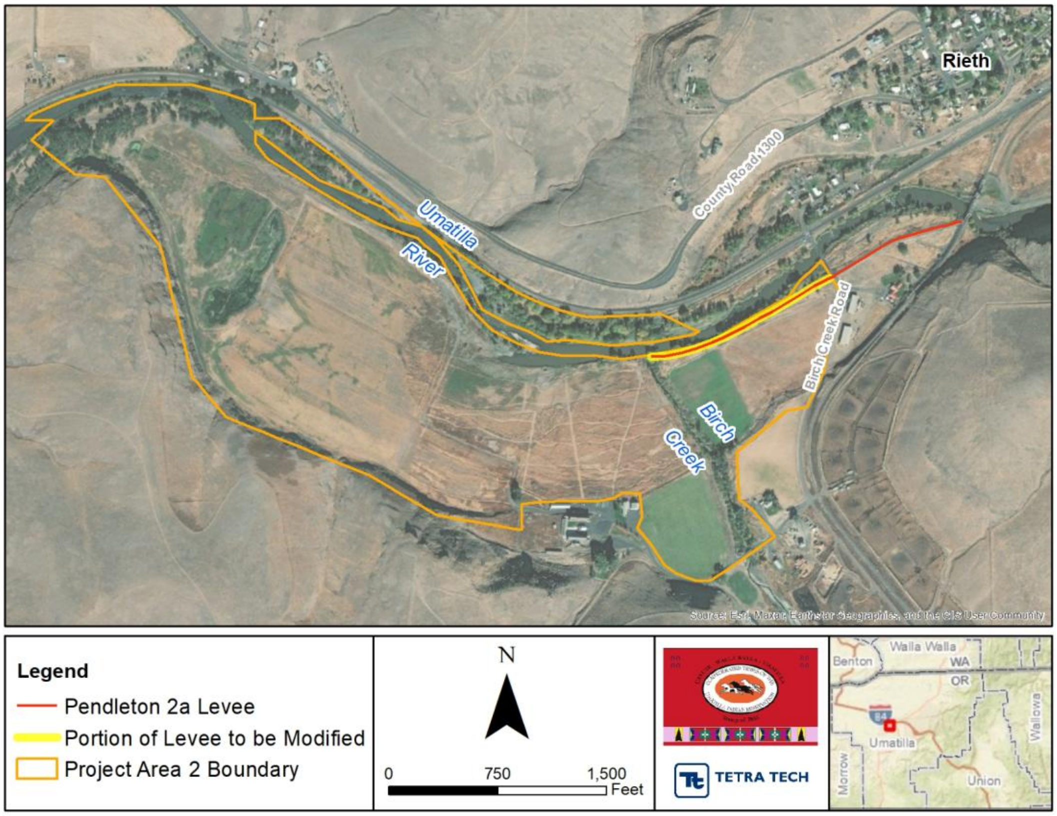


Figure 1. Pendleton 2a Levee Location and PA 2 Boundary

2. DESCRIPTION OF THE USACE PENDLETON 2A LEVEE

The USACE Pendleton 2a Levee is listed in the USACE National Levee Database as System ID# 500500041 (USACE, 2022), which states that it was authorized in 1950, and built in 1961. The Pendleton 2a Levee extends on the Umatilla River left bank from the Union Pacific Railroad (UPRR) bridge to the existing confluence of Birch Creek and the Umatilla River for 0.45 miles with a maximum height of 11 feet and a crest width of 19 feet. It was originally designed to protect the agricultural lands between the railroad and Birch Creek, and it currently protects those agricultural lands, Birch Creek Road, and a private residence. A reconstruction analysis (see Section 4, Volume 1 description below) reported that the current configuration and elevation of the levee matches well with the original design, with an authorized flood discharge of 16,400 cubic feet per second.

3. USACE SECTION 408 COORDINATION

Modifications to an existing USACE regulated levee require a Section 408 review and the USACE approval for construction. This requirement was established in Section 14 of the Rivers and Harbors Act of 1899, which has been amended, and is codified at 33 U.S.C. 408–the section of U.S. Code that gives the program its name (USC, 1982). Coordination between the CTUIR, BPA, Tetra Tech, and the USACE was initiated in 2019, and has continued since, including:

- March 25, 2019 – Initial email requesting determination for need of a USACE Section 408 review sent to the USACE from the CTUIR and Tetra Tech.
- July 29, 2019 – CTUIR received Project ID Number (408-FY19-N046) from the USACE.
- October 21, 2019 – CTUIR received Regulatory USACE ID (NWP-2019-489) from the USACE.
- January 9, 2020 – CTUIR received Letter of No Objection (LONO) from the City of Pendleton.
- January 13, 2020 – Confirmation by the USACE of City of Pendleton LONO.
- January 31, 2020 – Tetra Tech submitted the PA 2 30 Percent Design to the CTUIR, that included:
    - 30 Percent Basis of Design Report
        - Appendix A: Design Drawings
        - Appendix B: Supporting Reports
        - Appendix C: Construction Specifications
        - Appendix D: BPA Review Comments and Responses
        - Appendix E: Engineer’s Cost Estimate
    - Wetlands and Waters Delineation Report
- April 27, 2020 – CTUIR sent the PA 2 30 Percent Design to the USACE.
- October 29, 2020 – Conference call between the USACE and BPA regarding interagency operating status, attended by CTUIR and Tetra Tech.
- June 30, 2021 – USACE and BPA interagency coordination call and discussion of proposed Section 408 technical scope of work, attended by CTUIR and Tetra Tech.

- January 19, 2022 – Umatilla County provided LONO to CTUIR.
- January 21, 2022 – CTUIR provided the Umatilla County LONO to the USACE.
- February 9, 2022 – 1956 levee and revetment construction plan, profiles, and detail sheet 7 provided by the USACE to CTUIR, and forwarded to Tetra Tech.
- April 25, 2022 – 1956 levee and revetment construction plan, profiles, and all detail sheets provided by the USACE to Tetra Tech.
- May 19, 2022 – Presentation to the USACE by Tetra Tech of the reconstruction of the Pendleton 2a Levee to document the authorized design function, with the CTUIR and BPA in attendance.
- May 27, 2022 – Meeting minutes from the May 19, 2022, presentation sent to the USACE, CTUIR, and BPA by Tetra Tech.
- February 9, 2023 – Submitted Pendleton 2A Levee Setback Section 408 Preliminary Submittal to Assemble USACE Review Team.
- February 21, 2023 – Pendleton 2A Levee Setback Section 408 Submittal Overview Meeting.
    - Meeting notes distributed March 2, 2023
    - USACE comments provided March 9, 2023
- March 21, 2023 – Submitted Drilling Program Plan Section 408 Preliminary Submittal for USACE Review.
- April 10, 2023 – Pendleton 2A Levee Setback Section 408 Submittals Review Update Meeting.
    - Meeting notes distributed May 16, 2023
- April 10, 2023 – USACE Review of 60% Design Pendleton 2A Levee Setback Section 408 Submittal.
- May 26, 2023 – Submitted Drilling Program Plan Section 408 for Completeness Review.
- June 21, 2023 – Received notification from USACE of complete application.
- July 10, 2023 – Pendleton 2A Levee Setback 60% Design Section 408 Submittal Technical Review Meeting.
    - Meeting notes distributed August 1, 2023
- July 12, 2023 – Pendleton 2A Levee Setback 60% Design Section 408 Submittal technical review comments were received and include H&H and Real Estate comments.
- October 5, 2023 – Drilling Program Plan Section (408 #0193-FY23) Drilling Closeout and Approval Letter.
- November 29, 2023 – Conducted Geotechnical Drilling per Drilling Program Plan.
- February 1, 2024 – Meeting to present the status update and overview of the 90% submittal to be provided in February 2024.
    - Meeting notes distributed February 12, 2024
- February 9, 2024 – Submitted Exhibits to the USACE regarding the Pendleton 2A Levee and Protection Area.

- February 23, 2024 – Updated Pendleton 2A Levee Setback Section 408 Submittal (90% PS&E) for Review.
- February 29, 2024 – Meeting to discuss the extent of the Pendleton 2A Levee Influence area, additional technical memorandum requested by USACE of influence area extent.
- March 19, 2024 – USACE provided UmaBirch 90% document deficiency review comments.
- March 26, 2024 – Submitted technical memorandum summarizing influence of Pendleton 2A Levee.
- April 30, 2024 – Submitted responses to USACE UmaBirch 90% document deficiency review comments.
- May 7, 2024 – USACE confirmed that the Section 408 Pendleton 2A Levee influence area is reduced to downstream of Taylor Lane Bridge at water surface elevation (WSE) 960 as presented by Tetra Tech in the March 26, 2024, technical memorandum that summarized the influence of the Pendleton 2A Levee.
- June 24, 2024 – USACE provided review comments on the Pendleton 2A Levee Setback 90% Design and Real Estate Plan.
- August 9, 2024 – Submitted responses to USACE comments on the Pendleton 2A Levee Setback 90% Design.
- September 27, 2024 – USACE provided agreement and clarification on Tetra Tech responses and questions design approaches.
- November 18, 2024 – Confirmation from USACE that 100% Design Section 408 Submittal may proceed.
- November 20, 2024 – BPA facilitated meeting to request USACE concurrence on the Real Estate Plan and identify remaining steps for the 408 process related to the Pendleton 2A Levee Setback Design.
    - November 20, 2024 – BPA sent correspondence documenting USACE concurrence on the Real Estate Plan and proceeding to the 100% design Section 408 submittal.
- December 16, 2024 – Submitted the Pendleton 2A Levee Setback Section 408 100% Design to USACE.
- April 23, 2025 – USACE provided review comments the 100% design submittal.
- July 1, 2025 – Submitted the revised Pendleton 2A Levee Setback Section 408 100% Design to USACE (this submittal).

4. SECTION 408 SUPPORTING MATERIALS

Based on the coordination and discussions described in Section 3 above, supporting materials that were identified as necessary for the USACE Section 408 review process of the Project are provided separate from the cover letter and this Attachment 1. These supporting materials are provided as Volumes 1 through 7. This section provides an overview of the analyses and results contained within each volume. A crosswalk of the USACE guidance manuals that were referenced in developing each volume and associated analyses are provided in Table 1, below.

VOLUME 1 – PENDLETON 2A LEVEE SETBACK EXISTING DATA REVIEW AND LEVEE RECONSTRUCTION ANALYSIS

This technical memorandum provides a narrative form of the data and methodology used for the levee reconstruction analysis presented to the USACE by Tetra Tech via a Microsoft Teams call on May 19, 2022. The objective of this technical memorandum is to document the existing available information and examinations taken to reconstruct the existing levee from design drawings, historical data, recent LiDAR data, and topobathymetric survey data to determine whether the existing levee conditions are consistent with the historical design and intent of the levee. As stated in Section 2 above, the reconstruction analysis reported that the current configuration and elevation (e.g., maximum height of 11 feet and a crest width of 19 feet) of the levee matches well with the original (i.e., historical) design, and that the original design discharge was 16,400 cubic feet per second. The configuration and elevation, combined with the design discharge, was utilized in the analyses described in Volume 2.

VOLUME 2 – PENDLETON 2A LEVEE SETBACK HYDROLOGIC AND HYDRAULIC ANALYSES

This technical memorandum documents the hydrologic and hydraulic (H&H) analysis that was performed to determine a full range of flood events up to and including the authorized flood for the levee and evaluate without- and with-Project water surface elevations, velocities, and hydraulic loading at the levee. The hydraulic modeling results indicated the need for a setback levee and the subsequent analyses are described in Volumes 3 and 4.

VOLUME 3 – PENDLETON 2A LEVEE SETBACK INTERIOR DRAINAGE ANALYSIS

An interior drainage analysis was completed for the area to the east of Birch Creek Road to evaluate current interior drainage behavior associated with the range of events described in Volume 2. This technical memorandum documents the supporting engineering analyses and calculations of the interior drainage analysis used to confirm that the adjacent property to the east of the Project is not impacted by the setback levee design and maintains existing drainage characteristics.

VOLUME 4 – PENDLETON 2A LEVEE SETBACK DESIGN AND ANALYSIS

Based on the findings detailed in Volumes 2 and 3, it was determined that a setback levee positioned along Birch Creek Road would be necessary. This technical memorandum includes the findings of the geotechnical desktop study relevant to geotechnical and geological data, geotechnical field investigation report completed in 2023 and the results from the geotechnical design analysis.

VOLUME 5 – SAFETY ASSURANCE REVIEW (IF REQUIRED BY USACE)

It is understood that a Safety Assurance Review (SAR) may be requested from the USACE for the Project and would consist of an alteration-specific SAR plan for review. If an SAR plan is required, one will be developed in accordance with USACE standards and submitted for review. At this time no SAR has been developed.

VOLUME 6 – PENDLETON 2A LEVEE SETBACK OPERATION AND MAINTENANCE PLAN

An Operation and Maintenance (O&M) Plan for the proposed levee alterations was developed. The section of Pendleton 2a Levee that is proposed to be altered is not currently maintained. The USACE standards were utilized for the O&M plan and the CTUIR and Tetra Tech will work with local government agencies and landowners to develop an agreement as to who will be responsible for the O&M of the setback levee.

VOLUME 7 – PENDLETON 2A LEVEE SETBACK RISK ASSESSMENT

A Risk Assessment was completed for the Project, including qualitative risk estimates associated with potential failure modes with- and without the proposed design improvements (i.e., Project conditions). Failure modes such as overtopping, piping due to seepage, and rapid drawdown were evaluated. Factors of safety (FOS) were calculated for each failure mode for the with- and without-Project conditions. Comparison of each failure mode and associated FOS coupled with supportive information is provided.

Table 1. USACE Reporting Requirements and References

Submittal	Analysis Component	Requirements in USACE Manual	USACE Specific Location
Volume 1 – Existing Data Review and Levee Reconstruction	Comparison of Existing Levee with Historical Design Documents	Not Applicable	-
Volume 2 – H&H Analysis	Study Components for Channel Modification	EM 1110-2-1419	Chapter 6
	Study Components for Levees and Floodwalls	EM 1110-2-1419	Chapter 7
	Channel Stability Assessment for Flood Control Projects	EM 1110-2-1418	-
	Flood-Runoff Analysis	EM 1110-2-1417	-
	Hydrologic Frequency Analysis and Estimates	EM 1110-2-1415 ER 1110-2-1450	-
	Hydraulic Design for Local Flood Risk Management Projects	ER 1110-2-1450	-
	Hydraulic Design for Local Flood Risk Management Projects	ER 1110-2-1450	-
Volume 3 – Interior Drainage Analysis	Hydrologic Engineering Requirements for Interior Area Planning Studies	EM 1110-2-1413	Chapter 3, Section 3-3
	Hydrologic Engineering Requirements for Interior Area Design Studies	EM 1110-2-1413	Chapter 3, Section 3-4
	Reporting Requirements for Interior Area Hydrology Studies	EM 1110-2-1413	Chapter 3, Section 3-5
	Analysis Methods and Procedures for Riverine Interior Areas	EM 1110-2-1413	Chapter 4
	Determination of Permeability of Soil	EM 1110-2-1901	Chapter 2
	Content of Engineering Appendix to Feasibility Report	ER 1110-2-1150	Appendix C
	Content and Format of Design Documentation Report	ER 1110-2-1150	Appendix D
	Content and Format of Engineering Documentation Report	ER 1110-2-1150	Appendix E
Volume 4 – Setback Levee Design and Analysis	Field investigations	EM 1110-2-1913	Chapter 2
	Drilling in Levees	ER 1110-1-1807	-
	Laboratory Testing of Soils	EM 1110-2-1913	Chapter 3
		EM 1110-2-1906	-

Submittal	Analysis Component	Requirements in USACE Manual	USACE Specific Location
	Geotechnical Investigations	EM 1110-1-1804	-
	Slope Design and Settlement	EM 1110-2-1913	Chapter 6
	Stability Analyses	EM 1110-2-1902	-
	Settlement Analyses	EM 1110-1-1904	-
	Design and Analysis Requirements for Seismic Evaluation Reports	ER 1110-2-1806	Appendix F
	Levee Construction	EM 1110-2-1913	Chapter 7
	Levee Encroachment Standards and Procedures	PDR 1130-2-5	
Volume 6 – Operation and Maintenance Plan	Operation and Maintenance Manual Sections	ER 1110-2-401	Appendix A
	Maintenance and Operation of Levees	33 CFR Part 208, Section 208.10	-
	Guidelines for Landscape Planting and Vegetation Management at Levees	EP 1110-2-18	-
	USACE Inspection Guide for Flood Control Works	Levee Owner's Manual	Appendix C
Volume 7 – Risk Assessment	Risk Assessment Requirements for Flood Management Studies	ER 1105-2-101	-
	Risk-Based Analysis Procedures for Flood Damage Reduction Studies	EM 1110-2-1619	-

5. SUMMARY OF CHANGES INCORPORATED INTO THE 100 PERCENT

Table 2. Summary of Changes Incorporated into the 100 Percent

60 Percent	90 Percent	100 Percent	Comments
Volume 1 included a reference for the topobathymetric survey and surface development.	Volume 1 Section 3.1 includes an added section that describes the topobathymetric survey and surface development. The reference has been removed.	n/a	Section 3.1 Topobathymetric Survey and Surface Development may be found in Volume 1 page 5.
Volume 2 did not include a figure of the Without-Project authorized flood hydraulic modeling water surface elevation (WSE) results.	Volume 2 Section 4.1 added Figure 4-1 of the without-Project authorized flood results comparing the water surface elevation of the authorized flood in relation to the Pendleton Levee 2a top elevations.	n/a	Figure 4-1 Authorized Flood WSE vs Pendleton 2a Levee Top Elevations may be found in Volume 2 page 5.
Volume 2 did not include a sensitivity analysis of changes in roughness values in the hydraulic modeling.	Volume 2 Section 4.3 added sensitivity analysis of changes in roughness values in both the Without-Project and With-Project hydraulic model scenarios.	n/a	Section 4.3 Sensitivity Analysis may be found in Volume 2 page 7.
n/a	n/a	Volume 2 Section 5.1.2. – Discussion has been added identifying the required top of levee elevation and any portion of the levee that is below that elevation.	Section 5.1.2 With-Project Pendleton 2a Levee Overflow Relief) may be found in Volume 2 page 9.
Volume 2 Figure 5-1 shows Without- and With-Project Conditions	Volume 2 Figure 5-1 shows Without- and With-Project Conditions for the Authorized Flood WSE.	n/a	Figure 5-1 Without- and With-Project Authorized Flood WSE may be found in Volume 2 page 8.

60 Percent	90 Percent	100 Percent	Comments
for the 100-year inundation.			
Volume 2 Figure 5-2 shows Without- and With-Project Conditions for the 100-year Velocities.	Volume 2 Figure 5-1 shows Without- and With-Project Conditions for the Authorized Flood Velocities.	n/a	Figure 5-1 Without- and With-Project Authorized Flood Velocities may be found in Volume 2 page 10.
Volume 2 Figure 5-3. Without- and With-Project Conditions 100-Year WSEs at Location of Levee.	Volume 2 Figure 5-3. Without- and With-Project Conditions Authorized Flood WSEs at Location of Levee.	n/a	Figure 5-3 Without- and With-Project Conditions Authorized Flood WSEs at Location of Levee may be found in Volume 2 page 11.
Volume 2 Figure 5-4 Without-Project Conditions WSEs (2-, 10-, 25-, 100-Year) at Location of Levee and Volume 2 Figure 5-5 With-Project Conditions WSEs (2-, 10-, 25-, 100-Year) at Location of Levee.	Volume 2 Figure 5-4 With- and Without-Project Conditions WSEs (2-year, 10-year, 25-year, Authorized Flood) combines With- and Without-Project scenarios into one figure.	n/a	Volume 2 Figure 5-4 With- and Without-Project Conditions WSEs (2-year, 10-year, 25-year, Authorized Flood) may be found in Volume 2 page 12.
Volume 2 Attachment 1 – Proposed Design Drawings.	Volume 2 Attachment 1 – Proposed Design Drawings has been revised to focus on the Pendleton Levee 2a Setback Design. The levee setback work is a component of a larger habitat restoration project. The components of the restoration project are detailed in a separate design drawing document.	n/a	Volume 2 Attachment 1 – Proposed Design Drawings may be found in Volume 2 page 16.
n/a	n/a	Volume 2 Attachment 1 – Reference to geotextile has been removed from Sheet C-205. An aggregate filter blanket design under riprap has been added.	Volume 2 Attachment 1 – Proposed Design Drawings Aggregate Filter Blanket Design may be found in Volume 2 Sheet C-207, Detail 1 and 2.
n/a	n/a	Volume 2 Attachment 1 - A note has been added regarding timing of the removal of the existing levee	Volume 2 Attachment 1 – Proposed Design Drawings Construction Sequence Steps Note 3 may be found in Volume 2 Sheet C-200.
n/a	n/a	Volume 2 Attachment 1 – Design Drawings depiction of the control point network has been included	Volume 2 Attachment 1 – Proposed Design Drawings Control Points may be found in Volume 2 Sheet E-201.
n/a	n/a	Volume 2 Attachment 2 – Seepage filter specifications reference to USACE EM 1110-2-2902 Section 5.5.9.3.1 and USACE 1110-2-1901 have been added	Volume 2 Attachment 2 – Proposed Design Drawings Seepage Filter Specifications References Section 33 05 33.13 CORRUGATE-WALL, SMOOTH INERIOR HDPE GRAVEITY PIPE, 2.03 SEEPAGE FILTER MATERIAL

60 Percent	90 Percent	100 Percent	Comments
			may be found in Volume 2 page C-83.
n/a	n/a	Volume 2 Attachment 1 – Wingwalls have been revised to include weep holes.	Volume 2 Attachment 1 – Proposed Design Drawings Wingwalls with Weep Holes may be found in Volume 2 Sheet C-208.
Volume 2 Attachment 2 – Proposed Construction Specifications.	Volume 2 Attachment 2 – Proposed Construction Specifications has been revised to focus on the Pendleton Levee 2a Setback Design. The levee setback work is a component of a larger habitat restoration project. The components of the restoration project are detailed in a separate construction Specification document.	n/a	Volume 2 Attachment 2 – Proposed Construction Specifications may be found in Volume 2 page 34. See Section 31 23 00 EXCAVATION AND FILL details the necessary specifications for the levee earthwork, Section 33 05 33.13 CORRUGATED-WALL, SMOOTH INTERIOR HDPE GRAVITY PIPE details the necessary specifications for the culverts, flap gates, and SECTION 31 05 19.13 GEOTEXTILES details the necessary specifications for the geotextiles.
n/a	n/a	Volume 2 Section 5 Figures 5-1 and 5-5 labels have been added to section lines.	The red cross section lines in Figure 5-1 Without- and With-Project Conditions Authorized Flood WSE have been labeled and referenced Figures 5-5 Without- and With-Project Conditions Authorized Flood at Location of Levee, Figures 5-6 With- and Without-Project Conditions WSEs (2-year, 10-year, 25-year, Authorized Flood) may be found in Volume 2 pages 8, 13 and 14.
n/a	n/a	Volume 2 Section 5.2.1 added discussion regarding Class 50 and Class 200 riprap design and selection	Section 5.2.1 Riprap Design may be found in Volume 2 page 11.
n/a	n/a	Volume 2 Section 5.1.2 a description of the overflow portion of the setback levee, its intended purpose, and why it is a low risk was added	Section 5.1.2 With-Project Pendleton 2a Levee Overflow Relief may be found in Volume 2 page 9.
n/a	n/a	Volume 2 Section 5.3 revised to compare authorized flood WSEs to proposed levee setback crest elevations, and to document freeboard along the length of the proposed levee setback.	Section 5.3 Hydraulic Loading may be found in Volume 2 page 12.

60 Percent	90 Percent	100 Percent	Comments
		Volume 2 Attachment 2 - Construction Specifications revised to add scarification depth for subgrade surfaces receiving fill	Volume 2 Attachment 2 – Proposed Construction Specifications may be found in Volume 2 page 34. See Section 31 23 00 EXCAVATION AND FILL details the necessary information for levee earthwork.
n/a	n/a	Volume 2 Attachment 2 - Construction Specifications revised to add methodologies for tying setback levee into existing levee berm using benching and scarification of fill surfaces.	Volume 2 Attachment 2 – Proposed Construction Specifications may be found in Volume 2 page 34. See Section 31 23 00 EXCAVATION AND FILL details the necessary information for levee earthwork.
n/a	n/a	Volume 2 Attachment 2 - Construction Specifications revised to add a description of material to be tested whenever a change in material is encountered; the minimum number of tests required has also been added.	Volume 2 Attachment 2 – Proposed Construction Specifications may be found in Volume 2 page 34. See Section 31 23 00 EXCAVATION AND FILL details the necessary information for levee earthwork.
n/a	n/a	Volume 2 Attachment 2 - Construction Specifications revised to add quality control measures to ensure required riprap gradation.	Volume 2 Attachment 2 – Proposed Construction Specifications may be found in Volume 2 page 34. See Section 31 37 00 Riprap details the necessary information for riprap use.
Volume 2 Attachment 3 – Pendleton Levee 2a Levee System	Volume 2 Attachment 3 – Pendleton Levee 2a Levee System was replaced with the results of the Without-Project Conditions Sensitivity Analysis detailing the WSE based lower, design, and upper roughness scenarios.	n/a	Volume 2 Attachment 3 may be found in Volume 2 page 131.
n/a	Volume 2 Attachment 4 – With-Project Conditions Sensitivity Analysis detailing the WSE based lower, design, and upper roughness scenarios.	n/a	Volume 2 Attachment 4 may be found in Volume 2 page 135.
n/a	n/a	Volume 3 Section 3 – Reference to USACE EM 1110-2-1901 and explanation of the applicability of Darcy's Law has been added.	Section 3 Methodology may be found in Volume 3 page 3.
Volume 3 Section 4.2 Seepage	Volume 3 Section 4.2 Seepage consolidated subsections 4.2.1 Without-Project Seepage and	n/a	Volume 3 Section 4.2 Seepage may be found in Volume 3 page 6.

60 Percent	90 Percent	100 Percent	Comments
	4.2.2 With-Project Seepage and eliminated the headings.		
Volume 3 Section 4.2 Seepage	Volume 3 Figure 4-1. 100-year Umatilla River Hydraulic Modeling Results Without-Project and Figure 4-2. Without-Project Location of Maximum Hydraulic Gradient were eliminated.	n/a	n/a
Volume 3 Section 4.2 Seepage	Volume 3 Table 4-3 Without-Project Seepage Calculations was revised to With-Project Seepage Calculations and included With-Project East and With-Project West calculations.	n/a	Volume 3 Section 4.2 Seepage may be found in Volume 3 page 6.
n/a	Volume 3 Section 4.3 Uncontrolled Discharge was added and details the observed release of floodwater into the interior drainage during a flooding event in February 2020.	n/a	Volume 3 Section 4.3 Uncontrolled Discharge may be found in Volume 3 page 7.
Volume 3 Hydrologic Modeling Section 5.1 Without-Project Hydrologic Modeling	Volume 3 Section 5.1 Without-Project Hydrologic Modeling has been revised to Section 4.4 Without-Project Hydrologic Modeling and includes revisions to the supporting Figures 4-5 Without-Project Interior Drainage Area, Buildings, and Hydraulic Structures and 4-6 Without-Project HydroCAD Model Schematic; as well as revisions to Tables 4-4 Without-Project Interior Drainage Area Characteristics, 4-5 Without-Project Interior Drainage Area Time of Concentration, and Table 4-6 Without-Project Interior Drainage Area Outlet Configuration.	n/a	Volume 3 Section 4.4 Without-Project Hydrologic Modeling may be found in Volume 3 page 9.
Volume 3 Hydrologic Modeling Section 5.2 With-Project Hydrologic Modeling	Volume 3 Section 5.2 With-Project Hydrologic Modeling has been revised to Section 4.5 With-Project Hydrologic Modeling and includes revisions to the supporting Figures 4-8 With-Project Interior Drainage Area, Buildings, and Hydraulic Structures and 4-9 With-Project HydroCAD Model Schematic; as well as revisions to Tables 4-7 With-Project Interior Drainage Area Characteristics, 4-8 With-Project Interior Drainage Area Time of Concentration, and Table 4-9 With-Project Interior Drainage Area Outlet Configuration.	n/a	Volume 3 Section 4.5 With-Project Hydrologic Modeling may be found in Volume 3 page 12.

60 Percent	90 Percent	100 Percent	Comments
n/a	Volume 3 Section 5.0 Hydraulic Modeling includes two subsections 5.1 Without-Project Hydraulic Modeling and 5.2. With-Project Hydraulic Modeling and Results of the hydrologic modeling performed is the sections mentioned above were inserted into the without-Project and with-Project hydraulic models as upstream boundary conditions within each interior drainage area.	n/a	Volume 3 Section 4.5 With-Project and Without-Project Hydrologic Modeling may be found in Volume 3 page 16.
n/a	n/a	Volume 3 Attachment 3 – Pipe design calculations that comply with USACE EM 1110-2-2902 have been included	Volume 3 Attachment 3 – Thermoplastic Pipe Design Results.
Volume 4 Section 4 Initial Geotechnical Design Analysis included a review of the design criteria, initial slope stability analysis, and seepage analysis.	Volume 4 Section 4 was revised to discuss the Geotechnical Field investigation that included the USACE approved Umatilla Birch Geotechnical Drilling Program Plan. The results of the field investigation were completed by Carlson Geotechnical is provide as Attachment 1.	n/a	Volume 4 Section 4 Geotechnical Field Investigation may be found in Volume 4 page 9. The Carlson Geotechnical investigation report may be found as Attachment 1 Page 48.
n/a	Volume 4 Section 5 was added to the report and included the updated geotechnical slope stability and seepage analyses based on the field investigation and design updates.	n/a	Volume 4 Section 5 Geotechnical Design Analysis may be found in Volume 4 page 9.
n/a	n/a	Volume 4 Section 5 – Additional seepage and stability analyses were performed with the water surface elevation at the top of the levee.	Section 5 Geotechnical Design Analysis may be found in Volume 4 page 10.
Volume 6 Section 8 Maintenance and Inspection.	Volume 6 Section 8.2 was revised to Project Area 2 Habitat Features and discussed the stability of large woody material (LWM) and the unlikely to impact the Pendleton Levee 2a setback.	n/a	Volume 6 Section 8.2 may be found in Volume 6 page 6.
Volume 6 Section 8 Maintenance and Inspection.	Volume 6 Section 8.3 was revised to Encroachments and the text was revised to include the statement that all future encroachments will require to proceed through the 408 permitting process.	n/a	Volume 6 Section 8.3 may be found in Volume 6 page 6.
n/a	n/a	Volume 6 Section 8.7 revised to add reference to riprap specifications and classes, and to remove	Section 8.7 may be found in Volume 6 page 8.

60 Percent	90 Percent	100 Percent	Comments
		references to geotextile.	
Volume 6 Section 8 Maintenance and Inspection.	Volume 6 Section 8.12.2 was revised to include a discussion of the headwalls and wingwall associated with the culvert pipes.	n/a	Volume 6 Section 8.12.2 may be found in Volume 6 page 12.
Volume 6 Section 8 Maintenance and Inspection.	Volume 6 Section 8.12.3 was revised from a discussion on the Tideflex valves to metals flap gates.	n/a	Volume 6 Section 8.12.3 may be found in Volume 6 page 12.
n/a	Volume 6 Appendix D – Emergency Action Plan was added.	n/a	Volume 6 Appendix D – Emergency Action Plan may be found in Volume 6 page 47.
Volume 7 Section 3 Project Design Data	Volume 7 Section 3 references to 60 percent design was revised to 90 percent design throughout the section.	n/a	Volume 7 Section 3 may be found in Volume 7 page 3.
Volume 7 Section 4 Risk Assessment	Volume 7 Interior drainage System references to Tideflex valves was revised to flap gates	n/a	Volume 7 Section 4 may be found in Volume 7 page 6.

6. REFERENCES

USACE (U.S. Army Corps of Engineers). 2022. National Levee Database Pendleton 2a System ID 5005000041. Available online at: https://levees.sec.usace.army.mil/#/levees/system/5005000041/system

United States Code (USC). 1982. Protection of Navigable Waters and of Harbor and River Improvements Generally, 33 U.S.C. §§ 403-408 (Suppl. 3 1982). https://www.loc.gov/item/uscode1982-035033009/

VOLUME 1

TECHNICAL MEMORANDUM

To:	United States Army Corps of Engineers
Cc:	Confederated Tribes of the Umatilla Indian Reservation
From:	Jeremy Andrews, PE, and Chris James, CWM, CERP (Tetra Tech, Inc.)
Date:	December 16, 2024
Subject:	Volume 1 - Pendleton 2a Levee Setback Existing Data Review and Levee Reconstruction Analysis

1. Introduction

This technical memorandum is being provided by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Tetra Tech, Inc. (Tetra Tech) to the U.S. Army Corps of Engineers (USACE). It is intended to be a continuance of the USACE Section 408 process and review of UmaBirch In-Stream Design and Construction Oversight Project (the Project). The Project has been identified by the USACE as request #FY19-NO46 and is linked to the nationwide permit NWP-2019-489. The Project is associated with the USACE Pendleton 2a Levee which is listed in the USACE National Levee Database as System ID# 500500041 (USACE 2022). The purpose of the Project is to restore floodplain connectivity and natural riverine processes, while maintaining the function of the Pendleton 2a Levee. The USACE Section 408 review is requested because the Project proposes to setback a portion of the Pendleton 2a Levee downstream of Birch Creek Road located near Rieth, Oregon, in order to achieve the purpose of the Project.

This technical memorandum provides the available data review and reconstruction analysis necessary to determine the authorized use of the Pendleton 2a Levee. The review and analysis are in support of the United USACE Section 408 review of the Project. The Project is located on the Umatilla River from river mile (RM) 48.7 to RM 49.7 and Birch Creek from RM 0.0 to RM 0.3. The Project is part of a larger series of project's being proposed by the CTUIR and Bonneville Power Administration (BPA) located downstream on the Umatilla River and upstream on Birch Creek. To provide a phased construction approach based on funding, hydrology and geomorphology, and anticipated environmental permitting requirements, all project actions being proposed by the CTUIR and BPA, have been separated into four distinct project areas. Of these project areas, the USACE Pendleton 2a Levee is located within Project Area 2 (PA 2).

This technical memorandum is Volume 1 of 7. Combined, the volumes assist in documenting historic conditions, existing data, and analyses necessary to demonstrate that the proposed Project will not adversely impact the Pendleton 2a Levee system. Through the evaluation of available historic and current data, Tetra Tech concludes that the 2019 light detection and ranging (LiDAR) data (QSI 2019) coupled with topobathymetric survey data (see

Section 3.1 below), is an accurate terrain model of the original (i.e., historic 1959 levee and revetment based on construction plan, profiles, and detail sheets provided by the USACE to Tetra Tech) design, and currently provides the original authorized protection.

2. Purpose

The purpose of this technical memorandum is to document the available data and examinations undertaken to reconstruct the Pendleton 2a Levee in order to determine if the existing (i.e., current) conditions are consistent with the historical design (i.e., 1959 levee) and original authorized protection of the Pendleton 2a Levee system. In December 2021, representatives of the USACE, BPA, CTUIR, and Tetra Tech met to discuss the Pendleton 2a Levee and the scope of work for the Project and Section 408 review process. As a part of that meeting, and to support the Section 408 process, the USACE requested that the CTUIR and Tetra Tech reconstruct the historical Pendleton 2a Levee to determine whether the current levee conditions are consistent with the historical design and to document the original authorized protection. In order to determine the historic design, available data was reviewed that included design drawings and historical documentation provided by the USACE. To determine the current Pendleton 2a Levee conditions, 2019 LiDAR data (QSI 2019) and topobathymetric survey data (see Section 3.1 below) was utilized.

2.1 Background

The Project proposes modifications to a section of the existing Pendleton 2a Levee located along the south bank of the Umatilla River. The Pendleton 2a Levee (segment ID: 5004430001) is identified in the USACE National Levee Database as part of the Pendleton Zone 2 Flood Damage Reduction (FDR) Project, which is a federally authorized and constructed, and non-federally operated and maintained levee system (USACE 2022). The location of the Pendleton 2a Levee is shown in Figure 2-2, below. The Project proposes to remove a section of the existing levee and to replace it with a setback levee. The proposed section of the existing levee to be modified is shown in Figure 2-3, below.

2.2 USACE Correspondence

On May 19, 2022, Tetra Tech met via a Microsoft (MS) Teams call with representatives of the CTUIR, USACE, and BPA, and presented a summary of Tetra Tech’s examination of the existing available data and the resulting levee reconstruction analysis. As part of this presentation, Tetra Tech created a MS PowerPoint that graphically presented bullet lists and images of the data evaluation and historic levee reconstruction. The PowerPoint file is provided as Attachment 1 and meeting minutes from that presentation are provided as Attachment 2. The following sections build on the information presented in the PowerPoint with additional information necessary for this technical memorandum.

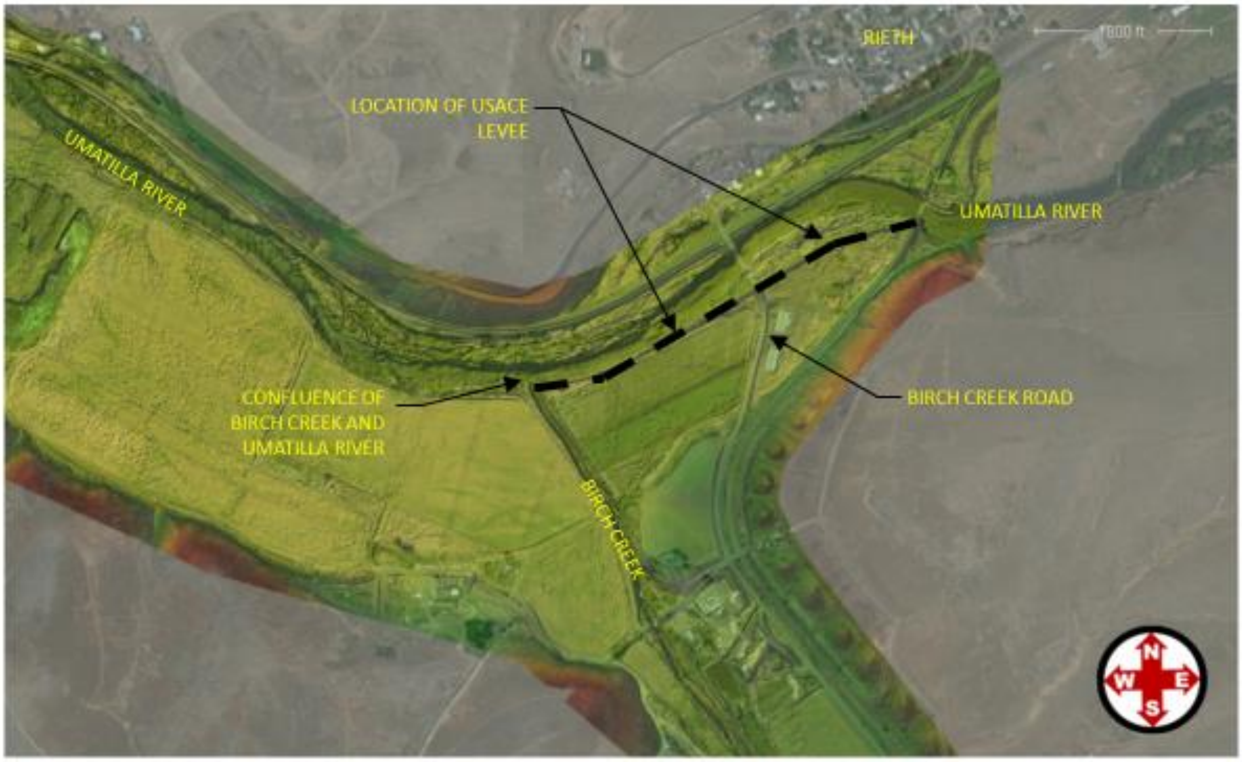


Figure 2-2. Pendleton 2a Levee Location

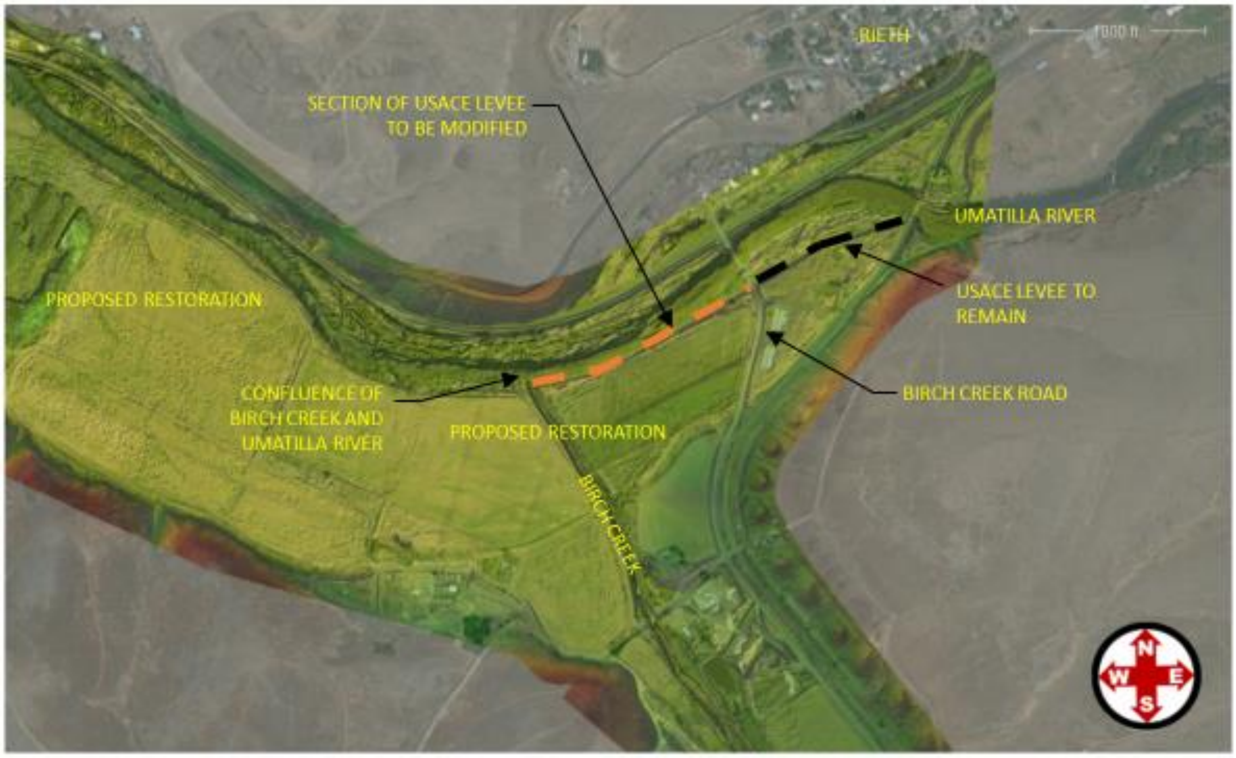


Figure 2-3. Section of Pendleton 2a Levee to be Modified

3. Existing Data Review

This section provides documentation of available data examined for the Pendleton 2a Levee reconstruction analysis, including exiting surface development, online databases, historic construction drawings, and other supporting documentation.

3.1 Topobathymetric Survey and Surface Development

Topobathymetric survey data for the Project was collected in June 2019, July 2021, and July 2023 and included stream channel topographic and bathymetric northing, easting, and elevation Global Positioning System (GPS) coordinates. Survey data was collected using Trimble R10 and R12 real-time kinematic (RTK) GPS with Global Navigation Satellite System (GLONASS) receivers in open canopy areas. The survey control point at the base station was established by collecting raw static GPS data for a minimum of 4 hours. The data was submitted to the Online Positioning User Service (OPUS) for post-processing and conversion to the preferred coordinate system: North American Datum (NAD) 83, Oregon State Plane, North Zone for the horizontal projection, and the North American Vertical Datum (NAVD) 88, using International Feet as the vertical projection. The on-site GPS survey data were merged with the existing 2019 LiDAR data (QSI, 2019) to provide a final surface for hydrologic and hydraulic modeling and project design development. Comparisons of GPS points versus the 2019 LiDAR data (QSI 2019) were made at fixed areas such as highways or gravel roads and indicated no need to make any horizontal or vertical adjustments to the 2019 LiDAR data (QSI 2019).

3.2 FEMA Designation

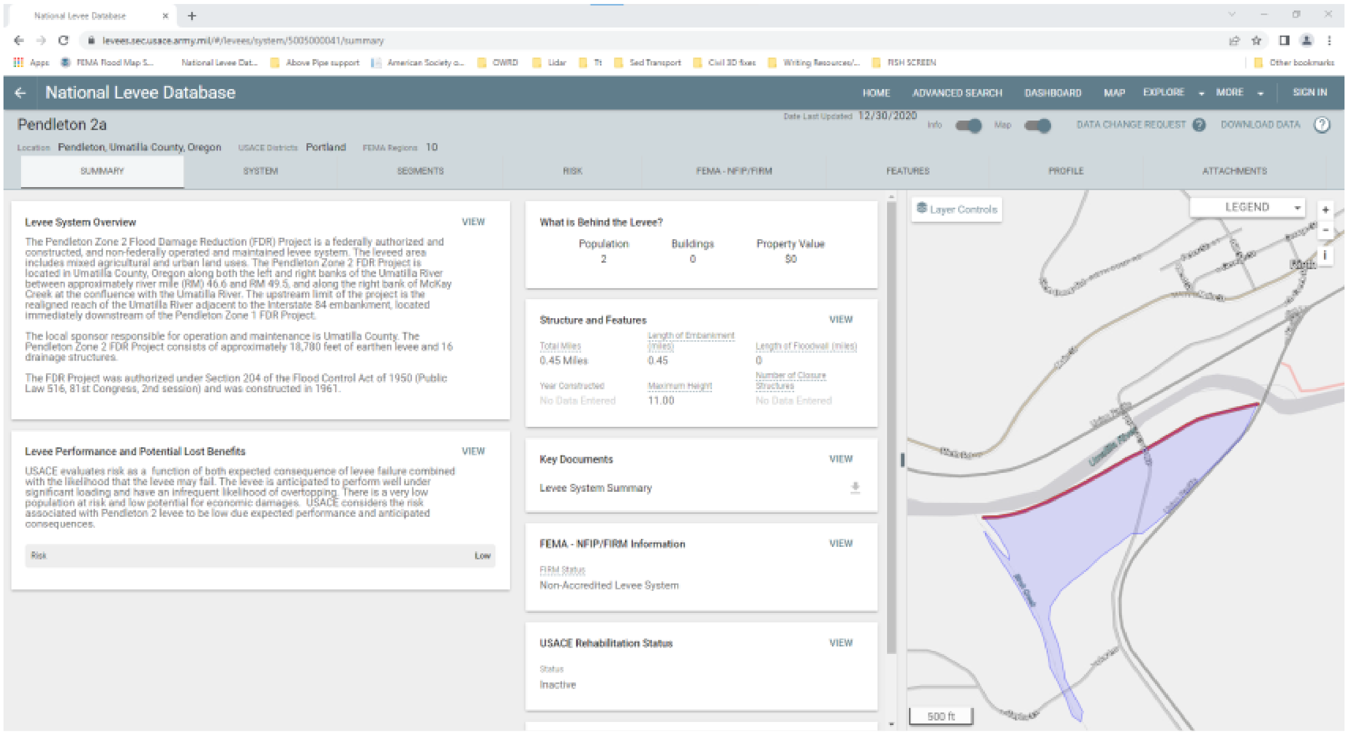
The section of levee to be modified is located within a Federal Emergency Management Agency (FEMA) Zone A (FEMA 2010) and is a FEMA non-accredited levee system (USACE 2022). Zone A includes areas that experience inundation as a result of a 1% Annual Exceedance Probability (AEP), or 100-year, flood (base flood). Zone A is estimated by FEMA through detailed studies of surrounding areas and interpolation, the designation indicates no known base flood elevations. The portion of the levee to remain is not within a FEMA Zone A, as shown in Figure 3-1 below which displays data from FEMA's National Flood Hazard Layer Viewer.

Figure 3-1. FEMA National Flood Layer

3.3 USACE National Levee Database

The section of levee to be modified is located within the Pendleton 2a Levee system and can be found on the USACE National Levee Database (database) (USACE 2022). According to the database, the Pendleton 2a Levee system is part of the Pendleton Zone 2 FDR Project and is a federally authorized and constructed, and non-federally operated and maintained levee system. In addition to the system overview summary, the database provides downloadable data about the levee system segments, risk, FEMA information, features, profiles, and additional attached data. All data available in the database are summarized in Attachment 3.

The FDR leveed area includes mixed agricultural and urban land uses located in Umatilla County, Oregon, along both the left and right banks of the Umatilla River between river mile (RM) 46.6 and RM 49.5, and along the right bank of Birch Creek at the confluence with the Umatilla River. The local sponsor responsible for operation and maintenance is Umatilla County. The FDR consists of approximately 18,780 feet of earthen levees and 16 drainage structures. The FDR was authorized under Section 204 of the Flood Control Act of 1950 and was constructed in 1961 (USACE 2022). Figure 3-2 shows the Pendleton 2a Levee summary from the database website.



Pendleton 2a

Location: Pendleton, Umatilla County, Oregon
USACE Districts: Portland
FEMA Regions: 10
Date Last Updated: 12/30/2020

Levee System Overview

The Pendleton Zone 2 Flood Damage Reduction (FDR) Project is a federally authorized and constructed, and non-federally operated and maintained levee system. The leveed area includes mixed agricultural and urban land uses. The Pendleton Zone 2 FDR Project is located in Umatilla County, Oregon along both the left and right banks of the Umatilla River between approximately river mile (RM) 46.6 and RM 49.5, and along the right bank of McKay Creek at the confluence with the Umatilla River. The upstream limit of the project is the realigned reach of the Umatilla River adjacent to the Interstate 84 embankment, located immediately downstream of the Pendleton Zone 1 FDR Project.

The local sponsor responsible for operation and maintenance is Umatilla County. The Pendleton Zone 2 FDR Project consists of approximately 18,780 feet of earthen levee and 16 drainage structures.

The FDR Project was authorized under Section 204 of the Flood Control Act of 1950 (Public Law 516, 81st Congress, 2nd session) and was constructed in 1961.

Levee Performance and Potential Lost Benefits

USACE evaluates risk as a function of both expected consequence of levee failure combined with the likelihood that the levee may fail. The levee is anticipated to perform well under significant loading and have an infrequent likelihood of overtopping. There is a very low population at risk and low potential for economic damages. USACE considers the risk associated with Pendleton 2 levee to be low due expected performance and anticipated consequences.

Risk: Low

What is Behind the Levee?

Population	Buildings	Property Value
2	0	$0

Structure and Features

Total Miles	Length of Embankment (miles)	Length of Floodwall (miles)
0.45 Miles	0.45	0
Year Constructed	**Maximum Height**	**Number of Closure Structures**
No Data Entered	11.00	No Data Entered

Key Documents

Levee System Summary

FEMA - NFIP/FIRM Information

FIRM Status: Non-Accredited Levee System

USACE Rehabilitation Status

Status: Inactive

Figure 3-2. USACE National Levee Database of Pendleton 2a Levee

3.4 Construction Documentation

The 1959 Umatilla River, Oregon Zone 2 Location Levee and Revetment Construction drawings (drawings), file number UR-46-1/1 through UR-46-1/10, were provided by the USACE and included necessary information to accurately correlate the historic levee with existing conditions. The drawing set includes coordinates, bearings, profiles, details, and sections with clear elevation data set to a vertical elevation datum identified as Mean Sea Level (MSL). See Figure 3-3 showing construction drawings (file number UR-46-1/7) of the sections of the Pendleton 2a Levee to remain and sections of the levee to be modified. See Figure 3-4 showing Profile – L from sheet UR-46-1/7, which is the portion of the Pendleton 2a Levee to be modified. Note the MSL label in the vertical axis and the callout for the approximate top of the existing levee. The 1959 levee construction drawings are provided as Attachment 4.

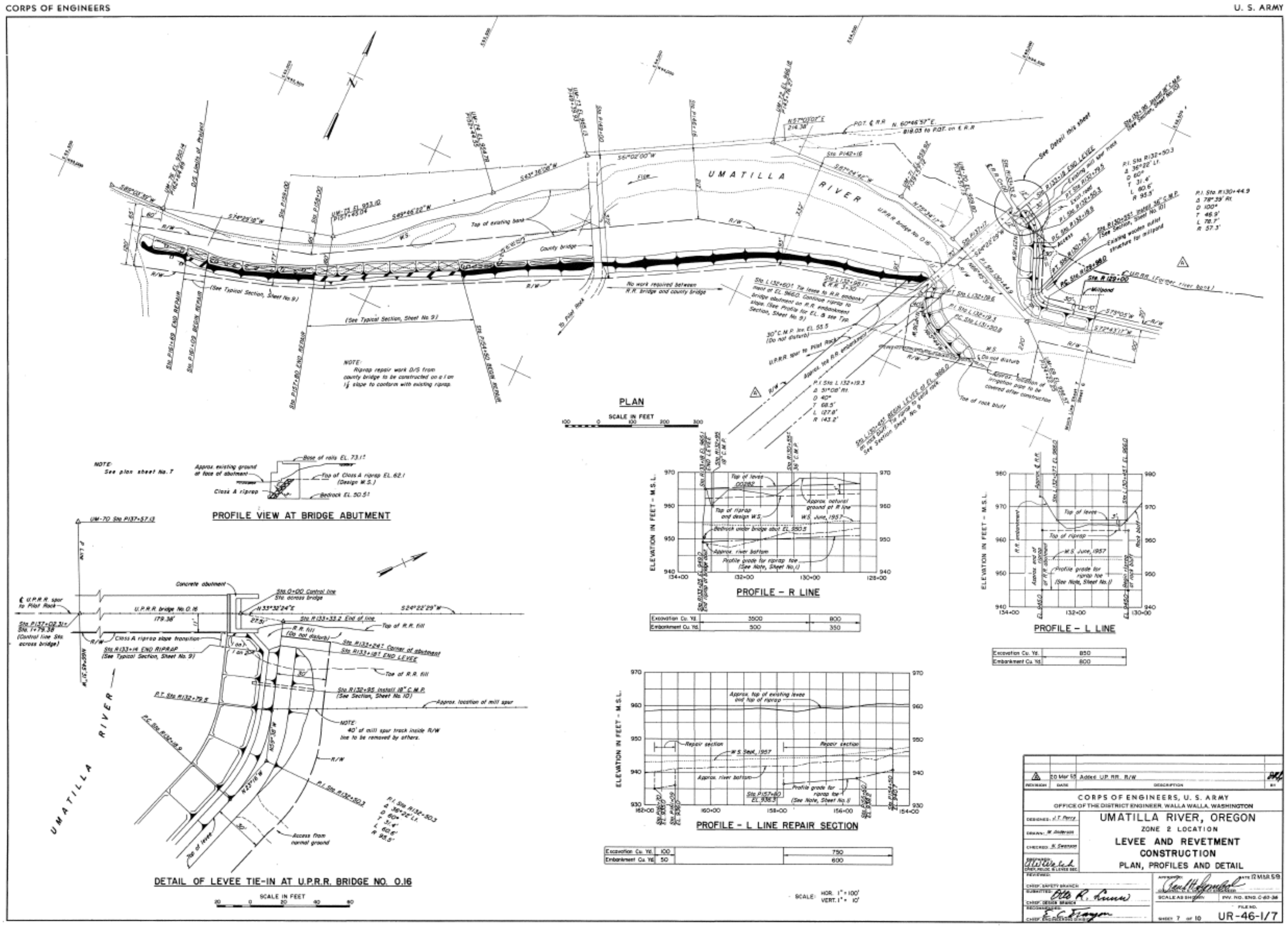
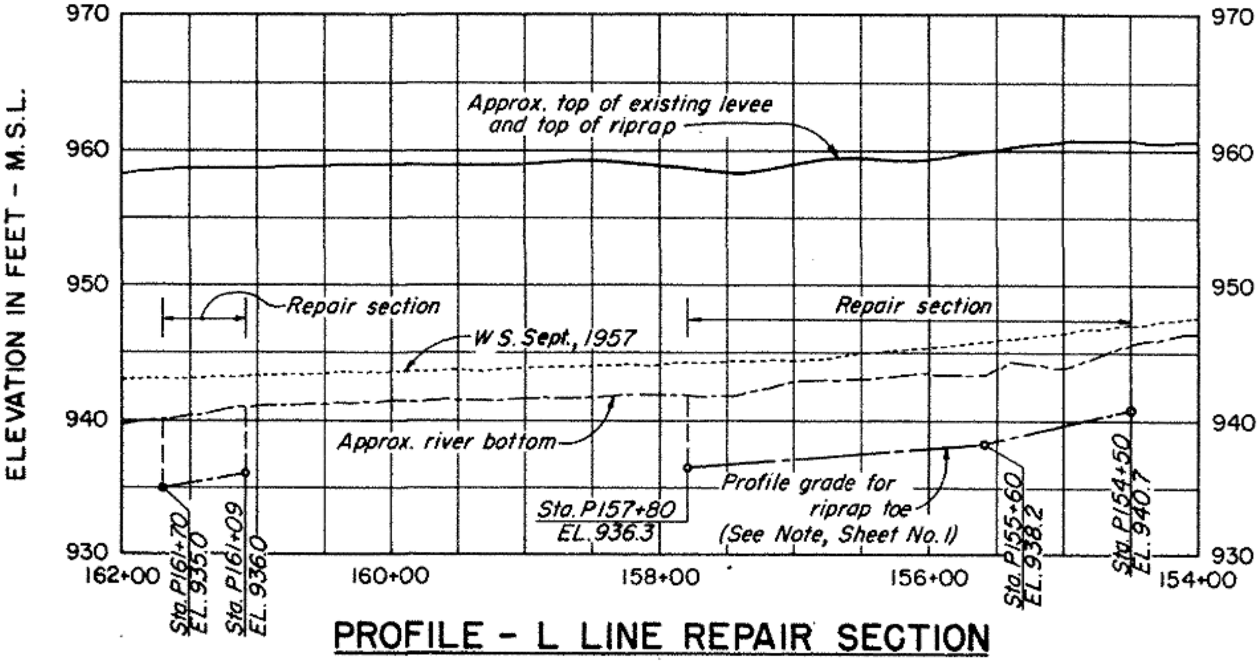


Figure 3-3. 1959 USACE Construction Drawing Sheet UR-46-1/7 of Pendleton 2a Levee

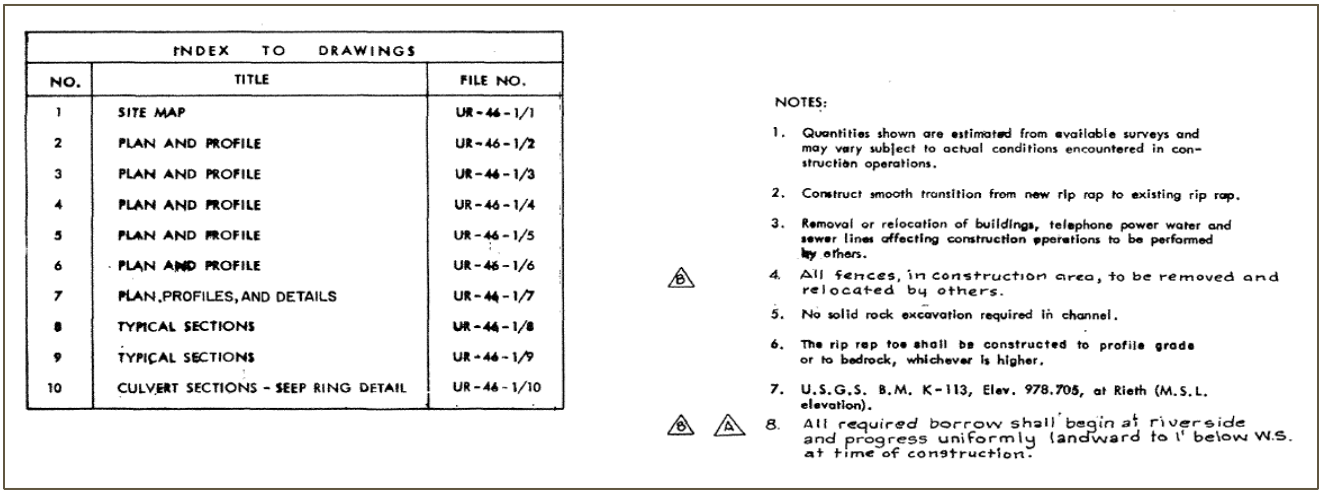


Excavation Cu. Yd.	100		750
Embankment Cu. Yd.	50		600

Figure 3-4. Construction profile of the portion of Pendleton 2a Levee to be modified

MSL was a common topographical survey vertical datum used at the time of the levee construction and was renamed National Geodetic Vertical Datum of 1929 (NGVD 29) (NGS, 2022a) to avoid confusion with being associated with a tidal sea level surface. In 1991 the NGVD 29 was replaced with the North America Vertical Datum of 1988 (NAVD 88) (NGS, 2022a), which is the vertical datum used for the Project and is the elevation basis for the proposed Project improvements.

The construction note 7 on sheet UR-46-1/1 of the drawings identifies the levee construction survey benchmark used for the levee construction as “United States Geological Survey (USGS) benchmark (B.M.) K-113 with an elevation of 978.705, at Rieth (Mean Sea Level elevation).” See Figure 3-5 showing construction notes from sheet UR-46-1/1.



INDEX TO DRAWINGS

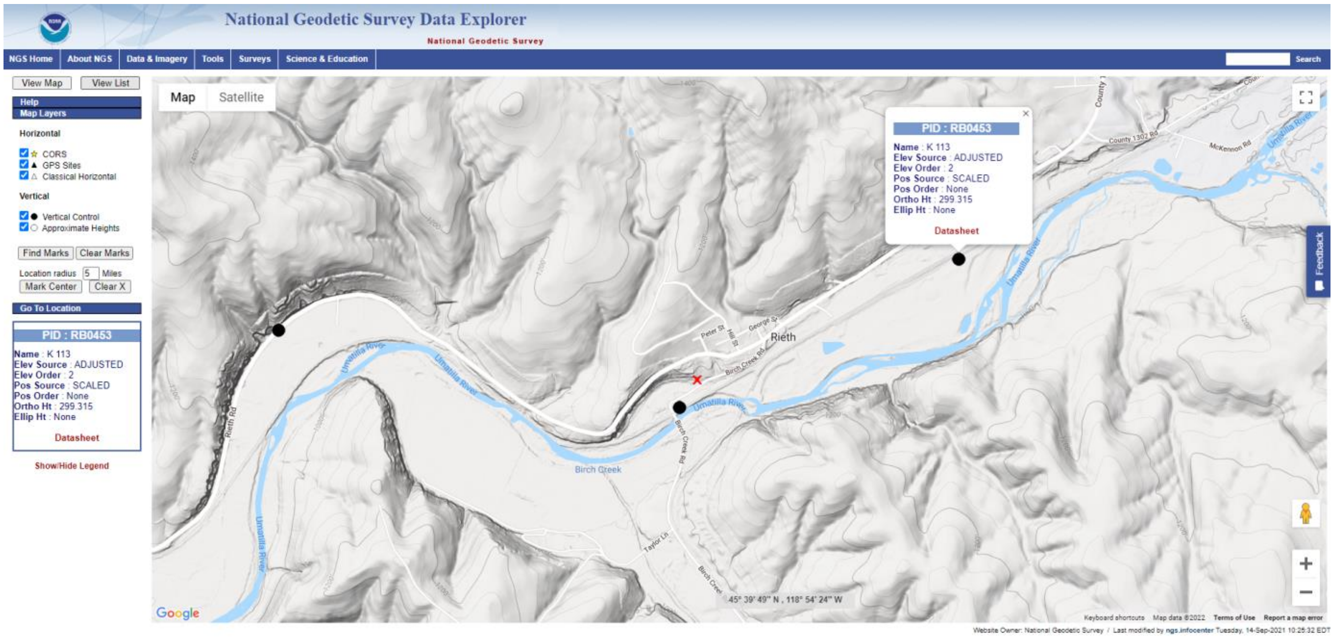
NO.	TITLE	FILE NO.
1	SITE MAP	UR-46-1/1
2	PLAN AND PROFILE	UR-46-1/2
3	PLAN AND PROFILE	UR-46-1/3
4	PLAN AND PROFILE	UR-46-1/4
5	PLAN AND PROFILE	UR-46-1/5
6	PLAN AND PROFILE	UR-46-1/6
7	PLAN, PROFILES, AND DETAILS	UR-46-1/7
8	TYPICAL SECTIONS	UR-46-1/8
9	TYPICAL SECTIONS	UR-46-1/9
10	CULVERT SECTIONS - SEEP RING DETAIL	UR-46-1/10

NOTES:

1. Quantities shown are estimated from available surveys and may vary subject to actual conditions encountered in construction operations.
2. Construct smooth transition from new rip rap to existing rip rap.
3. Removal or relocation of buildings, telephone power water and sewer lines affecting construction operations to be performed by others.
4. All fences, in construction area, to be removed and relocated by others.
5. No solid rock excavation required in channel.
6. The rip rap toe shall be constructed to profile grade or to bedrock, whichever is higher.
7. U.S.G.S. B.M. K-113, Elev. 978.705, at Rieth (M.S.L. elevation).
8. All required borrow shall begin at riverside and progress uniformly landward to 1' below W.S. at time of construction.

Figure 3-5. Construction Notes and Drawing Index from sheet UR-46-1/1.

Tetra Tech was able to locate the benchmark in the National Oceanic and Atmospheric Administration (NOAA) National Geodetic Database as B.M. K-113 (PID RB0453) (NGS, 2022b) and review the associated benchmark datasheet. The datasheet identified that the benchmark was constructed in 1934, which fits into the levee construction timeline. In addition, the datasheet listed the current elevation in NAVD 88 (981.92 feet) as well as the superseded elevation in NGVD 29 (978.71 feet). The NGVD 29 elevation matches the elevation of 978.705 feet MSL from the 1959 drawings. Based on the identified vertical datum correlation and B.M. K-113 documentation, an adjustment of +3.21 feet was determined for the conversion from NGVD 29 (MSL) to NAVD 88 based on the differences between the two elevations at the benchmark. See figure 3-6 below for a screen shot of the B.M. K-113 in the NOAA National Geodetic Survey Data Explorer.



☑ ☆ CORS
☑ ▲ GPS Sites
☑ △ Classical Horizontal
☑ ● Vertical Control
☑ ○ Approximate Heights

Location radius 5 Miles

PID : RB0453

Name : K 113
Elev Source : ADJUSTED
Elev Order : 2
Pos Source : SCALED
Pos Order : None
Ortho Ht : 299.315
Ellip Ht : None

Datasheet

Figure 3-6. B.M. K-113 in the NOAA Nation Geodetic Survey Data Explorer

4. Levee Reconstruction

4.1 Data Overlay

The 1959 plan view drawings were overlaid with the 2019 LiDAR data (QSI 2019) in AutoCAD and lined up based on known landmarks including road crossings and bridges. The 1959 plan view drawing was tied into contour data of the county road and Union Pacific Railroad (UPRR) bridges, two prominent landmark features that are easily distinguishable in both data sets. Each end section of the bridge created four points of contact that allowed for positioning the 1959 data onto the 2019 LiDAR data (QSI 2019) with a high level of confidence. See Figure 4-1 below for the overlay of the drawing onto the 2019 LiDAR data (QSI 2019).

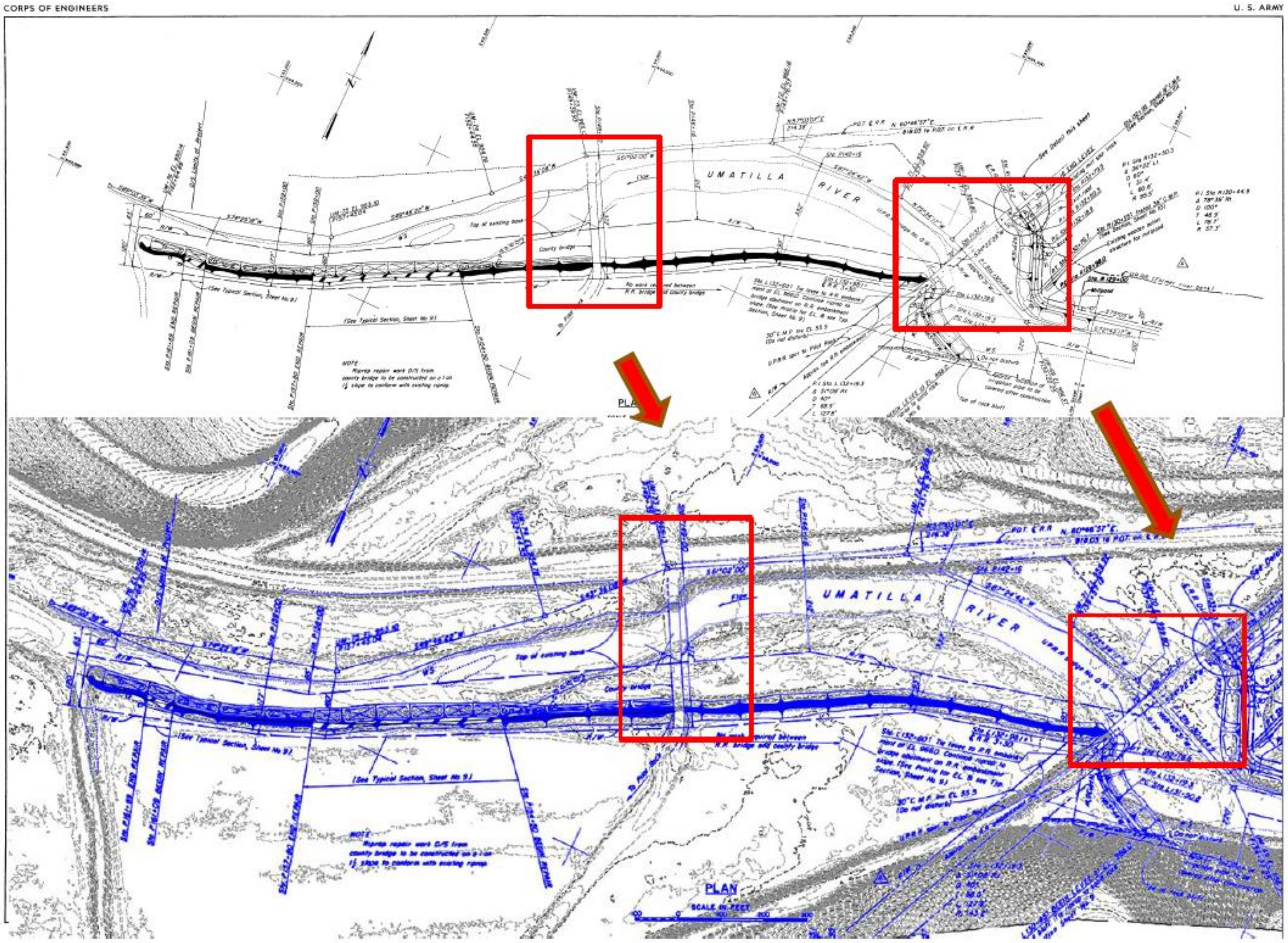


Figure 4-1. Pendleton 2a Levee 1959 Drawing (Top) Overlayed onto 2019 LiDAR Data (Bottom)

The 1959 constructed levee lines up well with the 2019 LiDAR data (QSI 2019) with one minor discrepancy where it appears that an access crossing was constructed sometime between the creation of the two datasets. See Figure 4-2 below for the overlay of the drawing onto the 2019 LiDAR data (QSI 2019) zoomed into the portion of the levee that will be modified by the proposed Project. The red arrows point to areas where the two data sets match well at the bridge ends and the toes of the slope on both the river and land sides of the levee. The red circle indicates the location of the access crossing.

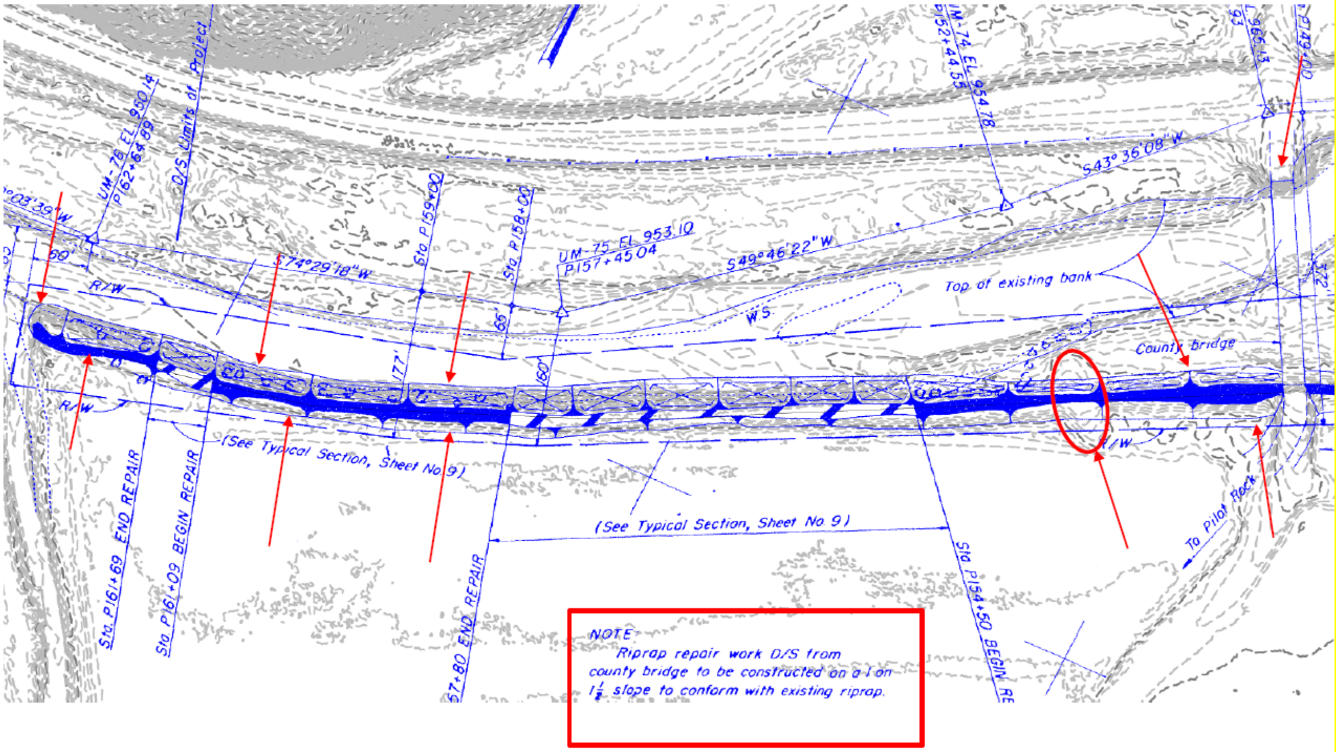


Figure 4-2. Zoomed-in scale of overlay onto 2019 LiDAR Data

4.2 Levee Elevation

In addition to the overlay of the two data sets, elevation information from the profiles in the 1959 drawings were extracted and converted to NAVD 88 for comparison to profile elevations from the 2019 LiDAR data (QSI 2019). Similar to the overlay exercise, Tetra Tech found that the elevations from the 1959 drawings aligned well with the elevations from the 2019 LiDAR data (QSI 2019). The 1959 elevations are based on Profile – L (shown in Figure 3-4) and were extracted from the far left and far right end of the profile at Station 162+00 and Station 154+00. The 2019 LiDAR data (QSI 2019) elevations are based on profiles extracted from the 2019 LiDAR data (QSI 2019) at locations that coincide with the 1959 profile locations. See Figure 4-3 below for the comparison of 1959 and the 2019 LiDAR data (QSI 2019) profile elevations.

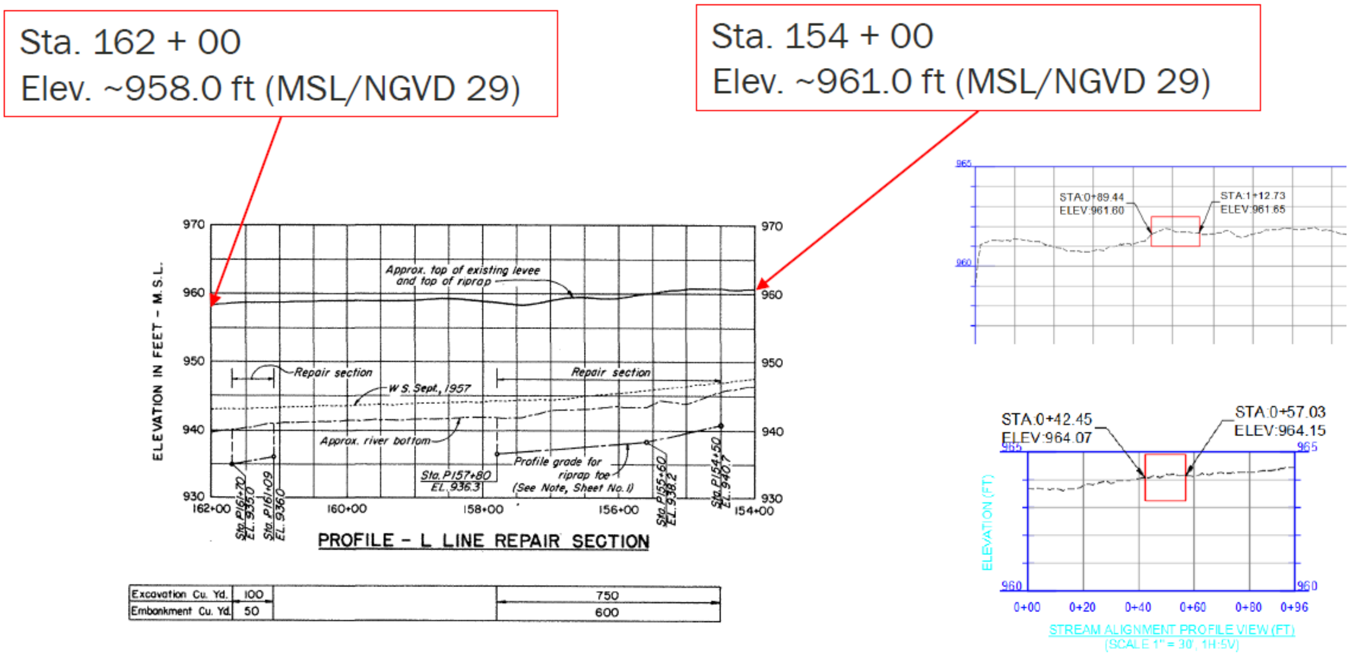


Figure 4-3. 1959 (Black Border) and 2019 (Blue Border) Profiles of Pendleton 2a Levee

In Figure 4-3, the 1959 profile is in black with callouts showing the approximate elevations in MSL. The 2019 LiDAR data (QSI 2019) profiles are shown in blue with callouts of the elevation in NAVD 88. The 1959 elevations were converted to NAVD 88 and compared to the 2019 LiDAR data (QSI 2019). The resulting difference at Station 162+00 is 0.4 feet, and at Station 154+00 is 0.2 feet. See Table 4-1 below for a summary of the 1959 and 2019 LiDAR data (QSI 2019) profiles elevation difference analysis.

Table 4-1. Comparison of 1959, 2019, and converted 1959 Profile elevations in feet

Station	MSL	+3.21-feet Conversion		Difference, feet
	1959	1959	2019 LiDAR Data	1959 vs 2019
162+00	958.0	961.21	961.6	0.4
154+00	961.0	964.21	964.1	0.2

The elevation difference between the 1959 and 2019 LiDAR data (QSI 2019) elevations is negligible and can be accounted for when considering standard tolerances in surveying methods, extracting elevations from a printed profile, 62 years of weathering on the surface of the levee, and occasional use of agricultural equipment on top of the levee. For the intent of this analysis, Tetra Tech concludes that the 2019 LiDAR data (QSI, 2019) coupled with the topobathymetric data (Section 3.1), is an accurate terrain model of the original (i.e., historic 1959 levee and revetment based on construction plan, profiles, and detail sheets provided by the USACE to Tetra Tech) design, and currently provides the original authorized protection.

4.2 Original Authorized Protection Flow

The 1959 drawings do not provide any associated hydrologic analysis, range of flows, or recurrence intervals normally associated with a flood protection design. The drawings do provide numerous cross sections labeled “Design W.S. 16,400 c.f.s.” While the acronyms W.S. and c.f.s. are not defined in the drawings, when considering the context of the labels in drawings and conventional use throughout flood control documentation, Tetra Tech assumes the full definition is “Design Water Surface 16,400 cubic-feet-per-second” and that 16,400 cubic feet per second (cfs) is the original design discharge for the Pendleton 2a Levee authorized protection. See Figure 4-4 for examples of the “design water surface [WS]” label in the drawings.

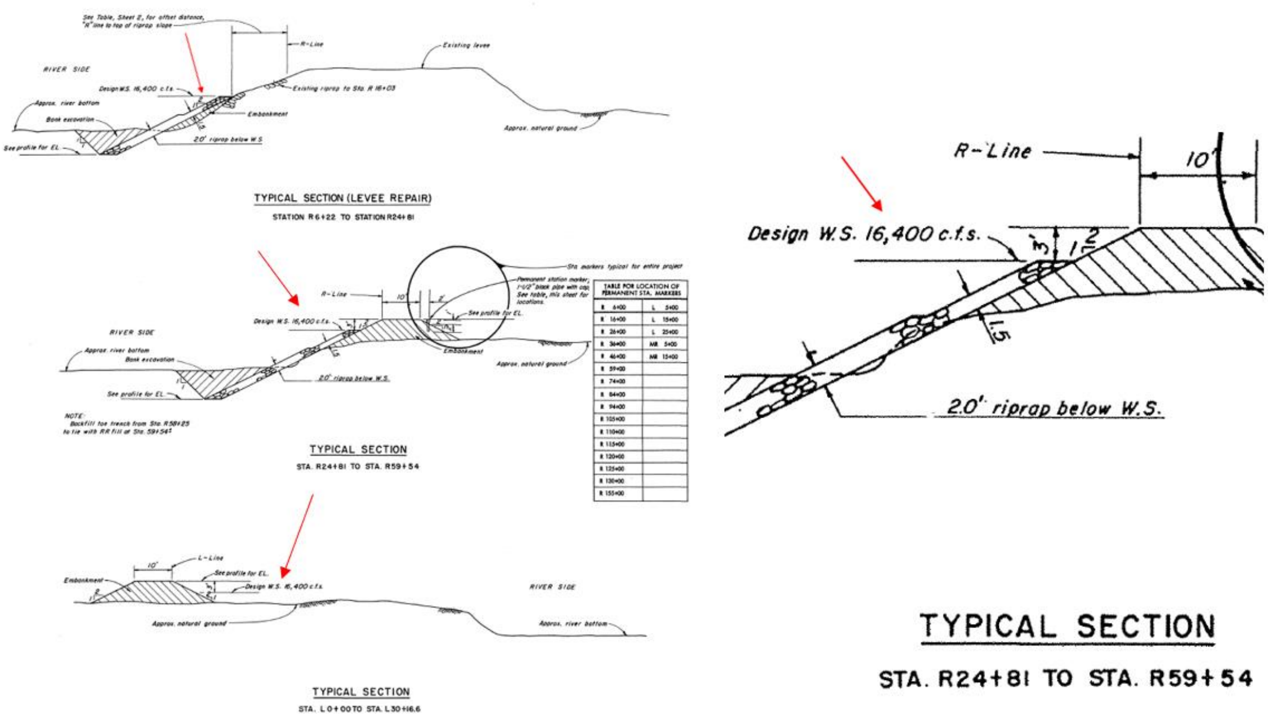


Figure 4-4. Example of “Design Water Surface” Labeled in the Cross Sections for the Pendleton 2a Levee

5. Conclusion

Based on the evaluation of available historic and current data, Tetra Tech concludes that the 2019 LiDAR data (QSI, 2019) coupled with the topobathymetric survey data (Section 3.1), is an accurate terrain model of the original (i.e., historic 1959 levee and revetment based on construction plan, profiles, and detail sheets provided by the USACE to Tetra Tech) design, and currently provides the original authorized protection. Furthermore, the 2019 LiDAR data (QSI, 2019) coupled with the topobathymetric survey data (Section 3.1) will be used in the subsequent Volumes 2 through 7 to demonstrate that the proposed Project will not impact the current Pendleton 2a Levee system from providing the current authorized protection and in support of the Project’s Section 408 process.

6. References

FEMA (Federal Emergency Management Agency). 2010. Flood Insurance Study – Umatilla County, Oregon and Incorporated Areas. Effective: September 3, 2010. Flood Insurance Rate Maps (FIRMs) panel 41059C1000G.

FEMA (Federal Emergency Management Agency). 2022. FEMA's National Food Hazard Layer (NFHL) Viewer. Available online at: https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd

National Geodetic Survey (NGS). 2022a. NOAA National Geodetic Survey, Datums and Reference frames. Available online at: https://www.ngs.noaa.gov/datums/vertical/national-geodetic-vertical-datum-1929.shtml.

NGS 2022b. NOAA National Geodetic Survey Data Explorer. Available online at: https://geodesy.noaa.gov/NGSDataExplorer/

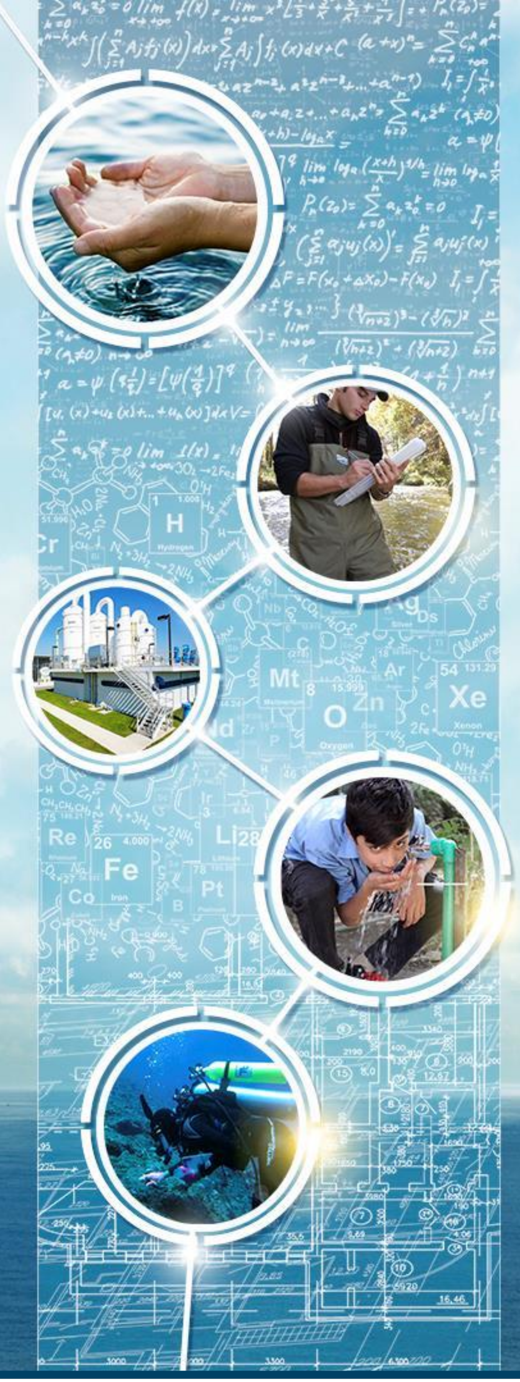
Quantum Spatial, Inc. (QSI). 2019. Aerial Light Detection and Ranging (LiDAR) Survey. Performed for Confederated Tribes of the Umatilla Indian Reservation UmaBirch In-Stream Design and Construction Oversight Project.

U.S. Army Corps of Engineers (USACE). 2022. National Levee Database. Available online at: https://levees.sec.usace.army.mil/#/levees/search/&viewType=map&resultsType=systems&advanced=true&hideList=false&eventSystem=false

7. Attachments

Attachment 1 – UmaBirch Pendleton 2a Levee Presentation
Attachment 2 – UmaBirch Pendleton 2a Levee Presentation Minutes
Attachment 3 – Pendleton 2a Levee National Levee Database
Attachment 4 – Pendleton 2a 1959 Construction Drawings

Attachment 1 – UmaBirch Pendleton 2a Levee Presentation



TETRA TECH

CAYUSE - WALLA WALLA - UMATILLA
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION
Treaty of 1855

UmaBirch Enhancement Design Project

Pendleton 2A Levee

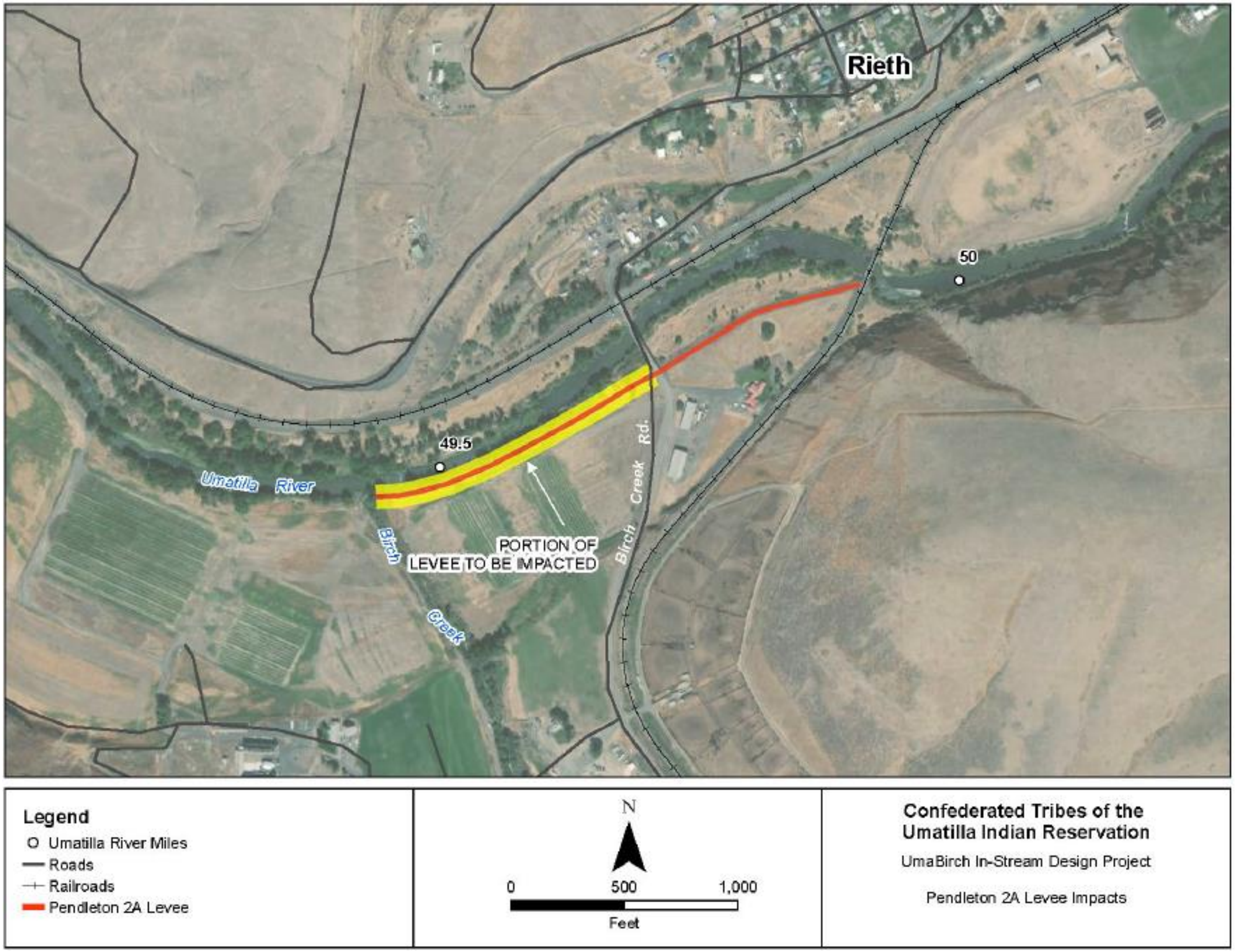
Existing Data Review and Levee “Reconstruction”

Overview

- Background
- Pendleton 2A Levee
  - Review of Existing Levee Documentation
  - Additional Levee Research
- Findings
- Next Steps

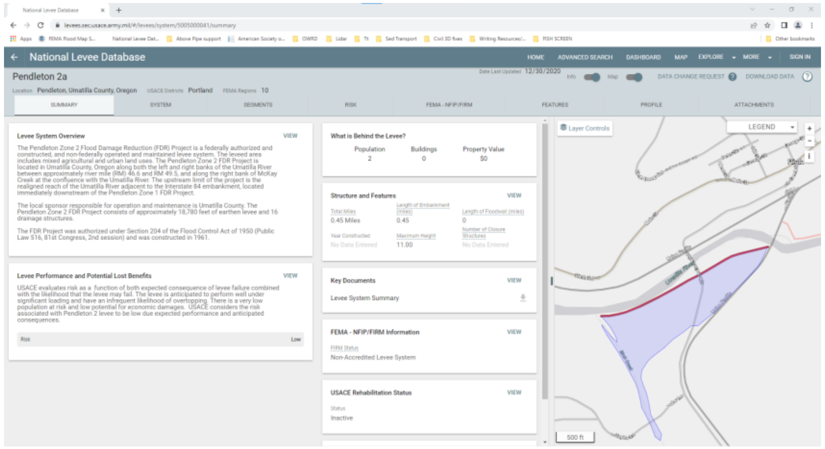
Background

Background Information - Location



Background Information - Levee

- Pendleton 2A Levee
  - Low Risk
  - Segment ID: 5004430001
  - Pendleton Zone 2 Flood Damage Reduction Project
  - Local sponsor: Umatilla County
  - Land ownership: (2) UmaBirch, LLC. & Unnamed
- Authorized under the 1936 Flood Control Act



Pendleton 2a

Location Pendleton, Umatilla County, Oregon USACE Districts Portland FEMA Regions 10

Date Last Updated 12/30/2020

Levee System Overview

The Pendleton Zone 2 Flood Damage Reduction (FDR) Project is a federally authorized and constructed, and non-federally operated and maintained levee system. The leveed area includes mixed agricultural and urban land uses. The Pendleton Zone 2 FDR Project is located in Umatilla County, Oregon along both the left and right banks of the Umatilla River between approximately river mile (RM) 46.6 and RM 49.5, and along the right bank of McKay Creek at the confluence with the Umatilla River. The upstream limit of the project is the realigned reach of the Umatilla River adjacent to the Interstate 84 embankment, located immediately downstream of the Pendleton Zone 1 FDR Project.

The local sponsor responsible for operation and maintenance is Umatilla County. The Pendleton Zone 2 FDR Project consists of approximately 18,780 feet of earthen levee and 16 drainage structures.

The FDR Project was authorized under Section 204 of the Flood Control Act of 1950 (Public Law 516, 81st Congress, 2nd session) and was constructed in 1961.

Levee Performance and Potential Lost Benefits

USACE evaluates risk as a function of both expected consequence of levee failure combined with the likelihood that the levee may fail. The levee is anticipated to perform well under significant loading and have an infrequent likelihood of overtopping. There is a very low population at risk and low potential for economic damages. USACE considers the risk associated with Pendleton 2 levee to be low due expected performance and anticipated consequences.

Risk Low

What is Behind the Levee?

Population	Buildings	Property Value
2	0	$0

Structure and Features

Total Miles	Length of Embankment (miles)	Length of Floodwall (miles)
0.45 Miles	0.45	0
Year Constructed	Maximum Height	Number of Closure Structures
No Data Entered	11.00	No Data Entered

Key Documents

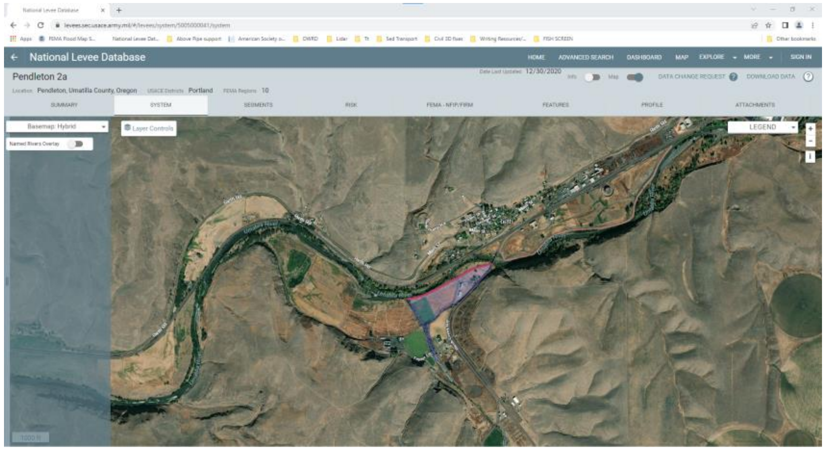
Levee System Summary

FEMA - NFIP/FIRM Information

FIRM Status
Non-Accredited Levee System

USACE Rehabilitation Status

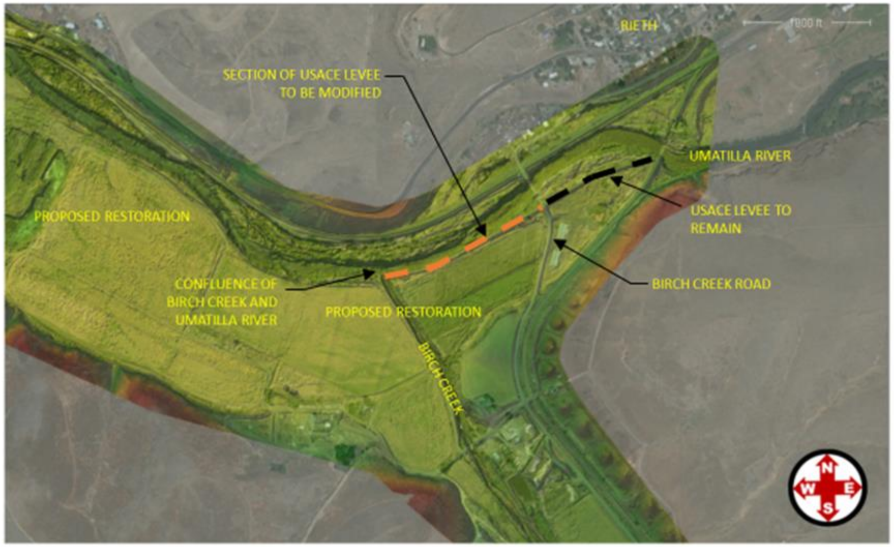
Status
Inactive

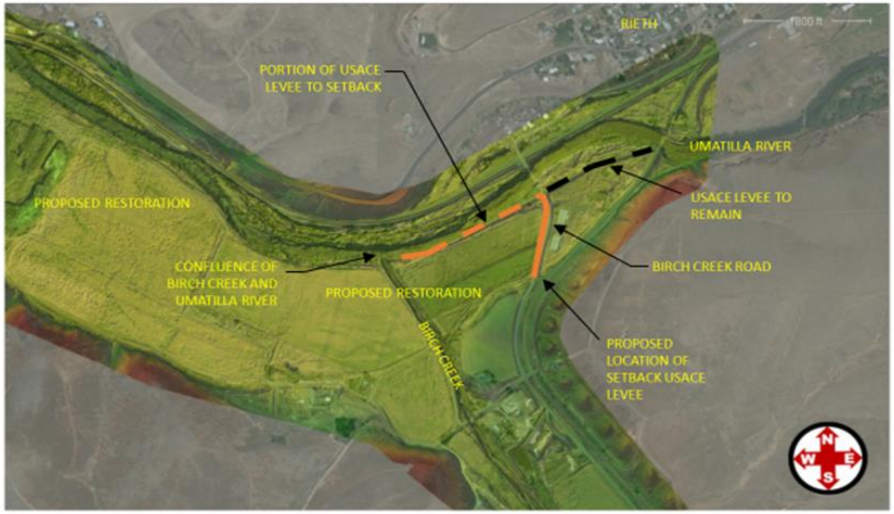


Background Information - Purpose

- As a part of the Umabirch Instream Design, Tetra Tech is proposing to modify the existing Pendleton 2A levee.

- Review and summarize available information and data on the construction of the Pendleton 2A levee to determine the authorized function.





TETRA TECH

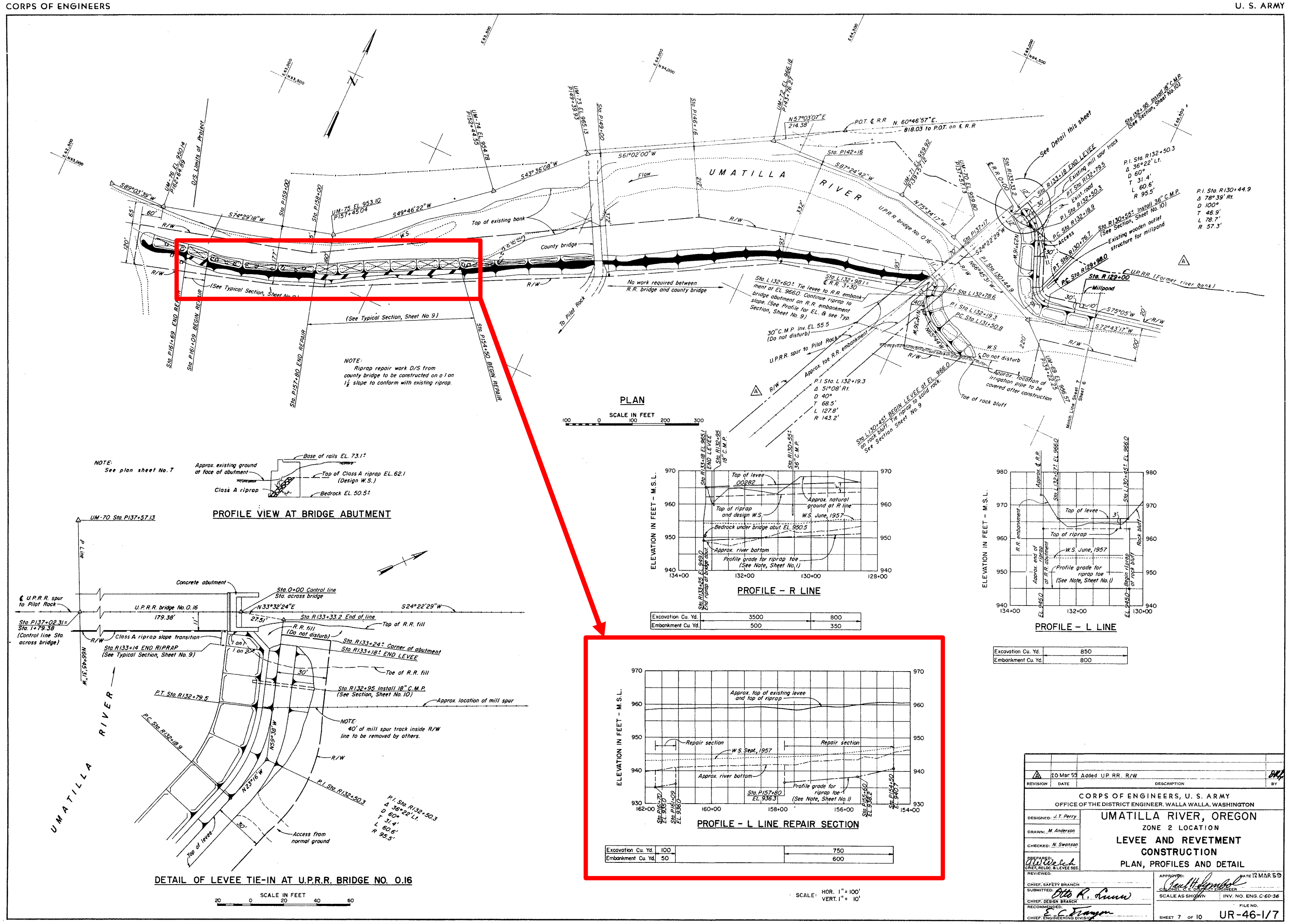
Available Data Review

Review of Data

- The following documentation was provided for review:
    - 1959 Levee & Revetment Construction Plan, Profiles, and Detail
    - 1959 easement deed with USACE Levee and Revetment Construction Plan and Profile drawings

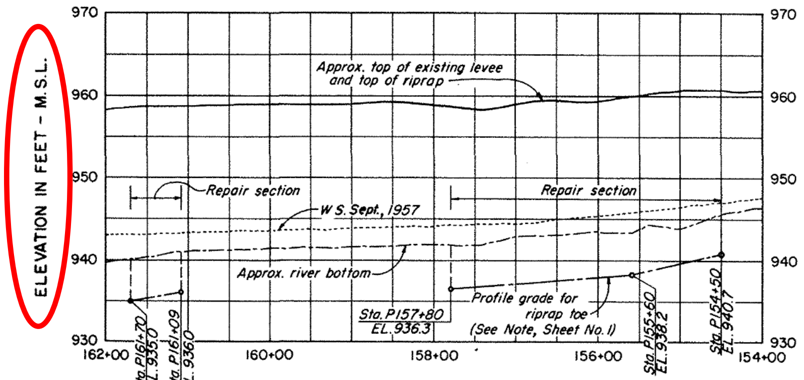
- Additional review:
    - NOAA National Geodetic Survey benchmark data
    - Historical vertical datum information

1959 Levee & Revetment Construction Plan, Profiles, and Detail



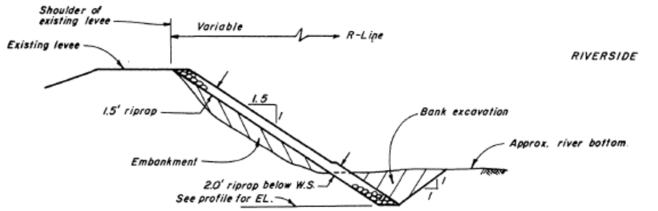
1959 Levee & Revetment Construction Plan, Profiles, and Detail (Continued)

- Full set of drawings provided
- Clear elevation data provided on profiles and typical cross sections with no elevations
- Vertical datum listed as “M.S.L.”
- From here, determined appropriate conversion for comparison to 2021 LiDAR (NAVD 88)



PROFILE – L LINE REPAIR SECTION

Excavation Cu. Yd.	100		750
Embankment Cu. Yd.	50		600

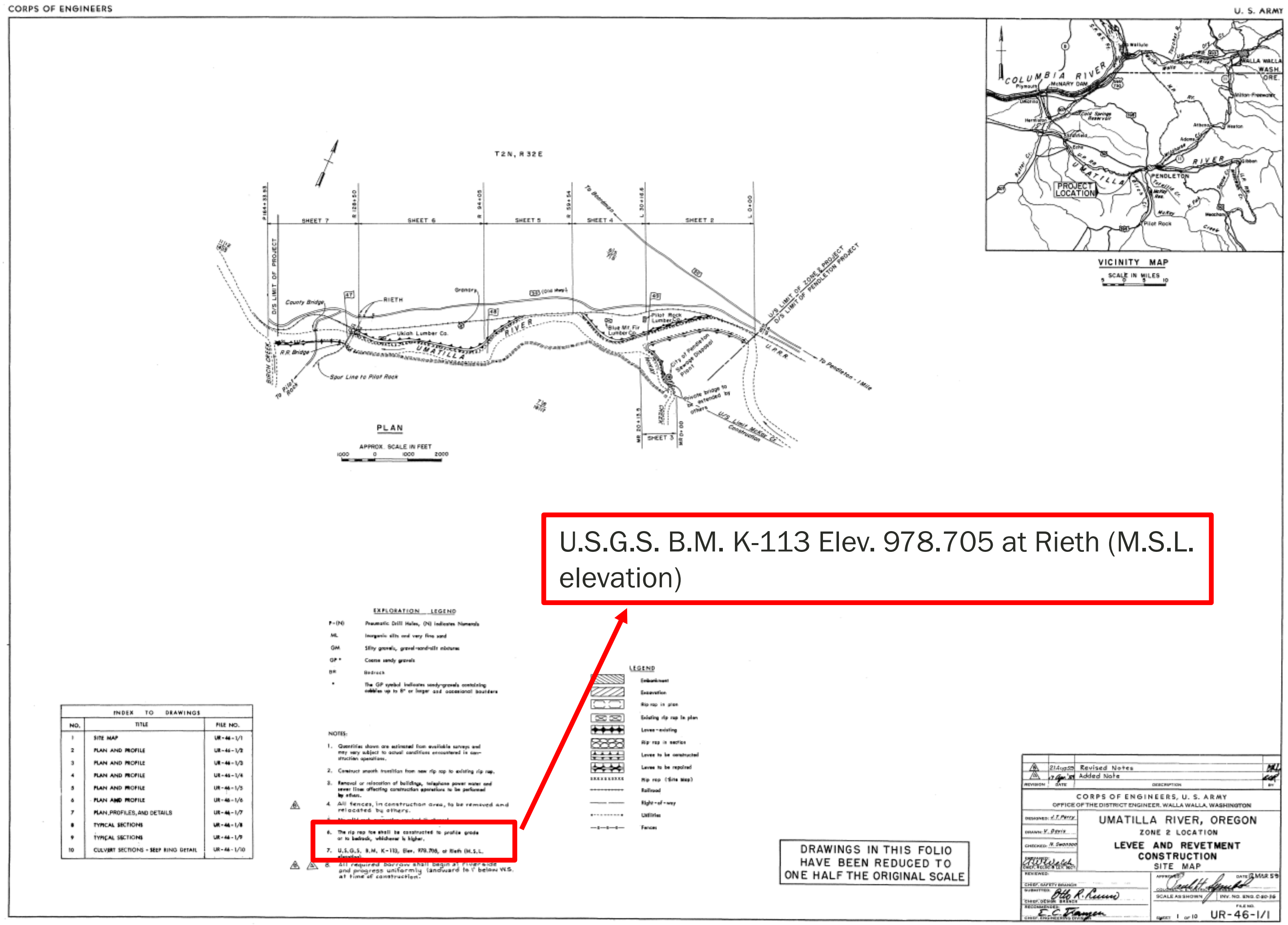


TYPICAL SECTION – (REPAIR EXISTING REVETTED LEVEE)

STA. P 154 + 50 TO STA. P 157 + 80
STA. P 161 + 09 TO STA. P 161 + 69

NOTE:
Place 12" gravel blanket under riprap where fine grained foundation materials are encountered.

1959 Easement Deed with Drawings – Datum Conversion



U.S.G.S. B.M. K-113 Elev. 978.705 at Rieth (M.S.L. elevation)

EXPLORATION LEGEND

P-(N)	Pneumatic Drill Holes, (N) indicates Numerals
ML	Inorganic silts and very fine sand
GM	Silty gravels, gravel-sand-silt mixtures
GP *	Coarse sandy gravels
BR	Bedrock
*	The GP symbol indicates sandy-gravels containing cobbles up to 8" or larger and occasional boulders

NOTES:

1. Quantities shown are estimated from available surveys and may vary subject to actual conditions encountered in construction operations.
2. Construct smooth transition from new rip rap to existing rip rap.
3. Removal or relocation of buildings, telephone power water and sewer lines affecting construction operations to be performed by others.
4. All fences, in construction area, to be removed and relocated by others.
5. [illegible]
6. The rip rap toe shall be constructed to profile grade or to bedrock, whichever is higher.
7. U.S.G.S. B.M. K-113, Elev. 978.705, at Rieth (M.S.L. elevation).
8. All required borrow shall begin at riverside and progress uniformly landward to 1' below W.S. at time of construction.

INDEX TO DRAWINGS

NO.	TITLE	FILE NO.
1	SITE MAP	UR-46-1/1
2	PLAN AND PROFILE	UR-46-1/2
3	PLAN AND PROFILE	UR-46-1/3
4	PLAN AND PROFILE	UR-46-1/4
5	PLAN AND PROFILE	UR-46-1/5
6	PLAN AND PROFILE	UR-46-1/6
7	PLAN, PROFILES, AND DETAILS	UR-46-1/7
8	TYPICAL SECTIONS	UR-46-1/8
9	TYPICAL SECTIONS	UR-46-1/9
10	CULVERT SECTIONS - SEEP RING DETAIL	UR-46-1/10

LEGEND

▧	Embankment
▨	Excavation
	Rip rap in plan
	Existing rip rap in plan
	Levee - existing
	Rip rap in section
	Levee to be constructed
	Levee to be repaired
xxxxxxxxxx	Rip rap (Site Map)
	Railroad
	Right-of-way
	Utilities
—o—o—o—	Fences

REVISION	DATE	DESCRIPTION	BY
B	21 Aug 59	Revised Notes	
A	7 Apr '59	Added Note	

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, WALLA WALLA, WASHINGTON

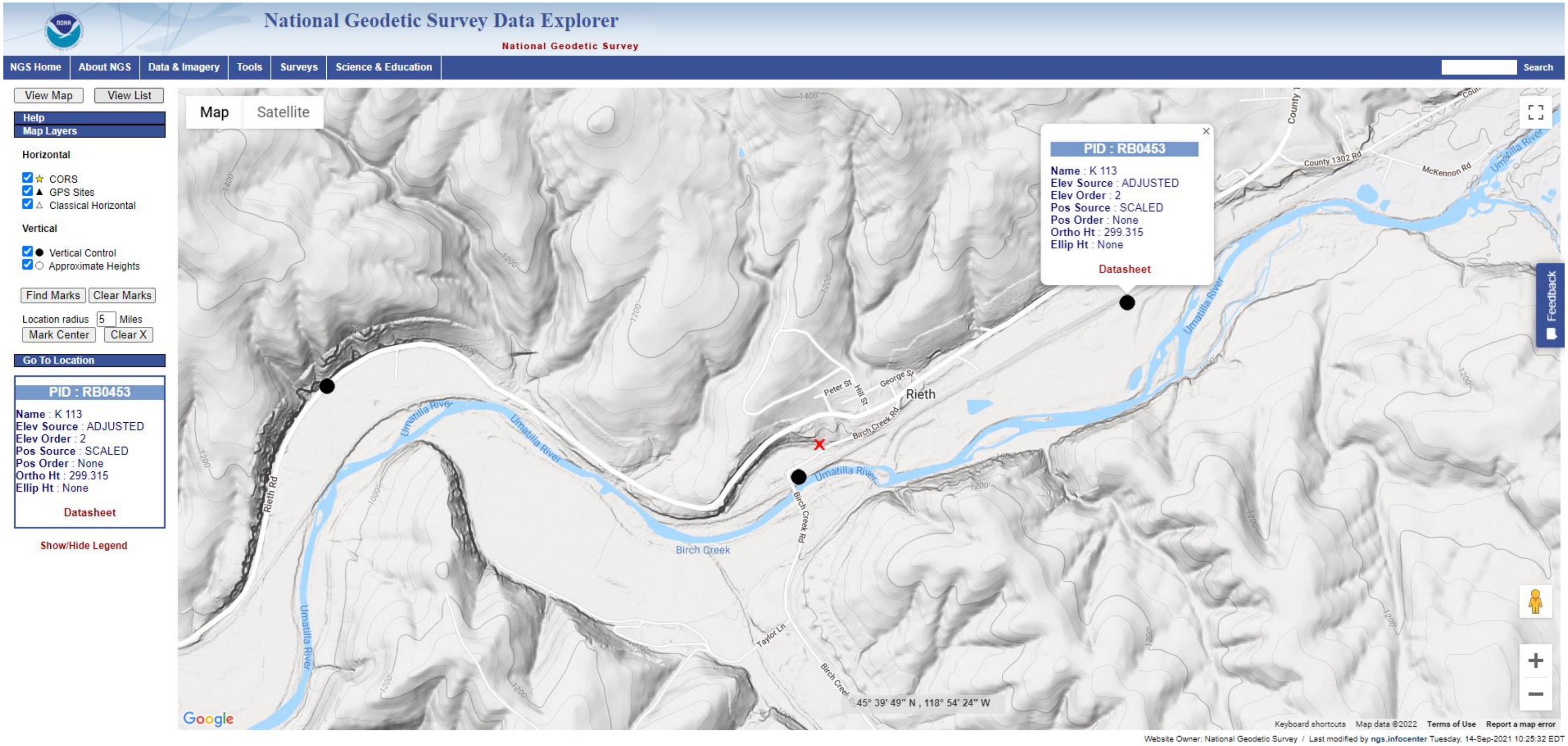
DESIGNED: J. T. Perry
DRAWN: V. Davis
CHECKED: N. Swanson
PREPARED: [illegible] Welch
CHIEF, RELOC. & SEC. SECT.

UMATILLA RIVER, OREGON
ZONE 2 LOCATION
LEVEE AND REVETMENT CONSTRUCTION
SITE MAP

REVIEWED:
CHIEF, SAFETY BRANCH
SUBMITTED: Otto R. Reuss
CHIEF, DESIGN BRANCH
RECOMMENDED: E. C. Flanagan
CHIEF, ENGINEERING DIVISION
APPROVED: Paul H. [illegible]
COLONEL, C. E. DISTRICT ENGINEER
DATE 2 MAR 59
SCALE AS SHOWN
INV. NO. ENG. C-80-36
SHEET 1 OF 10
FILE NO. UR-46-1/1

NOAA National Geodetic Survey Database – Datum Conversion (Continued)

- Located Benchmark K-113 (PID RB0453)



National Geodetic Survey Data Explorer

National Geodetic Survey

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View Map | View List

Help

Map Layers

Horizontal

☑ ☆ CORS
☑ ▲ GPS Sites
☑ △ Classical Horizontal

Vertical

☑ ● Vertical Control
☑ ○ Approximate Heights

Find Marks | Clear Marks

Location radius 5 Miles

Mark Center | Clear X

Go To Location

PID : RB0453

Name : K 113
Elev Source : ADJUSTED
Elev Order : 2
Pos Source : SCALED
Pos Order : None
Ortho Ht : 299.315
Ellip Ht : None

Datasheet

Show/Hide Legend

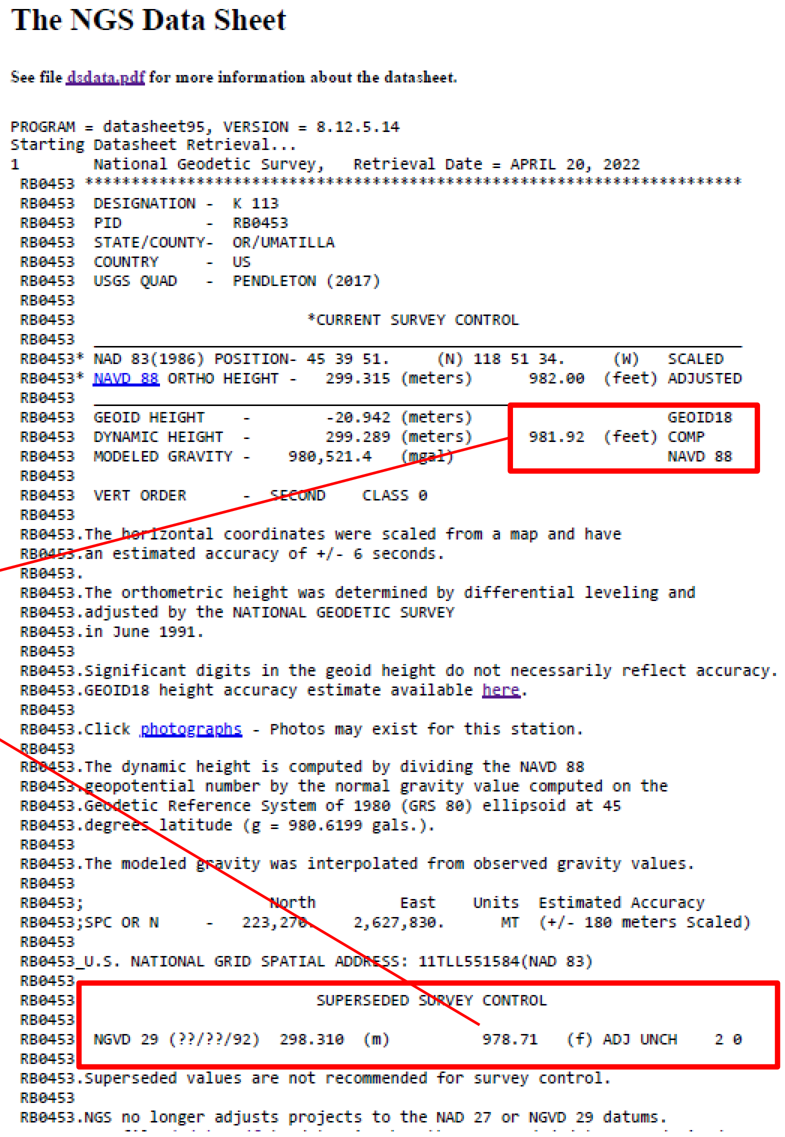
Website Owner: National Geodetic Survey / Last modified by ngs.infocenter Tuesday, 14-Sep-2021 10:25:32 EDT

NOAA National Geodetic Survey Database – Datum Conversion (Continued)

- Fits into known levee timeframe:

```
DESCRIBED BY US GEOLOGICAL SURVEY 1965
IN REITH.
AT RIETH, UMATILLA COUNTY, ON THE UNION PACIFIC RAILROAD, 215 FEET
WEST OF THE WEST END OF THE FOUNDATION OF THE OLD STATION, 50.4 FEET
SOUTH OF THE CENTERLINE OF THE MAIN TRACK, AT THE NORTH EDGE OF A
TRACK ROAD, A STANDARD DISK STAMPED K 113 1934 AND SET IN THE TOP OF A
CONCRETE POST.  NOTE-- IN PLACE BUT TIPPED SLIGHTLY.
```

- From NGS Data Sheet:
    - NAVD 88 Elev: 981.92 ft
    - NGVD 29 Elev: 978.71 ft
        - 1959 drawing listed as 978.705 ft MSL
- Adjustment of 3.21 ft (981.92 ft – 978.71 ft)



The NGS Data Sheet

See file dsdata.pdf for more information about the datasheet.

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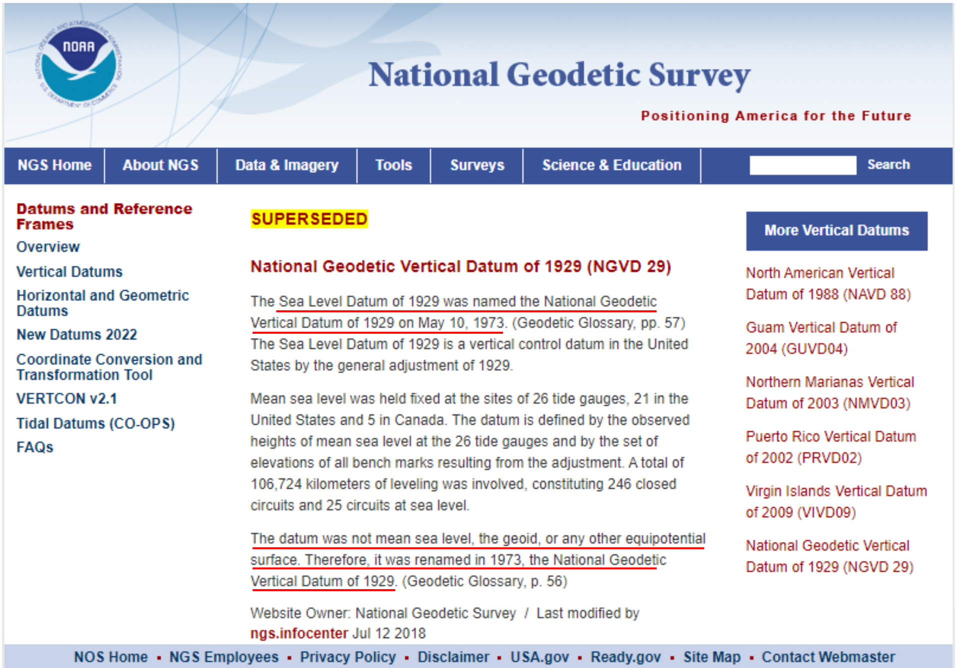
PROGRAM = datasheet95, VERSION = 8.12.5.14
Starting Datasheet Retrieval...
1        National Geodetic Survey,   Retrieval Date = APRIL 20, 2022
 RB0453 ***********************************************************************
 RB0453  DESIGNATION -  K 113
 RB0453  PID         -  RB0453
 RB0453  STATE/COUNTY-  OR/UMATILLA
 RB0453  COUNTRY     -  US
 RB0453  USGS QUAD   -  PENDLETON (2017)
 RB0453
 RB0453                        *CURRENT SURVEY CONTROL
 RB0453  ______________________________________________________________________
 RB0453* NAD 83(1986) POSITION- 45 39 51.     (N) 118 51 34.     (W)   SCALED
 RB0453* NAVD 88 ORTHO HEIGHT -   299.315 (meters)      982.00  (feet) ADJUSTED
 RB0453  ______________________________________________________________________
 RB0453  GEOID HEIGHT    -         -20.942 (meters)                    GEOID18
 RB0453  DYNAMIC HEIGHT  -         299.289 (meters)     981.92  (feet) COMP
 RB0453  MODELED GRAVITY -    980,521.4    (mgal)                      NAVD 88
 RB0453
 RB0453  VERT ORDER      -  SECOND    CLASS 0
 RB0453
 RB0453.The horizontal coordinates were scaled from a map and have
 RB0453.an estimated accuracy of +/- 6 seconds.
 RB0453.
 RB0453.The orthometric height was determined by differential leveling and
 RB0453.adjusted by the NATIONAL GEODETIC SURVEY
 RB0453.in June 1991.
 RB0453
 RB0453.Significant digits in the geoid height do not necessarily reflect accuracy.
 RB0453.GEOID18 height accuracy estimate available here.
 RB0453
 RB0453.Click photographs - Photos may exist for this station.
 RB0453
 RB0453.The dynamic height is computed by dividing the NAVD 88
 RB0453.geopotential number by the normal gravity value computed on the
 RB0453.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 RB0453.degrees latitude (g = 980.6199 gals.).
 RB0453
 RB0453.The modeled gravity was interpolated from observed gravity values.
 RB0453
 RB0453;                   North         East     Units  Estimated Accuracy
 RB0453;SPC OR N     -   223,270.     2,627,830.     MT  (+/- 180 meters Scaled)
 RB0453
 RB0453_U.S. NATIONAL GRID SPATIAL ADDRESS: 11TLL551584(NAD 83)
 RB0453
 RB0453                         SUPERSEDED SURVEY CONTROL
 RB0453
 RB0453  NGVD 29 (??/??/92)  298.310  (m)          978.71   (f) ADJ UNCH    2 0
 RB0453
 RB0453.Superseded values are not recommended for survey control.
 RB0453
 RB0453.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
```

Historical Vertical Datum Information – Datum Conversion (Continued)

- Confirmed that M.S.L. elevations on the 1959 USACE levee drawings were in the NGVD 29 vertical datum



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Datums and Reference Frames

Overview

Vertical Datums

Horizontal and Geometric Datums

New Datums 2022

Coordinate Conversion and Transformation Tool

VERTCON v2.1

Tidal Datums (CO-OPS)

FAQs

SUPERSEDED

National Geodetic Vertical Datum of 1929 (NGVD 29)

The Sea Level Datum of 1929 was named the National Geodetic Vertical Datum of 1929 on May 10, 1973. (Geodetic Glossary, pp. 57) The Sea Level Datum of 1929 is a vertical control datum in the United States by the general adjustment of 1929.

Mean sea level was held fixed at the sites of 26 tide gauges, 21 in the United States and 5 in Canada. The datum is defined by the observed heights of mean sea level at the 26 tide gauges and by the set of elevations of all bench marks resulting from the adjustment. A total of 106,724 kilometers of leveling was involved, constituting 246 closed circuits and 25 circuits at sea level.

The datum was not mean sea level, the geoid, or any other equipotential surface. Therefore, it was renamed in 1973, the National Geodetic Vertical Datum of 1929. (Geodetic Glossary, p. 56)

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More Vertical Datums

North American Vertical Datum of 1988 (NAVD 88)

Guam Vertical Datum of 2004 (GUVD04)

Northern Marianas Vertical Datum of 2003 (NMVD03)

Puerto Rico Vertical Datum of 2002 (PRVD02)

Virgin Islands Vertical Datum of 2009 (VIVD09)

National Geodetic Vertical Datum of 1929 (NGVD 29)

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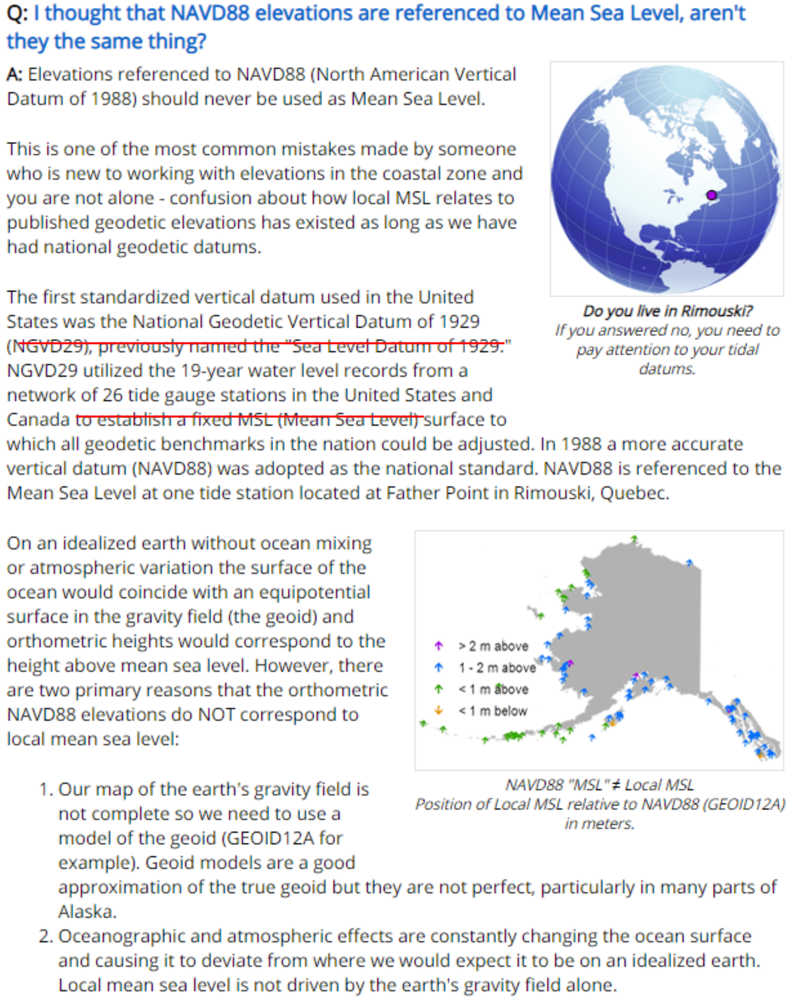


Q: I thought that NAVD88 elevations are referenced to Mean Sea Level, aren't they the same thing?

A: Elevations referenced to NAVD88 (North American Vertical Datum of 1988) should never be used as Mean Sea Level.

This is one of the most common mistakes made by someone who is new to working with elevations in the coastal zone and you are not alone - confusion about how local MSL relates to published geodetic elevations has existed as long as we have had national geodetic datums.

The first standardized vertical datum used in the United States was the National Geodetic Vertical Datum of 1929 (~~NGVD29), previously named the "Sea Level Datum of 1929.~~" NGVD29 utilized the 19-year water level records from a network of 26 tide gauge stations in the United States and Canada ~~to establish a fixed MSL (Mean Sea Level)~~ surface to which all geodetic benchmarks in the nation could be adjusted. In 1988 a more accurate vertical datum (NAVD88) was adopted as the national standard. NAVD88 is referenced to the Mean Sea Level at one tide station located at Father Point in Rimouski, Quebec.

Do you live in Rimouski?
If you answered no, you need to pay attention to your tidal datums.

On an idealized earth without ocean mixing or atmospheric variation the surface of the ocean would coincide with an equipotential surface in the gravity field (the geoid) and orthometric heights would correspond to the height above mean sea level. However, there are two primary reasons that the orthometric NAVD88 elevations do NOT correspond to local mean sea level:

1. Our map of the earth's gravity field is not complete so we need to use a model of the geoid (GEOID12A for example). Geoid models are a good approximation of the true geoid but they are not perfect, particularly in many parts of Alaska.
2. Oceanographic and atmospheric effects are constantly changing the ocean surface and causing it to deviate from where we would expect it to be on an idealized earth. Local mean sea level is not driven by the earth's gravity field alone.

NAVD88 "MSL" ≠ Local MSL
Position of Local MSL relative to NAVD88 (GEOID12A) in meters.

Source (top): Alaska Tidal Datum Portal – FAQs (https://dggs.alaska.gov/hazards/coastal/ak-tidal-datum-faq.html)
(left): NOAA National Geodetic Survey

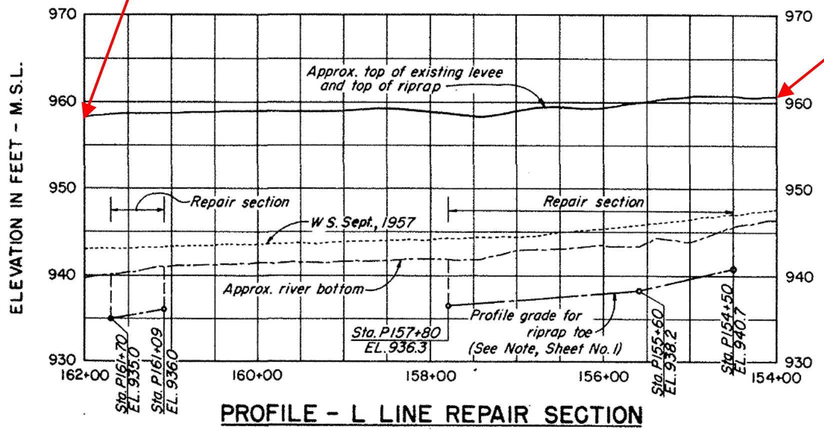
Findings

Confirmed 1959 Elevations in NAVD 88

TETRA TECH

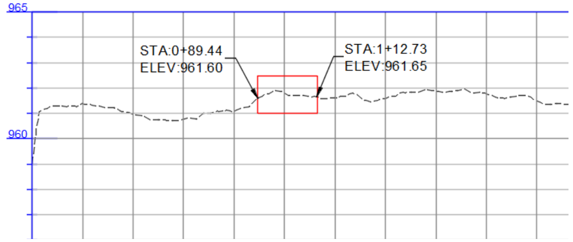
Sta. 162 + 00
Elev. ~958.0 ft (MSL/NGVD 29)

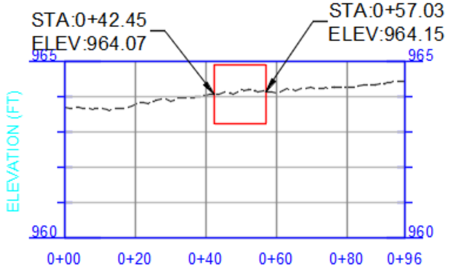
Sta. 154 + 00
Elev. ~961.0 ft (MSL/NGVD 29)



PROFILE - L LINE REPAIR SECTION

Excavation Cu. Yd.	100		750
Embankment Cu. Yd.	50		600

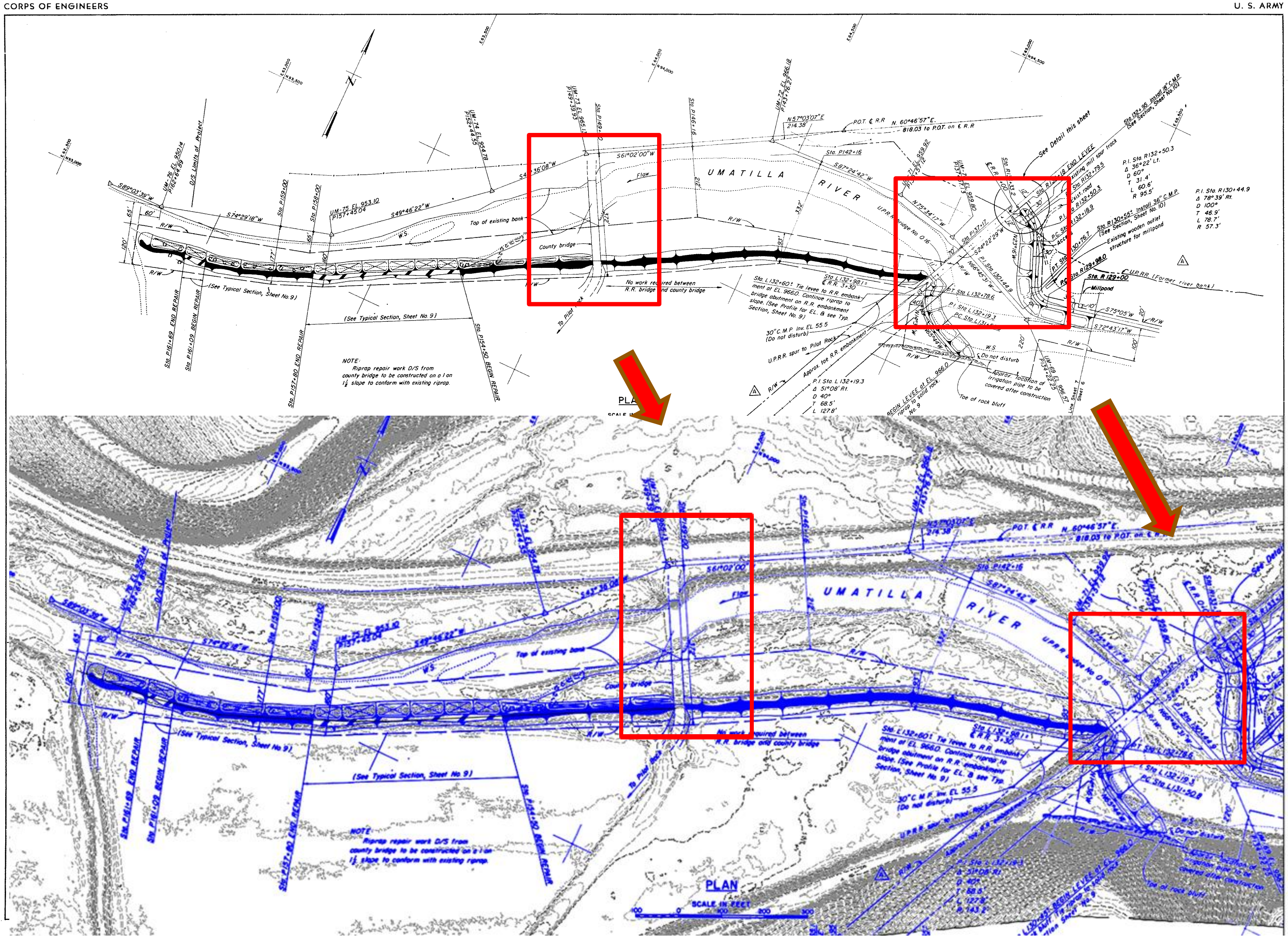




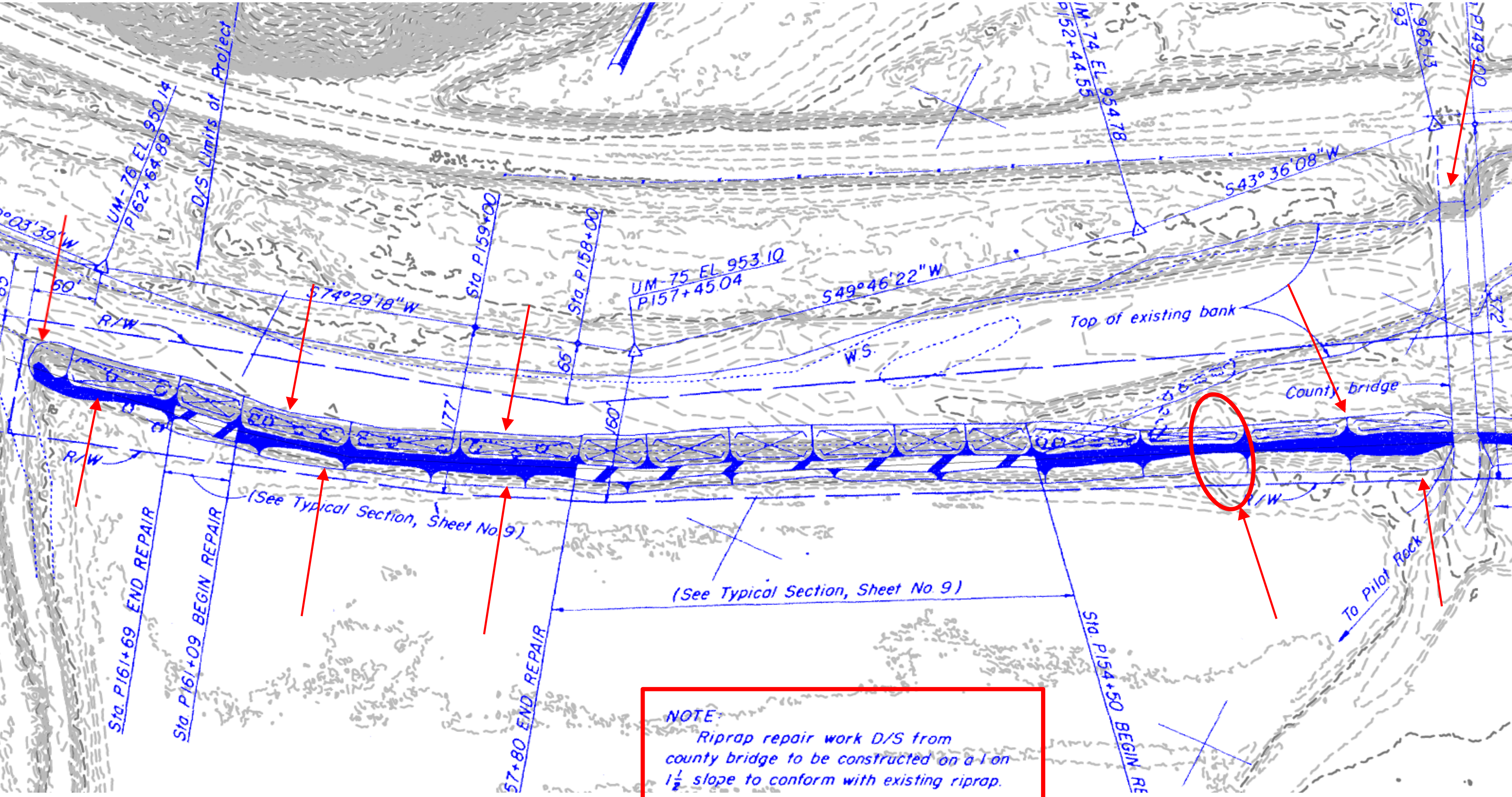
STREAM ALIGNMENT PROFILE VIEW (FT)
(SCALE 1" = 30', 1H:5V)

USACE 1959 Sta.	Elev. MSL/NGVD, ft (USACE 1959)	+3.21' Conversion to NAVD 88, ft	Elev. NAVD 88, ft (2021 LiDAR)
162+00	958.0	961.21	961.6
154+00	961.0	964.21	964.1

Confirmed 1959 Levee Layout, Profile, and Detail

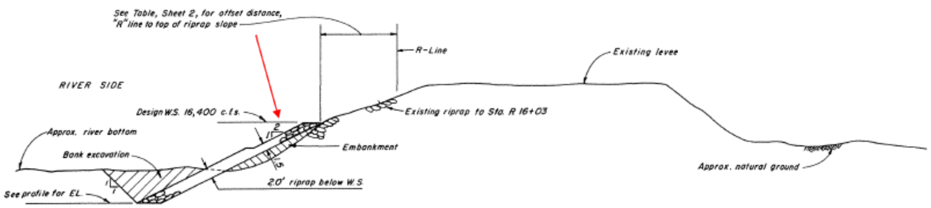


Confirmed 1959 Levee Layout, Profile, and Detail (Continued)



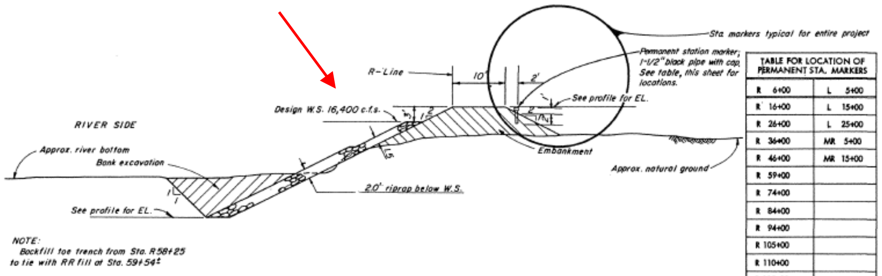
NOTE:
Riprap repair work D/S from county bridge to be constructed on a 1 on $1\frac{1}{2}$ slope to conform with existing riprap.

Confirmed 1959 Levee Layout, Profile, and Detail (Continued)



TYPICAL SECTION (LEVEE REPAIR)

STATION R6+22 TO STATION R24+81

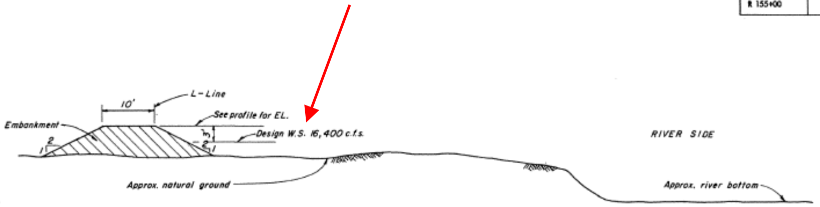


NOTE:
Backfill toe trench from Sta. R58+25
to tie with RR fill at Sta. 59+54±

TABLE FOR LOCATION OF PERMANENT STA. MARKERS	
R 6+00	L 5+00
R 16+00	L 15+00
R 26+00	L 25+00
R 36+00	MR 5+00
R 46+00	MR 15+00
R 59+00	
R 74+00	
R 84+00	
R 94+00	
R 105+00	
R 110+00	
R 115+00	
R 120+00	
R 125+00	
R 130+00	
R 155+00	

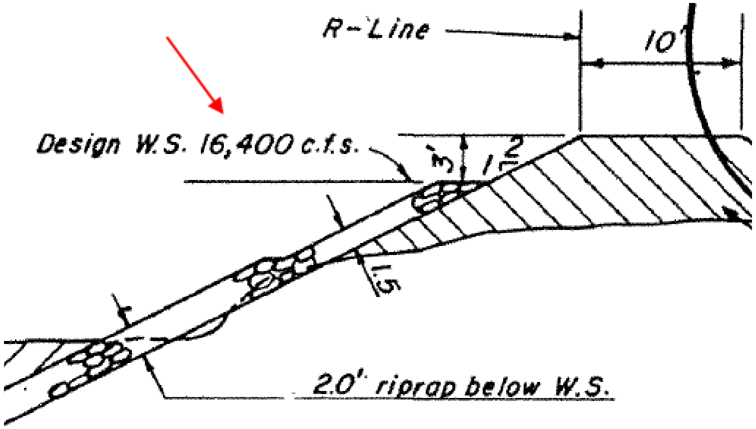
TYPICAL SECTION

STA. R24+81 TO STA. R59+54



TYPICAL SECTION

STA. L0+00 TO STA. L30+16.6



TYPICAL SECTION

STA. R24+81 TO STA. R59+54

Conclusions

- ✓ M.S.L. elevation is NGVD 29; Elevations adjusted by +3.21 ft for comparison to 2021 LiDAR data for levee in NAVD 88
- ✓ 1959 layout is to scale and compares very well to 2021 LiDAR data
- ✓ Repair drawings show interior riverside face and intent to “match” original riprap face and function
- ✓ Upstream design water surface elevation at 16,400 cfs
- ✓ Comparison to the 1959 layout confirmed that the current configuration matches the authorized function

TETRA TECH

Concurrence Request

Concurrence Request

- Use the current conditions as it matches the 1959 levee design function

- Use upstream water surface based on authorized flood at 16,400 cfs

TETRA TECH

Next Steps

Next Steps

- USACE – provide concurrence on authorized design function

- Tetra Tech – following concurrence, advance:
  - Hydrologic and Hydraulic Analyses
  - Interior Drainage Analysis
  - Setback Levee Design and Analysis
  - Safety Assurance Review (if requested by USACE)
  - Operation and Maintenance Plan
  - Risk Assessment

Attachment 2 – UmaBirch Pendleton 2a Levee Presentation Minutes

UmaBirch Levee Reconstruction Meeting Notes

Thursday 5/19/2022 – 10:00am to 11:30am

1. ATTENDEES

Name	Organization	Email
Sally Bird-Gauvin	USACE	Sally.A.Bird-Gauvin@usace.army.mil
Shane Cline	USACE	Shane.K.Cline@usace.army.mil
Danielle Erb	USACE	Danielle.H.Erb@usace.army.mil
Ben O'Connor	USACE	
Paul Schmidt	USACE	Paul.A.Schmidt@usace.army.mil
Terrina Smith	USACE	Terrina.L.Smith@usace.army.mil
Caroline Williams	USACE	Caroline.A.Williams@usace.army.mil
Tim Ludington	BPA	tsludington@bpa.gov
Doug Knapp	BPA	ddknapp@bpa.gov
Mike Lambert	CTUIR	MikeLambert@ctuir.org
Jude Love	CTUIR	judelove@ctuir.org
Rebecca Schwartz	CTUIR	RebeccaSchwartz@ctuir.org
Chris James	Tetra Tech	chris.james@tetratech.com
Jonathan Thompson	Tetra Tech	jonathan.thompson@tetratech.com
Jeremy Andrews	Tetra Tech	Jeremy.andrews@tetratech.com
Alexa Deep	Tetra Tech	alexa.deep@tetratech.com

2. MEETING NOTES

Meeting Objective

- Present an update on the Pendleton 2A levee reconstruction task.
- Follow up to December 2021 meeting regarding levee (meetings notes provided)

Levee Reconstruction Presentation

- Tetra Tech presented a PowerPoint presentation summarizing the information gathered and reviewed on the 2A levee, as well as the findings regarding reconstruction
- Background
    - Pendleton 2A levee located at confluence of Umatilla River and Birch Creek, just downstream of Pendleton, OR
    - Starts at the Union Pacific railroad, continues west over Birch Creek Road, and terminates at Birch Creek
    - Project impacts are proposed to the portion of the levee between Birch Creek Road and Birch Creek
    - Local sponsor: Umatilla County
    - Landowners: UmaBirch, LLC and unnamed private landowner
    - Section 408 request: modification of levee proposed as part of UmaBirch Instream Design Project
- Documents and information reviewed:
    - 1959 Levee & Revetment Construction Plan, Profiles, and Detail
    - 1959 easement deed with USACE Levee and Revetment Construction Plan and Profile drawings
    - NOAA National Geodetic Survey (NGS) benchmark data
    - Historical vertical datum information
- Findings:
    - 1959 documents on levee construction showed elevations in mean sea level (MSL) and contained a benchmark (USGS BM K-113) with a known elevation that was matched to NOAA NGS benchmark data
    - Historical vertical datum investigation showed that MSL was the same as NGVD 29, and that the name was changed to NGVD 29 in the 1970s to avoid confusion with actual mean sea level
    - NOAA NGS contained benchmark elevation in both NGVD 29 and NAVD 88, so elevations were adjusted based on the difference between the two (+3.21 ft) for comparison to the 2021 LiDAR data which is in NAVD 88
    - 1959 levee construction layout was to scale and compares well to LiDAR
    - Repair drawings show interior riverside face and intent to “match” original riprap face and function
    - Upstream design water surface elevation at 16,400 cfs

  - Comparison to the 1959 layout confirmed that the current configuration matches the authorized function
- Next steps:
  - Based on concurrence on authorized design function, Tetra Tech to advance:
    - Hydrologic and hydraulic analyses
    - Interior drainage analyses
    - Setback levee design and analyses
    - Safety assurance review (if requested)
    - Operations and maintenance plan
    - Risk assessment

Discussion

- Project intent
  - Turn property into conservation easement and reinstate floodplain connection
  - Landowner is okay with modifying or removing a portion of the levee so long as home remains protected
  - Project has been discussed with both the County and landowner who will remain informed throughout the process
    - Letters of support received from both City of Pendleton and Umatilla County
- Original levee purpose
  - Likely for agricultural use, intended to protect fields and nearby housing
  - May no longer be useful, but authorized function must be maintained
- Options for levee
  - Modify levee (e.g., with a setback) to maintain authorized function and tie back into high ground
  - Deauthorize and remove the levee from the USACE system, which requires an act of Congress
    - Likely cannot deauthorize just a portion as it impacts entire levee function
- Road acting as a levee
  - Would need to reclassify road prism as a levee, which includes owner agreeing to modification of road purpose, accepting associated responsibilities, and coordination with all utilities
  - Engineering analysis needed to ensure it still meets flood damage reduction requirements
  - Need to determine who would be responsible for maintaining

  - Differences between FEMA floodplain requirements vs. USACE levee requirements
  - Levee alignment would need to be redefined and modified to follow new alignment along Birch Creek Road
  - Real estate considerations
- Communications
  - USACE prefers a single submittal for review with follow up meetings for discussion as needed
  - USACE would like to review hydraulic model once finalized
  - Early coordination with the Services may be needed due to consultation backlog

Next Steps and Action Items

- Tetra Tech to proceed with developing 60% design submittal for review that includes the levee reconstruction information, hydrologic and hydraulic analyses, interior drainage analyses, and setback levee design and analyses.
- USACE to provide additional information/clarification regarding real estate implications for levee setback

Attachment 3 – Pendleton 2a Levee National Levee Database

Pendleton Levee 2a available downable data from *https://levees.sec.usace.army.mil/#/levees/system/5005000041/summary*

LEVEE SYSTEM OVERVIEW	The Pendleton Zone 2 Flood Damage Reduction (FDR) Project is a federally authorized and constructed, and non-federally operated and maintained levee system. The leveed area includes mixed agricultural and urban land uses. The Pendleton Zone 2 FDR Project is located in Umatilla County, Oregon along both the left and right banks of the Umatilla River between approximately river mile (RM) 46.6 and RM 49.5, and along the right bank of McKay Creek at the confluence with the Umatilla River. The upstream limit of the project is the realigned reach of the Umatilla River adjacent to the Interstate 84 embankment, located immediately downstream of the Pendleton Zone 1 FDR Project. The local sponsor responsible for operation and maintenance is Umatilla County. The Pendleton Zone 2 FDR Project consists of approximately 18,780 feet of earthen levee and 16 drainage structures. The FDR Project was authorized under Section 204 of the Flood Control Act of 1950 (Public Law 516, 81st Congress, 2nd session) and was constructed in 1961.
LEVEE PERFORMANCE AND POTENTIAL LOST BENEFITS	USACE evaluates risk as a function of both expected consequence of levee failure combined with the likelihood that the levee may fail. The levee is anticipated to perform well under significant loading and have an infrequent likelihood of overtopping. There is a very low population at risk and low potential for economic damages. USACE considers the risk associated with Pendleton 2 levee to be low due expected performance and anticipated consequences.
MAXIMUM HEIGHT	11.00
SYSTEM ID	5005000041
NAME	Pendleton 2a
SYSTEM TYPE	Levee System
SYSTEM SUB-TYPE	No data Entered
FLOOD OF RECORD FLOW (CFS)	-
FLOOD OF RECORD DATE	No data Entered
CLOSURE STRUCTURE MILES	No data Entered
CLOSURE STRUCTURE COUNT	No data Entered
LEVEE MILES	0.50
LEVEED AREA SQUARE MILES	0.04
FLOODWALL MILES	-
LOCATION	Pendleton, Umatilla County, Oregon

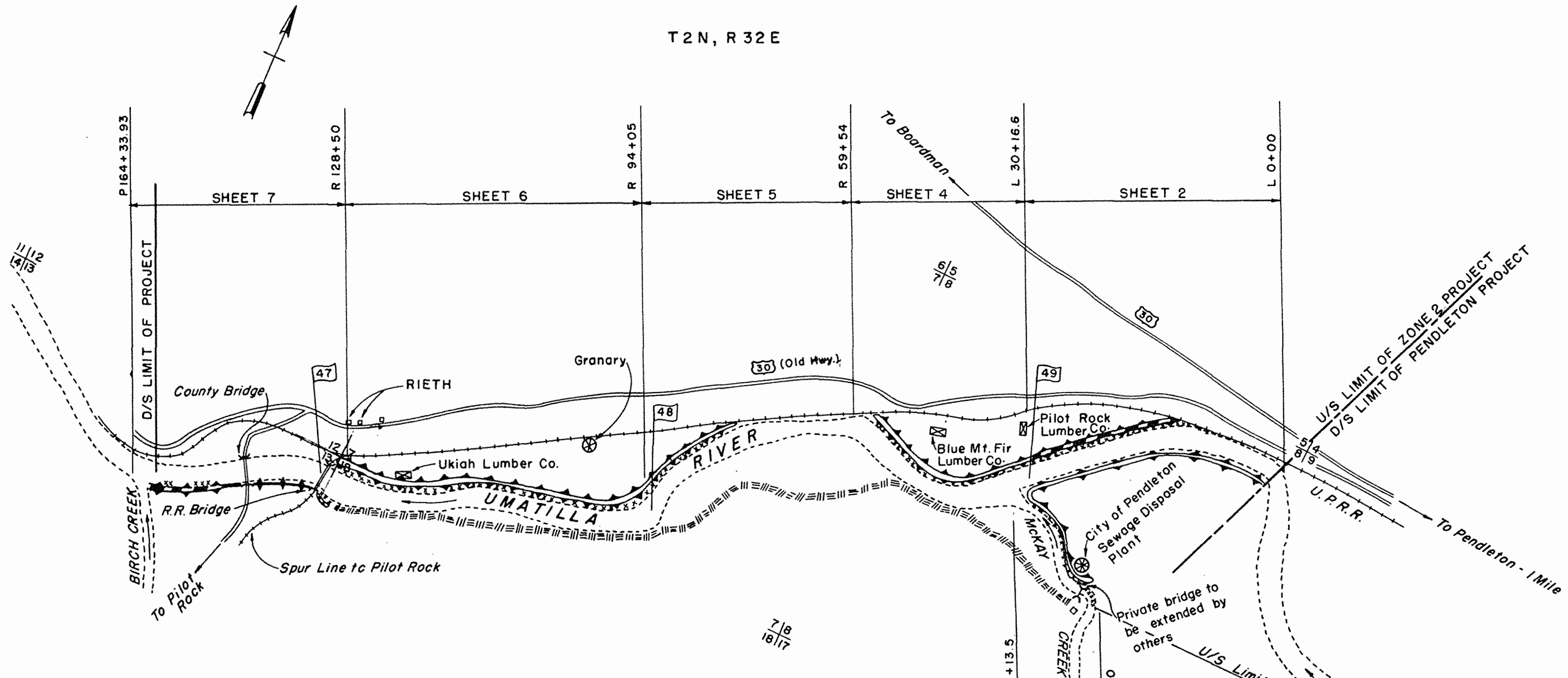
IS USACE	Yes
INCIPIENT OVERTOPPING ANNUAL EXCEEDANCE PROBALILITY (AEP)	0.0002
SWIF STATUS	No data Entered
WATERWAY	No data Entered
YEAR CONSTRUCTED	No data Entered
RIP STATUS	Inactive
FEMA ACCREDITATION RATING	Non-Accredited Levee System
SPONSORS	Pendleton 2
STATES	Oregon
COUNTIES	Umatilla
SEGMENT COUNT	1
SYSTEM CONTAINS NON PROJECT SEGMENT	No
DIVISION NAMES	Northwestern Division
DISTRICT NAMES	Portland
FEMA REGION NAMES	10
CONGRESSIONAL DISTRICTS	2
HUC4 NAMES	Middle Columbia
HAS EVACUATION PLAN	No data Entered
HAS WARNING SYSTEM	No data Entered
SEGMENT ID	5004430001
NAME	Pendleton 2 - Umatilla River - Area 4
SYSTEM ID	5005000041
AUTHORIZATION CATEGORY	USACE Federally constructed, turned over to public sponsor for operations and maintenance
CONSTRUCTION END YEAR	No data Entered
DESIGN FLOW	No data Entered
FLOOD REDUCTION CHANNEL	No data Entered
FREEBOARD	No data Entered
NONFEDERAL IEI DATE	No data Entered
PRIMARY WATERWAY	No data Entered
SECONDARY WATERWAY	No data Entered
POTENTIAL HAZARD	No data Entered
LIS ALIAS	No data Entered
PAL STATUS	No data Entered
PRIOR IDS	No data Entered
LEVEE MILES	0.496088941
FLOODWALL MILES	No data Entered

BEGIN LONGITUDE	-118.8813303
BEGIN LATITUDE	45.65761726
END LONGITUDE	-118.8722231
END LATITUDE	45.65761726
LSAC RATING NAME	Low
RISK ASSESSMENT DATA	01/01/2017
POPULATION BEHIND THE LEVEE	2
BUILDING BEHIND THE LEVEE	0
PROPERTY VALUE	$0
NON PROJECT	No
INTERESTED FEDERAL AGENCY	No data Entered
LEVEED AREA ID	5006430001
SYSTEM ID	5005000041
NAME	Pendleton 2a Protected Area
LEVEED SQUARE MILES	0.044
LEVEE STATION CODE	No data Entered
FEATURE NAME	No data Entered
MIN OVERTOP EVENT	No data Entered
EGRESS NUMBER	3
SUBMISSION ID	No data Entered
WARNING INDICATOR	No data Entered
EVACUATION PLAN INDICATOR	No data Entered
COMPUTED SOURCE DATE	No data Entered
COMPUTED SOURCE	No data Entered
LEVEED AREASOURCE	No data Entered
FEATURE CLASS	No data Entered
FIRM PANNELS, EFFECTIVE DATA	41059C1000G 03-Sep-2010 41059C1011G 03-Sep-2010 41059C1013G 03-Sep-2010
CROSS SECTION FEATURE ID	5018430010 5018430011
EMBANKMENT FEATURE ID	5001430003
CROSSING POINTS FEATURE ID	5015430013 5015430012 5015430011
LEVEE STATIONS FEATURE ID	5013430015 5013430014 5013430013 5013430012
PROFILE DATA	*X Coordinates* *Y Coordinates* *Elevation* *Distance* -118.872 45.65762 0 0

-118.872	45.65766	0	54.892
-118.873	45.6577	0	87.9243
-118.873	45.65775	0	116.326
-118.873	45.6578	0	139.1035
-118.873	45.65787	0	164.5332
-118.873	45.65792	0	183.8209
-118.873	45.65798	0	205.0093
-118.873	45.65802	0	219.7523
-118.873	45.65804	0	229.4693
-118.873	45.65804	485.1355	267.7606
-118.873	45.65802	0	298.2628
-118.873	45.65804	0	328.765
-118.873	45.65804	0	328.8518
-118.873	45.65802	0	359.3279
-118.873	45.65801	0	382.3191
-118.873	45.65796	0	442.0922
-118.873	45.65794	0	478.7596
-118.873	45.65794	0	478.7791
-118.874	45.6579	0	542.9569
-118.874	45.65784	0	644.8791
-118.874	45.65782	0	666.6932
-118.874	45.65779	0	710.899
-118.875	45.65773	0	784.1446
-118.875	45.65773	0	796.9616
-118.875	45.65771	0	812.1496
-118.875	45.65758	0	914.3769
-118.875	45.65744	0	1015.533
-118.876	45.6573	0	1117.861
-118.876	45.65716	0	1220.671
-118.876	45.65708	0	1274.912
-118.876	45.65703	0	1313.598
-118.877	45.657	0	1339.793
-118.877	45.65687	0	1444.364
-118.877	45.6567	0	1567.94
-118.878	45.65656	0	1673.183
-118.878	45.65642	0	1777.142
-118.878	45.65628	0	1883.857
-118.879	45.65615	0	1987.967
-118.879	45.65608	0	2045.59
-118.879	45.65595	0	2153.91
-118.879	45.65591	0	2193.961
-118.879	45.65591	0	2194.028
-118.88	45.65585	0	2256.768

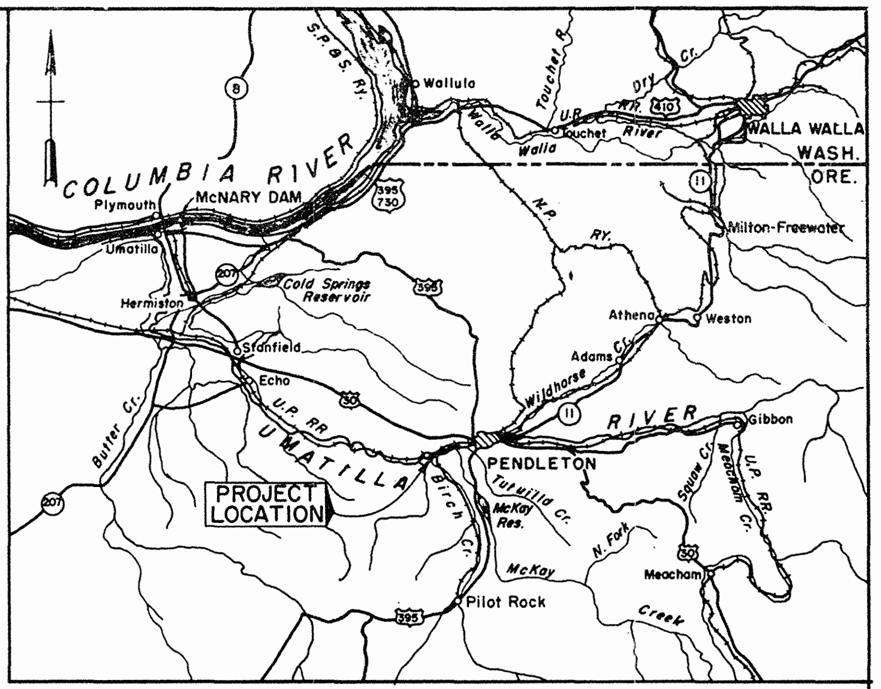
	-118.88	45.65574	0	2357.1
	-118.88	45.65567	0	2465.996
	-118.881	45.65561	0	2572.904
	-118.881	45.65561	0	2680.413
ATTACHEMENTS	No data Entered			

Attachment 4 – Pendleton 2a 1959 Construction Drawings



PLAN

APPROX. SCALE IN FEET
1000 0 1000 2000



VICINITY MAP

SCALE IN MILES
5 0 5 10

EXPLORATION LEGEND

P-(N)	Pneumatic Drill Holes, (N) indicates Numerals
ML	Inorganic silts and very fine sand
GM	Silty gravels, gravel-sand-silt mixtures
GP *	Coarse sandy gravels
BR	Bedrock
*	The GP symbol indicates sandy-gravels containing cobbles up to 8" or larger and occasional boulders

LEGEND

▧	Embankment
▨	Excavation
⬭⬭	Rip rap in plan
⊠⊠	Existing rip rap in plan
◆◆◆	Levee - existing
○○○	Rip rap in section
▲▼▲▼	Levee to be constructed
◆▲▼◆	Levee to be repaired
xxxxxxxxxx	Rip rap (Site Map)
+++++++++	Railroad
—— ——	Right-of-way
•--------•	Utilities
—x—x—x—	Fences

NOTES:

1. Quantities shown are estimated from available surveys and may vary subject to actual conditions encountered in construction operations.
2. Construct smooth transition from new rip rap to existing rip rap.
3. Removal or relocation of buildings, telephone power water and sewer lines affecting construction operations to be performed by others.
4. B All fences, in construction area, to be removed and relocated by others.
5. No solid rock excavation required in channel.
6. The rip rap toe shall be constructed to profile grade or to bedrock, whichever is higher.
7. U.S.G.S. B.M. K-113, Elev. 978.705, at Rieth (M.S.L. elevation).
8. B A All required borrow shall begin at riverside and progress uniformly landward to 1' below W.S. at time of construction.

INDEX TO DRAWINGS

NO.	TITLE	FILE NO.
1	SITE MAP	UR-46-1/1
2	PLAN AND PROFILE	UR-46-1/2
3	PLAN AND PROFILE	UR-46-1/3
4	PLAN AND PROFILE	UR-46-1/4
5	PLAN AND PROFILE	UR-46-1/5
6	PLAN AND PROFILE	UR-46-1/6
7	PLAN, PROFILES, AND DETAILS	UR-44-1/7
8	TYPICAL SECTIONS	UR-44-1/8
9	TYPICAL SECTIONS	UR-46-1/9
10	CULVERT SECTIONS - SEEP RING DETAIL	UR-46-1/10

DRAWINGS IN THIS FOLIO
HAVE BEEN REDUCED TO
ONE HALF THE ORIGINAL SCALE

REVISION	DATE	DESCRIPTION	BY
B	21Aug59	Revised Notes	OKL
A	17 Apr '59	Added Note	ECR

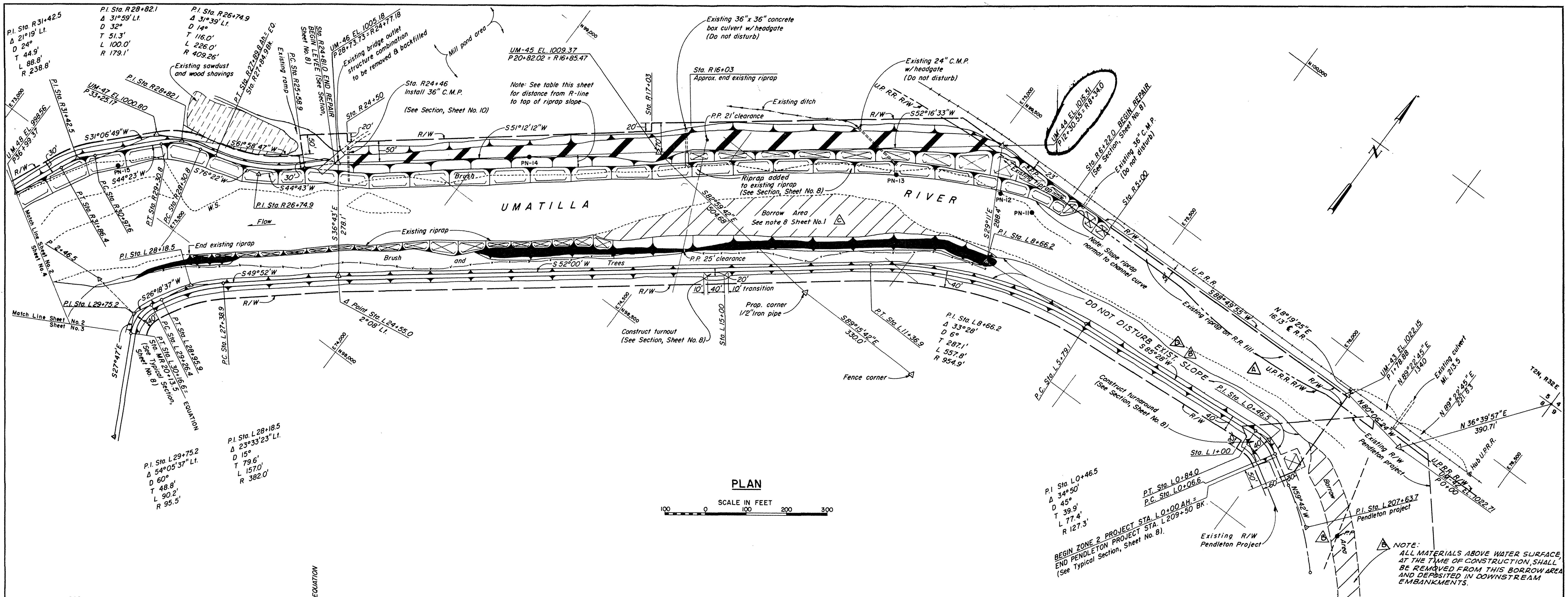
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, WALLA WALLA, WASHINGTON

DESIGNED: J. T. Perry
DRAWN: V. Davis
CHECKED: N. Swanson
PREPARED: A W Welch
CHIEF, RELOC. & LEV. SECT.

UMATILLA RIVER, OREGON
ZONE 2 LOCATION
LEVEE AND REVETMENT CONSTRUCTION
SITE MAP

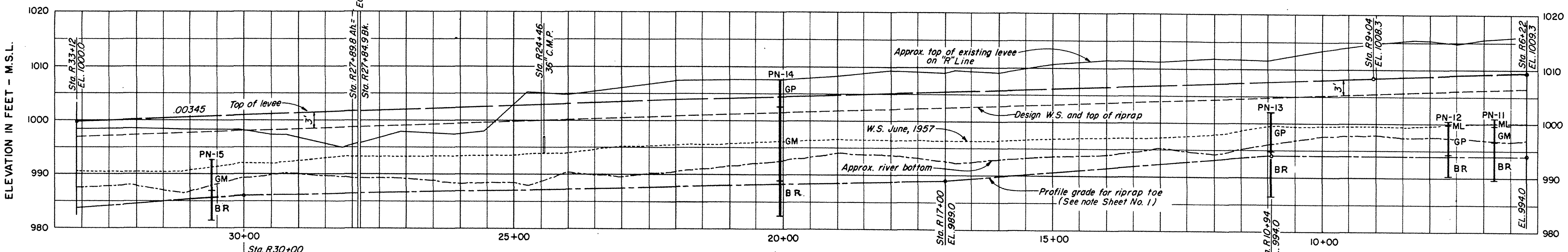
REVIEWED:
CHIEF, SAFETY BRANCH
SUBMITTED: Otto R. Rumm
CHIEF, DESIGN BRANCH
RECOMMENDED: E. C. Franzen
CHIEF, ENGINEERING DIVISION

APPROVED: Paul H. Symbol DATE 12 MAR 59
COLONEL, C. E. DISTRICT ENGINEER
SCALE AS SHOWN
INV. NO. ENG. C-60-36
FILE NO.
SHEET 1 OF 10 UR-46-1/1



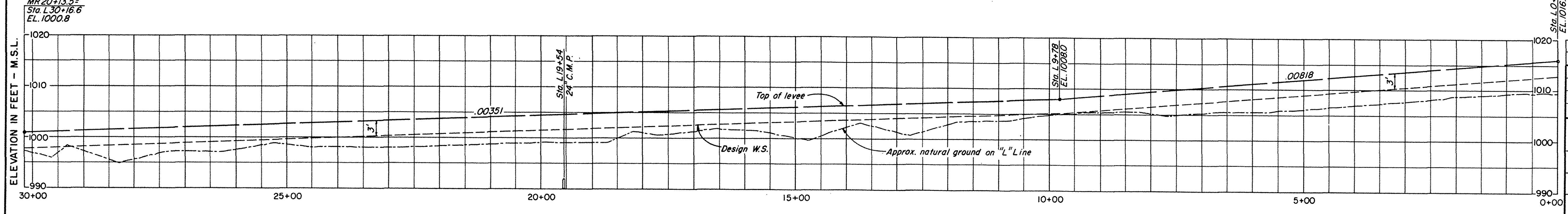
PLAN

B NOTE:
ALL MATERIALS ABOVE WATER SURFACE, AT THE TIME OF CONSTRUCTION, SHALL BE REMOVED FROM THIS BORROW AREA AND DEPOSITED IN DOWNSTREAM EMBANKMENTS.



PROFILE - R LINE

Excavation Cu. Yd.	600	2000	1950	1300	950	1400
Embankment Cu. Yd.	1000	1600	100	250	450	150



PROFILE - L LINE

Excavation Cu. Yd.	0	0	0	0	0	0
Embankment Cu. Yd.	1700	2250	1850	1550	1800	2300

OFF SETS FROM "R" LINE TO TOP OF RIPRAP SLOPE

STATION	OFFSET	STATION	OFFSET
R 6 + 22	26' LT.	R 15 + 03	24' LT.
R 6 + 54	27' LT.	R 16 + 03	28' LT.
R 7 + 04	33' LT.	R 16 + 85.5	30' LT.
R 7 + 22	38' LT.	R 17 + 03	33' LT.
R 7 + 54	49' LT.	R 18 + 03	30' LT.
R 8 + 00	70' LT.	R 19 + 03	27' LT.
R 8 + 34	82' LT.	R 20 + 03	27' LT.
R 9 + 03	62' LT.	R 21 + 03	25' LT.
R 10 + 03	45' LT.	R 22 + 03	26' LT.
R 11 + 03	32' LT.	R 23 + 03	30' LT.
R 12 + 03	32' LT.	R 24 + 03	30' LT.
R 13 + 03	21' LT.	R 24 + 77	21' LT.
R 14 + 03	23' LT.	R 24 + 81	0'

REVISION	DATE	DESCRIPTION	BY
E	24MAR60	Revised elevation on UM-44	OHL
D	24FEB60	Revised note	
C	21Aug59	Added note.	
B	24Jun59	Added power pole & line. Added notes.	
A	20Mar59	Added U.P.R.R. R/W	

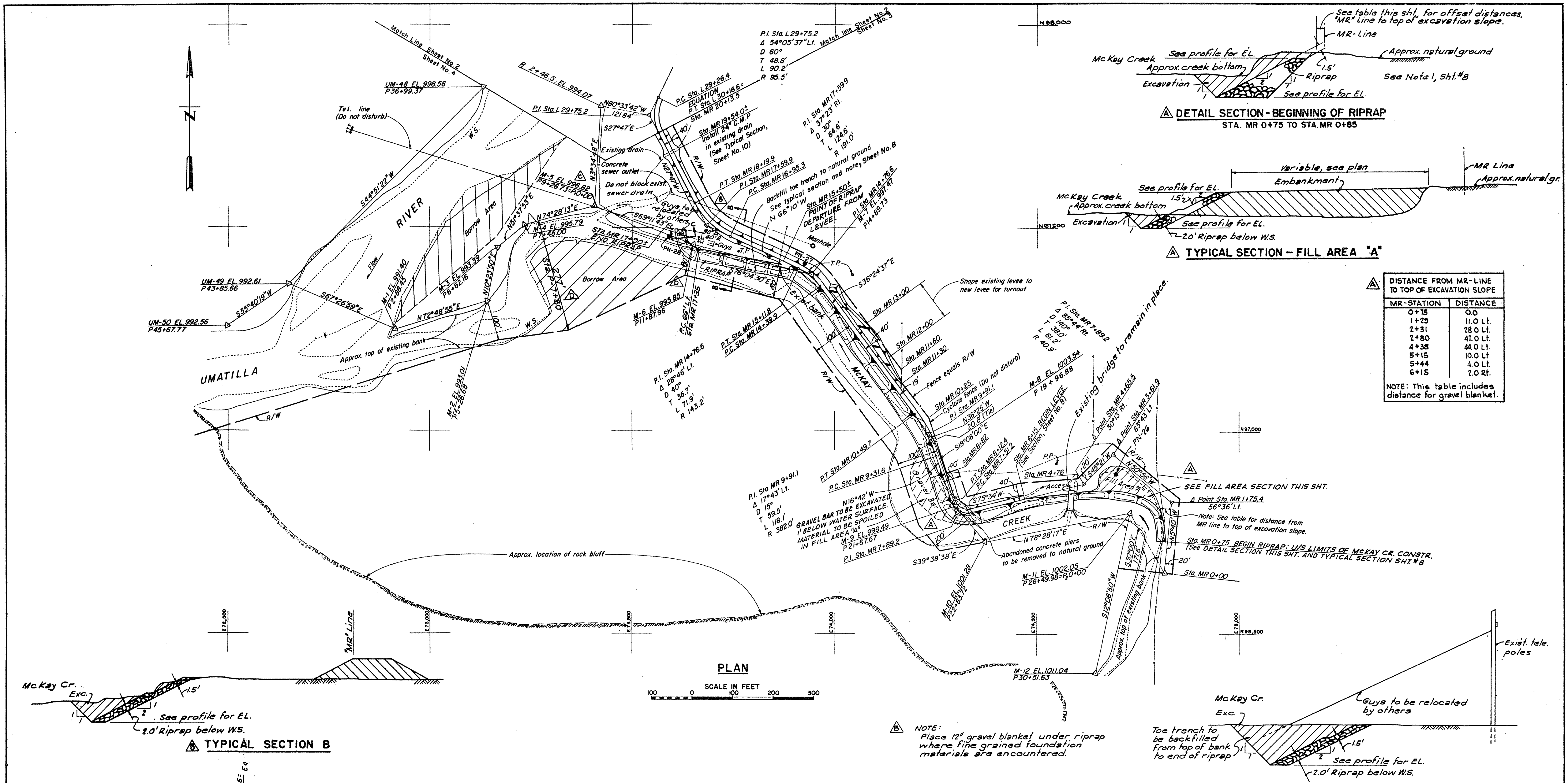
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, WALLA WALLA, WASHINGTON

DESIGNED: J. T. Perry
DRAWN: M. Anderson
CHECKED: N. Swanson
PREPARED: A. W. Welch
CHIEF, RELOC. & LEV. SECT.

UMATILLA RIVER, OREGON
ZONE 2 LOCATION
LEVEE AND REVETMENT CONSTRUCTION
PLAN AND PROFILES

REVIEWED:
CHIEF, SAFETY BRANCH
SUBMITTED: Otto R. Rum
CHIEF, DESIGN BRANCH
RECOMMENDED: E. C. Tranger
CHIEF, ENGINEERING DIVISION

APPROVED: Paul H. Symbol
DATE 12 MAR 59
COLONEL, C. E. DISTRICT ENGINEER
SCALE AS SHOWN
INV. NO. ENG. C-60-36
FILE NO.
SHEET 2 OF 10
UR-46-1/2



Ⓐ DETAIL SECTION - BEGINNING OF RIPRAP

STA. MR 0+75 TO STA. MR 0+85

Ⓐ TYPICAL SECTION - FILL AREA "A"

Ⓐ

DISTANCE FROM MR-LINE TO TOP OF EXCAVATION SLOPE	
MR-STATION	DISTANCE
0+75	0.0
1+29	11.0 Lt.
2+31	28.0 Lt.
2+80	47.0 Lt.
4+38	44.0 Lt.
5+15	10.0 Lt.
5+44	4.0 Lt.
6+15	2.0 Rt.

NOTE: This table includes distance for gravel blanket.

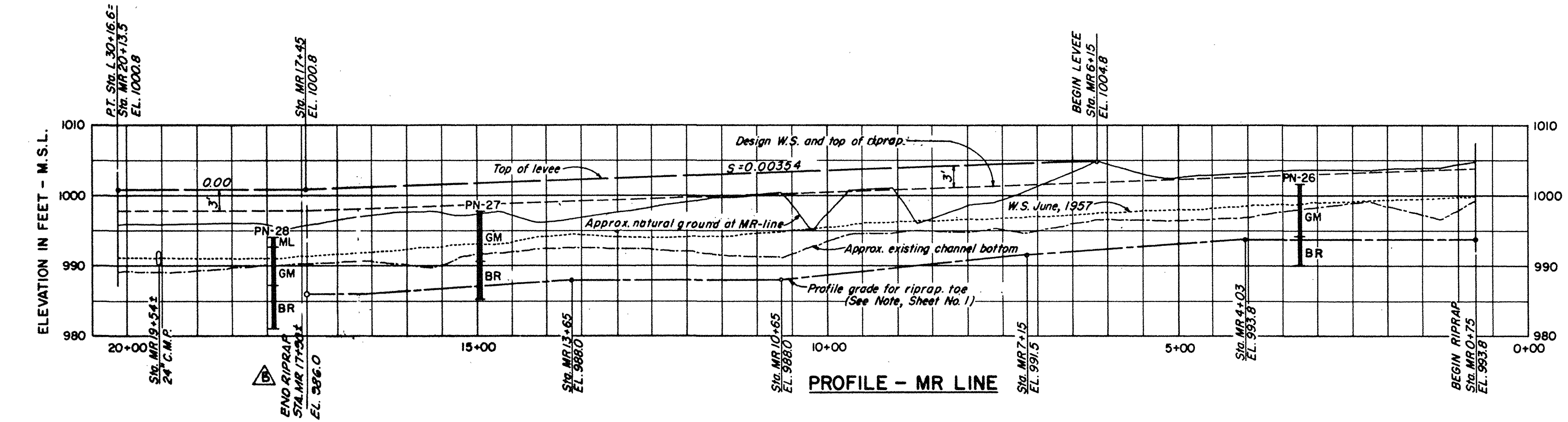
PLAN

SCALE IN FEET
100 0 100 200 300

Ⓑ TYPICAL SECTION B

Ⓑ NOTE:
Place 12" gravel blanket under riprap where fine grained foundation materials are encountered.

Ⓑ TYPICAL SECTION C



PROFILE - MR LINE

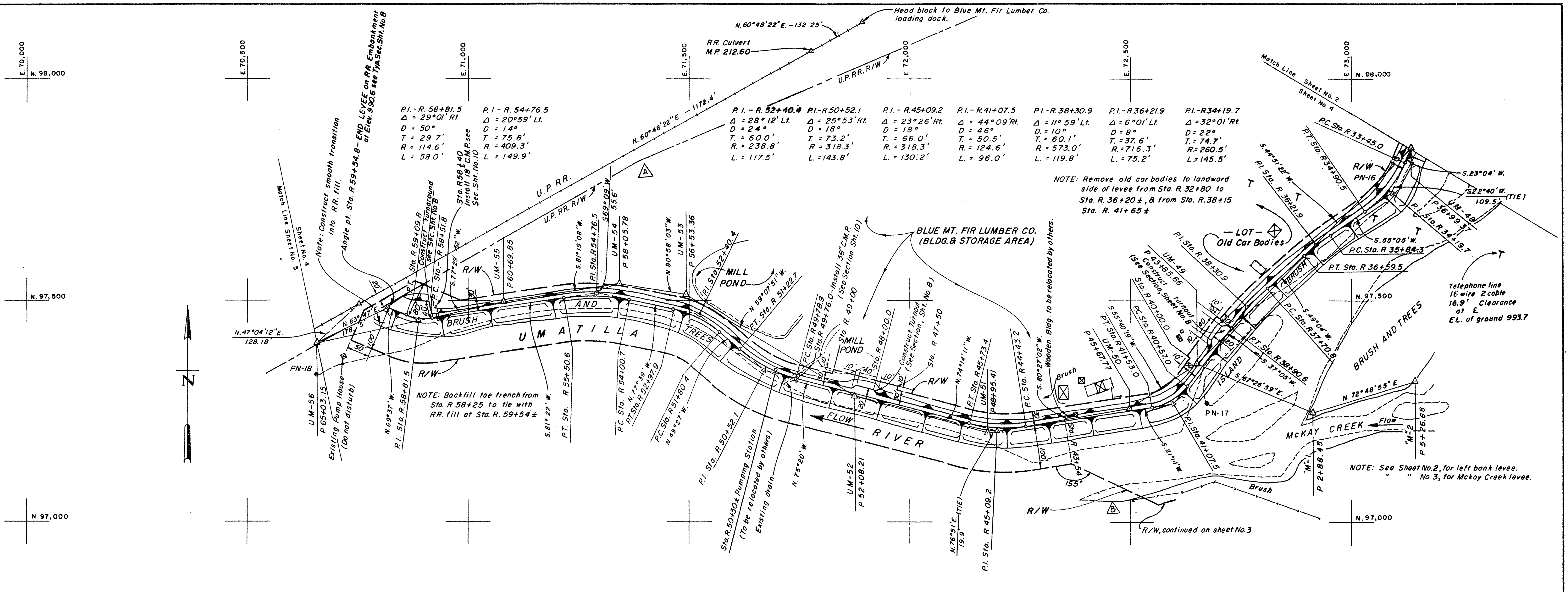
Excavation Cu. Yd.	1050	2150	1900	1100
Embankment Cu. Yd.	2300	1500	1050	Ⓒ 1250

REVISION	DATE	DESCRIPTION	BY
Ⓓ	24 FEB 60	Revised and added distance to R/W line	
Ⓒ	21 Aug 59	Added note, corrected quantities	
Ⓑ	24 Jun 59	Added riprap, sections & notes.	
Ⓐ	17 Apr '59	Revised line & bridge location. Added sections & gravel bar	ACR

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, WALLA WALLA, WASHINGTON

UMATILLA RIVER, OREGON
ZONE 2 LOCATION
LEVEE AND REVETMENT CONSTRUCTION
PLAN AND PROFILE

DESIGNED: J. T. Perry
DRAWN: M. Anderson
CHECKED: N. Swanson
PREPARED: A.W. Welch
CHIEF, RELOC. & LEV. SECT.
REVIEWED:
CHIEF, SAFETY BRANCH
SUBMITTED: Otto R. Lunn
CHIEF, DESIGN BRANCH
RECOMMENDED: E. C. Franzen
CHIEF, ENGINEERING DIVISION
APPROVED: Paul H. Symbol
DATE 12 MAR 59
COLONEL, C. E. DISTRICT ENGINEER
SCALE AS SHOWN
INV. NO. ENG. C-60-36
FILE NO.
SHEET 3 OF 10
UR-46-1/3



NOTE: Backfill toe trench from Sta. R.58+25 to tie with RR. fill at Sta. R. 59+54±

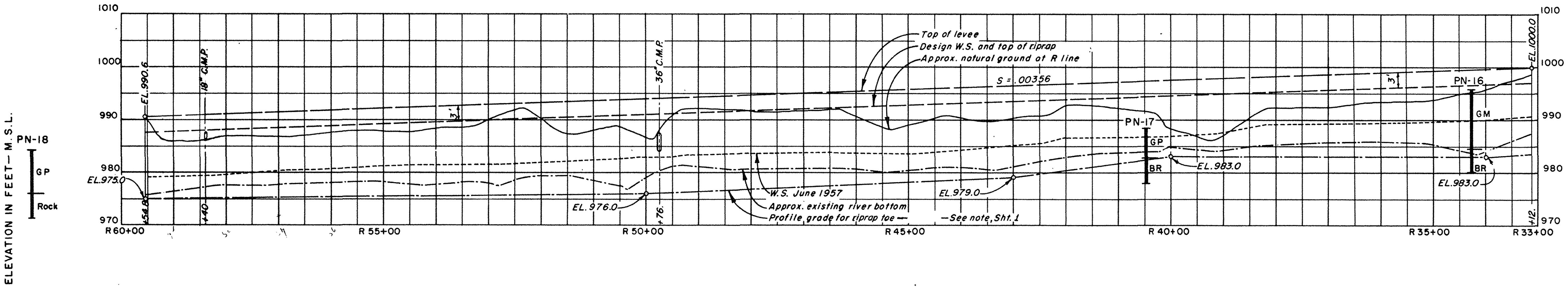
NOTE: Remove old car bodies to landward side of levee from Sta. R. 32+80 to Sta. R. 36+20±, & from Sta. R.38+15 Sta. R. 41+65±.

NOTE: See Sheet No.2, for left bank levee.
" " No. 3, for Mckay Creek levee.

PLAN

SCALE IN FEET

100 0 100 200 300



EXCAVATION, Cu. yds.	1700	1200	1900	2000	1500	400
EMBANKMENT, Cu. yds.	1450	2300	1850	2600	3350	500

PROFILE "R" LINE — ZONE NO. 2

SCALE: HORIZ. - 1"=100'
VERT. - 1"=10'

REVISION	DATE	DESCRIPTION	BY
B	24Jun59	Revised R/W	
A	20 Mar 59	Added U.P. RR. R/W	

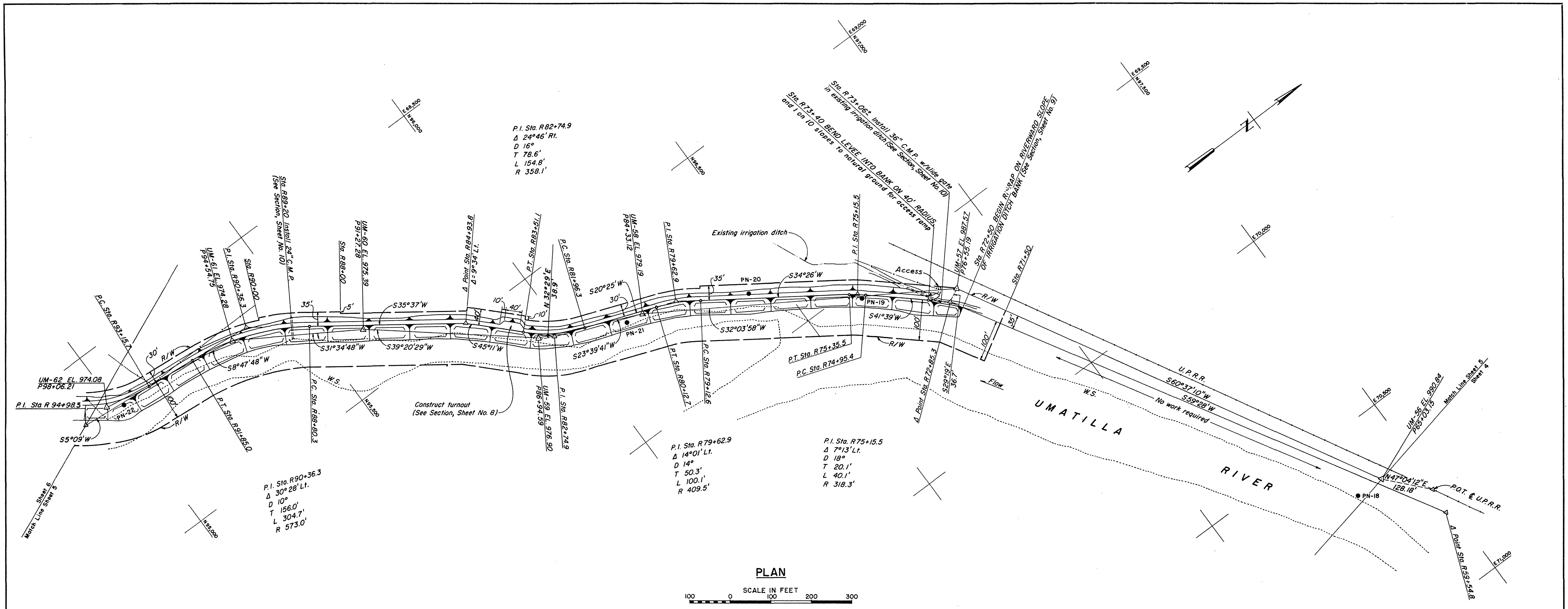
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, WALLA WALLA, WASHINGTON

DESIGNED: J.T. Perry
DRAWN: C.P.D.
CHECKED: N. Swanson
PREPARED: A.W. Welch
CHIEF, RELOC. & LEVEE SEC

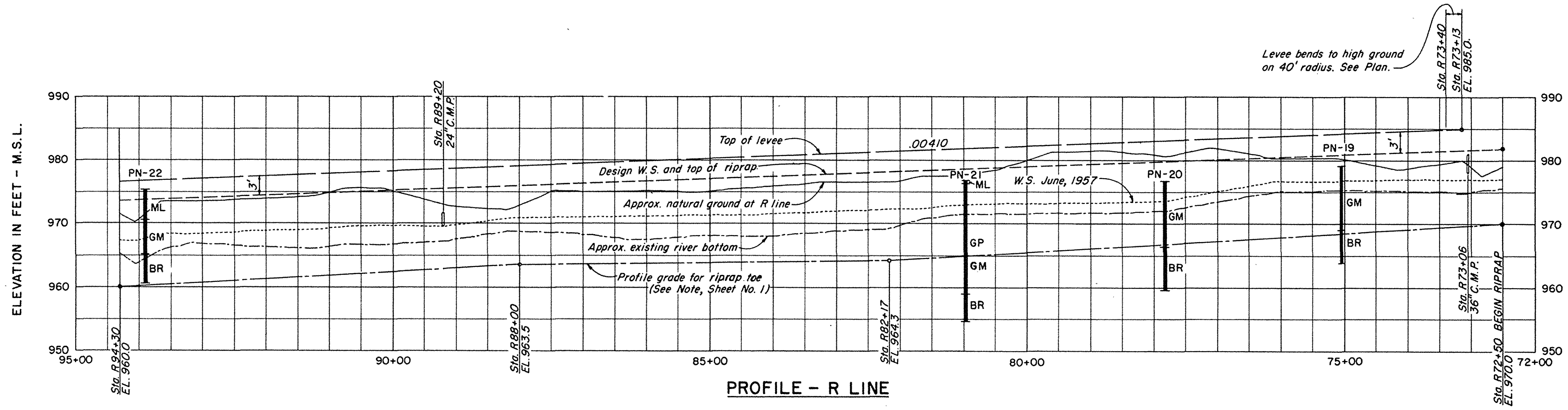
UMATILLA RIVER, OREGON
ZONE 2 LOCATION
LEVEE AND REVETMENT CONSTRUCTION
PLAN AND PROFILE

REVIEWED:
CHIEF, SAFETY BRANCH
SUBMITTED: Otto R. Reum
CHIEF, DESIGN BRANCH
RECOMMENDED: E. C. Swanson
CHIEF, ENGINEERING DIVISION

APPROVED: DATE 12 MAR 59
COLONEL, C. E. DISTRICT ENGINEER
SCALE AS SHOWN
INV. NO. ENG. C-60-36
FILE NO.
SHEET 4 OF 10 UR-46-1/4



PLAN



PROFILE - R LINE

Excavation Cu. Yd.	2450	3000	2750	2300	1600
Embankment Cu. Yd.	1300	1800	1500	1400	600

REVISION	DATE	DESCRIPTION	BY

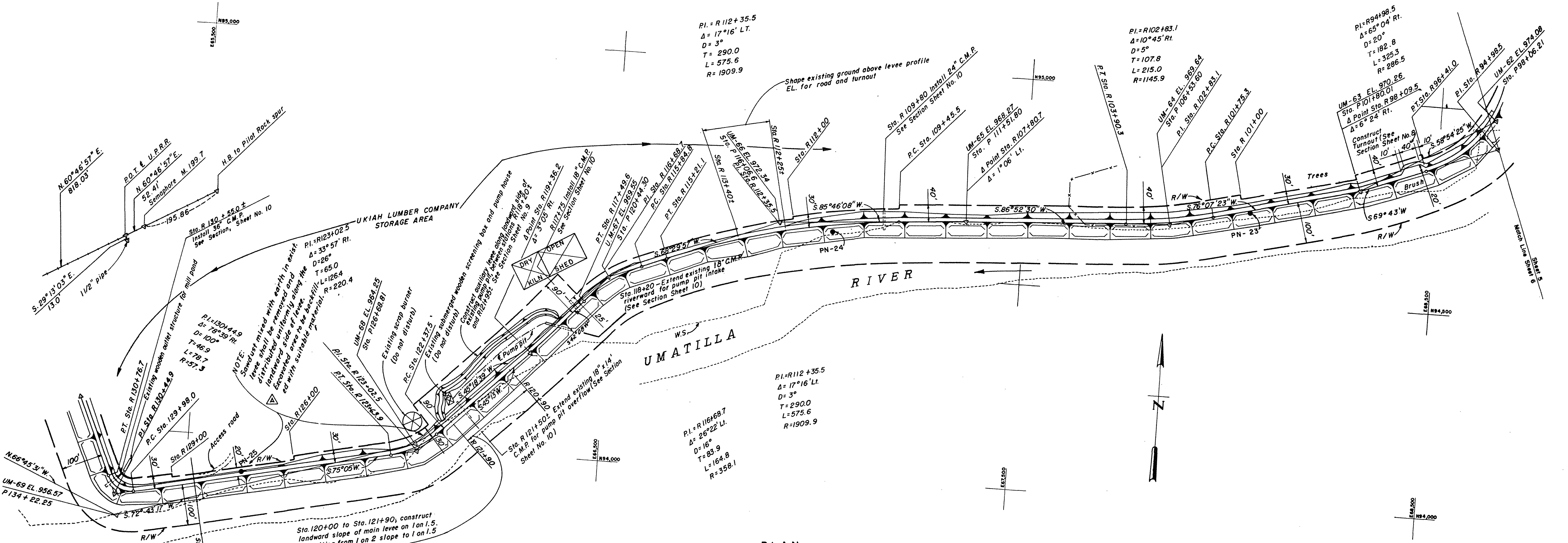
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, WALLA WALLA, WASHINGTON

DESIGNED: J. T. Perry
DRAWN: M. Anderson
CHECKED: N. Swanson
PREPARED: A. W. Welch
CHIEF, RELOC. & LEV. SECT.

UMATILLA RIVER, OREGON
ZONE 2 LOCATION
LEVEE AND REVETMENT CONSTRUCTION
PLAN AND PROFILE

REVIEWED:
CHIEF, SAFETY BRANCH
SUBMITTED: Otto R. Reuno
CHIEF, DESIGN BRANCH
RECOMMENDED: E. C. Frangon
CHIEF, ENGINEERING DIVISION

APPROVED: Paul H. Symbol
DATE 12 MAR 59
COLONEL, C. E. DISTRICT ENGINEER
SCALE AS SHOWN
INV. NO. ENG. C-60-36
SHEET 5 OF 10
FILE NO. UR-46-1/5



PLAN

SCALE IN FEET
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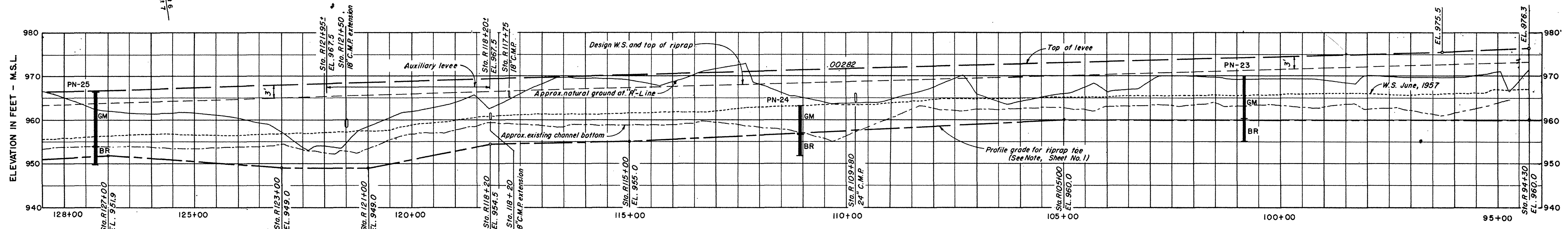


PROFILE - R LINE

Excavation	1850	1550	1650	2100	1100	800	1900
Embankment	750	6050	1300	1250	3700	2450	2450
		△			△		

REVISION	DATE	DESCRIPTION	BY
△	21 Aug 59	Revised note and quantities.	

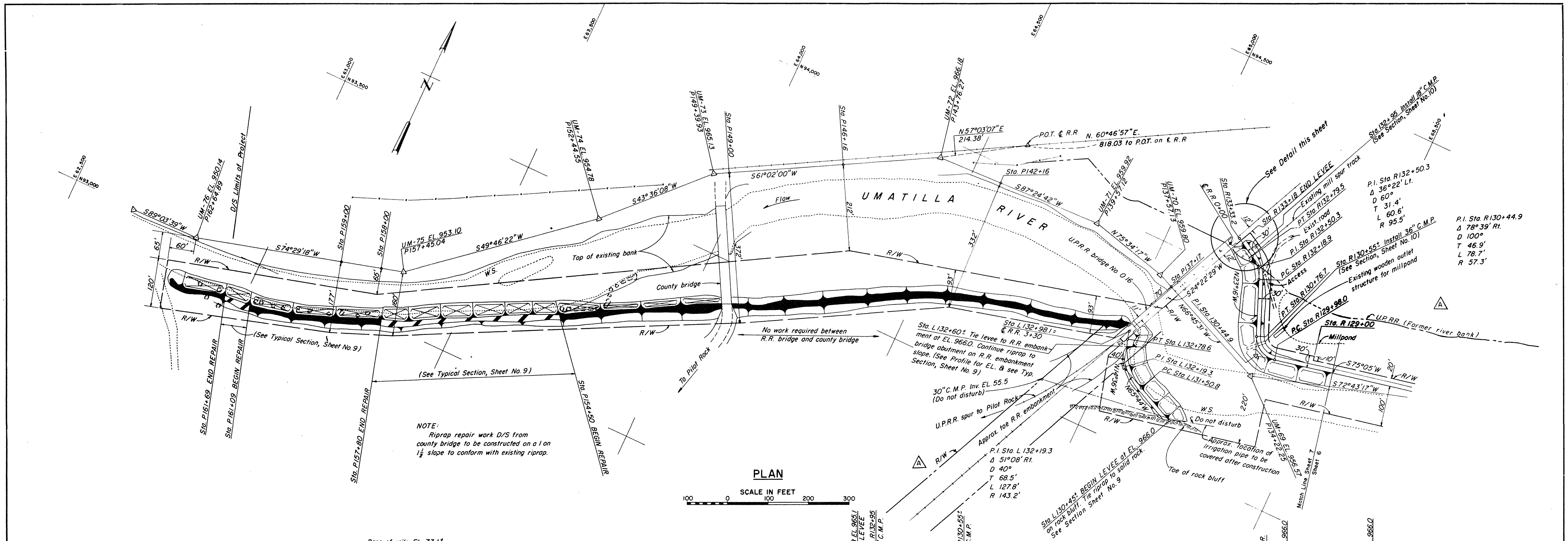
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, WALLA WALLA, WASHINGTON

DESIGNED: J. T. Perry
DRAWN: E. Johnson
CHECKED: N. Swanson
PREPARED: A. W. Welch
CHIEF, RELOC. & LEVEE SEC.

UMATILLA RIVER, OREGON
ZONE 2 LOCATION
LEVEE AND REVETMENT
CONSTRUCTION
PLAN AND PROFILE

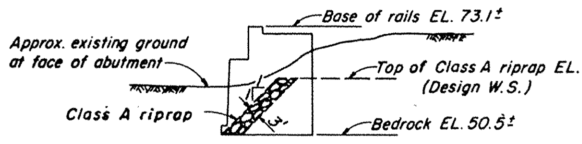
REVIEWED:
CHIEF, SAFETY BRANCH
SUBMITTED: Otto R. Lucas
CHIEF, DESIGN BRANCH
RECOMMENDED: E. C. Thompson
CHIEF, ENGINEERING DIVISION

APPROVED: DATE 12 MAR 59
COLONEL, C. E. DISTRICT ENGINEER
SCALE AS SHOWN INV. NO. ENG. C-60-36
FILE NO.
SHEET 6 OF 10 UR-46-1/6

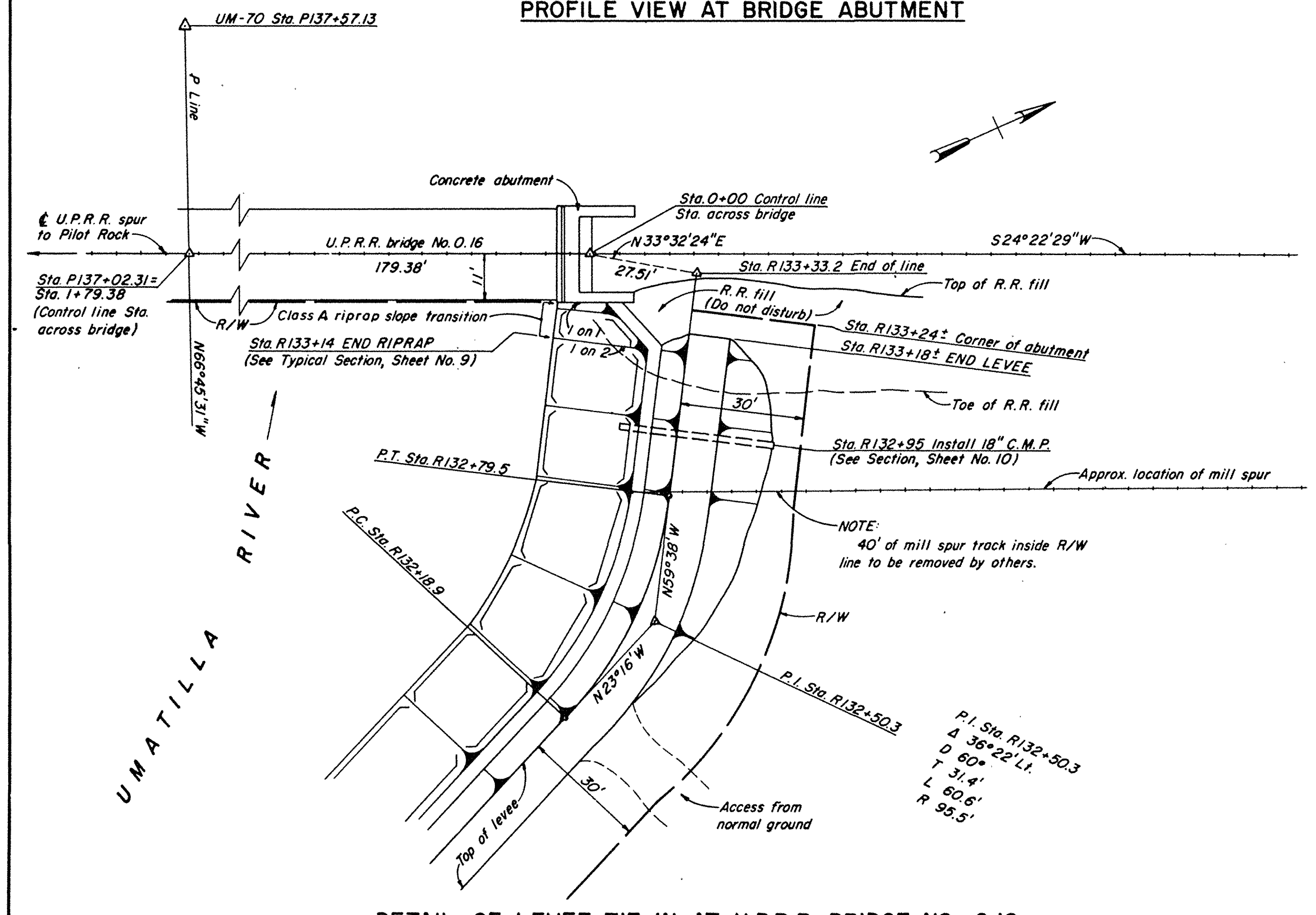


PLAN

NOTE:
See plan sheet No. 7

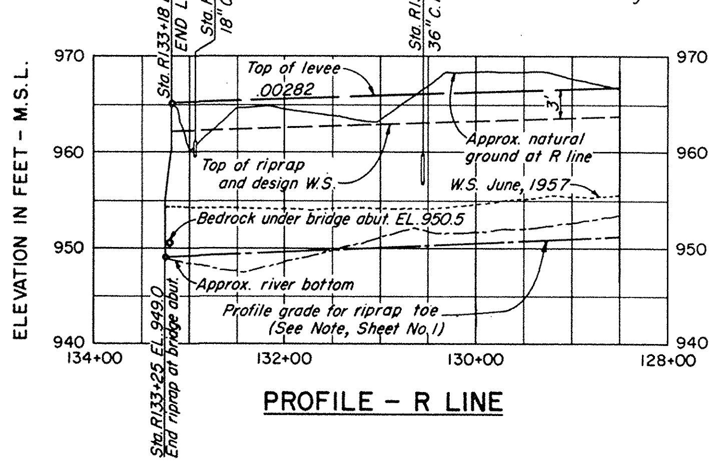


PROFILE VIEW AT BRIDGE ABUTMENT



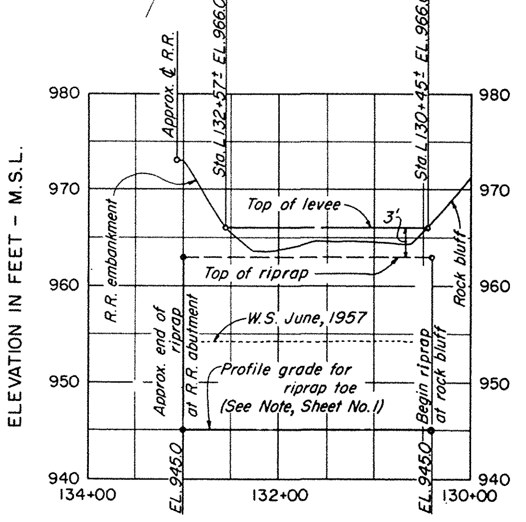
DETAIL OF LEVEE TIE-IN AT U.P.R.R. BRIDGE NO. 0.16

SCALE IN FEET
20 0 20 40 60



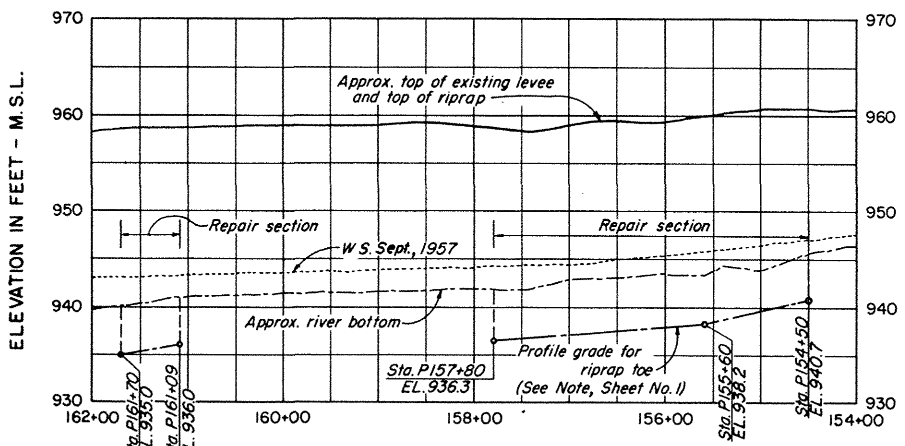
PROFILE - R LINE

Excavation Cu. Yd.	3500	800
Embankment Cu. Yd.	500	350



PROFILE - L LINE

Excavation Cu. Yd.	850
Embankment Cu. Yd.	800



PROFILE - L LINE REPAIR SECTION

Excavation Cu. Yd.	100	750
Embankment Cu. Yd.	50	600

SCALE: HOR. 1" = 100'
VERT. 1" = 10'

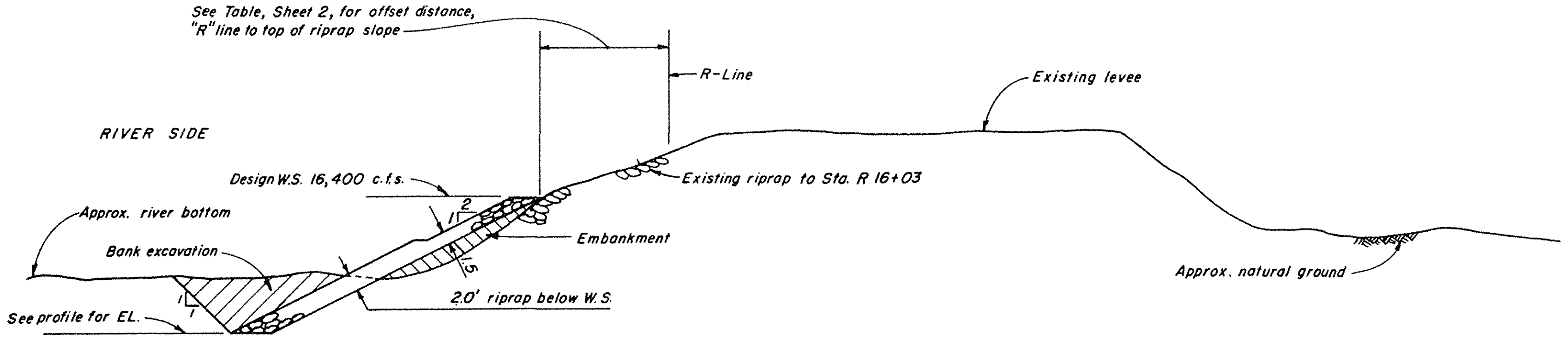
REVISION	DATE	DESCRIPTION	BY
△	20 Mar 59	Added U.P. RR. R/W	

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER. WALLA WALLA, WASHINGTON

DESIGNED: J. T. Perry
DRAWN: M. Anderson
CHECKED: N. Swanson
PREPARED: A.W. Welch
CHIEF, RELOC. & LEVEE SEC.
REVIEWED:
CHIEF, SAFETY BRANCH
SUBMITTED: Otto R. Linn
CHIEF, DESIGN BRANCH
RECOMMENDED:
CHIEF, ENGINEERING DIVISION

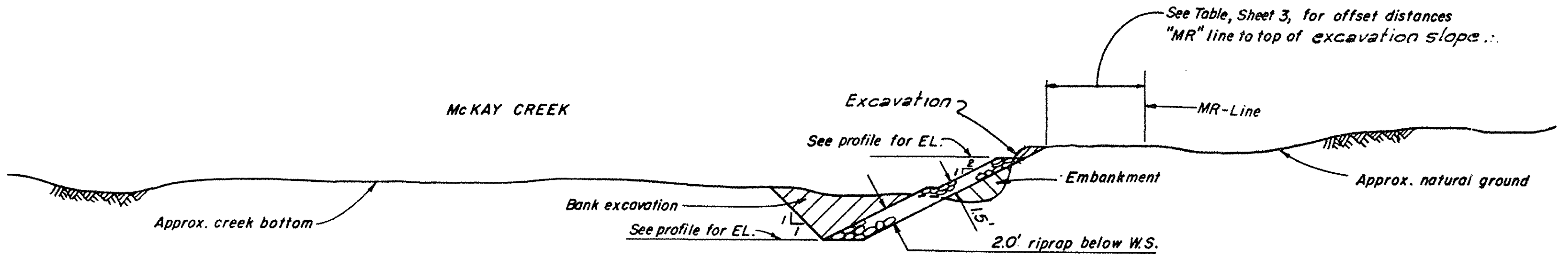
UMATILLA RIVER, OREGON
ZONE 2 LOCATION
LEVEE AND REVETMENT CONSTRUCTION
PLAN, PROFILES AND DETAIL

APPROVED: DATE 12 MAR 59
COLONEL, C. E. DISTRICT ENGINEER
SCALE AS SHOWN
INV. NO. ENG. C-60-36
FILE NO.
SHEET 7 OF 10
UR-46-1/7



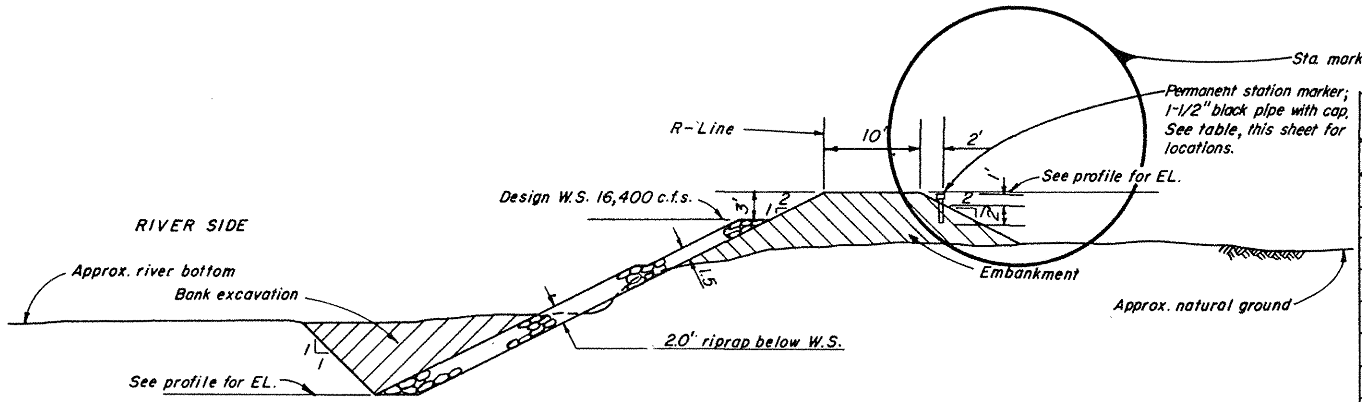
TYPICAL SECTION (LEVEE REPAIR)

STATION R6+22 TO STATION R24+81



TYPICAL SECTION Ⓐ

STA. MR0+85 TO STA. MR6+15

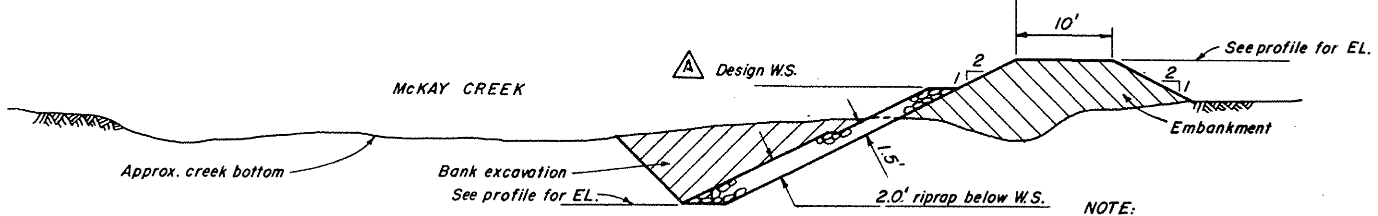


NOTE:
Backfill toe trench from Sta. R58+25
to tie with RR fill at Sta. 59+54±

TYPICAL SECTION

STA. R24+81 TO STA. R59+54

TABLE FOR LOCATION OF PERMANENT STA. MARKERS	
R 6+00	L 5+00
R 16+00	L 15+00
R 26+00	L 25+00
R 36+00	MR 5+00
R 46+00	MR 15+00
R 59+00	
R 74+00	
R 84+00	
R 94+00	
R 105+00	
R 110+00	
R 115+00	
R 120+00	
R 125+00	
R 130+00	
R 155+00	

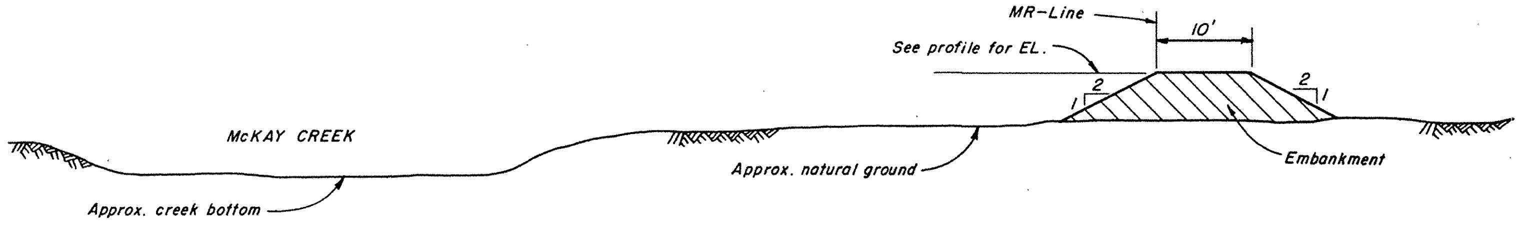


NOTE:
Backfill toe trench from Sta. MR 16+68.
end of riprap back to edge of existing channel
at Sta. MR 15+30±

TYPICAL SECTION

STA. MR6+15 TO STA. MR15+50 Ⓑ

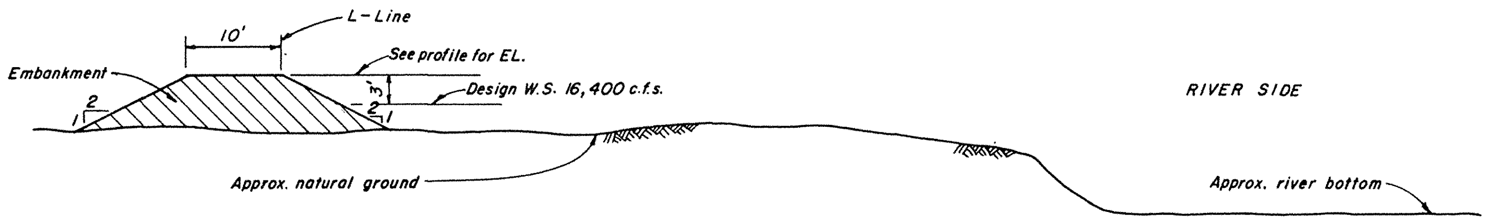
.See typical section B Sht. 3 for riprap section Ah.



TYPICAL SECTION

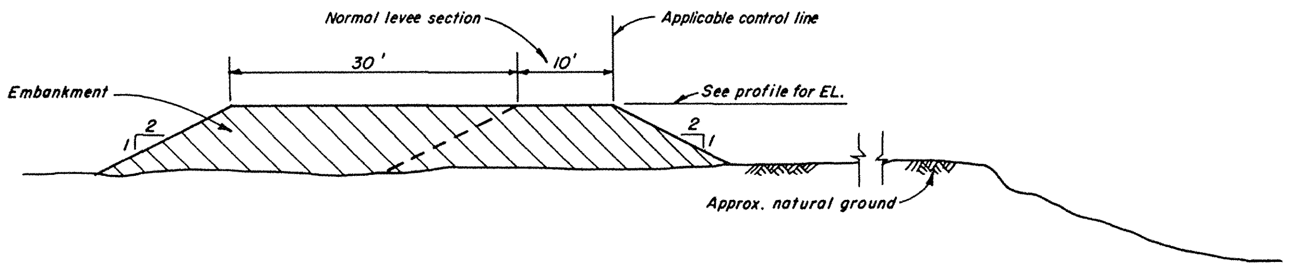
STA. MR16+68 TO STA. MR 20+13.5

NOTE:
1. Place 12" gravel blanket under riprap, where fine grained foundation materials are encountered.



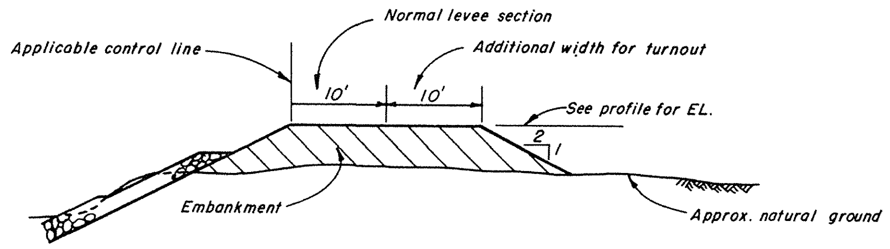
TYPICAL SECTION

STA. L0+00 TO STA. L30+16.6



TYPICAL TURNAROUND SECTION

SEE PLAN FOR LOCATIONS



TYPICAL TURNOUTS SECTION

SEE PLAN FOR LOCATIONS

REVISION	DATE	DESCRIPTION	BY
Ⓑ	21 Aug 59	Corrected station of typical section, added note.	
Ⓐ	17 Apr '59	Revised notes and section	

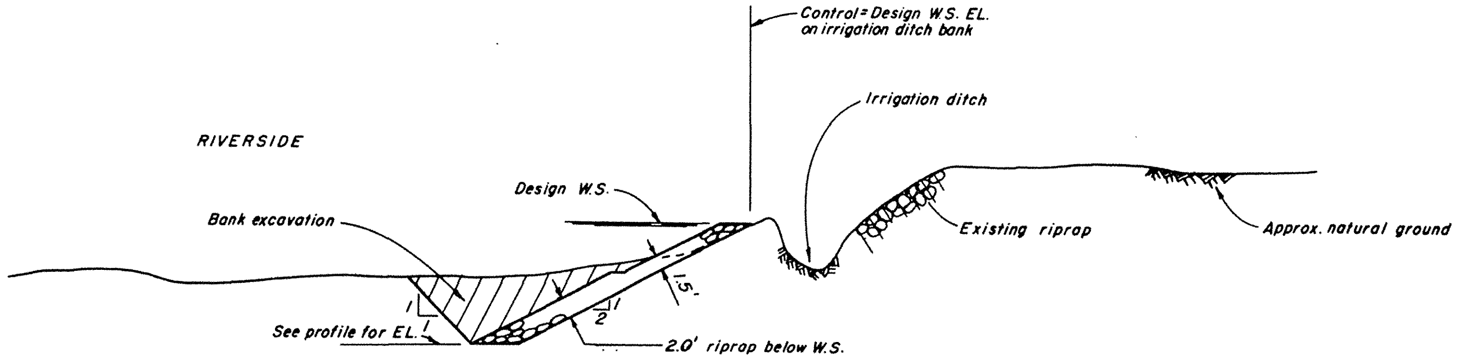
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, WALLA WALLA, WASHINGTON

DESIGNED J.T. Perry
DRAWN: E. Johnson
CHECKED: N. Swanson
PREPARED: A.W. Welch
CHIEF, RELOC. & LEVEE SEC.

UMATILLA RIVER, OREGON
ZONE 2 LOCATION
LEVEE AND REVETMENT CONSTRUCTION
TYPICAL SECTIONS

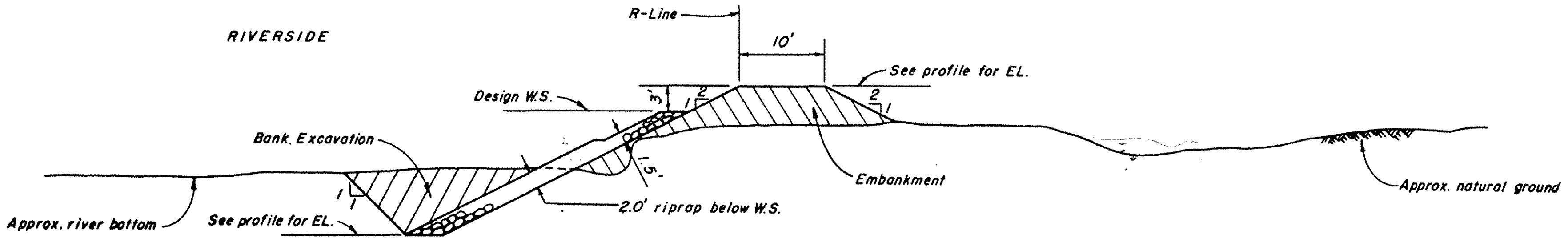
REVIEWED:
CHIEF, SAFETY BRANCH
SUBMITTED: Otto R. Reeme
CHIEF, DESIGN BRANCH
RECOMMENDED: E. C. Granger
CHIEF, ENGINEERING DIVISION

APPROVED: DATE 12 MAR 59
COLONEL, C. E. DISTRICT ENGINEER
SCALE AS SHOWN
INV. NO. ENG. C-60-36
FILE NO.
SHEET 8 OF 10
UR-46-1/8



TYPICAL SECTION

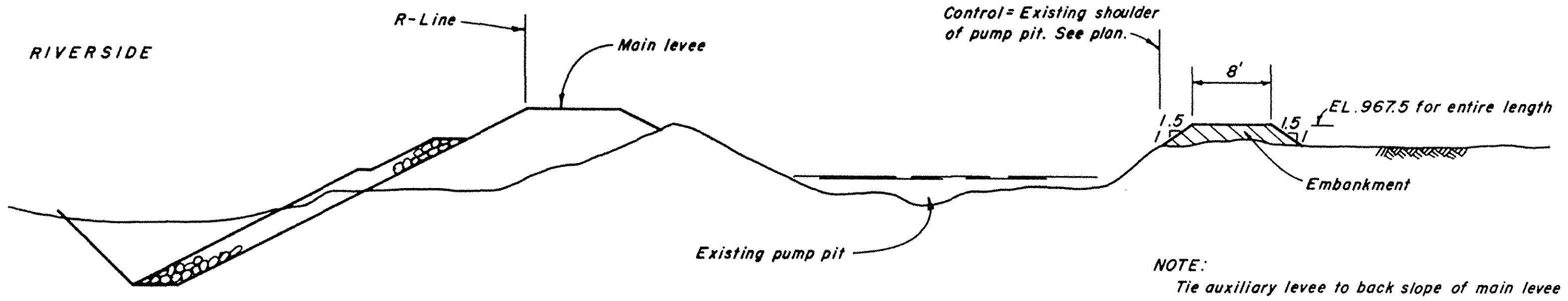
STA. R72+50 TO STA. R73+40±



NOTE:
1. See plan-detail from R133+14 to tie in at R.R. Bridge.
2. Fill on levee section remains same to Sta. 133+18 with riprap transition slope as shown on plan to bridge abutment.

TYPICAL SECTION

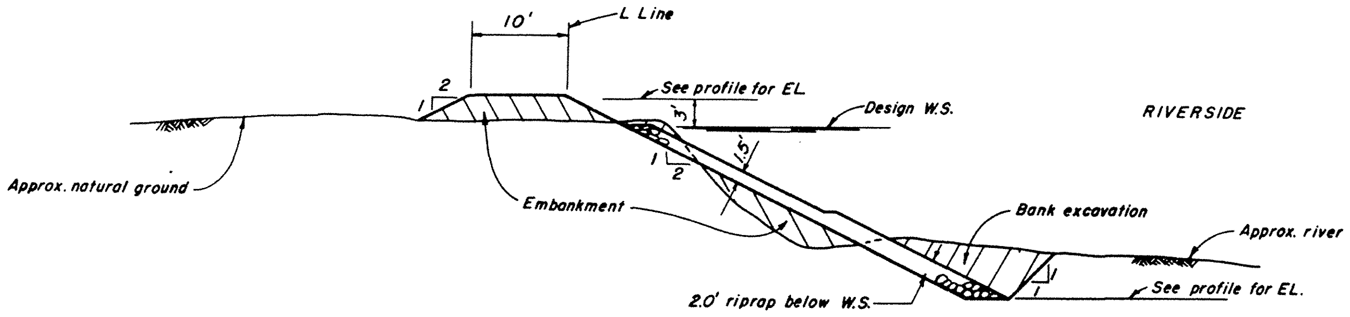
STA. R73+40 TO STA.R133+14



NOTE:
Tie auxiliary levee to back slope of main levee around each end of pump pit. See plan.

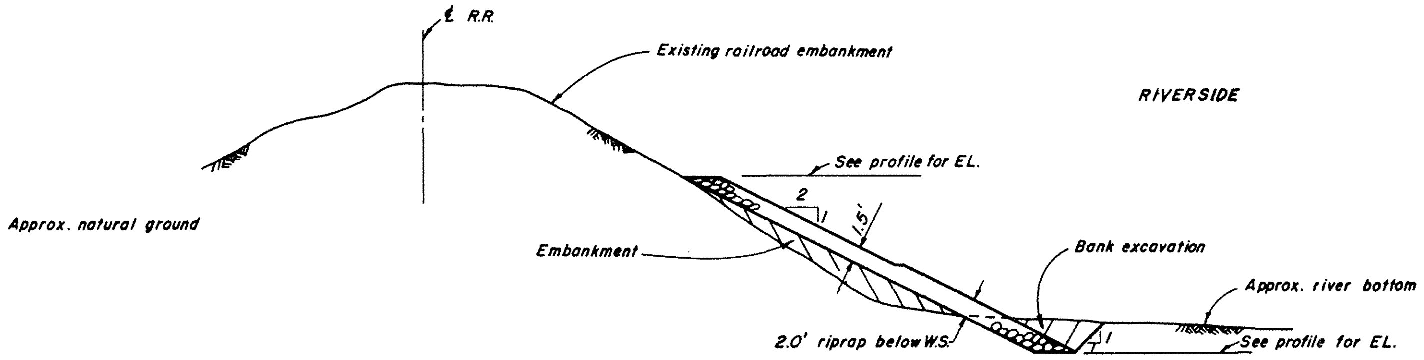
TYPICAL SECTION AUXILIARY LEVEE

STA. R118+20 TO STA. R121+95±



TYPICAL SECTION

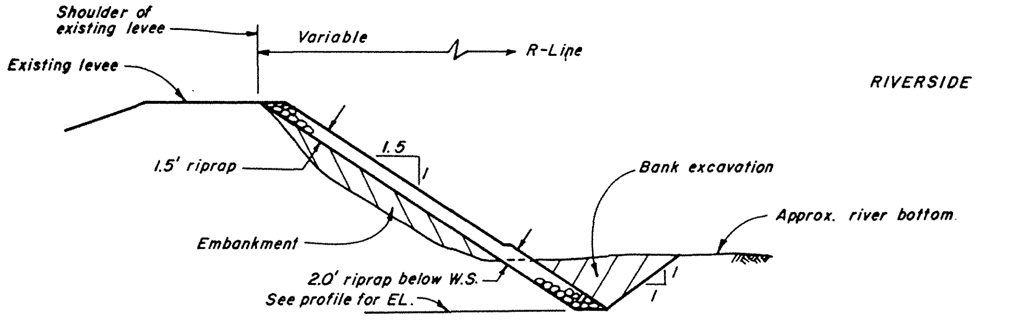
STA. L130+45 TO STA. L 132 + 57±



TYPICAL RIPRAP SECTION ON R.R. EMBANKMENT

STA. L 132+57± TO R.R. BRIDGE ABUTMENT

Note:
Do not extend face of riprap beyond riverward face of R.R. abutment, above approx. river bottom.



TYPICAL SECTION - (REPAIR EXISTING REVETTED LEVEE)

STA. P 154 + 50 TO STA. P 157 + 80
STA. P 161 + 09 TO STA. P 161 + 69

NOTE:
Place 12" gravel blanket under riprap where fine grained foundation materials are encountered.

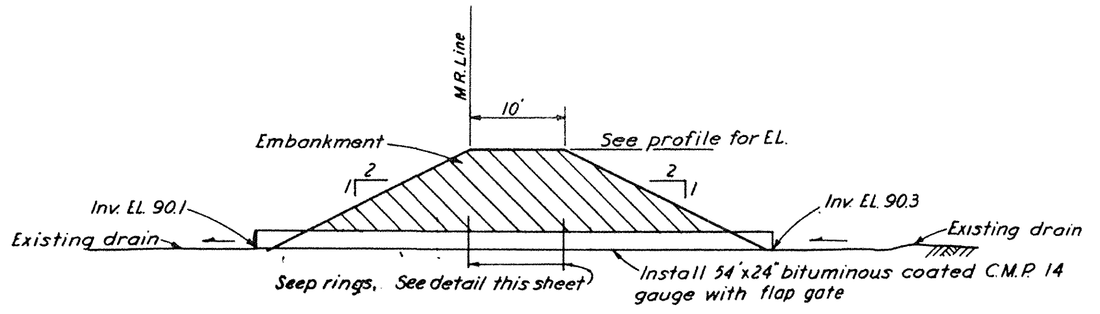
REVISION	DATE	DESCRIPTION	BY
A	24 MAR 60	Revised "R" Stations to "P" Stations	

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, WALLA WALLA, WASHINGTON

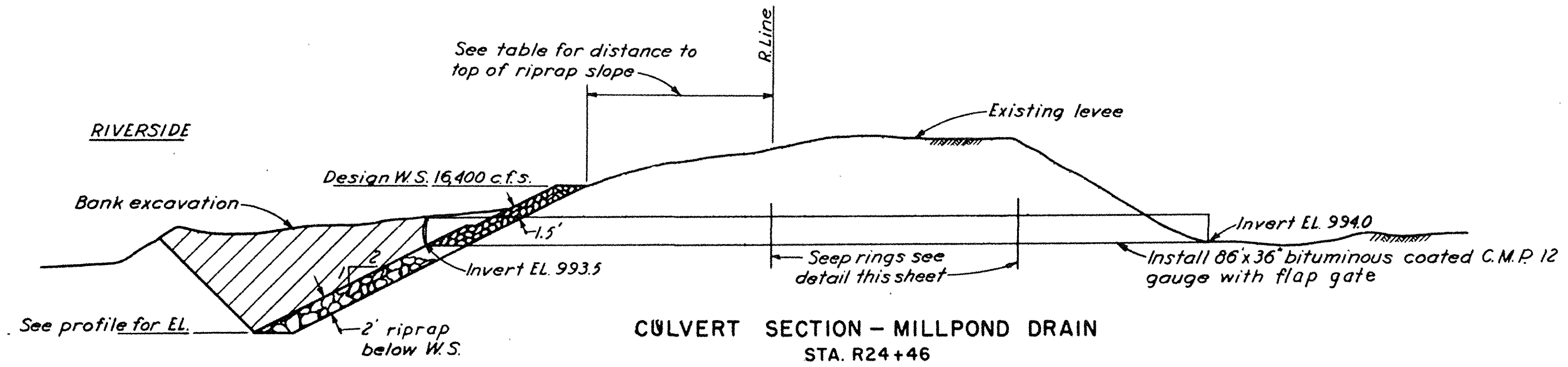
UMATILLA RIVER, OREGON
ZONE 2 LOCATION
LEVEE AND REVETMENT
CONSTRUCTION
TYPICAL SECTIONS

DESIGNED: J.T. Perry
DRAWN: E. Johnson
CHECKED: N. Swanson
PREPARED:
CHIEF, RELOC. & LEVEE SEC.
REVIEWED:
CHIEF, SAFETY BRANCH
SUBMITTED: Otto R. Rinne
CHIEF, DESIGN BRANCH
RECOMMENDED: E. C.
CHIEF, ENGINEERING DIVISION

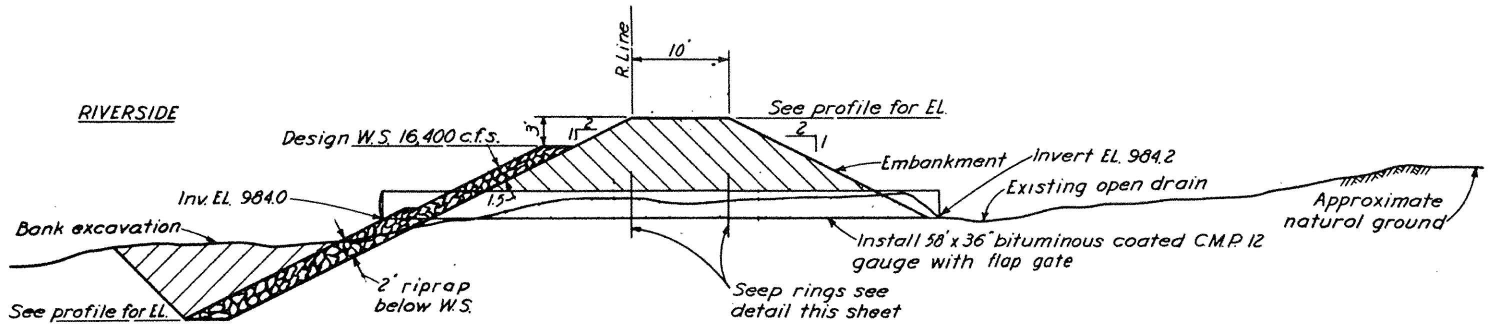
APPROVED: DATE 12 MAR 59
COLONEL, C. E. DISTRICT ENGINEER
SCALE AS SHOWN
INV. NO. ENG. C-60-36
FILE NO. UR-46-1/9
SHEET 9 OF 10



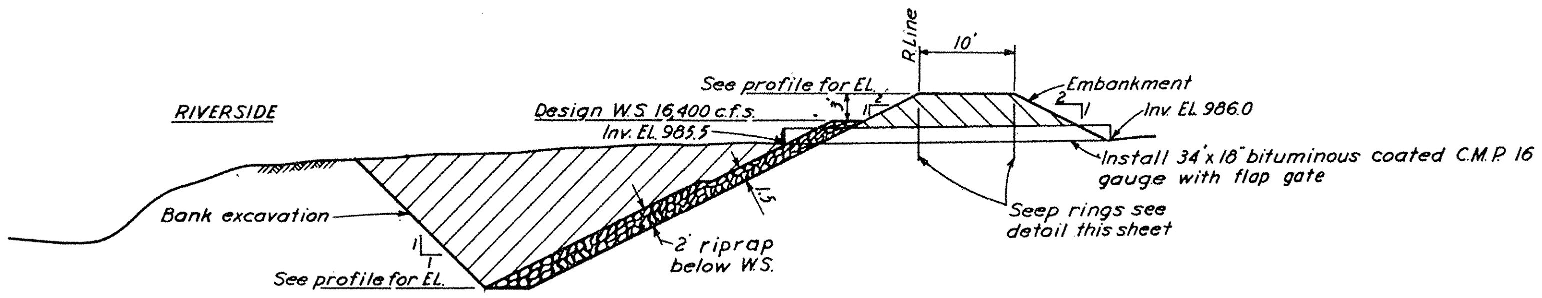
CULVERT SECTION
STA. MR 19+54±



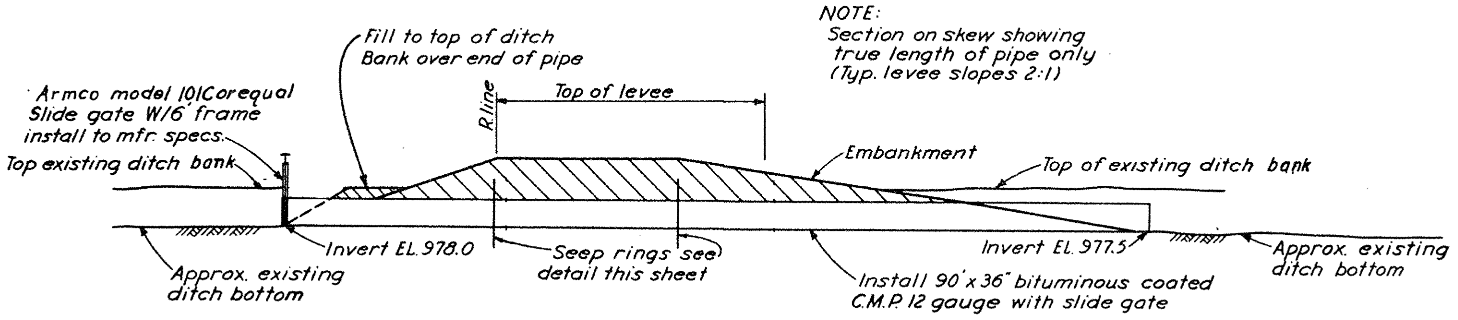
CULVERT SECTION – MILLPOND DRAIN
STA. R24+46



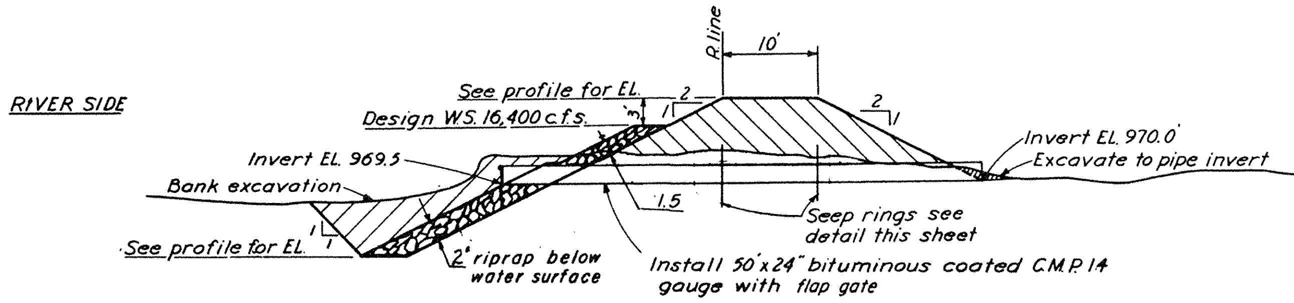
CULVERT SECTION – MILLPOND DRAIN
STA. R49+76



CULVERT SECTION
STA. R58+40

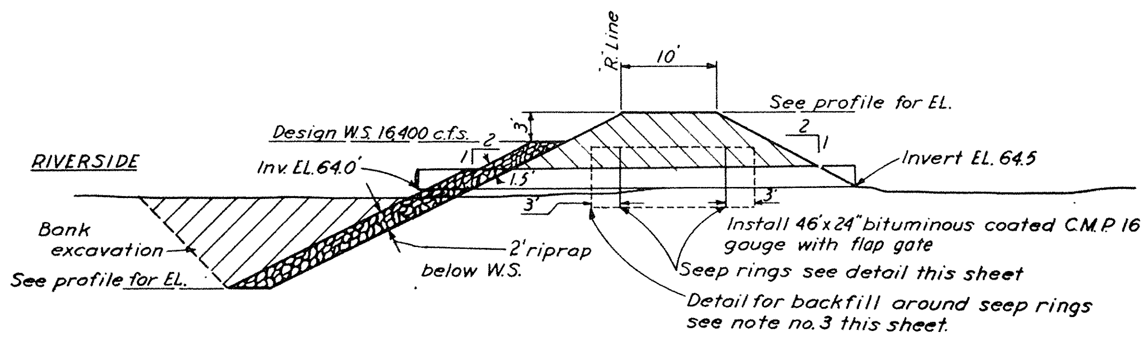


CULVERT SECTION – IRRIGATION INTAKE
STA. R73+06

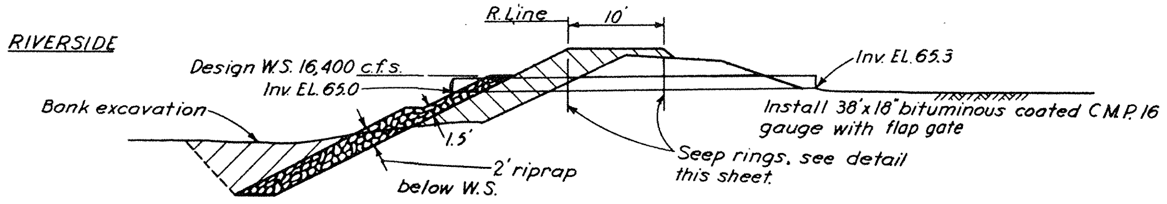


CULVERT SECTION
STA. R89+20

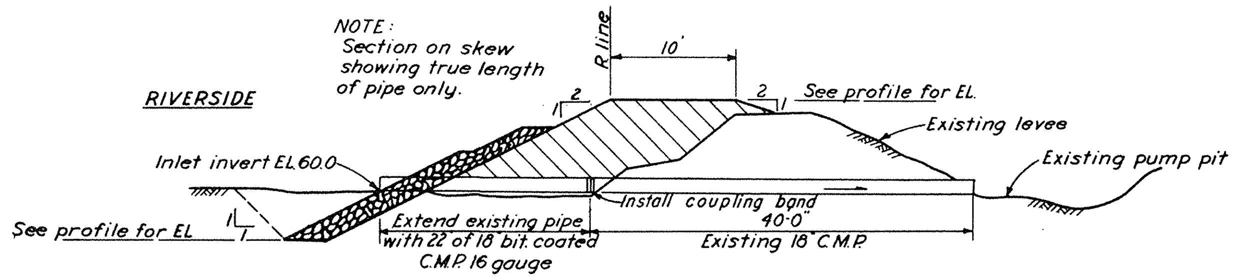
NOT TO SCALE



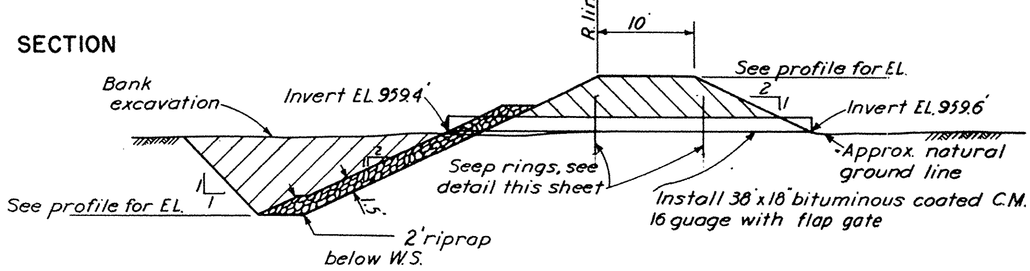
CULVERT SECTION
STA. R 109+80



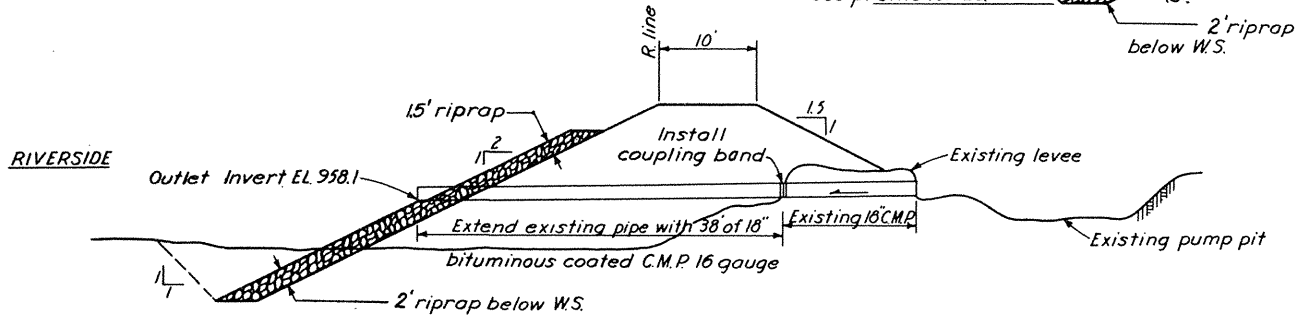
CULVERT SECTION
STA. R 117+75



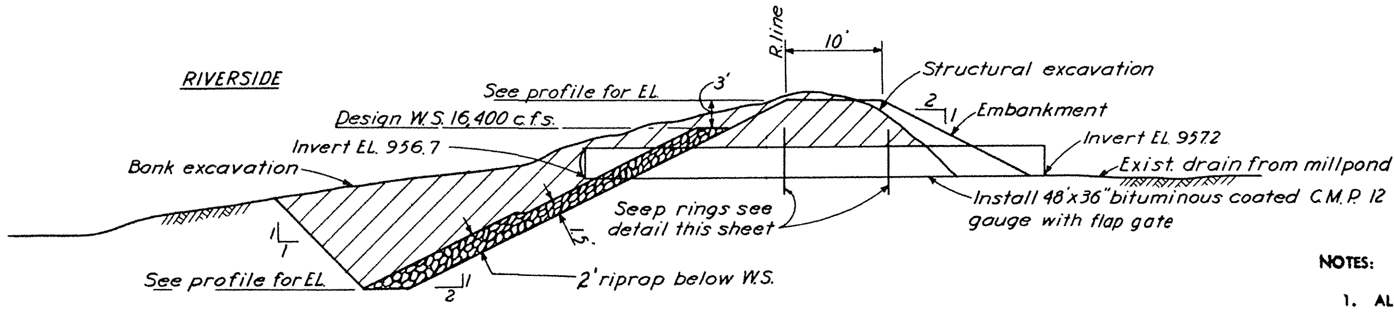
CULVERT EXTENSION SECTION
STA. R118+20±



CULVERT SECTION
STA. R 132+95



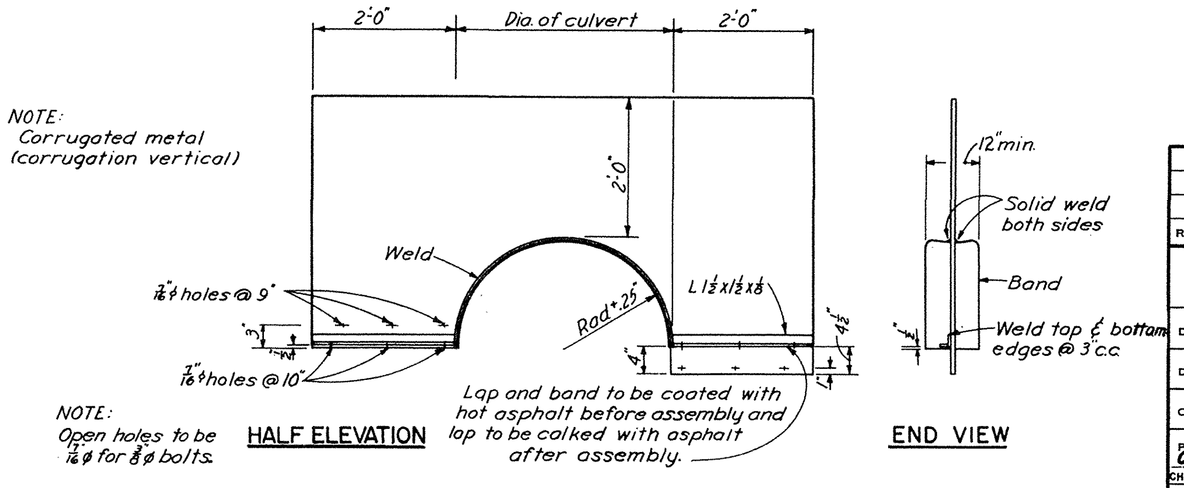
CULVERT EXTENSION SECTION
STA. R121+50±



CULVERT SECTION – MILLPOND DRAIN
STA. R130+55±

NOTES:

1. ALL SEEP RINGS SHALL BE INSTALLED DIRECTLY BELOW THE LEVEE SHOULDERS, OR AS DIMENSIONED OR DIRECTED.
2. ALL AUTOMATIC FLAP GATES, ARMCO MODEL 10C OR EQUAL, INSTALLED TO MFRS. SPECIFICATIONS.
3. ALL C.M.P. SHALL BE BACK FILLED BETWEEN SEEP RINGS AND 3 FEET BEYOND, WITH FINE GRAINED IMPERVIOUS MATERIALS. SEE DETAIL, SECTION, STA. R109+80 (SEE SPECS.)
4. PLACE 12" GRAVEL BLANKET UNDER RIPRAP WHERE FINE GRAINED FOUNDATION MATERIALS ARE ENCOUNTERED.



DETAIL OF SEEP RINGS

REVISION	DATE	DESCRIPTION	BY

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, WALLA WALLA, WASHINGTON

DESIGNED: J.T. Perry
DRAWN: B. Chapman
CHECKED: N. Swanson
PREPARED: Q.W. Welch
CHIEF, RELOC. & LEVEE SEC.

UMATILLA RIVER, OREGON
ZONE 2 LOCATION
LEVEE AND REVETMENT CONSTRUCTION
CULVERT SECTIONS - SEEP RING DETAIL

REVIEWED:
CHIEF, SAFETY BRANCH
SUBMITTED: Otto R. Rumm
CHIEF, DESIGN BRANCH
RECOMMENDED:
CHIEF, ENGINEERING DIVISION

APPROVED:
DATE 12 MAR 59
COLONEL, C. E. DISTRICT ENGINEER
SCALE AS SHOWN
INV. NO. ENG. C-60-36
FILE NO.
SHEET 10 OF 10
UR-46-1/10

VOLUME 2

TETRA TECH

TECHNICAL MEMORANDUM

To: United States Army Corps of Engineers

Cc: Confederated Tribes of the Umatilla Indian Reservation

From: Jeremy Andrews, PE, and Chris James, CWM, CERP (Tetra Tech, Inc.)

Date: July 1, 2025

Subject: Volume 2 – Pendleton 2a Levee Setback Hydrologic and Hydraulic Analyses

1. Introduction

This technical memorandum is being provided by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Tetra Tech, Inc. (Tetra Tech) to the U.S. Army Corps of Engineers (USACE). It is intended to be a continuance of the USACE Section 408 process and review of UmaBirch In-Stream Design and Construction Oversight Project (the Project). The Project has been identified by the USACE as request #FY19-NO46 and is linked to the nationwide permit NWP-2019-489. The Project is associated with the USACE Pendleton 2a Levee which is listed in the USACE National Levee Database as System ID# 500500041 (USACE, 2022a). The purpose of the Project is to restore floodplain connectivity and natural riverine processes, while maintaining the function of the Pendleton 2a Levee. The USACE Section 408 review is requested because the Project proposes to setback a portion of the Pendleton 2a Levee downstream of Birch Creek Road located near Rieth, Oregon, in order to achieve the purpose of the Project.

This technical memorandum provides the Hydrologic and Hydraulic (H&H) Analyses for the Project to document available hydrologic information and hydraulic performance, which was utilized in the hydraulic evaluation of the without-Project condition (defined as existing Project conditions with the current Pendleton 2a Levee) and the with-Project condition (defined as proposed Project conditions with a levee setback). The Project is located on the Umatilla River from river mile (RM) 48.7 to RM 49.7 and Birch Creek from RM 0.0 to RM 0.3. The Project is part of a larger series of project’s being proposed by the CTUIR and Bonneville Power Administration (BPA) located downstream on the Umatilla River and upstream on Birch Creek. To provide a phased construction approach based on funding, hydrology and geomorphology, and anticipated environmental permitting requirements, all project actions being proposed by the CTUIR and BPA, have been separated into four distinct project areas. Of these project areas, the USACE Pendleton 2a Levee is located within Project Area 2 (PA 2).

This technical memorandum is Volume 2 of 7. Combined, the volumes assist in documenting historic conditions, existing data, and analyses necessary to demonstrate that the proposed Project will not adversely impact the

Pendleton 2a Levee system. Specific to Volume 2, Tetra Tech has concluded that Pendleton 2a Levee proposed setback design in the Project design (see Attachment 1) is necessary to protect Birch Creek Road and the interior drainage area east of Birch Creek Road for the with-Project conditions and to maintain the current authorized flood protection.

2. Purpose

The purpose of this technical memorandum is to document available hydrologic information and to utilize the available hydrology and information from Volume 1 – Pendleton 2a Levee Setback Existing Data Review and Levee Reconstruction Analysis to perform hydraulic analyses. The specific hydraulic analyses include evaluating the without-Project condition (defined as existing Project conditions with the current Pendleton 2a Levee) and the with-Project condition (defined as proposed Project conditions with a levee setback). In December 2021, representatives of the USACE, BPA, CTUIR, and Tetra Tech met to discuss the Pendleton 2a Levee and the scope of work for the Project and Section 408 review process. As a part of that meeting, and to support the Section 408 process, the USACE requested that the CTUIR and Tetra Tech reconstruct the historical Pendleton 2a Levee (see Volume 1) and utilize that information to evaluate the without- and with-Project conditions.

2.1 Background

The Project proposes modifications to a section of the existing Pendleton 2a Levee located along the south bank of the Umatilla River. The Pendleton 2a Levee (segment ID: 5004430001) is identified in the USACE National Levee Database as part of the Pendleton Zone 2 Flood Damage Reduction (FDR) Project, which is a federally authorized and constructed, and non-federally operated and maintained levee system (USACE, 2022). Volume 1 – Pendleton 2a Levee Setback Existing Data Review and Levee Reconstruction Analysis provide detailed information regarding the historic (i.e., 1959 levee) and current conditions associated with the Pendleton 2a Levee system. Utilizing Volume 1, the USACE guidance and supporting material (see Section 2.2 below), along with the hydrologic data described in Section 3 below, hydraulic analyses were completed in support of evaluating the without- and with-Project conditions (see Section 4 below).

2.2 USACE Materials

The guidance and supporting USACE materials utilized in this analysis include:

- EM 1110-2-1419: Hydrologic Engineering Requirements for Flood Damage Reduction Studies
- EM 1110-2-1418: Channel Stability Assessment for Flood Control Projects
- EM 1110-2-1417: Flood Runoff Analysis
- EM 1110-2-1415: Hydrologic Frequency Analysis
- ER 1110-2-1450: Hydrologic Frequency Estimates

Throughout this technical memorandum, the H&H analyses reference the following volumes:

- Volume 1 – Pendleton 2a Levee Setback Existing Data Review and Levee Reconstruction Analysis
- Volume 3 – Pendleton 2a Levee Setback Interior Drainage Analysis
- Volume 4 – Pendleton 2a Levee Setback Design and Analysis

3. Hydrologic Analysis

The purpose of this section is to summarize the available hydrologic data and analyses performed, including review of available streamgage and historical storm data as well as determination of the authorized flood for the existing Pendleton 2a Levee.

3.1 Streamgage Data

Streamgage data were evaluated to develop peak flows for the Umatilla River and Birch Creek at the Project location, which has a drainage area of 913 square miles. Peak flows were evaluated for the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year return periods. The Oregon Water Resources Department (OWRD) Peak Discharge Estimation Mapping Tool was utilized to identify nearby streamgages on both bodies of water. The ratio of the ungaged Project area to the gaged site was then computed to determine the suitability of the streamgage for use in the computation of a gage transfer using procedures described by Thomas et al. (1994), Sumioka et al. (1998), and Cooper (2006).

For estimating flows in the Umatilla River, the USGS gage 14026000, Umatilla River at Yoakum, Oregon, has a period of record of 88 years and a drainage area of 1270 square miles (USGS, 2022a). The ratio of the ungaged to gaged site drainage area is 0.94, which is within the suitable range of 0.5-1.5 for a gage transfer (Thomas et al., 1994, Sumioka et al., 1998, and Cooper, 2006). Peak flows for the Umatilla River at the Project location were then computed using the gage transfer method.

Similarly, USGS gage 14025000, Birch Creek at Rieth, Oregon, was identified for use in estimating peak flows for Birch Creek at the Project site. This gage has a period of record of 47 years, a drainage area of 291 square miles, and is located within the Project area near the Taylor Lane Bridge (USGS, 2022b).

The Yoakum gage is downstream of the Project site and the confluence of the Umatilla River and Birch Creek. As a result of its location, its historic record accounts for the combination of Birch Creek and Umatilla flows. In order to model the Project and the confluence correctly, the Birch Creek flows were subtracted from the results of the Yoakum gage transfer method. The peak flows for the Umatilla River and Birch Creek that were utilized in the hydraulic model are summarized in Table 3-1.

Table 3-1. Umatilla River and Birch Creek Peak Flows

Return Period (years)	Peak Flow (cubic feet per second)	
	Umatilla River	Birch Creek
2	5,667	573
5	8,790	1,090
10	11,330	1,570
25	15,240	2,360
50	18,550	3,050
100	22,300	3,800

3.2 Authorized Flood

The authorized flood for the USACE Pendleton 2a Levee has been determined to be between the 25- and 50-year recurrence interval for the Umatilla River at approximately 16,400 cfs (see Volume 1). The return periods and associated peak flow values, Table 3-1, were graphed with a best fit nonlinear curve to identify a recurrence interval equal to 16,400 cfs on the Umatilla River. It was determined that 16,400 cfs is approximately the 27-year recurrence interval on the Umatilla River. Likewise, the return periods and associated peak flows, Table 3-1, were graphed with a best fit nonlinear curve to identify the 27-year recurrence interval for Birch Creek. It was determined that 2,650 cfs is approximately the 27-year recurrence interval for Birch Creek. Therefore, throughout this analysis, the authorized flood includes flow values of 16,400 cfs and 2,650 cfs for the Umatilla River and Birch Creek, respectively.

4. Hydraulic Analysis

The purpose of this section is to discuss the hydraulic analyses of the without-Project (existing) and with-Project (proposed) conditions at the location of the existing Pendleton 2a Levee.

4.1 Without-Project Conditions

To evaluate the with-Project conditions, a detailed 2-Dimensional (2-D) model using GeoHECRAS version 4.1 was generated for existing conditions, which combines Geographic Information Systems (GIS) and Hydraulic Engineering Center – River Analysis System (HEC-RAS) version 6.3 software (USACE, 2022b) into one user interface for efficient task management. Model inputs included a topographic surface, land use information, and upstream and downstream boundary conditions based on the hydrologic analysis discussed in Section 3 above. Surface development is discussed in Volume 1, the final surface was inserted into the model to represent the without-Project conditions.

To develop land use inputs, the geolocation feature in GeoHECRAS was utilized to overlay an aerial map on the Project extents, and a land cover file was generated for Manning's roughness values that generally follow recommendations provided by Chow (1959) as well as professional experience and judgment based on site conditions. The existing channel roughness was estimated to be 0.04 based on site reconnaissance and engineering judgement. Table 4-1 summarizes the Manning's roughness values by land use type for the without-Project condition.

Table 4-1. Without-Project Manning's Roughness Values

Land Use/Land Cover	Manning's n Value
Shrub/Scrub	0.060
Road	0.020
Agriculture	0.035
Developed	0.100
Channel	0.040
Forested	0.080

Up- and downstream boundary conditions were established in the model based on the hydrologic data review (see Section 3 above). The upstream boundary conditions were determined by the authorized flood for the Umatilla River (16,400 cfs) and Birch Creek (2,650 cfs) estimated as the 27-year recurrence interval (Section 3.2 above). For the downstream boundary condition located downstream of the Project, normal depth representing the energy slope of the Umatilla River at the downstream extent was utilized.

Following the input of all geometry and hydraulic parameters, an unsteady flow analysis was computed to validate the model based on the authorized flood WSE against the Pendleton 2a Levee top elevation. Figure 4-4 in Volume 1 depicts 3 feet of freeboard from the WSE generated from the authorized flood and the top elevation of the Pendleton 2a Levee. Figure 4-1 below illustrates the without-Project authorized flood modeling results against the Pendleton 2a Levee top elevations. Results indicate an average difference of 3.2 ft. (ranges from 4 ft. to 2.4 ft.) matching up strongly with Figure 4-4 in Volume 1.

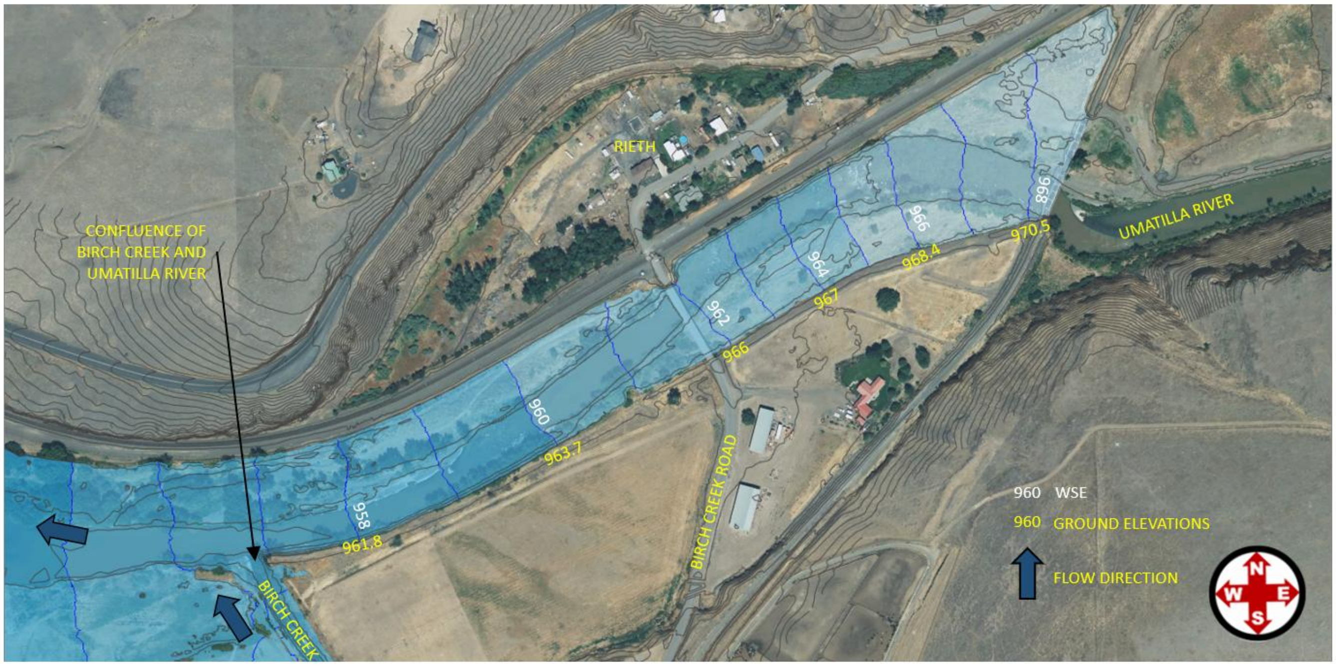


Figure 4-1. Authorized Flood WSE vs Pendelton 2a Levee Top Elevations

4.2 With-Project Conditions

Based on the without-Project conditions, a design for the Project area was developed that includes the levee setback conditions as well as modifications to the Umatilla River channel to realign it into historic meanders. Proposed designs are provided in Attachment 1 and an overview of the Pendleton 2a Levee setback is shown in Figure 4-2 below. Design and evaluation of the proposed setback levee is discussed further in Volume 4 and the interior drainage analysis is included in Volume 3.

To evaluate the with-Project conditions, inputs discussed in Section 4.1 above were modified for the proposed levee setback. This includes the modification of the existing surface as well as the land cover inputs to account for the levee setback condition and other channel modifications. Table 4-2 summarizes the Manning’s roughness values by land use type for the with-Project condition.

Table 4-2. With-Project Manning's Roughness Values

Land Use/Land Cover	Manning's n Value
Shrub/Scrub/Levee/Island	0.060
Road	0.020
Agriculture	0.035
Developed	0.100
Channel/Pond	0.040
Forested	0.080
Floodplain/Wetlands	0.050

Features such as large wood structures and boulder clusters were inserted into the model to represent the habitat features associated with the restoration design. Engineered large wood structures were stamped into the modeling terrain based on the dimensions of the structure. Roughness regions were added at each large wood structure location to represent local roughness generated by the wood, a Manning's n value of 0.075 was selected for each large wood structure. Likewise, roughness regions were added at locations of boulder clusters, a Manning's n value of 0.065 was selected for each boulder cluster.

The model was then rerun for the authorized flood and the results were compared to the without-Project condition, as discussed in Section 5 below.

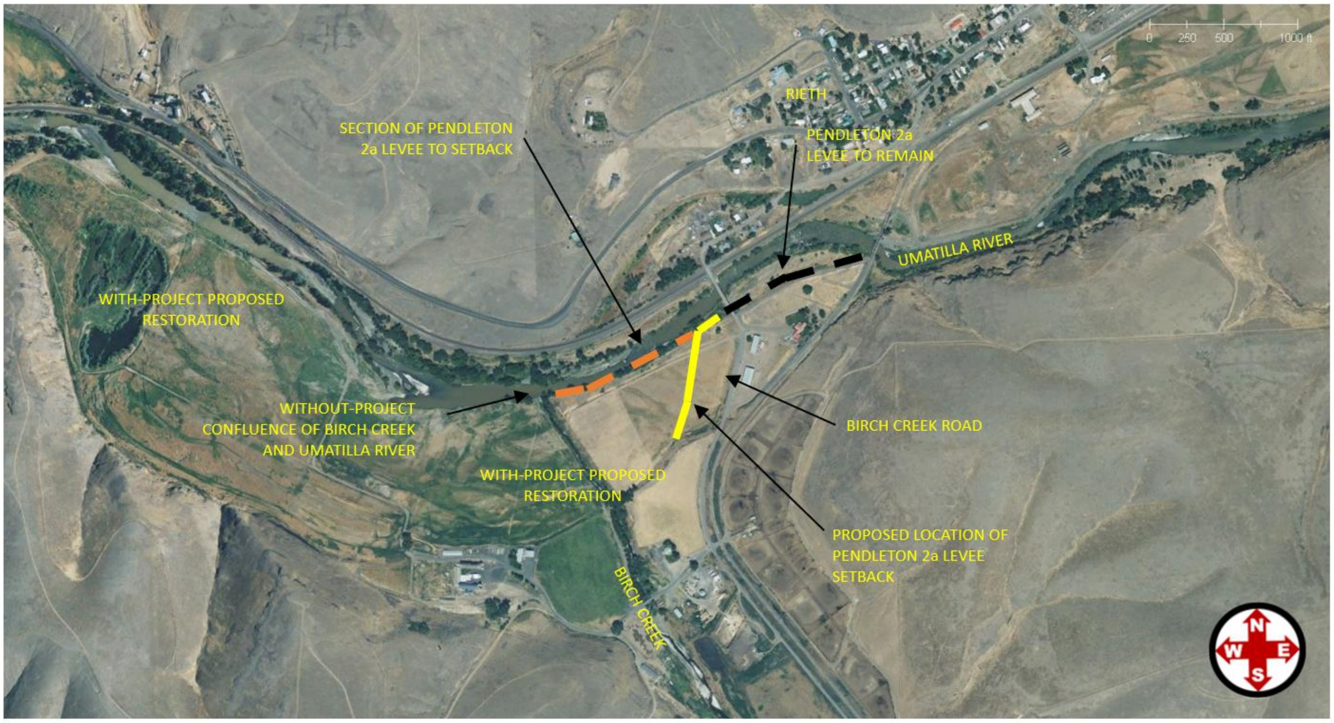


Figure 4-2. Overview of the Without- and With-Project Conditions of Pendleton 2a Levee

4.3 Sensitivity Analysis

A sensitivity analysis utilizing changes in roughness was performed. Without- and with-Project model simulations were repeated with both higher and lower roughness values (see Table 4-3 and Table 4-4) to evaluate model sensitivity to roughness. Results of the sensitivity analysis are provided as Attachments 3 and 4.

Table 4-3. Without-Project Manning's Roughness Values by Land Use

Land Use/Land Cover	Manning's n Value	Higher Manning's n Value	Lower Manning's n Value
Shrub/Scrub	0.060	0.070	0.050
Road	0.020	0.025	0.015
Agriculture	0.035	0.045	0.025
Developed	0.100	0.120	0.080
Channel	0.040	0.050	0.030
Forested	0.080	0.090	0.070

Table 4-4. With-Project Manning's Roughness Values by Land Use

Land Use/Land Cover	Manning's n Value	Higher Manning's n Value	Lower Manning's n Value
Shrub/Scrub/Levee/Island	0.060	0.070	0.050
Road	0.020	0.025	0.015
Agriculture	0.035	0.045	0.025
Developed	0.100	0.120	0.080
Channel/Pond	0.040	0.050	0.030
Forested	0.080	0.090	0.070
Floodplain/Wetlands	0.050	0.060	0.040

5. Results

The purpose of this section is to discuss the results of the hydraulic analysis of the without- and with-Project conditions at the location of the existing Pendleton 2a Levee. Specific results include water surface elevations (WSEs) at the levee location and Birch Creek Road as well as velocities, hydraulic loading, and rating curves. The results of the authorized flood are discussed in the following sections. Without- and With-Project Authorized flood water surface elevations are shown in Figure 5-1 below. Without- and With-Project Authorized flood water velocities are shown in Figure 5-1 below. Water surface elevations for the 2-year, 10-year, and 25-year peak flows for the without-Project conditions compared to the with-Project conditions can be found in Figure 5-6 below.

5.1 Water Surface Elevations

A comparison of inundation depths between without-Project conditions and with-Project conditions is shown in Figure 5-1. To achieve the Project objectives, the modifications will decrease flow capacity of the existing Umatilla River main channel and will increase the inundation depths in the Umatilla River and Birch Creek floodplains (see Figure 5-1, white annotation are water surface elevations and yellow annotations are ground elevations). Overall results show that the inundation extents from without-Project to with-Project will be maintained in the Project area; however, floodplain inundation depths will be increased near Birch Creek Road.

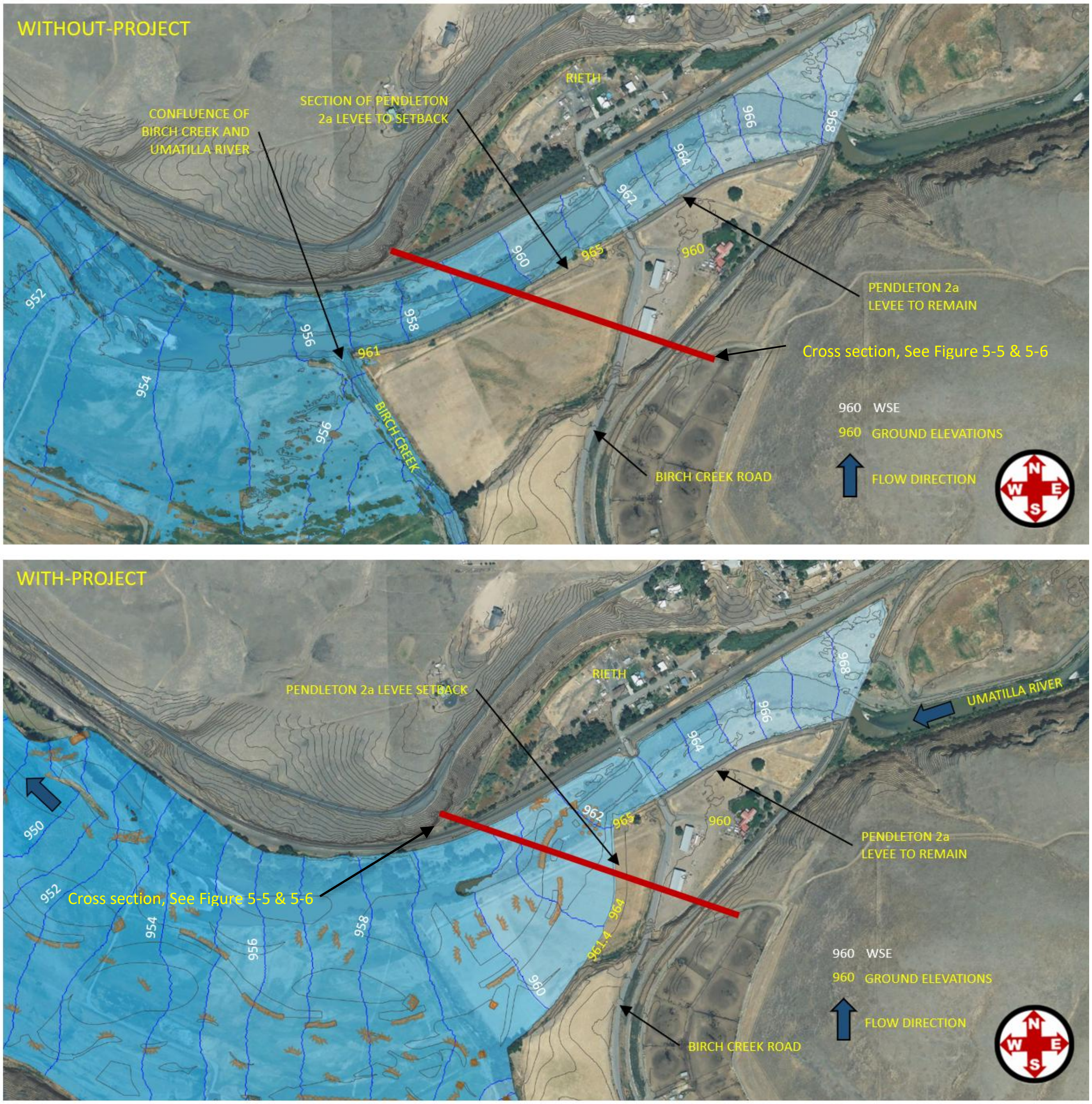


Figure 5-1. Without- and With-Project Conditions Authorized Flood WSE (see Figure 5-5 for Cross Section)

5.1.1 Birch Creek Road

The purpose of the Project is to restore floodplain connectivity and natural riverine processes, while maintaining the function of the Pendleton 2a Levee. To convert the Project area from a primarily agricultural use into a conversation easement based on the purpose of the Project, the proposed with-Project conditions are necessary. Specifically, because the floodplain water surface elevations will be increased near Birch Creek Road, the proposed Pendleton 2a Levee setback will be necessary to protect Birch Creek Road and adjacent private property. As a result, the design focused on the proposed setback levee confining the authorized flood to the without-Project floodplain extents. Figure 5-1 above illustrates these results.

5.1.2 Existing Pendleton 2a Levee System

The existing Pendleton 2a Levee system upstream of the proposed channel modification will see little to no change in the inundation extents with the implementation of the setback levee under the with-Project conditions. Depths in the existing main channel of the Umatilla River will increase slightly; however, the levee system confines the authorized flood to the without-Project extents and will maintain protection of Birch Creek Road, the Birch Creek Road Bridge, and the adjacent private property. Although the depths do increase under the authorized flood with-Project conditions, velocities decrease along the Pendleton 2a Levee system (see Section 5.2 below). As a result, the proposed Project will not adversely impact the Pendleton 2a Levee system because it confines the authorized flood to the without-Project extents and decreases velocities along the upstream portions of system. See Section 5.2 below for velocities along the exiting Pendleton 2a Levee system.

5.1.2 With-Project Pendleton 2a Levee Overflow Relief

The proposed with-Project Pendleton 2a Levee setback conditions will create an interior drainage area between the with-Project Pendleton 2a Levee and Birch Creek Road. The new internal drainage area is hydraulically connected, via two existing culverts under Birch Creek Road, to an existing interior drainage area defined by Birch Creek Road, a Union Pacific Railroad embankment, and the existing Pendleton 2a Levee to remain in place. The existing interior drainage area is on private property and is not a part of the Project. The existing interior drainage area has recently experienced flooding from an uncontrolled discharge where the Birch Creek Road culverts failed, inundating the interior drainage area, and overtopped Birch Creek Road.

The crest elevations and extents of the with-Project Pendleton 2a Levee overflow relief shall not adversely impact the interior drainage areas to the east of the Project. As the Umatilla River experiences flooding conditions, the design includes gravity drains through the Pendleton 2a Levee setback equipped with check valves to prevent floodwaters from entering the with-Project interior drainage area from the Umatilla River. The uncontrolled discharge from upstream flooding into the interior drainage area overtops Birch Creek Road and the overtopping relief section of the proposed levee setback and does not increase flooding to the habitable structure located within the interior drainage area.

The overflow relief section of the proposed setback levee has a crest elevation to allow for the interior drainage to flow to back to the Umatilla River floodplain during large flow events. This crest elevation does not meet +3-feet above the authorized flood water surface elevation requirement. However, hydraulic modeling of the overflow relief during the authorized flood and of the interior drainage area shows that the risk of flooding into the interior drainage areas due to the overflow relief is minimal. The modeling indicates that the authorized flood water surface elevations are still below the overflow relief crest and the Umatilla River has access to a much wider floodplain, and as a result a much smaller response to increase in floodplain elevation to flood flow. The without-and with-project conditions, uncontrolled discharge documentation, and hydrologic and hydraulic analysis of the interior drainage areas are discussed in detail in Volume 3.

5.2 Velocities

A comparison of velocities between the without-Project and with-Project conditions is shown in Figure 5-2. Based on the comparison results, the with-Project creates an overall decrease in velocities in the main channel of the Umatilla River and Birch Creek by decreasing main channel flow capacity and increasing floodplain inundation (Tetra Tech, 2022). In addition, the Project modifications decrease velocities overall while providing a great various in velocities in the floodplain. The same decrease in velocities can be found along the Pendleton 2a Levee system upstream of the proposed levee setback (See Figure 5-2).

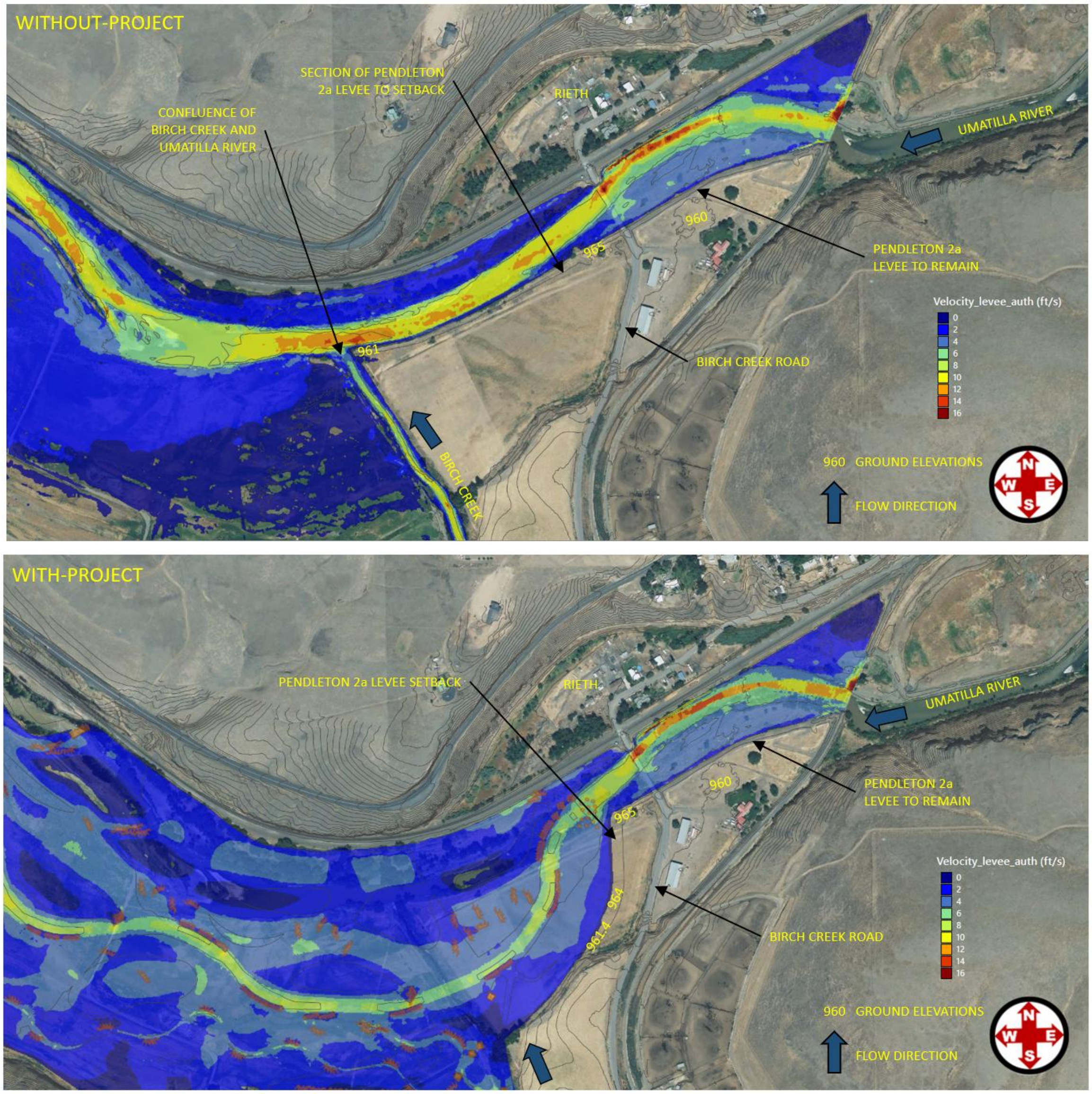


Figure 5-2. Without- and With-Project Conditions Authorized Flood Velocities

5.2.1 Riprap Design

With-Project condition velocities were utilized to design riprap revetment for the proposed levee setback. Oregon Department of Transportation Hydraulics Design Manual (ODOT Manual) Chapter 15 (ODOT, 2014) velocity-based riprap design chart was utilized to size the riprap. See Figure 5-3 for ODOT Riprap sizing chart.

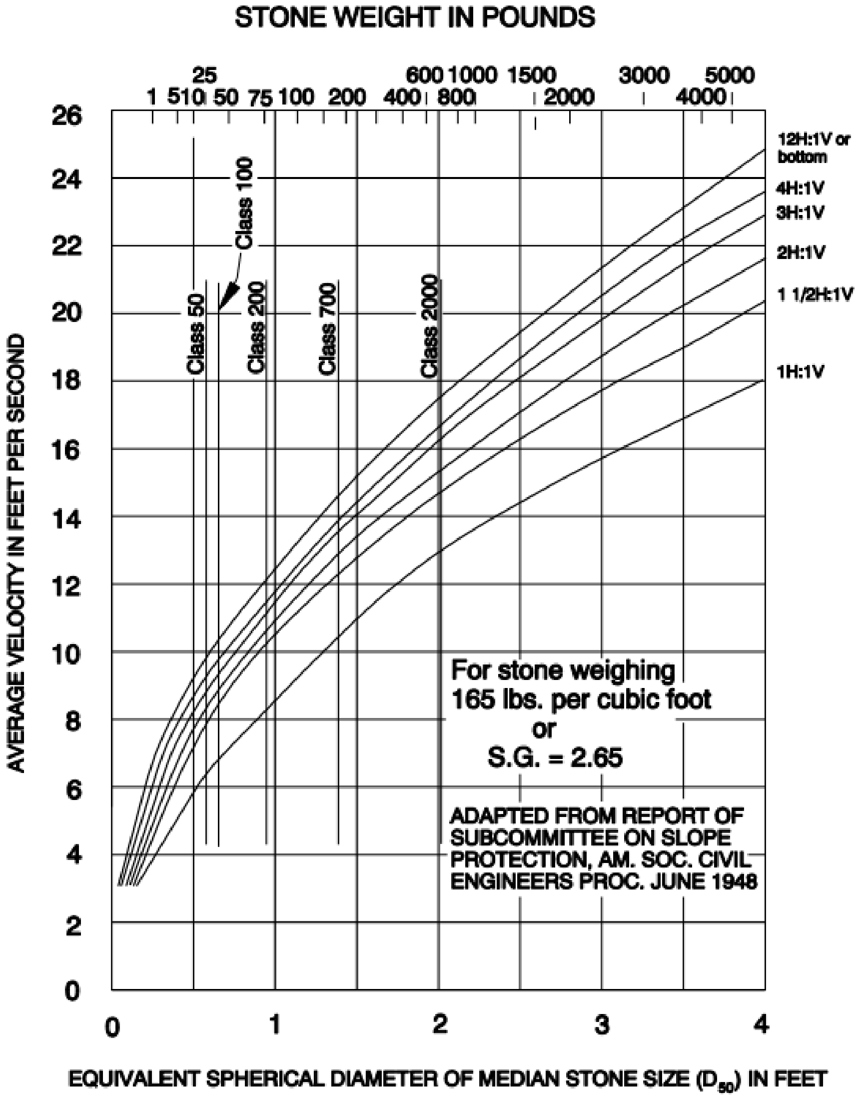


Figure 5-3. ODOT Velocity Based Riprap Sizing Chart

Authorized flood velocities along the riverside face of the setback levee are up to 2 feet per second (Figure 5-2). The slope of the riverside face of the setback levee is six horizontal to one vertical (i.e., 6H:1V). A riprap protection would not be required per ODOT Manual for the proposed side slope and with-Project condition velocities. However, ODOT Class 200 was selected for riprap revetment to accommodate future conditions that may result in higher than the authorized flood velocities.

For the overflow relief protection riprap sizing, the design velocities are based on 100-year recurrence interval where the interior drainage area is inundated and the levee's primary outlets flap gates are closed to prevent inflow from the 100-year floodwaters and the overflow relief is discharging flow to the Umatilla River floodplain (See Volume 3 – Interior Drainage Analysis, for a detailed description of the hydrologic and hydraulic analysis). Under this scenario, the velocities at the overflow relief are in the range of 0.2 – 3.0 feet per second (See Figure 5.4 -100-Year Flood Velocities at Pendleton Levee 2a Setback Overflow Relief). This scenario is similar to stream barbs describe in the ODOT Manual, where the barb is projected out across the thalweg with flow passing over perpendicular to the centerline axis. In this scenario, the ODOT Manual recommends doubling the rock size obtain in Figure 5-3. Based on the velocities for a bottom slope and doubling of rock sizing in the design chart, Class 50 riprap will be placed as protection in the overflow relief.

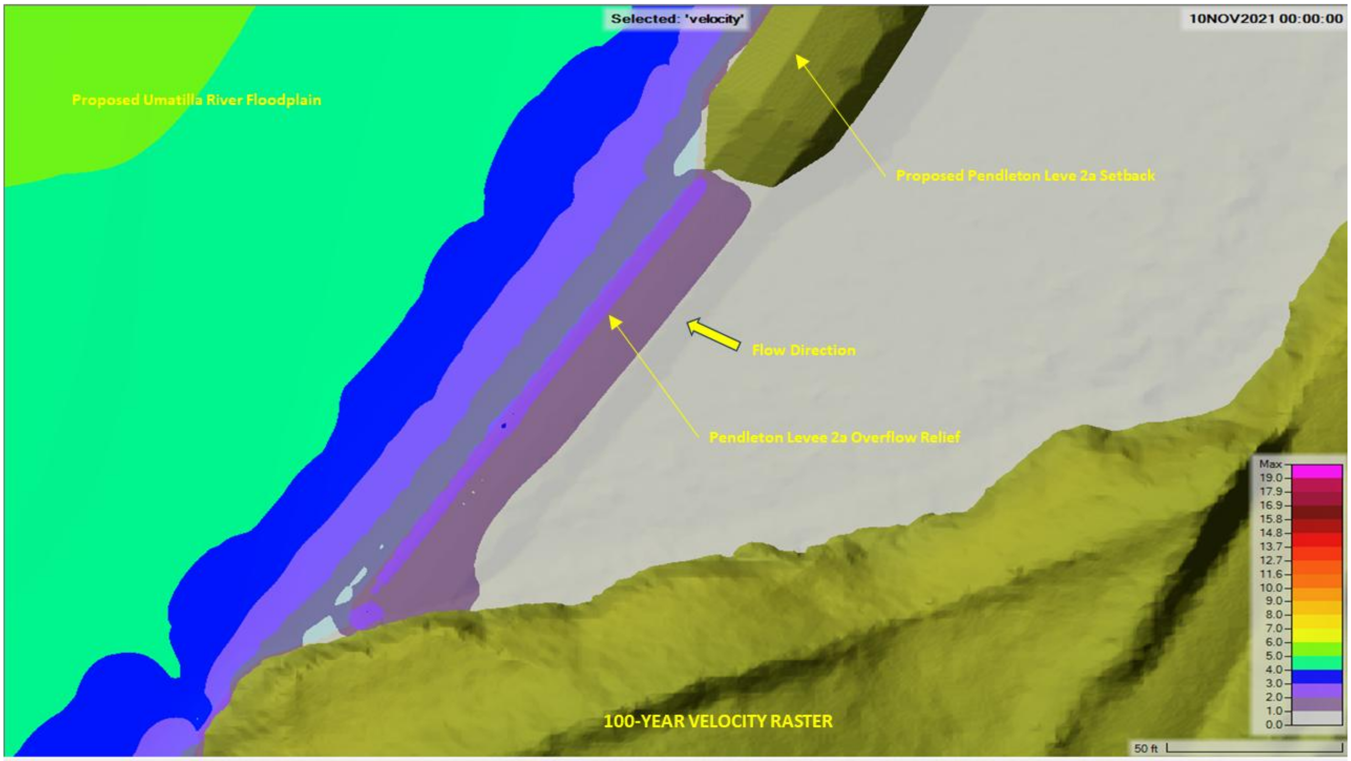


Figure 5-4. 100-Year Flood Velocities at Pendleton Levee 2a Setback Overflow Relief

5.3 Hydraulic Loading

Hydraulic loading for the without- and with-Project conditions under the authorized flood is presented in Figures 5-5 and 5-6. Figure 5-5 shows a representative cross sectional-view of the authorized flood water surface elevation along the proposed levee setback, at the location indicated on Figure 5-1. At this location, the proposed levee setback crest elevation is 964.6 feet[1] and the water surface elevation is 961.6 feet, indicating that the levee is not overtopped at the authorized flood and 3 feet of freeboard is maintained.

Figure 5-6 shows the elevation profile along the proposed levee setback crest and along a parallel profile for the authorized flood water surface. Elevations along the proposed levee crest range from 965.3 feet at the upstream end of the levee crest (i.e., Construction Point 216, Sheet C-202, Attachment 1) to 964.2 feet at the downstream end of the crest before the overflow relief section (i.e., Construction Point 215, Sheet C-202, Attachment 1). Water surface elevations immediately adjacent and parallel to the proposed levee setback crest range from 962.3 feet at the upstream end to 961.0 feet at the downstream end. The dotted line on Figure 5-6 shows represents 3 feet of freeboard above the authorized flood water surface elevation; this demonstrates that 3 feet of freeboard is maintained along the proposed levee setback alignment (excluding the overflow section) during the authorized flood.

As shown in the figures and discussed in Section 5.1, the levee setback is not overtopped during the authorized flood. Hydraulic loading results, and an evaluation of interior drainage and the levee setback design, are discussed in further detail in Volumes 3 and 4, respectively.

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[1] The vertical datum for all elevations in this section is NAVD88.

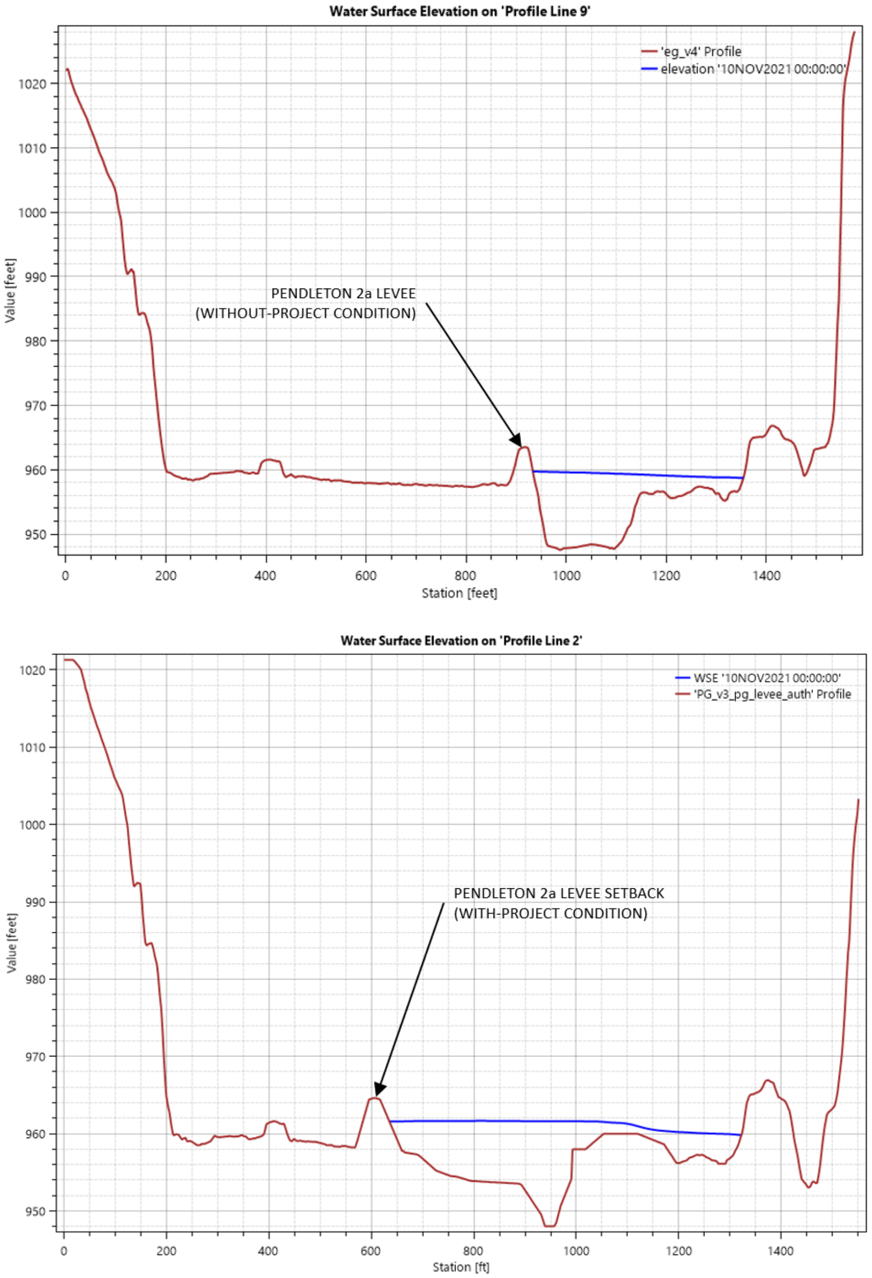
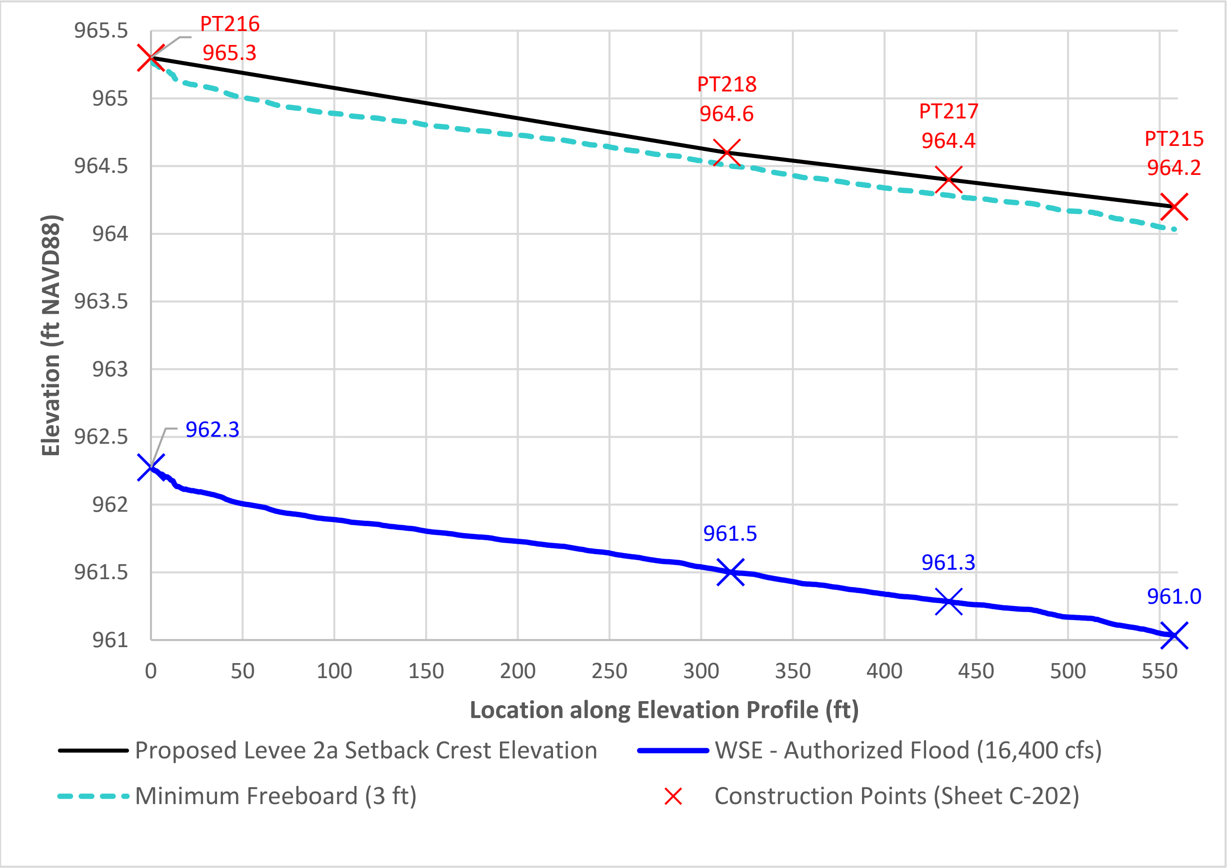


Figure 5-5. Without- and With-Project Conditions Authorized Flood at Location of Levee

(a)



(b)

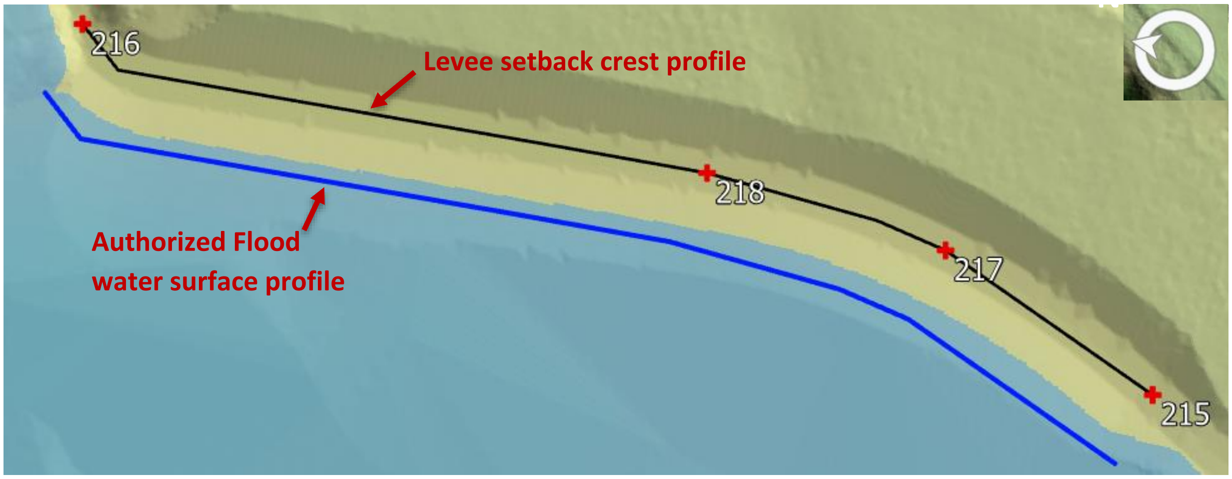


Figure 5-6. (a) Elevation Profile along Proposed Levee Setback Crest and Adjacent Water Surface
(b) Location of Elevation Profile Lines

5.4 Rating Curves

As discussed in section 5.1, the purpose of the Project is to restore floodplain connectivity and natural riverine processes, while maintaining the function of the Pendleton 2a Levee. To convert the Project area from a primarily agricultural use into a conservation easement based on the purpose of the Project, the proposed levee setback (with-Project) condition is necessary to accommodate the Project modifications. Under the with-Project conditions, the Pendleton Levee 2a setback continues to perform its original authorized function. To illustrate the continuation of the original function from without- to with-Project conditions, the stage discharge relationships for each condition for the 2-year, 10-year, 25-year, and authorized flood flows are presented in Figures 5-7. The location of the cross section in Figure 5-7 is shown in Figure 5-1 above.

6. Conclusions

This technical memorandum documented the hydrologic and hydraulic analysis necessary for the Section 408 process. These analyses included detailed evaluation of stream gage data, historic storm flows, inundation extents, and hydraulic loading for the with- and without-Project conditions. The results indicate that the authorized flood water surface elevation would be higher than Birch Creek Road and portions of the interior drainage area west of Birch Creek Road without a setback of the levee system for the Project. As a result, the proposed levee setback top elevation is set to provide protection against the authorized flood and maintain the required 3 feet of freeboard along the proposed setback. The proposed Pendleton 2a Levee setback design (see Attachment 1) is a part of the Project that will convert the Project area from primarily agricultural use to a conversation easement based on the purpose of the Project and is necessary to protect the Birch Creek Road and the interior drainage area west of Birch Creek Road for the with-Project conditions. In addition, the analyses results indicated that the with-Project conditions (e.g., WSE, velocities, and levee setback elevation) will maintain protection of Birch Creek Road, the Birch Creek Road Bridge, and the adjacent private property. Although the depths do increase slightly under the authorized flood with-Project conditions, velocities decrease along the Pendleton 2a Levee system. As a result, the proposed Project will not adversely impact the Pendleton 2a Levee system because it confines the authorized flood to the without-Project extents and decreases velocities along the upstream portions of system.

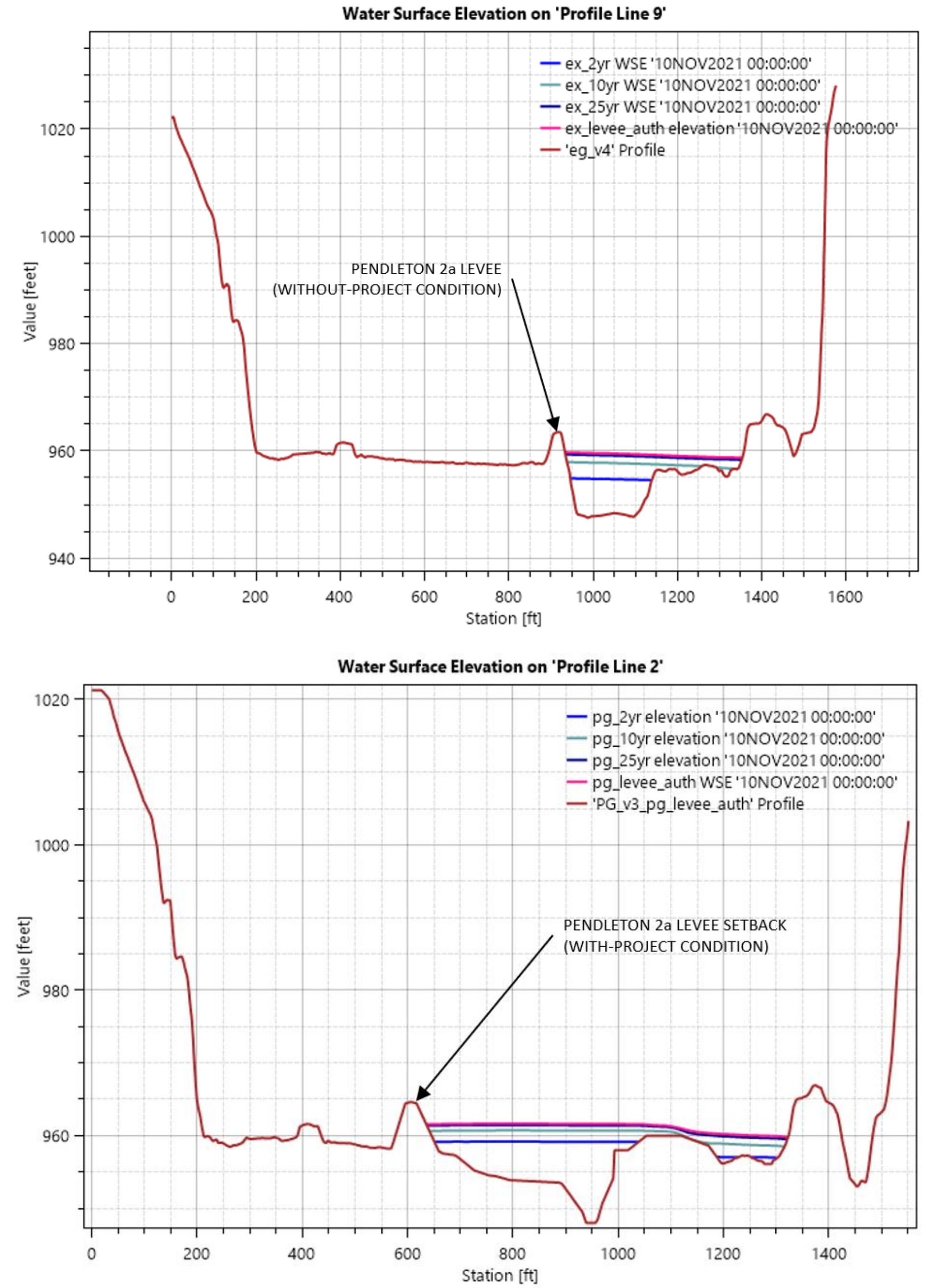


Figure 5-7. With- and Without-Project Conditions WSEs (2-year, 10-year, 25-year, Authorized Flood)

7. References

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USGS. 2022b. Streamgage 14025000, Birch Creek at Rieth, OR. Available online at: https://waterdata.usgs.gov/nwis/inventory/?site_no=14025000&agency_cd=USGS

8. Attachments

Attachment 1 – Proposed Design Drawings

Attachment 2 – Proposed Construction Specifications

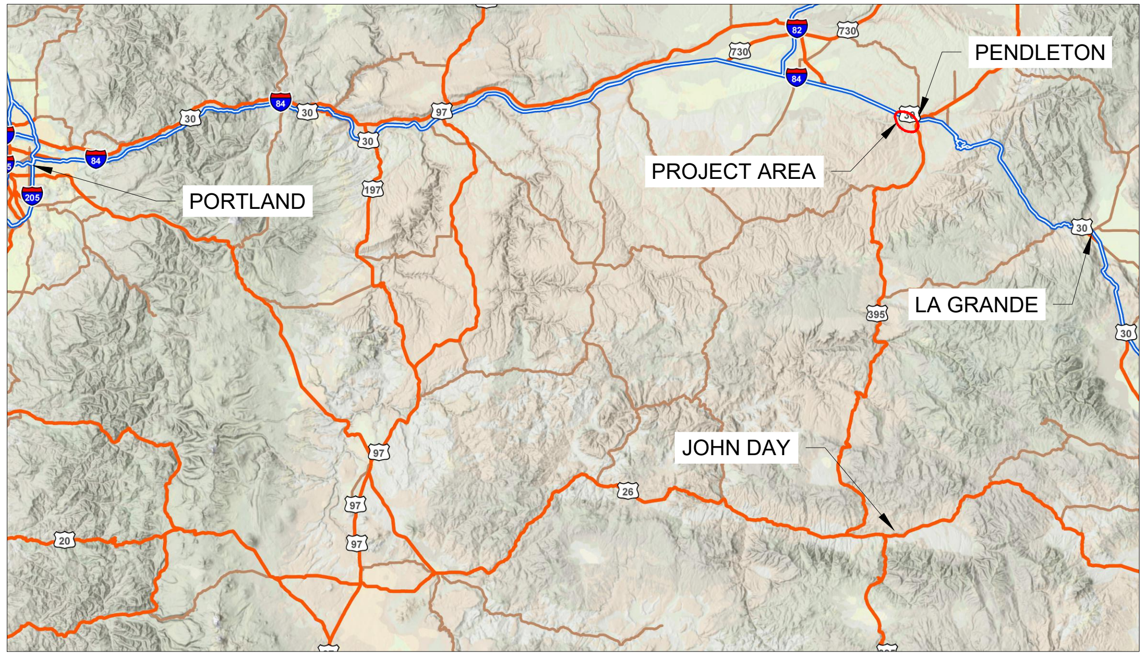
Attachment 3 – Without-Project Conditions Sensitivity Analysis

Attachment 4 – With-Project Conditions Sensitivity Analysis

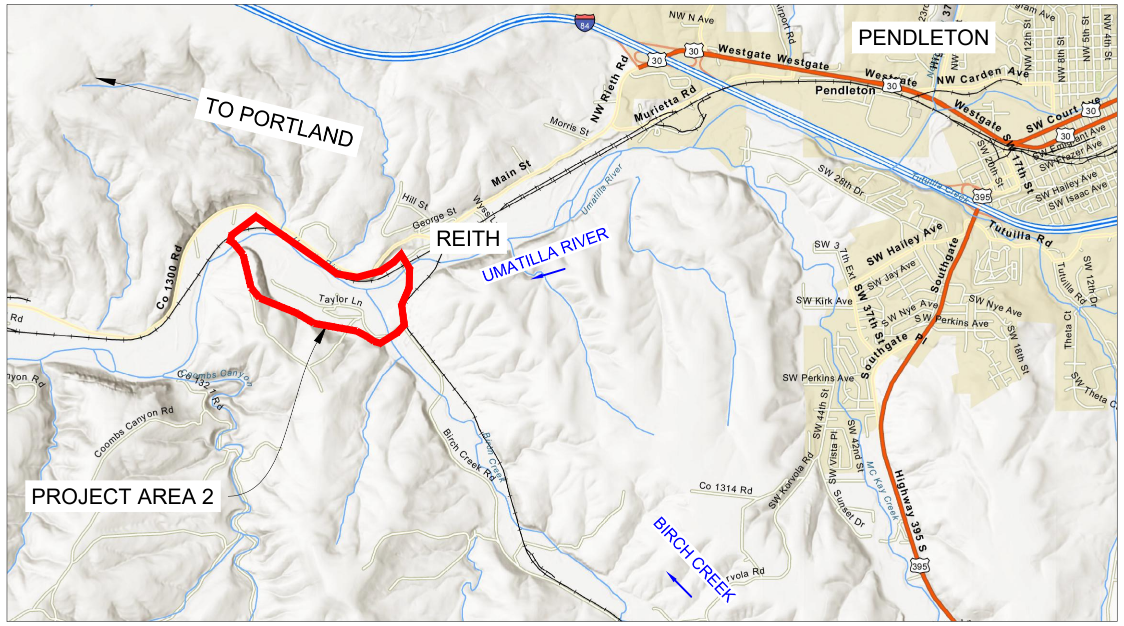
Attachment 1 – Proposed Design Drawings

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

PROJECT AREA 2 PROPOSED LEVEE SETBACK - 100 PERCENT DESIGN



LOCATION MAP
SCALE: NTS



VICINITY MAP
SCALE: NTS

SHEET LIST	
DWG #	**TITLE**
G-201	COVER SHEET
G-202	GENERAL NOTES
G-203 - G-205	GENERAL NOTES - HIP IV CONSERVATION METHODS
E-201	GENERAL OVERVIEW
E-202	EXISTING CONDITIONS OVERVIEW
C-200	RECOMMENDED CONSTRUCTION SEQUENCE
C-201	EXISTING USACE LEVEE REMOVAL & PROPOSED LEVEE SETBACK OVERVIEW
C-202 - C-206	PROPOSED LEVEE SETBACK
C-207 - C-208	PROPOSED LEVEE SETBACK DETAILS
C-209	CONSTRUCTION POINTS
C-210	TESC DETAILS
C-211	PLANTING PLAN

TETRA TECH
www.tetratech.com
19803 North Creek Parkway
Bothell, Washington 98011
Phone: 425-482-7600 Fax: 425-482-7652

REGISTERED PROFESSIONAL ENGINEER
OREGON
SEPTEMBER 13, 2005
SENDA OZKAN
EXPIRES: 12/31/2024

PLAN SHEET SIZE ANSI B (11" X 17")

REV.	DATE	REVISION DESCRIPTION	DRW	ENG	CHK	APP
2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

COVER SHEET

DWG. NO.: G-201
CREATED: 12/16/24
1 of 19

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PLOT DETAILS: HARVEY, SPENCER December 12, 2024 12:45 PM

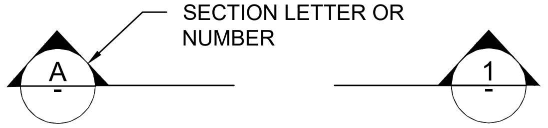
ABBREVIATIONS

1H:1V	HORIZONTAL TO VERTICAL EXAGGERATION
μS	MICRO SECONDS
μS/CM	MICRO SECONDS PER CENTIMETER
°C	DEGREE CELSIUS
%	PERCENT
Ø	DIAMETER
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
APP	APPROVED BY
APPROX	APPROXIMATE
BMP	BEST MANAGEMENT PRACTICE
BPA	BONNEVILLE POWER ADMINISTRATION
CHK	CHECKED BY
CO	COUNTY
CP	CONTROL POINT
CPEP	CORRUGATED POLYETHYLENE PIPE (SMOOTH INTERIOR)
CTUIR	CONFEDERATED TRIBES OF THE UMATILLA RESERVATION
CWA	CLEAN WATER ACT
CY	CUBIC YARDS
D	DEPTH
DBH	DIAMETER AT BREAST HEIGHT
DC	DIRECT CURRENT
DIA	DIAMETER
DWG	DRAWING
DRW	DRAWN BY
EC	ENVIRONMENTAL COMPLIANCE
EG	FOR EXAMPLE (LATIN: EXEMPLI GRATIA)
ENG	ENGINEERED BY
EQIV	EQUIVALENT
ESA	ENDANGERED SPECIES ACT
ETC	ET CETERA
EX	EXISTING
FT, '	FOOT
HARN	HIGH ACCURACY REFERENCE NETWORK
HDPE	HIGH DENSITY POLY ETHYLENE
HEC-RAS	HYDRAULIC ENGINEERING CENTER RIVER ANALYSIS SYSTEM
HIP	HABITAT IMPROVEMENT PROGRAM
HUC	HYDROLOGIC UNIT CODE
HZ	HERTZ
ID	IDENTIFICATION
IE	INVERT ELEVATOIN

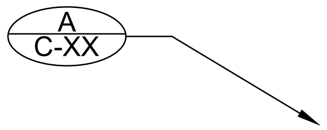
IN, "	INCH
L	LENGTH
LBS	POUNDS
LF	LINEAR FEET
LiDAR	LIGHT DETECTION AND RANGING
LT	LEFT
LWD	LARGE WOODY DEBRIS
M	METER
MAX	MAXIMUM
MI	MILE
MIN	MINIMUM
MJR	MAJOR
MNR	MINOR
MS	MILLISECONDS
N/A	NOT APPLICABLE
NAVD	NORTH AMERICAN VERTICAL DATUM OF 1988
NEPA	NATIONAL ENVIRONMENTAL POLICY ACT
NMFS	NATIONAL MARINE FISHERIES SERVICE
NHPA	NATIONAL HISTORIC PRESERVATION ACT
NTS	NOT TO SCALE
PDC	PULSED DIRECT CURRENT
OC	ON CENTER
ODFW	OREGON DEPARTMENT OF FISH AND WILDLIFE
ODOT	OREGON DEPARTMENT OF TRANSPORTATION
OHW	ORDINARY HIGH WATER
OWRD	OREGON WATER RESOURCES DEPARTMENT
OZ/SY	OUNCE PER SQUARE YARD
PREFAB	PREFABRICATED
PRO	PROPOSED
PSI	POUNDS PER SQUARE INCH
RT	RIGHT
STA	STATION
TEMP	TEMPORARY
TESC	TEMPORARY EROSION AND SEDIMENT CONTROL
TYP	TYPICAL
USACE	US ARMY CORPS OF ENGINEERS
USFS	UNITED STATES FOREST SERVICE
UPRR	UNION PACIFIC RAILROAD
V	VOLTS
W/	WITH
WSEL	WATER SURFACE ELEVATION
XS	CROSS SECTION
YR	YEAR

SYMBOLS

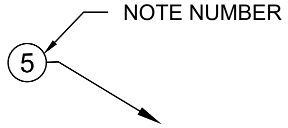
SECTIONS ARE REFERENCED IN THE FOLLOWING MANNER:



CONSTRUCTION DETAILS ARE REFERENCED IN THE FOLLOWING MANNER:



NOTES ARE REFERENCED IN THE FOLLOWING MANNER:



RECOMMENDED CONSTRUCTION SEQUENCING:

- SEE SHEET C-200 FOR RECOMMENDED CONSTRUCTION SEQUENCING.

GENERAL NOTES:

1. HORIZONTAL PROJECTION: NAD83 OREGON STATE PLANES, NORTH ZONE, INTERNATIONAL FOOT.
2. VERTICAL PROJECTION: NAVD88.
3. PROJECT ALIGNMENT. ELEVATION, AND STATIONING BASED ON 2020 LiDAR TOPOGRAPHIC DATA BY QUANTUM SPATIAL. INC. AND SUPPLEMENTED BY BATHYMETRIC SURVEY CONDUCTED BY TETRA TECH IN JUNE 2021.
4. PROPOSED PROJECT DESIGN, CONSTRUCTION ACTIVITIES, AND MATERIALS SUBJECT TO APPROVAL BY LANDOWNER.
5. AERIAL IMAGERY PROVIDED BY QUANTUM SPATIAL. INC, 2020, AND GOOGLE EARTH, 2019.

GENERAL CONSTRUCTION NOTES:

1. THE CONTRACTOR SHALL CONSTRUCT THE DESIGN ELEMENTS IN ACCORDANCE WITH THE PLANS STAMPED "ISSUED FOR CONSTRUCTION". THESE PLANS WILL BE PROVIDED TO THE CONTRACTOR BY THE CONTRACTING AGENCY PRIOR TO CONSTRUCTION. WORK SHALL NOT BE DONE WITHOUT THE CURRENT SET OF APPROVED CONSTRUCTION PLANS.
2. THE CONTRACTOR SHALL COMPLY WITH THE MOST RECENT AND APPLICABLE BPA HIP AND US ARMY CORPS OF ENGINEERS (USACE) TERMS & CONDITIONS.
3. CONTRACTOR SHALL CONTACT THE OREGON UTILITY NOTIFICATION CENTER 1-800-332-2344 (OR 811) BEFORE ANY EXCAVATION WORK BEGINS.
4. THE CONTRACTOR SHALL PURSUE WORK IN A CONTINUOUS AND EFFICIENT MANNER TO ENSURE TIMELY COMPLETION OF THE PROJECT.
5. ALL WORK WITHIN THE ACTIVE CHANNEL SHALL OCCUR WITHIN THE ALLOWABLE FISH WINDOW (JULY 1 - OCTOBER 31).
6. ALL CONSTRUCTION ACTIVITIES SHALL MINIMIZE DISTURBANCE TO AND MAXIMIZE RE-USE OF EXISTING RIPARIAN VEGETATION.
7. THE CONTRACTOR SHALL PROTECT ALL CONTROL POINTS DURING CONSTRUCTION ACTIVITIES.
8. CONTRACTOR SHALL PROVIDE AN EROSION AND SEDIMENT CONTROL AND DEWATERING PLAN TO OWNER WITHIN TEN (10) BUSINESS DAYS OF NOTICE TO PROCEED.

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SENDA OZKAN
76918PE
EXPIRES: 12/31/2024

PLAN SHEET SIZE ANSI B (11" X 17")

REV.	DATE	REVISION DESCRIPTION	DRW	ENG	CHK	APP
2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

GENERAL NOTES

DWG. NO.: G-202
CREATED: 12/16/24
2 of 19

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK\.SHEET FILES_LEVEE REMOVAL SHEET SET\01 COVER PAGE AND NOTES.DWG
PLOT DETAILS: HARVEY, SPENCER December 12, 2024 12:45 PM ----

HIP GENERAL CONSERVATION MEASURES APPLICABLE TO ALL ACTIONS

THE ACTIVITIES COVERED UNDER THE HIP ARE INTENDED TO PROTECT AND RESTORE FISH AND WILDLIFE HABITAT WITH LONG-TERM BENEFITS TO ESA-LISTED SPECIES. THE FOLLOWING GENERAL CONSERVATION MEASURES (DEVELOPED IN COORDINATION WITH USFWS AND NMFS) WILL BE APPLIED TO ALL ACTIONS OF THIS PROJECT.

PROJECT DESIGN AND SITE PREPARATION.

1. STATE AND FEDERAL PERMITS.

A. ALL APPLICABLE REGULATORY PERMITS AND OFFICIAL PROJECT AUTHORIZATIONS WILL BE OBTAINED BEFORE PROJECT IMPLEMENTATION.

B. THESE PERMITS AND AUTHORIZATIONS INCLUDE, BUT ARE NOT LIMITED TO, NATIONAL ENVIRONMENTAL POLICY ACT, NATIONAL HISTORIC PRESERVATION ACT, THE APPROPRIATE STATE AGENCY REMOVAL AND FILL PERMIT, USACE CLEAN WATER ACT (CWA) 404 PERMITS, CWA SECTION 401 WATER QUALITY CERTIFICATIONS, AND FEMA NO-RISE ANALYSES.

2. TIMING OF IN-WATER WORK.

A. APPROPRIATE STATE (OREGON DEPARTMENT OF FISH AND WILDLIFE (ODFW), WASHINGTON DEPARTMENT OF FISH AND WILDLIFE (WDFW), IDAHO DEPARTMENT OF FISH AND GAME (IDFG), AND MONTANA FISH WILDLIFE AND PARKS (MFWP)) GUIDELINES FOR TIMING OF IN-WATER WORK WINDOWS (IWW) WILL BE FOLLOWED.

B. CHANGES TO ESTABLISHED WORK WINDOWS WILL BE APPROVED BY REGIONAL STATE BIOLOGISTS AND BPA'S EC LEAD.

C. BULL TROUT. FOR AREAS WITH DESIGNATED IN-WATER WORK WINDOWS FOR BULL TROUT OR AREAS KNOWN TO HAVE BULL TROUT, PROJECT PROPONENTS WILL CONTACT THE APPROPRIATE USFWS FIELD OFFICE TO INSURE THAT ALL REASONABLE IMPLEMENTATION MEASURES ARE CONSIDERED AND AN APPROPRIATE IN-WATER WORK WINDOW IS BEING USED TO MINIMIZE PROJECT EFFECTS.

D. LAMPREY. WORKING IN STREAM OR RIVER CHANNELS THAT CONTAIN PACIFIC LAMPREY WILL BE AVOIDED FROM MARCH 1 TO JULY 1 FOR REACHES <5,000 FEET IN ELEVATION AND FROM MARCH 1 TO AUGUST 1 FOR REACHES >5,000 FEET. IF EITHER TIMEFRAME IS INCOMPATIBLE WITH OTHER OBJECTIVES, THE AREA WILL BE SURVEYED FOR NESTS AND LAMPREY PRESENCE, AND AVOIDED IF POSSIBLE. IF LAMPREYS ARE KNOWN TO EXIST, THE PROJECT SPONSOR WILL UTILIZE DEWATERING AND SALVAGE PROCEDURES (SEE FISH SALVAGE AND ELECTROFISHING SECTIONS) TO MINIMIZE ADVERSE EFFECTS.

E. THE IN-WATER WORK WINDOW WILL BE PROVIDED IN THE CONSTRUCTION PLANS.

3. CONTAMINANTS.

A. EXCAVATION OF MORE THAN 20 CUBIC YARDS WILL REQUIRE A SITE VISIT AND DOCUMENTED ASSESSMENT FOR POTENTIAL CONTAMINANT SOURCES. THE SITE ASSESSMENT WILL BE STORED WITH PROJECT FILES OR AS AN APPENDIX TO THE BASIS OF DESIGN REPORT.

B. THE SITE ASSESSMENT WILL SUMMARIZE:

1. THE SITE VISIT, CONDITION OF THE PROPERTY, AND IDENTIFICATION OF ANY AREAS USED FOR VARIOUS INDUSTRIAL PROCESSES;
2. AVAILABLE RECORDS, SUCH AS FORMER SITE USE, BUILDING PLANS, AND RECORDS OF ANY PRIOR CONTAMINATION EVENTS;
3. INTERVIEWS WITH KNOWLEDGEABLE PEOPLE, SUCH AS SITE OWNERS, OPERATORS, OCCUPANTS, NEIGHBORS, OR LOCAL GOVERNMENT OFFICIALS; AND
4. THE TYPE, QUANTITY, AND EXTENT OF ANY POTENTIAL CONTAMINATION SOURCES.

4. SITE LAYOUT AND FLAGGING.

A. CONSTRUCTION AREAS TO BE CLEARLY FLAGGED PRIOR TO CONSTRUCTION.

B. AREAS TO BE FLAGGED WILL INCLUDE:

1. SENSITIVE RESOURCE AREAS, SUCH AS AREAS BELOW ORDINARY HIGH WATER, SPAWNING AREAS, SPRINGS, AND WETLANDS;
2. EQUIPMENT ENTRY AND EXIT POINTS;
3. ROAD AND STREAM CROSSING ALIGNMENTS;
4. STAGING, STORAGE, AND STOCKPILE AREAS; AND
5. NO-SPRAY AREAS AND BUFFERS.

5. TEMPORARY ACCESS ROADS AND PATHS.

A. EXISTING ACCESS ROADS AND PATHS WILL BE PREFERENTIALLY USED WHENEVER REASONABLE, AND THE NUMBER AND LENGTH OF TEMPORARY ACCESS ROADS AND PATHS THROUGH RIPARIAN AREAS AND FLOODPLAINS WILL BE MINIMIZED.

B. VEHICLE USE AND HUMAN ACTIVITIES, INCLUDING WALKING, IN AREAS OCCUPIED BY TERRESTRIAL ESA-LISTED SPECIES WILL BE MINIMIZED.

C. TEMPORARY ACCESS ROADS AND PATHS WILL NOT BE BUILT ON SLOPES WHERE GRADE, SOIL, OR OTHER FEATURES SUGGEST A LIKELIHOOD OF EXCESSIVE EROSION OR FAILURE. IF SLOPES ARE STEEPER THAN 30%, THEN THE ROAD WILL BE DESIGNED BY A CIVIL ENGINEER WITH EXPERIENCE IN STEEP ROAD DESIGN.

D. THE REMOVAL OF RIPARIAN VEGETATION DURING CONSTRUCTION OF TEMPORARY ACCESS ROADS WILL BE MINIMIZED. WHEN TEMPORARY VEGETATION REMOVAL IS REQUIRED, VEGETATION WILL BE CUT AT GROUND LEVEL (NOT GRUBBED).

E. AT PROJECT COMPLETION, ALL TEMPORARY ACCESS ROADS AND PATHS WILL BE OBLITERATED, AND THE SOIL WILL BE STABILIZED AND REVEGETATED. ROAD AND PATH OBLITERATION REFERS TO THE MOST COMPREHENSIVE DEGREE OF DECOMMISSIONING AND INVOLVES DECOMPACTING THE SURFACE AND DITCH, PULLING THE FILL MATERIAL ONTO THE RUNNING SURFACE, AND RESHAPING TO MATCH THE ORIGINAL CONTOUR.

F. HELICOPTER FLIGHT PATTERNS WILL BE ESTABLISHED IN ADVANCE AND LOCATED TO AVOID TERRESTRIAL ESA-LISTED SPECIES AND THEIR OCCUPIED HABITAT DURING SENSITIVE LIFE STAGES.

6. TEMPORARY STREAM CROSSINGS.

A. EXISTING STREAM CROSSINGS OR BEDROCK WILL BE PREFERENTIALLY USED WHENEVER REASONABLE, AND THE NUMBER OF TEMPORARY STREAM CROSSINGS WILL BE MINIMIZED.

B. TEMPORARY BRIDGES AND CULVERTS WILL BE INSTALLED TO ALLOW FOR EQUIPMENT AND VEHICLE CROSSING OVER PERENNIAL STREAMS DURING CONSTRUCTION. TREATED WOOD SHALL NOT BE USED ON TEMPORARY BRIDGE CROSSINGS OR IN LOCATIONS IN CONTACT WITH OR DIRECTLY OVER WATER.

C. FOR PROJECTS THAT REQUIRE EQUIPMENT AND VEHICLES TO CROSS IN THE WET:

1. THE LOCATION AND NUMBER OF ALL WET CROSSINGS SHALL BE APPROVED BY THE BPA EC LEAD AND DOCUMENTED IN THE CONSTRUCTION PLANS;
2. VEHICLES AND MACHINERY SHALL CROSS STREAMS AT RIGHT ANGLES TO THE MAIN CHANNEL WHENEVER POSSIBLE;
3. NO STREAM CROSSINGS WILL OCCUR 300 FEET UPSTREAM OR 100 FEET DOWNSTREAM OF AN EXISTING REDD OR SPAWNING FISH; AND
4. AFTER PROJECT COMPLETION, TEMPORARY STREAM CROSSINGS WILL BE OBLITERATED AND BANKS RESTORED.

7. STAGING, STORAGE, AND STOCKPILE AREAS.

A. STAGING AREAS (USED FOR CONSTRUCTION EQUIPMENT STORAGE, VEHICLE STORAGE, FUELING, SERVICING, AND HAZARDOUS MATERIAL STORAGE) WILL BE 150 FEET OR MORE FROM ANY NATURAL WATER BODY OR WETLAND. STAGING AREAS CLOSER THAN 150 FEET WILL BE SUBJECT TO APPROVAL BY THE EC LEAD.

B. NATURAL MATERIALS USED FOR IMPLEMENTATION OF AQUATIC RESTORATION, SUCH AS LARGE WOOD, GRAVEL, AND BOULDERS, MAY BE STAGED WITHIN 150 FEET IF CLEARLY INDICATED IN THE PLANS THAT AREA IS FOR NATURAL MATERIALS ONLY.

C. ANY LARGE WOOD, TOPSOIL, AND NATIVE CHANNEL MATERIAL DISPLACED BY CONSTRUCTION WILL BE STOCKPILED FOR USE DURING SITE RESTORATION AT A SPECIFICALLY IDENTIFIED AND FLAGGED AREA.

D. ANY MATERIAL NOT USED IN RESTORATION, AND NOT NATIVE TO THE FLOODPLAIN, WILL BE DISPOSED OF OUTSIDE THE 100-YEAR FLOODPLAIN.

8. EQUIPMENT.

A. MECHANIZED EQUIPMENT AND VEHICLES WILL BE SELECTED, OPERATED, AND MAINTAINED IN A MANNER THAT MINIMIZES ADVERSE EFFECTS ON THE ENVIRONMENT (E.G., MINIMALLY-SIZED, LOW PRESSURE TIRES; MINIMAL HARD-TURN PATHS FOR TRACKED VEHICLES; TEMPORARY MATS OR PLATES WITHIN WET AREAS OR ON SENSITIVE SOILS).

B. EQUIPMENT WILL BE STORED, FUELED, AND MAINTAINED IN A CLEARLY IDENTIFIED STAGING AREA THAT MEETS STAGING AREA CONSERVATION MEASURES.

C. EQUIPMENT WILL BE REFUELED IN A VEHICLE STAGING AREA OR IN AN ISOLATED HARD ZONE, SUCH AS A PAVED PARKING LOT OR ADJACENT, ESTABLISHED ROAD (THIS MEASURE APPLIES ONLY TO GAS-POWERED EQUIPMENT WITH TANKS LARGER THAN 5 GALLONS).

D. BIODEGRADABLE LUBRICANTS AND FLUIDS WILL BE USED ON EQUIPMENT OPERATING IN AND ADJACENT TO THE STREAM CHANNEL AND LIVE WATER.

E. EQUIPMENT WILL BE INSPECTED DAILY FOR FLUID LEAKS BEFORE LEAVING THE VEHICLE STAGING AREA FOR OPERATION WITHIN 150 FEET OF ANY NATURAL WATER BODY OR WETLAND.

F. EQUIPMENT WILL BE THOROUGHLY CLEANED BEFORE OPERATION BELOW ORDINARY HIGH WATER, AND AS OFTEN AS NECESSARY DURING OPERATION, TO REMAIN GREASE FREE.

9. EROSION CONTROL.

A. TEMPORARY EROSION CONTROL MEASURES INCLUDE:

1. TEMPORARY EROSION CONTROLS WILL BE IN PLACE BEFORE ANY SIGNIFICANT ALTERATION OF THE ACTION SITE AND APPROPRIATELY INSTALLED DOWNSLOPE OF PROJECT ACTIVITY WITHIN THE RIPARIAN BUFFER AREA UNTIL SITE REHABILITATION IS COMPLETE;
2. IF THERE IS A POTENTIAL FOR ERODED SEDIMENT TO ENTER THE STREAM, SEDIMENT BARRIERS WILL BE INSTALLED AND MAINTAINED FOR THE DURATION OF PROJECT IMPLEMENTATION;
3. TEMPORARY EROSION CONTROL MEASURES MAY INCLUDE SEDGE MATS, FIBER WATTLES, SILT FENCES, JUTE MATTING, WOOD FIBER MULCH AND SOIL BINDER, OR GEOTEXTILES AND GEOSYNTHETIC FABRIC;
4. SOIL STABILIZATION UTILIZING WOOD FIBER MULCH AND TACKIFIER (HYDRO-APPLIED) MAY BE USED TO REDUCE EROSION OF BARE SOIL IF THE MATERIALS ARE NOXIOUS WEED FREE AND NONTOXIC TO AQUATIC AND TERRESTRIAL ANIMALS, SOIL MICROORGANISMS, AND VEGETATION;
5. SEDIMENT WILL BE REMOVED FROM EROSION CONTROLS ONCE IT HAS REACHED 1/3 OF THE EXPOSED HEIGHT OF THE CONTROL; AND
6. ONCE THE SITE IS STABILIZED AFTER CONSTRUCTION, TEMPORARY EROSION CONTROL MEASURES WILL BE REMOVED.

B. EMERGENCY EROSION CONTROLS. THE FOLLOWING MATERIALS FOR EMERGENCY EROSION CONTROL WILL BE AVAILABLE AT THE WORK SITE:

1. A SUPPLY OF SEDIMENT CONTROL MATERIALS; AND
2. AN OIL-ABSORBING FLOATING BOOM WHENEVER SURFACE WATER IS PRESENT.

10. DUST ABATEMENT.

A. THE PROJECT SPONSOR WILL DETERMINE THE APPROPRIATE DUST CONTROL MEASURES BY CONSIDERING SOIL TYPE, EQUIPMENT USAGE, PREVAILING WIND DIRECTION, AND THE EFFECTS CAUSED BY OTHER EROSION AND SEDIMENT CONTROL MEASURES.

B. WORK WILL BE SEQUENCED AND SCHEDULED TO REDUCE EXPOSED BARE SOIL SUBJECT TO WIND EROSION.

C. DUST-ABATEMENT ADDITIVES AND STABILIZATION CHEMICALS (TYPICALLY MAGNESIUM CHLORIDE, CALCIUM CHLORIDE SALTS, OR LIGNINSULFONATE) WILL NOT BE APPLIED WITHIN 25 FEET OF WATER OR A STREAM CHANNEL AND WILL BE APPLIED SO AS TO MINIMIZE THE LIKELIHOOD THAT THEY WILL ENTER STREAMS. APPLICATIONS OF LIGNINSULFONATE WILL BE LIMITED TO A MAXIMUM RATE OF 0.5 GALLONS PER SQUARE YARD OF ROAD SURFACE, ASSUMING MIXED 50:50 WITH WATER.

D. APPLICATION OF DUST ABATEMENT CHEMICALS WILL BE AVOIDED DURING OR JUST BEFORE WET WEATHER, AND AT STREAM CROSSINGS OR OTHER AREAS THAT COULD RESULT IN UNFILTERED DELIVERY OF THE DUST ABATEMENT MATERIALS TO A WATERBODY (TYPICALLY THESE WOULD BE AREAS WITHIN 25 FEET OF A WATERBODY OR STREAM CHANNEL; DISTANCES MAY BE GREATER WHERE VEGETATION IS SPARSE OR SLOPES ARE STEEP).

E. SPILL CONTAINMENT EQUIPMENT WILL BE AVAILABLE DURING APPLICATION OF DUST ABATEMENT CHEMICALS.

F. PETROLEUM-BASED PRODUCTS WILL NOT BE USED FOR DUST ABATEMENT.

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REGISTERED PROFESSIONAL ENGINEER
OREGON
SEPTEMBER 13, 2005
SENDA OZKAN
EXPIRES: 12/31/2024

PLAN SHEET SIZE ANSI B (11" X 17")

REV.	DATE	REVISION DESCRIPTION	DRW	ENG	CHK	APP
2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

GENERAL NOTES - HIP IV
CONSERVATION METHODS

DWG. NO.: G-203

CREATED: 12/16/24

PROJECT DESIGN AND SITE PREPARATION (CONTINUED).

11. SPILL PREVENTION, CONTROL, AND COUNTER MEASURES.

A. A DESCRIPTION OF HAZARDOUS MATERIALS THAT WILL BE USED, INCLUDING INVENTORY, STORAGE, AND HANDLING PROCEDURES WILL BE AVAILABLE ON-SITE.

B. WRITTEN PROCEDURES FOR NOTIFYING ENVIRONMENTAL RESPONSE AGENCIES WILL BE POSTED AT THE WORK SITE.

C. SPILL CONTAINMENT KITS (INCLUDING INSTRUCTIONS FOR CLEANUP AND DISPOSAL) ADEQUATE FOR THE TYPES AND QUANTITY OF HAZARDOUS MATERIALS USED AT THE SITE WILL BE AVAILABLE AT THE WORK SITE.

D. WORKERS WILL BE TRAINED IN SPILL CONTAINMENT PROCEDURES AND WILL BE INFORMED OF THE LOCATION OF SPILL CONTAINMENT KITS.

E. ANY WASTE LIQUIDS GENERATED AT THE STAGING AREAS WILL BE TEMPORARILY STORED UNDER AN IMPERVIOUS COVER, SUCH AS A TARPAULIN, UNTIL THEY CAN BE PROPERLY TRANSPORTED TO AND DISPOSED OF AT A FACILITY THAT IS APPROVED FOR RECEIPT OF HAZARDOUS MATERIALS.

F. PUMPS USED ADJACENT TO WATER SHALL USE SPILL CONTAINMENT SYSTEMS.

12. INVASIVE SPECIES CONTROL.

A. PRIOR TO ENTERING THE SITE, ALL VEHICLES AND EQUIPMENT WILL BE POWER WASHED, ALLOWED TO FULLY DRY, AND INSPECTED TO MAKE SURE NO PLANTS, SOIL, OR OTHER ORGANIC MATERIAL ADHERES TO THE SURFACE.

B. WATERCRAFT, WADERS, BOOTS, AND ANY OTHER GEAR TO BE USED IN OR NEAR WATER WILL BE INSPECTED FOR AQUATIC INVASIVE SPECIES.

C. WADING BOOTS WITH FELT SOLES ARE NOT TO BE USED DUE TO THEIR PROPENSITY FOR AIDING IN THE TRANSFER OF INVASIVE SPECIES UNLESS DECONTAMINATION PROCEDURES HAVE BEEN APPROVED BY THE EC LEAD.

WORK AREA ISOLATION AND FISH SALVAGE.

1. WORK AREA ISOLATION.

A. ANY WORK AREA WITHIN THE WETTED CHANNEL WILL BE ISOLATED FROM THE ACTIVE STREAM WHENEVER ESA-LISTED FISH ARE REASONABLY CERTAIN TO BE PRESENT, OR IF THE WORK AREA IS LESS THAN 300-FEET UPSTREAM FROM KNOWN SPAWNING HABITATS.

B. WORK AREA ISOLATION AND FISH SALVAGE ACTIVITIES WILL COMPLY WITH THE IN-WATER WORK WINDOW.

C. DESIGN PLANS WILL INCLUDE ALL ISOLATION ELEMENTS AND AREAS (COFFER DAMS, PUMPS, DISCHARGE AREAS, FISH SCREENS, FISH RELEASE AREAS, ETC.).

D. WORK AREA ISOLATION AND FISH CAPTURE ACTIVITIES WILL OCCUR DURING PERIODS OF THE COOLEST AIR AND WATER TEMPERATURES POSSIBLE, NORMALLY EARLY IN THE MORNING VERSUS LATE IN THE DAY, AND DURING CONDITIONS APPROPRIATE TO MINIMIZE STRESS AND DEATH OF SPECIES PRESENT.

2. FISH SALVAGE.

A. MONITORING AND RECORDING WILL TAKE PLACE FOR DURATION OF SALVAGE. THE SALVAGE REPORT WILL BE COMMUNICATED TO AGENCIES VIA THE PROJECT COMPLETION FORM (PCF).

B. SALVAGE ACTIVITIES SHOULD TAKE PLACE DURING CONDITIONS TO MINIMIZE STRESS TO FISH SPECIES, TYPICALLY PERIODS OF THE COOLEST AIR AND WATER TEMPERATURES WHICH OCCUR IN THE MORNING VERSUS LATE IN THE DAY.

C. SALVAGE OPERATIONS WILL FOLLOW THE ORDERING, METHODS, AND CONSERVATION MEASURES SPECIFIED BELOW:

1. SLOWLY REDUCE WATER FROM THE WORK AREA TO ALLOW SOME FISH TO LEAVE VOLITIONALLY.
2. BLOCK NETS WILL BE INSTALLED AT UPSTREAM AND DOWNSTREAM LOCATIONS AND MAINTAINED IN A SECURED POSITION TO EXCLUDE FISH FROM ENTERING THE PROJECT AREA.
3. BLOCK NETS WILL BE SECURED TO THE STREAM CHANNEL BED AND BANKS UNTIL FISH CAPTURE AND TRANSPORT ACTIVITIES ARE COMPLETE. BLOCK NETS MAY BE LEFT IN PLACE FOR THE DURATION OF THE PROJECT TO EXCLUDE FISH AS LONG AS PASSAGE REQUIREMENTS ARE MET.
4. NETS WILL BE MONITORED HOURLY DURING IN-STREAM DISTURBANCE.
5. IF BLOCK NETS REMAIN IN PLACE MORE THAN ONE DAY, THE NETS WILL BE MONITORED AT LEAST DAILY TO ENSURE THEY ARE SECURED AND FREE OF ORGANIC ACCUMULATION. IF BULL TROUT ARE PRESENT, NETS ARE TO BE CHECKED EVERY 4 HOURS FOR FISH IMPINGEMENT.
6. CAPTURE FISH THROUGH SEINING AND RELOCATE TO STREAMS.
7. WHILE DEWATERING, ANY REMAINING FISH WILL BE COLLECTED BY HAND OR DIP NETS.
8. SEINES WITH A MESH SIZE TO ENSURE CAPTURE OF THE RESIDING ESA-LISTED FISH WILL BE USED.
9. MINNOW TRAPS WILL BE LEFT IN PLACE OVERNIGHT AND USED IN CONJUNCTION WITH SEINING.
10. ELECTROFISH TO CAPTURE AND RELOCATE FISH NOT CAUGHT DURING SEINING PER ELECTROFISH CONSERVATION MEASURES.
11. CONTINUE TO SLOWLY DEWATER STREAM REACH.
12. COLLECT ANY REMAINING FISH IN COLD-WATER BUCKETS AND RELOCATED TO THE STREAM.
13. LIMIT THE TIME FISH ARE IN A TRANSPORT BUCKET.
14. MINIMIZE PREDATION BY TRANSPORTING COMPARABLE SIZES IN BUCKETS.
15. BUCKET WATER TO BE CHANGED EVERY 15 MINUTES OR AERATED.
16. BUCKETS WILL BE KEPT IN SHADED AREAS OR COVERED.
17. DEAD FISH WILL NOT BE STORED IN TRANSPORT BUCKETS, BUT WILL BE LEFT ON THE STREAM BANK TO AVOID MORTALITY COUNTING ERRORS.

D. SALVAGE GUIDELINES FOR BULL TROUT, LAMPREY, MUSSELS, AND NATIVE FISH.

1. CONDUCT SITE SURVEY TO ESTIMATE SALVAGE NUMBERS.
2. PRE-SELECT SITE(S) FOR RELEASE AND/OR MUSSEL BED RELOCATION.
3. SALVAGE OF BULL TROUT WILL NOT TAKE PLACE WHEN WATER TEMPERATURES EXCEED 15 DEGREES CELSIUS.
4. IF DRAWDOWN LESS THAN 48 HOURS, SALVAGE OF LAMPREY AND MUSSELS MAY NOT BE NECESSARY IF TEMPERATURES SUPPORT SURVIVAL IN SEDIMENTS.
5. SALVAGE MUSSELS BY HAND, LOCATING BY SNORKELING OR WADING.
6. SALVAGE LAMPREY BY ELECTROFISHING (SEE ELECTROFISHING FOR LARVAL LAMPREY SETTINGS AND LARVAL LAMPREY DRY SHOCKING SETTINGS).
7. SALVAGE BONY FISH AFTER LAMPREY WITH NETS OR ELECTROFISHING (SEE ELECTROFISHING FOR APPROPRIATE SETTINGS).
8. REGULARLY INSPECT DEWATERED SITE SINCE LAMPREY LIKELY TO EMERGE AFTER DEWATERING AND MUSSELS MAY BECOME VISIBLE.
9. MUSSELS MAY BE TRANSFERRED IN COOLERS.
10. MUSSELS WILL BE PLACED INDIVIDUALLY TO ENSURE ABILITY TO BURROW INTO NEW HABITAT.

3. ELECTROFISHING.

A. INITIAL SITE SURVEY AND INITIAL SETTINGS.

1. IDENTIFY SPAWNING ADULTS AND ACTIVE REDDS TO AVOID.
2. RECORD WATER TEMPERATURE. ELECTROFISHING WILL NOT OCCUR WHEN WATER TEMPERATURES ARE ABOVE 18 DEGREES CELSIUS.
3. IF POSSIBLE, A BLOCK NET WILL BE PLACED DOWNSTREAM AND CHECKED REGULARLY TO CAPTURE STUNNED FISH THAT DRIFT DOWNSTREAM.
4. INITIAL SETTINGS WILL BE 100 VOLTS, PULSE WIDTH OF 500 MICRO SECONDS, AND PULSE RATE OF 30 HERTZ.
5. RECORDS FOR CONDUCTIVITY, WATER TEMPERATURE, AIR TEMPERATURE, ELECTROFISHING SETTINGS, ELECTROFISHER MODEL, ELECTROFISHER CALIBRATION, FISH CONDITIONS, FISH MORTALITIES, AND TOTAL CAPTURE RATES WILL BE INCLUDED IN THE SALVAGE LOG BOOK.

B. ELECTROFISHING TECHNIQUE.

1. SAMPLING WILL BEGIN USING STRAIGHT DC. POWER WILL REMAIN ON UNTIL THE FISH IS NETTED WHEN USING STRAIGHT DC. GRADUALLY INCREASE VOLTAGE WHILE REMAINING BELOW MAXIMUM LEVELS.
2. MAXIMUM VOLTAGE WILL BE 1100 VOLTS WHEN CONDUCTIVITY IS <100 MILLISECONDS, 800 VOLTS WHEN CONDUCTIVITY IS BETWEEN 100 AND 300 MILLISECONDS, AND 400 VOLTS WHEN CONDUCTIVITY IS >300 MILLISECONDS.
3. IF FISH CAPTURE IS NOT SUCCESSFUL USING STRAIGHT DC, THE ELECTROFISHER WILL BE SET TO INITIAL VOLTAGE FOR PDC. VOLTAGE, PULSE WIDTH, AND PULSE FREQUENCY WILL BE GRADUALLY INCREASED WITHIN MAXIMUM VALUES UNTIL CAPTURE IS SUCCESSFUL.
4. MAXIMUM PULSE WIDTH IS 5 MILLISECONDS. MAXIMUM PULSE RATE IS 70 HERTZ
5. ELECTROFISHING WILL NOT OCCUR IN ONE AREA FOR AN EXTENDED PERIOD.
6. THE ANODE WILL NOT INTENTIONALLY COME INTO CONTACT WITH FISH. THE ZONE FOR POTENTIAL INJURY OF 0.5 M FROM THE ANODE WILL BE AVOIDED.
7. SETTINGS WILL BE LOWERED IN SHALLOWER WATER SINCE VOLTAGE GRADIENTS LIKELY TO INCREASE.
8. ELECTROFISHING WILL NOT OCCUR IN TURBID WATER WHERE VISIBILITY IS POOR (I.E. UNABLE TO SEE THE BED OF THE STREAM).
9. OPERATIONS WILL IMMEDIATELY STOP IF MORTALITY OR OBVIOUS FISH INJURY IS OBSERVED. ELECTROFISHING SETTINGS WILL BE REEVALUATED.

C. SAMPLE PROCESSING.

1. FISH SHALL BE SORTED BY SIZE TO AVOID PREDATION DURING CONTAINMENT.
2. SAMPLERS WILL REGULARLY CHECK CONDITIONS OF FISH HOLDING CONTAINERS, AIR PUMPS, WATER TRANSFERS, ETC.
3. FISH WILL BE OBSERVED FOR GENERAL CONDITIONS AND INJURIES
4. EACH FISH WILL BE COMPLETELY REVIVED BEFORE RELEASE. ESA-LISTED SPECIES WILL BE PRIORITIZED FOR SUCCESSFUL RELEASE.

D. BULL TROUT ELECTROFISHING.

1. ELECTROFISHING FOR BULL TROUT WILL ONLY OCCUR FROM MAY 1 TO JULY 31. NO ELECTROFISHING WILL OCCUR IN ANY BULL TROUT OCCUPIED HABITAT AFTER AUGUST 15. IN FMO HABITATS ELECTROFISHING MAY OCCUR ANY TIME.
2. ELECTROFISHING OF BULL TROUT WILL NOT OCCUR WHEN WATER TEMPERATURES EXCEED 15 DEGREES CELSIUS.

E. LARVAL LAMPREY ELECTROFISHING.

1. PERMISSION FROM EC LEAD WILL BE OBTAINED IF LARVAL LAMPREY ELECTROFISHER IS NOT ONE OF FOLLOWING PRE-APPROVED MODELS: ABP-2 "WISCONSIN", SMITH-ROOT LR-24, OR SMITH-ROOT APEX BACKPACK.
2. LARVAL LAMPREY SAMPLING WILL INCORPORATE 2-STAGE METHOD: "TICKLE" AND "STUN".
3. FIRST STAGE: USE 125 VOLT DC WITH A 25 PERCENT DUTY CYCLE APPLIED AT A SLOW RATE OF 3 PULSES PER SECOND. IF TEMPERATURES ARE BELOW 10 DEGREES CELSIUS, VOLTAGE MAY BE INCREASED GRADUALLY (NOT TO EXCEED 200 VOLTS). BURSTED PULSES (THREE SLOW AND ONE SKIPPED) RECOMMENDED TO INCREASE EMERGENCE.
4. SECOND STAGE (OPTIONAL FOR EXPERIENCED NETTERS): IMMEDIATELY AFTER LAMPREY EMERGE, USE A FAST PULSE SETTING OF 30 PULSES PER SECOND.
5. USE DIP NETS FOR VISIBLE LAMPREY. SIENES AND FINE MESH NET SWEEPS MAY BE USED IN POOR VISIBILITY.
6. SAMPLING WILL OCCUR SLOWLY (>60 SECONDS PER METER) STARTING AT UPSTREAM AND WORKING DOWNSTREAM.
7. MULTIPLE SWEEPS TO OCCUR WITH 15 MINUTES BETWEEN SWEEPS.
8. POST-DRAWDOWN "DRY-SHOCKING" WILL BE APPLIED IF LARVAL LAMPREY CONTINUE TO EMERGE. ANODES TO BE PLACED ONE METER APART TO SAMPLE ONE SQUARE METER AT A TIME FOR AT LEAST 60 SECONDS. FOR TEMPERATURES LESS THAN 10 DEGREES CELSIUS, MAXIMUM VOLTAGE MAY BE GRADUALLY INCREASED TO 400 VOLTS (DRY-SHOCKING ONLY).

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OREGON
SEPTEMBER 13, 2005
SENDA OZKAN
EXPIRES: 12/31/2024

PLAN SHEET SIZE ANSI B (11" X 17")

REV.	DATE	REVISION DESCRIPTION	DRW	ENG	CHK	APP
2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

GENERAL NOTES - HIP IV
CONSERVATION METHODS

DWG. NO.:
G-204

CREATED:
12/16/24

WORK AREA ISOLATION AND FISH SALVAGE (CONTINUED).

4. DEWATERING.

A. DEWATERING WILL OCCUR AT A RATE SLOW ENOUGH TO ALLOW SPECIES TO NATURALLY MIGRATE OUT OF THE WORK AREA.

B. WHERE A GRAVITY FEED DIVERSION IS NOT POSSIBLE, A PUMP MAY BE USED. PUMPS WILL BE INSTALLED TO AVOID REPETITIVE DEWATERING AND REWATERING.

C. WHEN FISH ARE PRESENT, PUMPS WILL BE SCREENED IN ACCORDANCE WITH NMFS FISH SCREEN CRITERIA. NMFS ENGINEERING REVIEW AND APPROVAL WILL BE OBTAINED FOR PUMPS EXCEEDING 3 CUBIC FEET PER SECOND.

D. DISSIPATION OF FLOW ENERGY AT THE BYPASS OUTFLOW WILL BE PROVIDED TO PREVENT DAMAGE TO THE STREAM CHANNEL AND RIPARIAN VEGETATION.

E. SEEPAGE WATER WILL BE PUMPED TO A TEMPORARY STORAGE AND TREATMENT SITE INTO UPLAND AREAS TO ALLOW WATER TO PERCOLATE THROUGH SOIL AND VEGETATION PRIOR TO REENTERING THE STREAM CHANNEL.

CONSTRUCTION AND POST CONSTRUCTION CONSERVATION MEASURES.

1. FISH PASSAGE.

A. FISH PASSAGE WILL BE PROVIDED FOR ADULT AND JUVENILE FISH LIKELY TO BE PRESENT DURING CONSTRUCTION UNLESS PASSAGE DID NOT EXIST BEFORE CONSTRUCTION, THE STREAM IS NATURALLY IMPASSABLE, OR PASSAGE WILL NEGATIVELY IMPACT ESA-LISTED SPECIES OR THEIR HABITAT.

B. FISH PASSAGE ALTERNATIVES WILL BE APPROVED BY THE BPA EC LEAD UNDER ADVISEMENT BY THE NMFS HABITAT BIOLOGIST.

2. CONSTRUCTION AND DISCHARGE WATER.

A. SURFACE WATER MAY BE DIVERTED TO MEET CONSTRUCTION NEEDS ONLY IF DEVELOPED SOURCES ARE UNAVAILABLE OR INADEQUATE.

B. DIVERSIONS WILL NOT EXCEED 10% OF THE AVAILABLE FLOW.

C. CONSTRUCTION DISCHARGE WATER WILL BE COLLECTED AND TREATED TO REMOVE DEBRIS, NUTRIENTS, SEDIMENT, PETROLEUM HYDROCARBONS, METALS, AND OTHER POLLUTANTS.

3. TIME AND EXTENT OF DISTURBANCE.

A. EARTHWORK REQUIRING IN-STREAM MECHANIZED EQUIPMENT (INCLUDING DRILLING, EXCAVATION, DREDGING, FILLING, AND COMPACTING) WILL BE COMPLETED AS QUICKLY AS POSSIBLE.

B. MECHANIZED EQUIPMENT WILL WORK FROM TOP OF BANK UNLESS WORK FROM ANOTHER LOCATION WILL RESULT IN LESS HABITAT DISTURBANCE (TURBIDITY, VEGETATION DISTURBANCE, ETC.).

4. CESSATION OF WORK.

A. PROJECT OPERATIONS WILL CEASE WHEN HIGH FLOW CONDITIONS MAY RESULT IN INUNDATION OF THE PROJECT AREA (FLOOD EFFORTS TO DECREASE DAMAGES TO NATURAL RESOURCES PERMITTED).

B. WATER QUALITY LEVELS EXCEEDED. SEE CWA SECTION 401 WATER QUALITY CERTIFICATION AND TURBIDITY MEASURES.

5. SITE RESTORATION.

A. DISTURBED AREAS, STREAM BANKS, SOILS, AND VEGETATION WILL BE CLEANED UP AND RESTORED TO IMPROVED OR PRE-PROJECT CONDITIONS.

B. PROJECT-RELATED WASTE WILL BE REMOVED.

C. TEMPORARY ACCESS ROADS AND STAGING WILL BE DECOMPACTED AND RESTORED. SOILS WILL BE LOOSENED IF NEEDED FOR REVEGETATION OR WATER INFILTRATION.

D. THE PROJECT SPONSOR WILL RETAIN THE RIGHT OF REASONABLE ACCESS TO THE SITE TO MONITOR AND MAINTAIN THE SITE OVER THE LIFE OF THE PROJECT.

6. REVEGETATION.

A. PLANTING AND SEEDING WILL OCCUR PRIOR TO OR AT THE BEGINNING OF THE FIRST GROWING SEASON AFTER CONSTRUCTION.

B. A MIX OF NATIVE SPECIES (INVASIVE SPECIES NOT ALLOWED) APPROPRIATE TO THE SITE WILL BE USED TO REESTABLISH VEGETATION, PROVIDE SHADE, AND REDUCE EROSION. REESTABLISHED VEGETATION SHOULD BE AT LEAST 70% OF PRE-PROJECT CONDITIONS WITHIN THREE YEARS.

C. VEGETATION SUCH AS WILLOWS, SEDGES, OR RUSH MATS WILL BE SALVAGED FROM DISTURBED OR ABANDONED AREAS TO BE REPLANTED.

D. SHORT-TERM STABILIZATION MEASURE MAY INCLUDE THE USE OF NON-NATIVE STERILE SEED MIX (WHEN NATIVE NOT AVAILABLE), WEED-FREE CERTIFIED STRAW, OR OTHER SIMILAR TECHNIQUES.

E. SURFACE FERTILIZER WILL NOT BE APPLIED WITHIN 50 FEET OF ANY STREAM, WATER BODY, OR WETLAND.

F. FENCING WILL BE INSTALLED AS NECESSARY TO PREVENT ACCESS TO REVEGETATED SITES BY LIVESTOCK OR UNAUTHORIZED PERSONS.

G. INVASIVE PLANTS WILL BE REMOVED OR CONTROLLED UNTIL NATIVE PLANT SPECIES ARE WELL ESTABLISHED (TYPICALLY THREE YEARS POST-CONSTRUCTION).

7. SITE ACCESS AND IMPLEMENTATION MONITORING.

A. THE PROJECT SPONSOR WILL PROVIDE CONSTRUCTION MONITORING DURING IMPLEMENTATION TO ENSURE ALL CONSERVATION MEASURES ARE ADEQUATELY FOLLOWED, EFFECTS TO LISTED SPECIES ARE NOT GREATER THAN PREDICTED, AND INCIDENTAL TAKE LIMITATIONS ARE NOT EXCEEDED.

B. THE PROJECT SPONSOR OR DESIGNATED REPRESENTATIVE WILL SUBMIT THE (PCF) WITHIN 30 DAYS OF PROJECT COMPLETION.

8. CWA SECTION 401 WATER QUALITY CERTIFICATION.

A. THE PROJECT SPONSOR OR DESIGNATED REPRESENTATIVE WILL COMPLETE AND RECORD WATER QUALITY OBSERVATIONS (SEE TURBIDITY MONITORING) TO ENSURE IN-WATER WORK IS NOT DEGRADING WATER QUALITY.

B. DURING CONSTRUCTION, APPROPRIATE STATE WATER QUALITY PROVISIONS PROVIDED BY THE OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY, WASHINGTON DEPARTMENT OF ECOLOGY, AND IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY WILL BE FOLLOWED.

STAGED REWATERING PLAN.

A. WHEN REINTRODUCING WATER TO DEWATERED AREAS AND NEWLY CONSTRUCTED CHANNELS, A STAGED REWATERING PLAN WILL BE APPLIED.

B. THE FOLLOWING WILL BE APPLIED TO ALL REWATERING EFFORTS. COMPLEX REWATERING EFFORTS MAY REQUIRE ADDITIONAL NOTES OR A DEDICATED SHEET IN THE CONSTRUCTION DETAILS.

1. TURBIDITY MONITORING PROTOCOL WILL BE APPLIED TO REWATERING EFFORTS.
2. PRE-WASH THE AREA BEFORE REWATERING. TURBID WASH WATER WILL BE DETAINED AND PUMPED TO THE FLOODPLAIN OR SEDIMENT CAPTURE AREAS RATHER THAN DISCHARGING TO FISH-BEARING STREAMS.
3. INSTALL SEINE NETS AT UPSTREAM END TO PREVENT FISH FROM MOVING DOWNSTREAM UNTIL 2/3 OF TOTAL FLOW IS RESTORED TO THE CHANNEL.
4. STARTING IN EARLY MORNING INTRODUCE 1/3 OF NEW CHANNEL FLOW OVER PERIOD OF 1-2 HOURS.
5. INTRODUCE SECOND THIRD OF FLOW OVER NEXT 1 TO 2 HOURS AND BEGIN FISH SALVAGE OF BYPASS CHANNEL IF FISH ARE PRESENT.
6. REMOVE UPSTREAM SEINE NETS ONCE 2/3 FLOW IN REWATERED CHANNEL AND DOWNSTREAM TURBIDITY IS WITHIN ACCEPTABLE RANGE (LESS THAN 40 NTU OR LESS THAN 10% BACKGROUND).
7. INTRODUCE FINAL THIRD OF FLOW ONCE FISH SALVAGE EFFORTS ARE COMPLETE AND DOWNSTREAM TURBIDITY VERIFIED TO BE WITHIN ACCEPTABLE RANGE.
8. INSTALL PLUG TO BLOCK FLOW INTO OLD CHANNEL OR BYPASS. REMOVE ANY REMAINING SEINE NETS.
9. IN LAMPREY SYSTEMS, LAMPREY SALVAGE AND DRY SHOCKING MAY BE NECESSARY.

TURBIDITY MONITORING.

A. RECORD THE READING, LOCATION, AND TIME FOR THE BACKGROUND READING APPROXIMATELY 100 FEET UPSTREAM OF THE PROJECT AREA USING A RECENTLY CALIBRATED TURBIDIMETER OR VIA VISUAL OBSERVATION (SEE THE HIP HANDBOOK TURBIDITY MONITORING SECTION FOR A VISUAL OBSERVATION KEY).

B. RECORD THE TURBIDITY READING, LOCATION, AND TIME AT THE MEASUREMENT COMPLIANCE LOCATION POINT.

1. 50 FEET DOWNSTREAM FOR STREAMS LESS THAN 30 FEET WIDE.
2. 100 FEET DOWNSTREAM FOR STREAMS BETWEEN 30 AND 100 FEET WIDE.
3. 200 FEET DOWNSTREAM FOR STREAMS GREATER THAN 100 FEET WIDE.
4. 300 FEET FROM THE DISCHARGE POINT OR NONPOINT SOURCE FOR LOCATIONS SUBJECT TO TIDAL OR COASTAL SCOUR.

C. TURBIDITY SHALL BE MEASURED (BACKGROUND LOCATION AND COMPLIANCE POINTS) EVERY 4 HOURS WHILE WORK IS BEING IMPLEMENTED.

D. IF THERE IS A VISIBLE DIFFERENCE BETWEEN A COMPLIANCE POINT AND THE BACKGROUND, THE EXCEEDANCE WILL BE NOTED IN THE PCF. ADJUSTMENTS OR CORRECTIVE MEASURES WILL BE TAKEN IN ORDER TO REDUCE TURBIDITY.

E. IF EXCEEDANCES OCCUR FOR MORE THAN TWO CONSECUTIVE MONITORING INTERVALS (AFTER 8 HOURS), THE ACTIVITY WILL STOP UNTIL THE TURBIDITY LEVEL RETURNS TO BACKGROUND. THE BPA EC LEAD WILL BE NOTIFIED OF ALL EXCEEDANCES AND CORRECTIVE ACTIONS AT PROJECT COMPLETION.

F. IF TURBIDITY CONTROLS (COFFER DAMS, WADDLES, FENCING, ETC.) ARE DETERMINED INEFFECTIVE, CREWS WILL BE MOBILIZED TO MODIFY AS NECESSARY. OCCURRENCES WILL BE DOCUMENTED IN THE PCF.

G. FINAL TURBIDITY READINGS, EXCEEDANCES, AND CONTROL FAILURES WILL BE SUBMITTED TO THE BPA EC LEAD USING PCF.

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SENDA OZKAN
EXPIRES: 12/31/2024

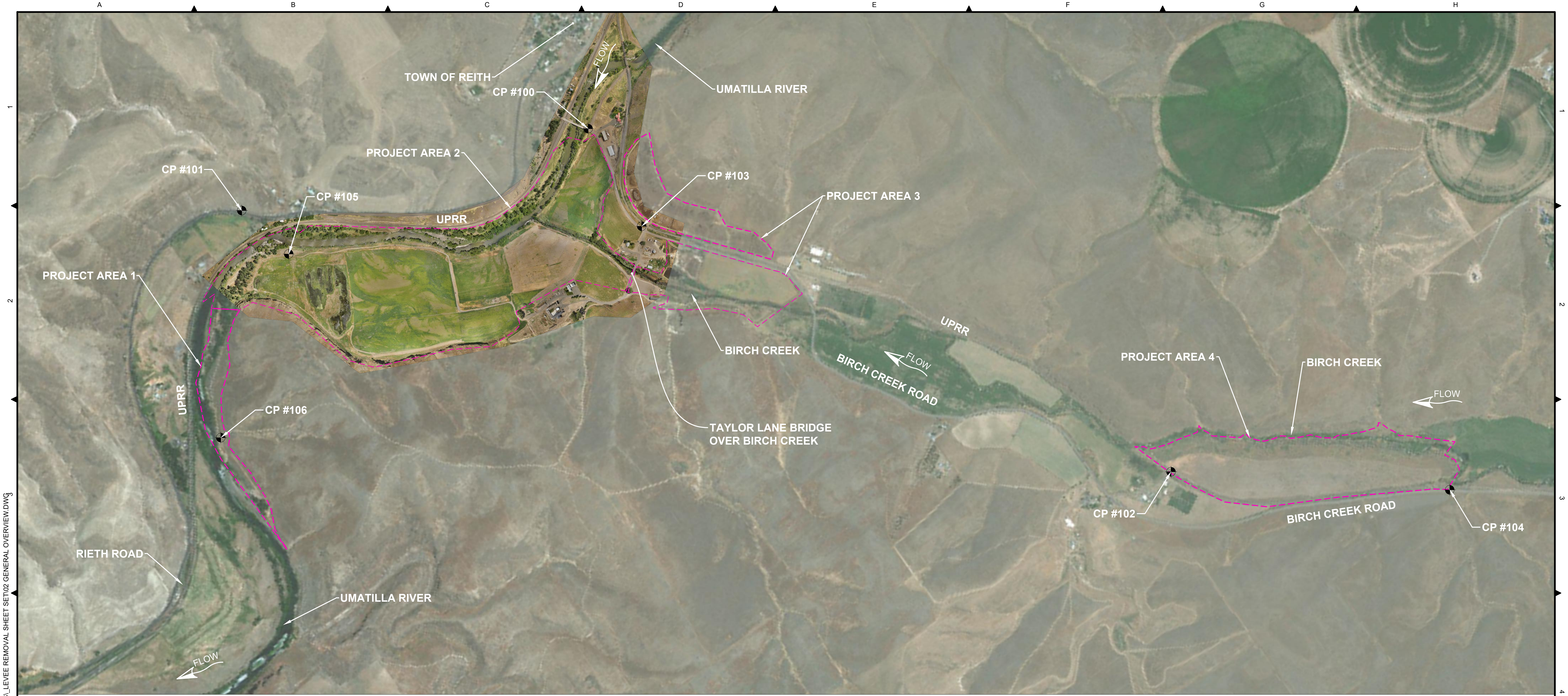
PLAN SHEET SIZE ANSI B (11" X 17")

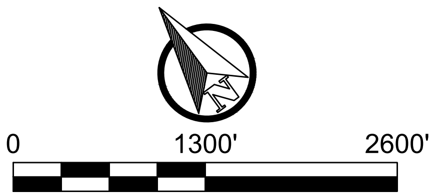
REV.	DATE	REVISION DESCRIPTION	DRW	ENG	CHK	APP
2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

GENERAL NOTES - HIP IV
CONSERVATION METHODS

DWG. NO.: G-205
CREATED: 12/16/24
5 of 19





CONTROL POINTS TABLE

POINT #	NORTHING	EASTING	ELEVATION
100	729832.28	8617228.00	967.4
101	731598.17	8612789.10	964.4
102	721572.08	8620994.98	1035.4
103	728346.97	8617064.95	985.3
104	719227.39	8623920.51	1083.9
105	730758.89	8612971.30	943.7
106	729262.42	8610809.93	945.5

LEGEND

▭	PROJECT AREA BOUNDARY
◈	CONTROL POINT (CP #XXX)

NOTES:

1. OVERVIEW OF ALL PROJECT AREAS.

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK\.SHEET FILES_LEVEE REMOVAL SHEET SET\02 GENERAL OVERVIEW.DWG
PLOT DETAILS: HARVEY, SPENCER December 16, 2024 4:16 PM ----

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PLAN SHEET SIZE ANSI B (11" X 17")

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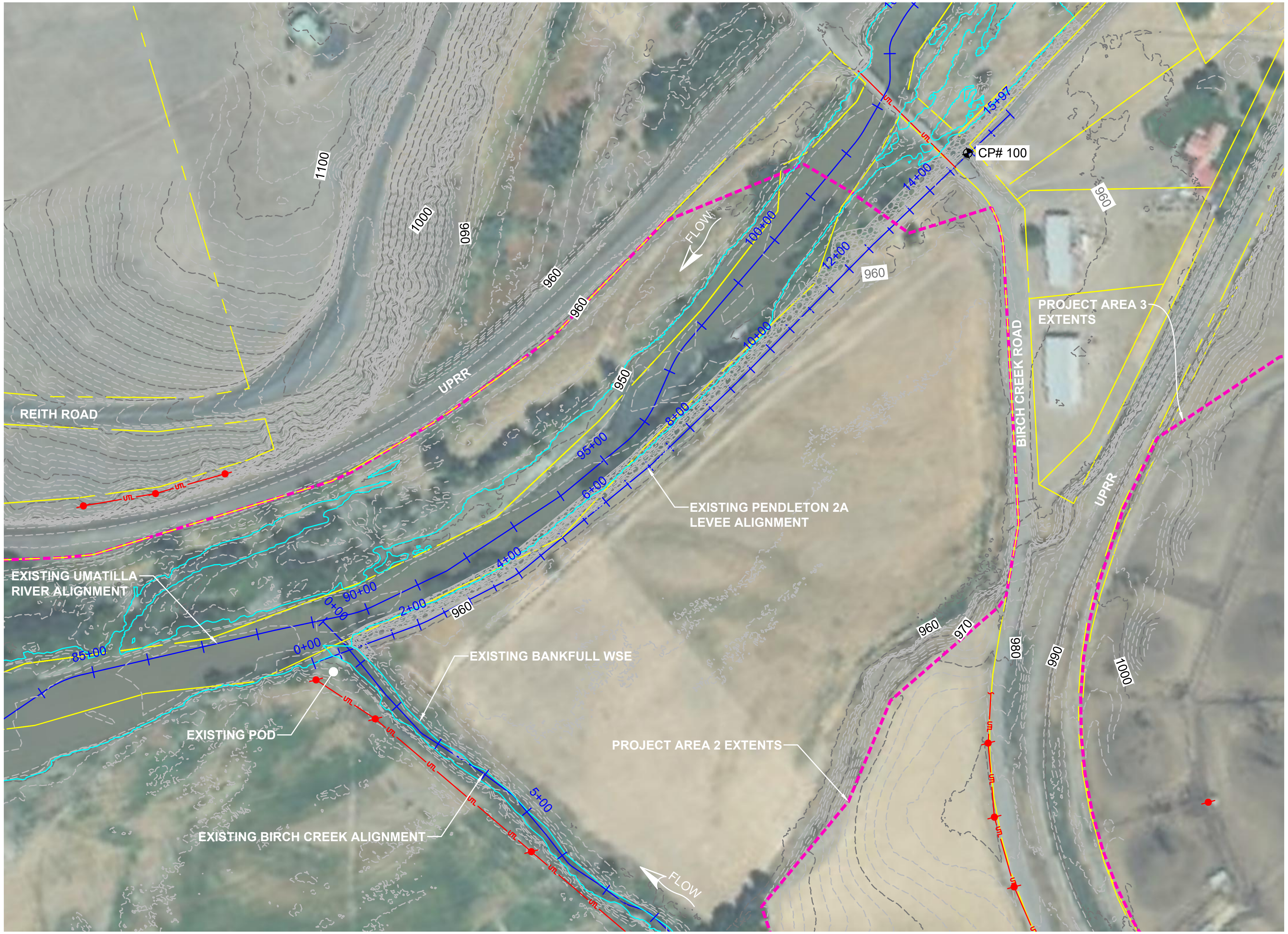
CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

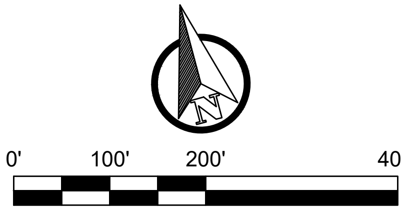
GENERAL OVERVIEW

DWG. NO.: E-201

CREATED: 12/16/24

6 of 19





LEGEND

- - - EXISTING 2-FOOT CONTOUR
- - - EXISTING 10-FOOT CONTOUR
— EXISTING PROPERTY LINE
—+— EXISTING ALIGNMENT
— EXISTING OHW
≻- - -≺ EXISTING CULVERT
—UL— EXISTING POWER/COMM UTILITY
- - - PROJECT AREA BOUNDARY
▨ EXISTING RIPRAP
● EXISTING POWER POLE
⯐ CONTROL POINT (CP #XXX)

CONTROL POINTS TABLE			
POINT #	NORTHING	EASTING	ELEVATION
100	729832.28	8617228.00	967.4

NOTES:

1. SEE SHEET E-201 FOR ADDITIONAL CONTROL POINT LOCATIONS.

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK\.SHEET FILES_LEVEE REMOVAL SHEET SET\03 LEVEE EXISTING.DWG
PLOT DETAILS: HARVEY, SPENCER December 16, 2024 4:01 PM ----

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Senda Ozkan

CAYUSE - WALLA WALLA - UMATILLA
CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION
Treaty of 1855

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CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

EXISTING CONDITIONS
OVERVIEW

DWG. NO.: E-202

CREATED: 12/16/24

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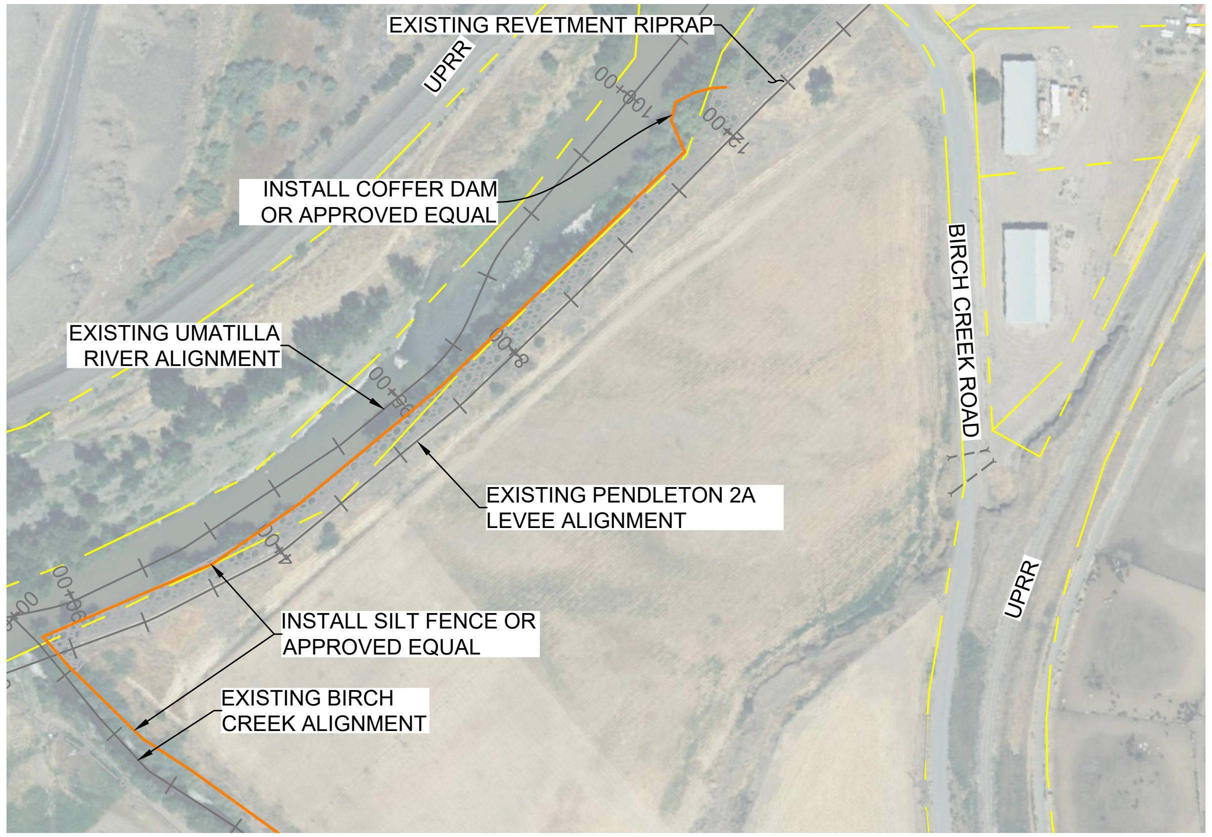
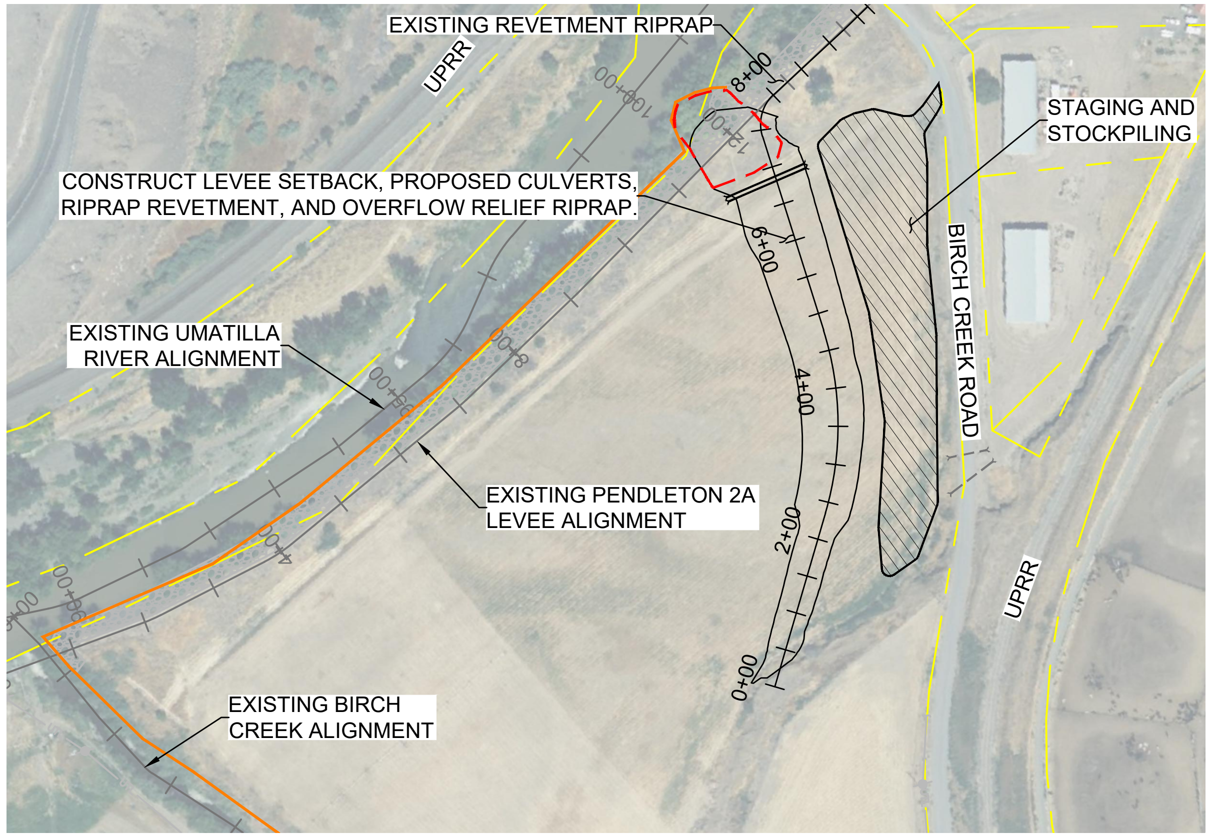
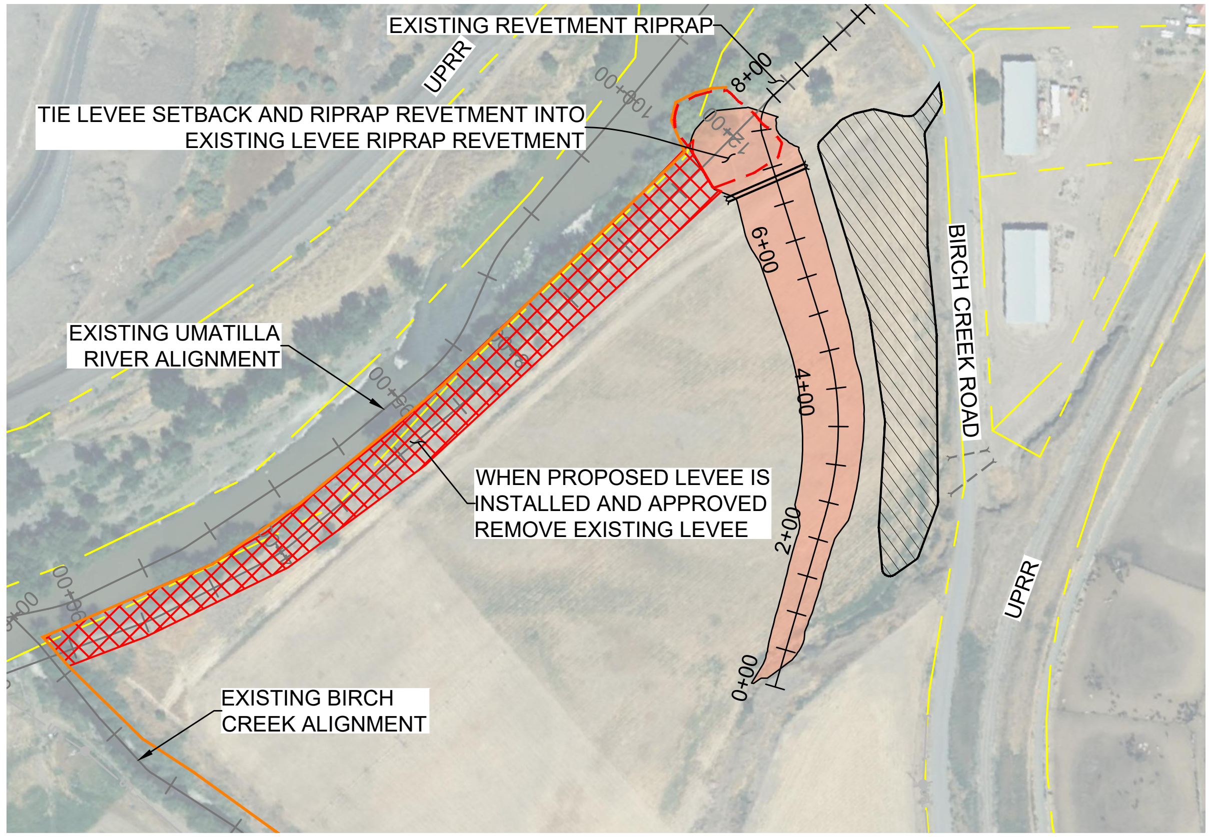


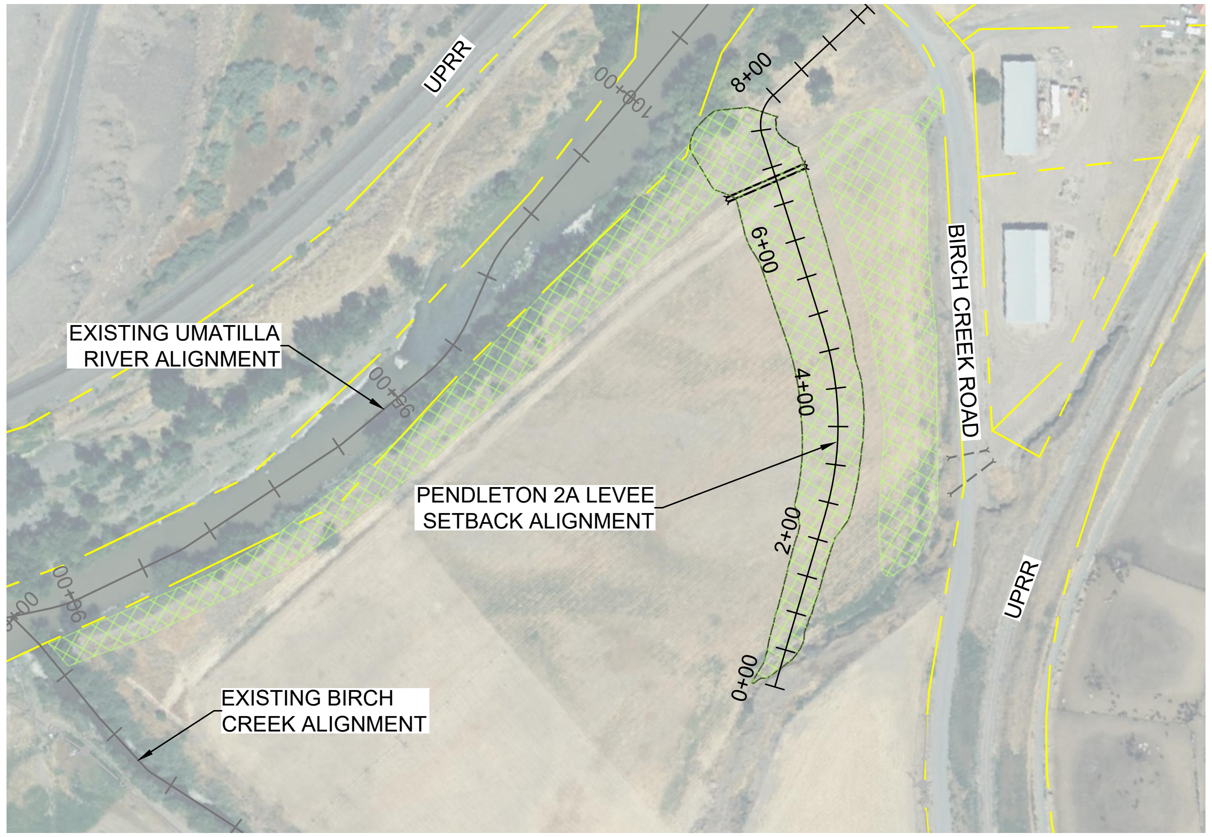
STEP 1: EXISTING CONDITIONS AND INSTALL ESC (SEE SHEET C-201)



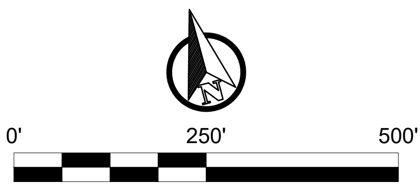
STEP 2: FLOODPLAIN WORK - STAGING, CLEARING, BENCHING, ETC.



STEP 3: ACTIVE CHANNEL WORK - EXISTING LEVEE REMOVAL



STEP 4: STABILIZE AND REVEGETATE, CLEANUP, AND DEMOBILIZATION



LEGEND

- EXISTING PROPERTY LINE
- EXISTING ALIGNMENT
- ▨ EXISTING RIPRAP
- EXISTING CULVERT
- PROPOSED ALIGNMENT
- ▨ PROPOSED STAGING AREA
- PROPOSED CULVERT
- 🟧 PROPOSED LEVEE FILL
- 🟥 EXISTING USACE LEVEE REMOVAL AREA
- 🟩 SEEDING AND STABILIZATION
- PROPOSED BONDING BENCH EXTENTS
- PROPOSED TESC BOUNDARY

CONSTRUCTION SEQUENCE STEPS:

1. EXISTING CONDITIONS.
2. FLOODPLAIN WORK:
   - SEPARATE AND STOCKPILE EARTH AND ROCK MATERIALS IN THE STAGING AREA OR AREAS AS DIRECTED BY OWNER'S REPRESENTATIVE OR ENGINEER OF RECORD.
   - CONSTRUCT BONDING BENCHES ABOVE ORDINARY HIGH WATER
   - CONSTRUCT LEVEE SETBACK, PROPOSED CULVERTS, RIPRAP REVETMENT, AND OVERFLOW RELIEF RIPRAP.
   - USACE OR ENGINEER OF RECORD TO APPROVE LEVEE SETBACK CONSTRUCTION PRIOR TO PROGRESSING TO STEP 3.
3. ACTIVE CHANNEL WORK:
   - REMOVAL OF EXISTING LEVEE MATERIAL CANNOT BE INITIATED PRIOR TO ACCEPTANCE OF CONSTRUCTED LEVEE BY ENGINEER OF RECORD AND ON-FEDERAL LEVEE SPONSOR.
   - IF NEEDED ISOLATE EXISTING UMATILLA RIVER, AND CONDUCT FISH SALVAGE, AS NEEDED, TO REMOVE ANY STRANDED FISH WHERE NECESSARY AS DIRECTED BY OWNER'S REPRESENTATIVE OR ENGINEER.
   - DEWATER AND TIE PROPOSED LEVEE SETBACK AND RIPRAP REVETMENT INTO EXISTING LEVEE RIPRAP REVETMENT.
4. POST CONSTRUCTION:
   - STABILIZE AND REVEGETATE SITE (SEEDING AND PLANTING).
   - SITE CLEANUP AND DEMOBILIZATION.

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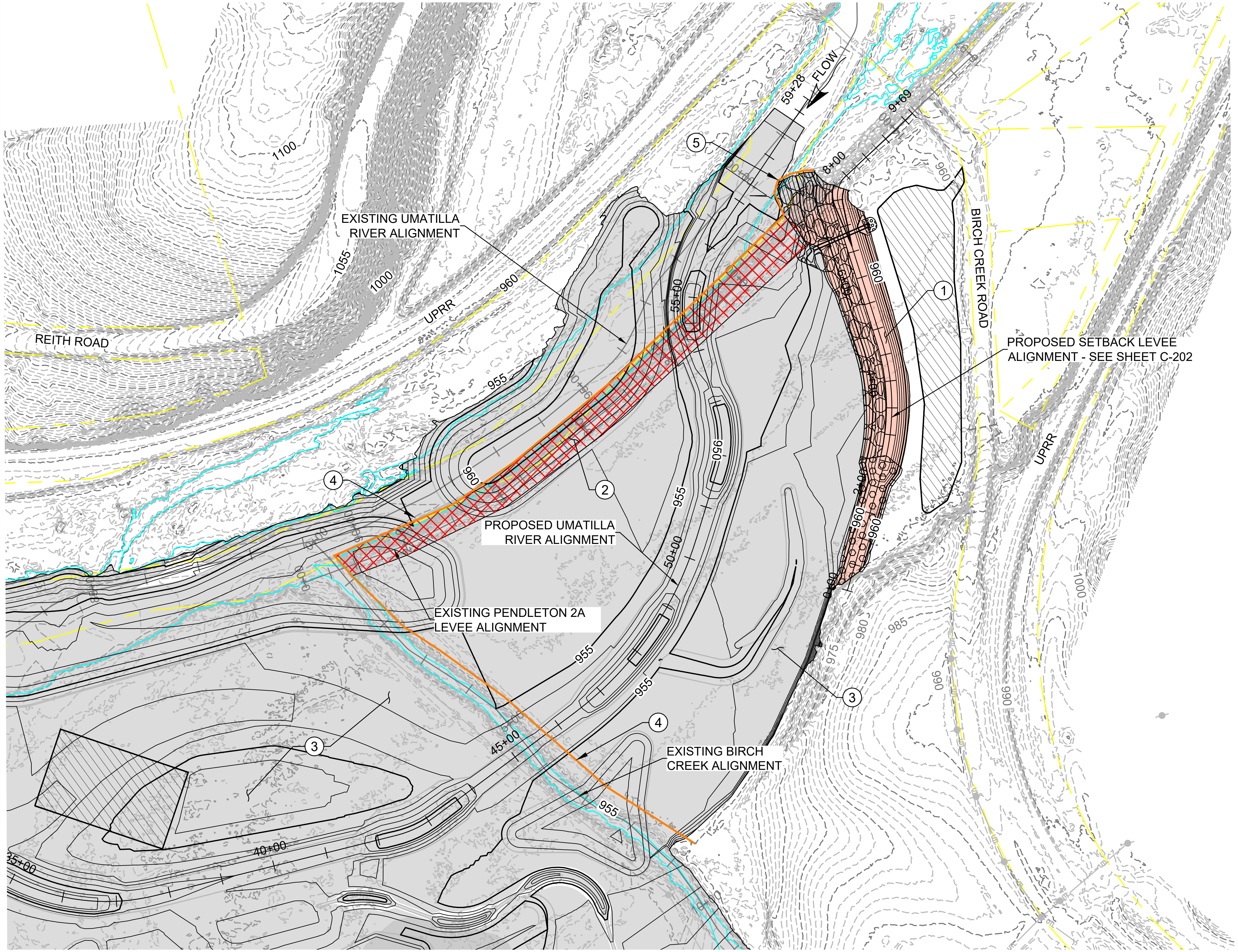
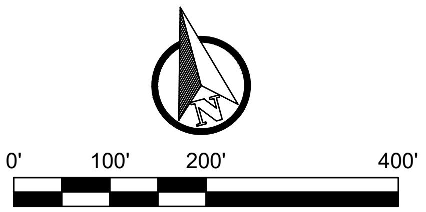
CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

RECOMMENDED
CONSTRUCTION SEQUENCE

DWG. NO.: C-200
CREATED: 12/16/24
8 of 19

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK\.SHEET FILES_LEVEE REMOVAL SHEET SET\04 Z CONSTRUCTION SEQUENCING.DWG
PLOT DETAILS: HARVEY, SPENCER December 16, 2024 4:59 PM ----





LEGEND

- - -	EXISTING 2-FOOT CONTOUR
— — —	EXISTING 10-FOOT CONTOUR
——	EXISTING PROPERTY LINE
—+—	EXISTING ALIGNMENT
——	EXISTING OHW
≻- - -≺	EXISTING CULVERT
— UG —	EXISTING POWER/COMM UTILITY
——	PROPOSED 1-FOOT CONTOUR
——	PROPOSED 5-FOOT CONTOUR
—+—	PROPOSED ALIGNMENT
——	PROPOSED TESC BOUNDARY
≻——≺	PROPOSED CULVERT
▨	EXISTING USACE LEVEE REMOVAL AREA
▨	EXISTING RIPRAP
▭	PROPOSED LEVEE FILL
▨	PROPOSED ODOT CLASS 200 RIPRAP
▨	PROPOSED ODOT CLASS 50 RIPRAP
▨	PROPOSED STAGING AREA
▭	PROPOSED GRADING

NOTES:
1. PROPOSED SETBACK LEVEE. SEE SHEETS C-202 - C-205 FOR PROPOSED FINAL GRADES.
2. REMOVE APPROXIMATELY 1,100-LF OF EXISTING USACE LEVEE.
3. PROJECT AREA 2 PROPOSED GRADING PROVIDED IN SEPARATE DRAWING SET.
4. PROPOSED SILT FENCE OR APPROVED EQUAL PER DETAILS ON C-210.
5. PROPOSED COFFER DAM OR APPROVED EQUAL PER DETAILS ON C-210.

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK\.SHEET FILES_LEVEE REMOVAL SHEET SET\05 LEVEE REMOVAL AND PROPOSED OVERVIEW.DWG
PLOT DETAILS: HARVEY, SPENCER December 16, 2024 4:57 PM ----

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REGISTERED PROFESSIONAL ENGINEER
76918PE
OREGON
SEPTEMBER 13, 2005
SENDA OZKAN
EXPIRES: 12/31/2024

CAYUSE - WALLA WALLA - UMATILLA
CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION
Treaty of 1855

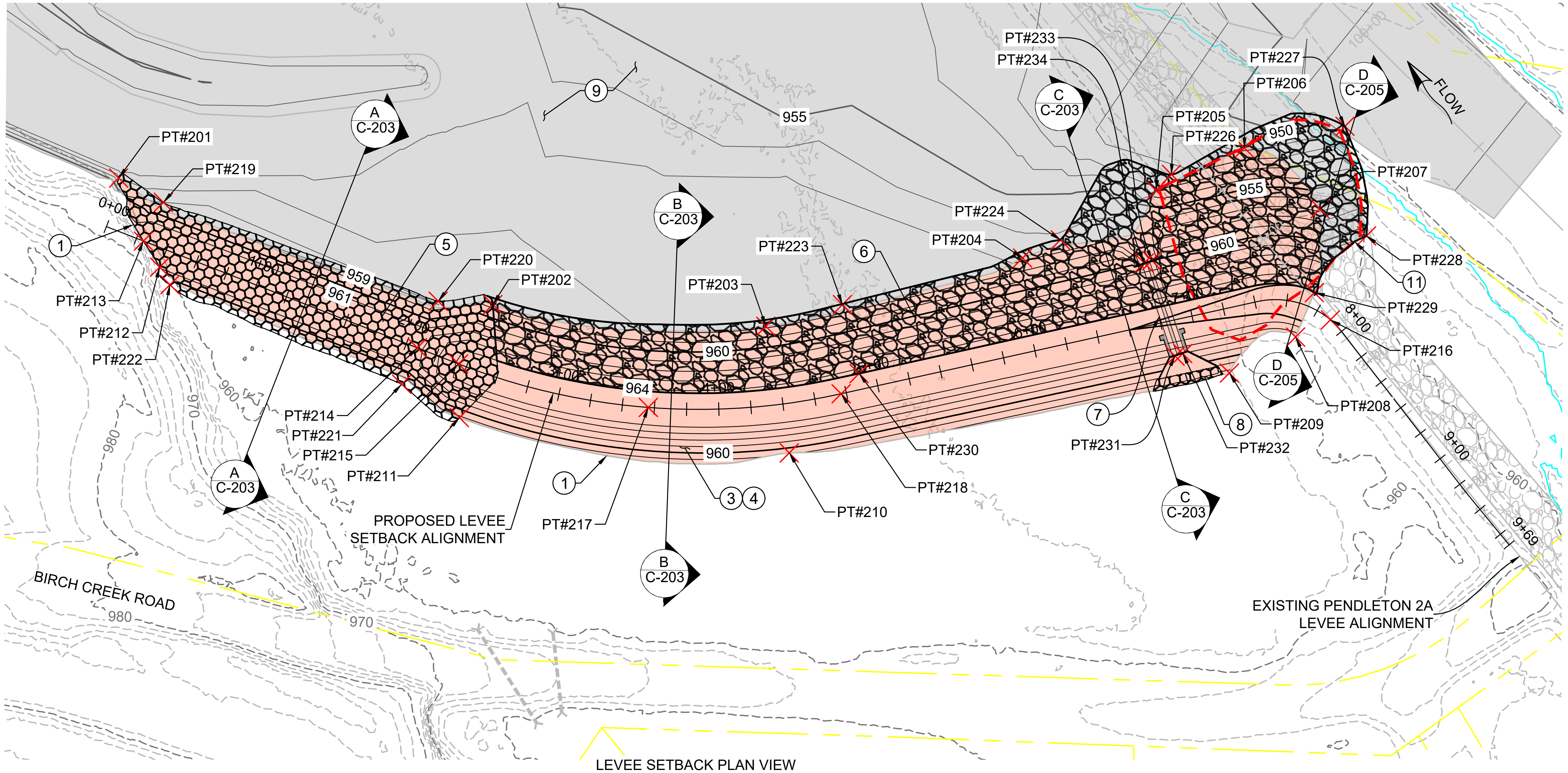
PLAN SHEET SIZE ANSI B (11" X 17")

REV.	DATE	REVISION DESCRIPTION	DRW	ENG	CHK	APP
2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

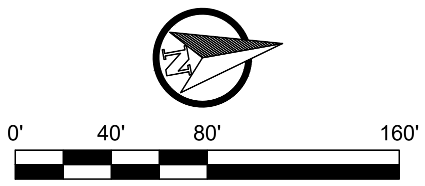
EXISTING LEVEE REMOVAL & SETBACK LEVEE OVERVIEW

DWG. NO.: C-201
CREATED: 12/16/24
9 of 19



LEVEE SETBACK PLAN VIEW

1" = 80'

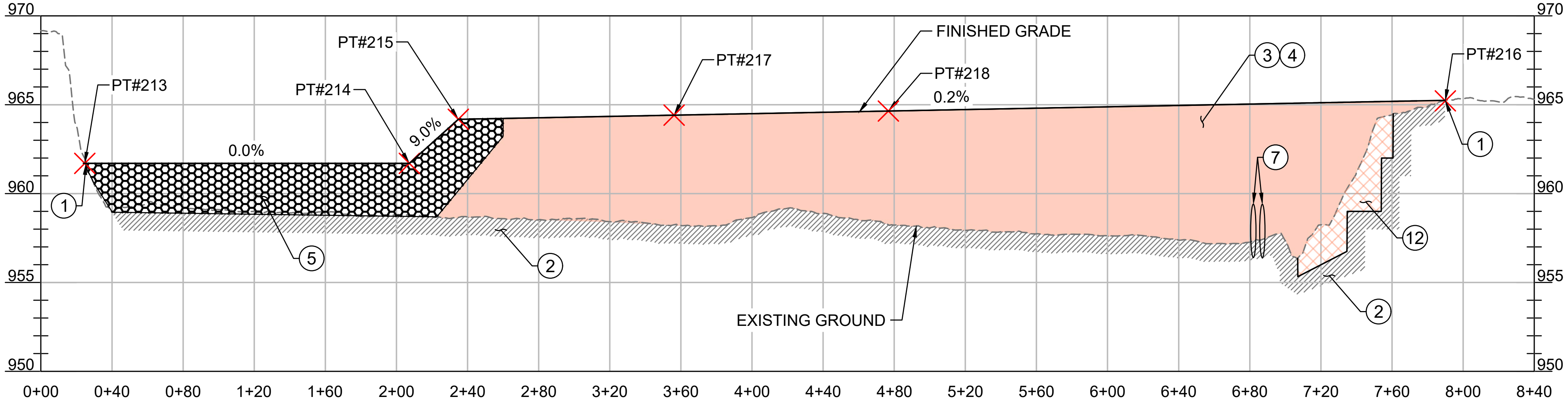


NOTES:

1. DAYLIGHT PROPOSED FINISHED GRADE TO MATCH EXISTING GROUND.
2. PREPARE SUBGRADE TO A DEPTH OF 6 IN AND IN ACCORDANCE WITH SPECIFICATION SECTIONS 31 23 00 AND 32 10 00.
3. PLACE LEVEE FILL IN ACCORDANCE WITH THE SPECIFICATION SECTION 31 23 00.
4. LEVEE FILL MATERIAL SHALL BE NON-ORGANIC MATERIAL IN ACCORDANCE WITH SPECIFICATIONS SECTION 31 23 00 SOURCE FROM ADJACENT ONSITE FLOODPLAIN EXCAVATIONS. SEE NOTE 9.
5. PROPOSED LEVEE RIPRAP OVERFLOW RELIEF PER DETAIL 1 ON SHEET C-207.
6. PROPOSED LEVEE RIPRAP REVETMENT PER DETAIL 2 ON SHEET C-207.
7. INSTALL TWO (2) 62-LF 36 IN Ø CPEP CULVERTS AND ASSOCIATES HEADWALLS, WINGWALLS, AND INTERNAL SEEPAGE FILTER PER SHEETS C-206 TO C-208.
8. AT INLET INSTALL CLASS 50 RIPRAP MINIMUM 12 IN THICK UNDERLAIN BY FILTER BLANKET.
9. PROJECT AREA 2 PROPOSED GRADING PROVIDED IN SEPARATE DRAWING SET.
10. SEE SHEET SHEET C-209 FOR CONSTRUCTION POINT COORDINATES.
11. TIE PROPOSED LEVEE RIPRAP REVETMENT INTO EXISTING RIPRAP
12. SEE SHEETS C-204 AND C-205 FOR BONDING BENCH DETAILS.

LEGEND

- - -	EXISTING 2-FOOT CONTOUR
- - -	EXISTING 10-FOOT CONTOUR
—	EXISTING PROPERTY LINE
—+—	EXISTING ALIGNMENT
—	EXISTING OHW
>- - -<	EXISTING CULVERT
—	PROPOSED 1-FOOT CONTOUR
—	PROPOSED 5-FOOT CONTOUR
—+—	PROPOSED ALIGNMENT
═	PROPOSED CULVERT
▨	EXISTING RIPRAP
▨	PROPOSED LEVEE FILL
▨	PROPOSED BONDING BENCH EXCAVATION
[ ]	PROPOSED BONDING BENCH EXTENTS
▨	PROPOSED ODOT CLASS 200 RIPRAP
▨	PROPOSED ODOT CLASS 50 RIPRAP
▨	PROPOSED GRADING
▨	PROPOSED SUBSURFACE PREPARATION
✕	CONSTRUCTION POINT NUMBER



LEVEE SETBACK PROFILE VIEW

1"=80' (1H:10V)

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK_SHEET FILES_LEVEE REMOVAL SHEET SET\06 PROPOSED LEVEE SETBACK.DWG
PLOT DETAILS: HARVEY, SPENCER December 16, 2024 5:31 PM

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OREGON
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SENDA OZKAN
EXPIRES: 12/31/2024

PLAN SHEET SIZE ANSI B (11" X 17")

REV.	DATE	REVISION DESCRIPTION	DRW	ENG	CHK	APP
2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

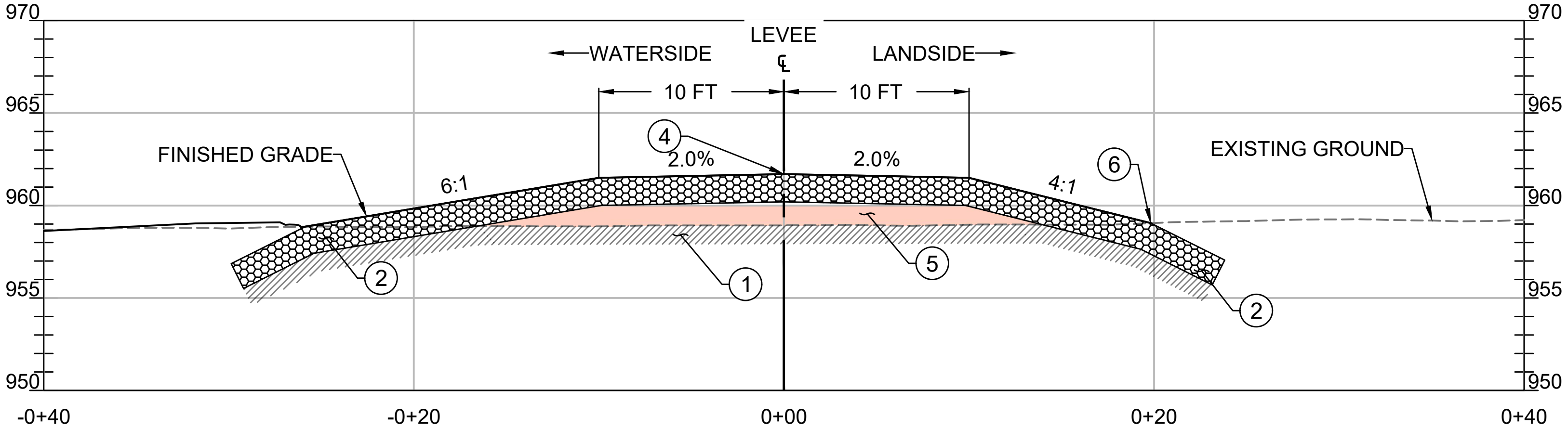
PROPOSED LEVEE
SETBACK

DWG. NO.:
C-202

CREATED:
12/16/24

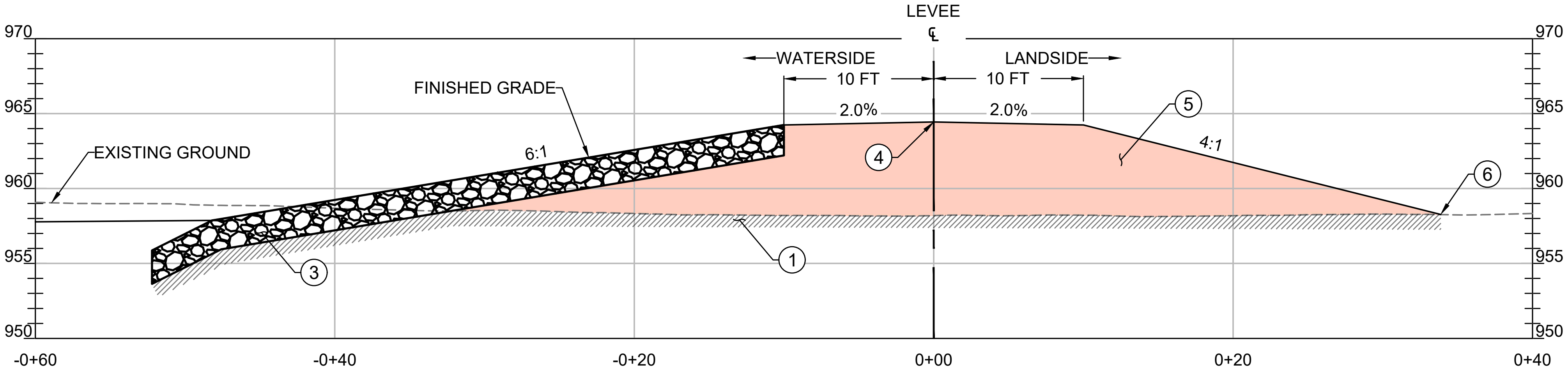
10 of 19

NOTES:
1. PREPARE SUBGRADE TO A DEPTH OF 6 IN AND IN ACCORDIANCE WITH SPECIFICATION SECTION 31 23 00 AND 32 10 00.
2. INSTALL 18 IN LAYER OF ODOT CLASS 50 RIPRAP UNDERLAIN BY FILTER BLANKET PER DETAIL 1 ON SHEET C-207.
3. INSTALL 24 IN LAYER OF ODOT CLASS 200 RIPRAP UNDERLAIN BY FILTER BLANKET PER DETAIL 2 ON SHEET C-207.
4. LEVEE CREST ELEVATION VARIES. SEE CONSTRUCTION PONT DATA TABLE ON SHEET C-209.
5. PLACE LEVEE FILL PER SPECIFICATION SECTION 31 23 00.
6. DAYLIGHT FINISHED GRADE TO EXISTING GROUND.

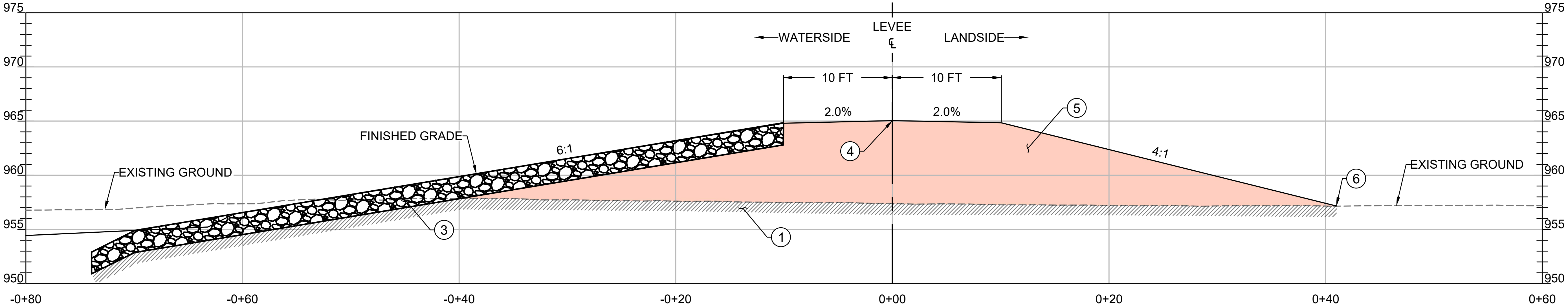


A C-202 LEVEE SECTION
SCALE 1" = 10' 1H:1V

LEGEND
- - - EXISTING GROUND
— FINISHED GRADE
🟧 PROPOSED LEVEE FILL
▩ PROPOSED ODOT CLASS 200 RIPRAP
▩ PROPOSED ODOT CLASS 50 RIPRAP
▨ PROPOSED SUBSURFACE PREPARATION



B C-202 LEVEE SECTION
SCALE 1" = 10' 1H:1V



C C-202 LEVEE SECTION
SCALE 1" = 10' 1H:1V

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CAYUSE - WALLA WALLA - UMATILLA
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PLAN SHEET SIZE ANSI B (11" X 17")

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2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

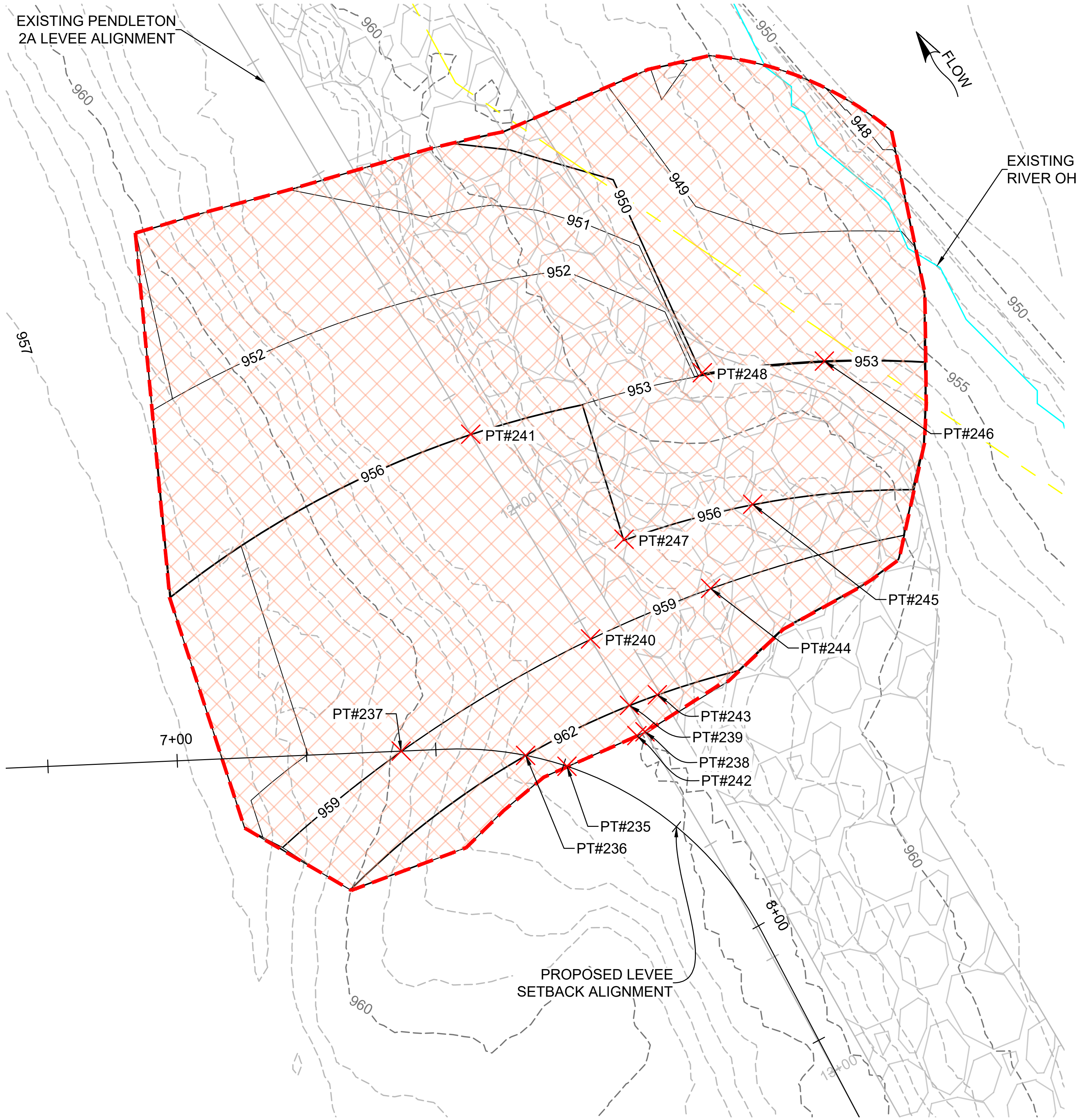
PROPOSED LEVEE SETBACK

DWG. NO.: C-203

CREATED: 12/16/24

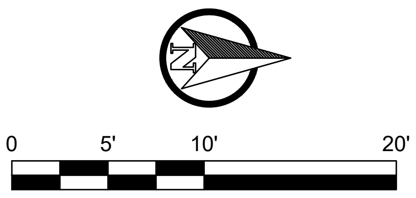
11 of 19

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK_SHEET FILES_LEVEE REMOVAL SHEET SET\07 PROPOSED LEVEE SETBACK.DWG
PLOT DETAILS: HARVEY, SPENCER December 16, 2024 4:10 PM



LEVEE SETBACK PLAN VIEW

1" = 20'

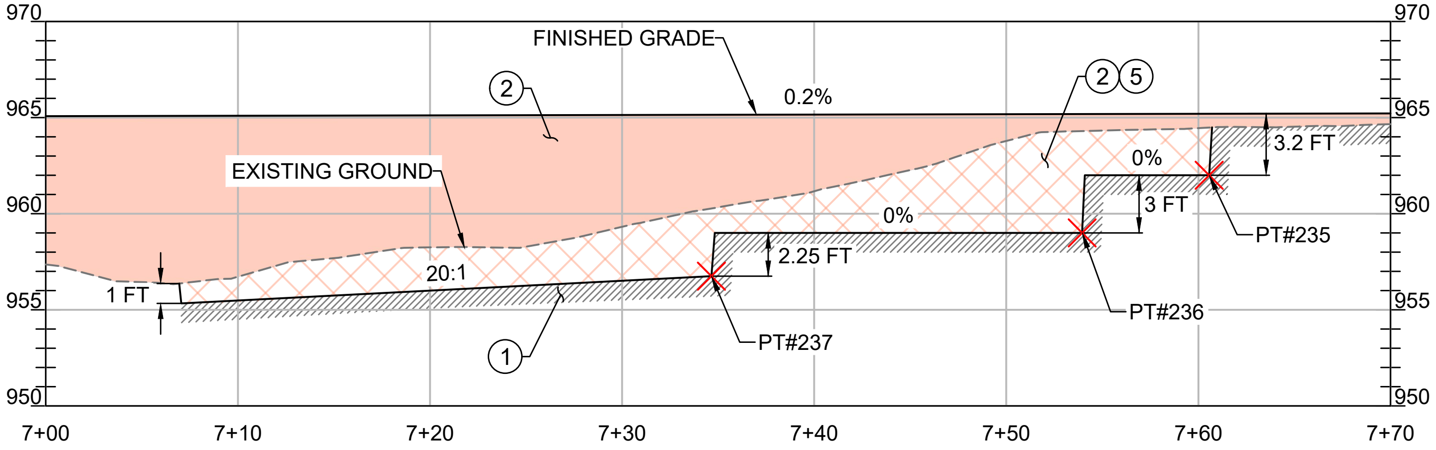


LEGEND

- - - EXISTING 1-FOOT CONTOUR
– – – EXISTING 5-FOOT CONTOUR
— EXISTING OHW
▨ EXISTING RIPRAP
— PROPOSED 1-FOOT CONTOUR
— PROPOSED 5-FOOT CONTOUR
—+— PROPOSED ALIGNMENT
▭ PROPOSED LEVEE FILL
▨ PROPOSED BONDING BENCH EXCAVATION
[ ] PROPOSED BONDING BENCH EXTENTS
▨ PROPOSED SUBSURFACE PREPARATION
× CONSTRUCTION POINT NUMBER

NOTES:

1. PREPARE SUBGRADE TO A DEPTH OF 6 IN AND IN ACCORDANCE WITH SPECIFICATION SECTIONS 31 23 00 AND 32 10 00.
2. PLACE LEVEE FILL IN ACCORDANCE WITH THE SPECIFICATION SECTION 31 23 00.
3. LEVEE FILL MATERIAL SHALL BE NON-ORGANIC MATERIAL IN ACCORDANCE WITH SPECIFICATIONS SECTION 31 23 00 SOURCE FROM ADJACENT ONSITE FLOODPLAIN EXCAVATIONS.
4. SEE SHEET SHEET C-209 FOR CONSTRUCTION POINT COORDINATES.
5. SEE SHEETS C-205 FOR BONDING BENCH DETAILS.



LEVEE SETBACK PROFILE VIEW

1" = 10'

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SEPTEMBER 13, 2005
SENDA OZKAN
EXPIRES: 12/31/2024

PLAN SHEET SIZE ANSI B (11" X 17")

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2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

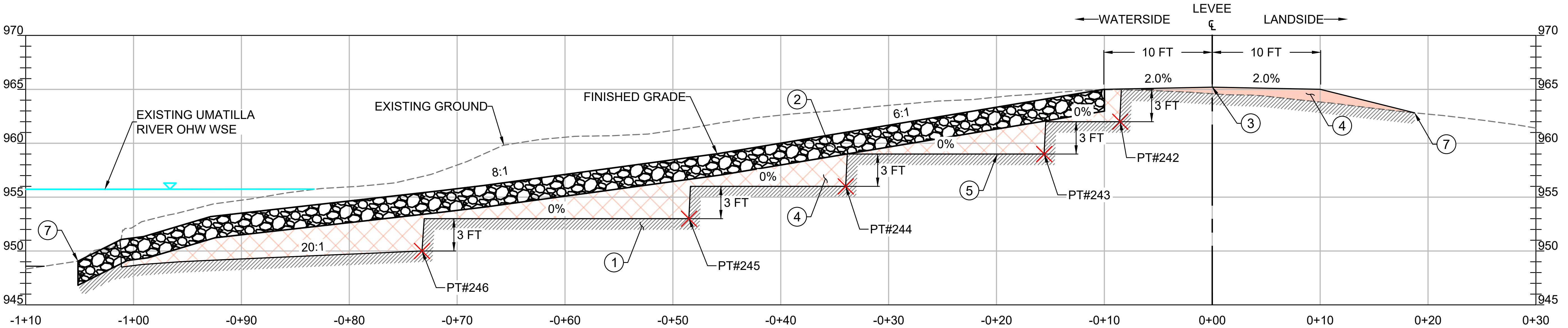
PROPOSED LEVEE
SETBACK

DWG. NO.: C-204

CREATED: 12/16/24

12 of 19

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK\SHEET FILES_LEVEE REMOVAL SHEET SET\07 PROPOSED LEVEE SETBACK.DWG
PLOT DETAILS: HARVEY, SPENCER December 16, 2024 4:15 PM

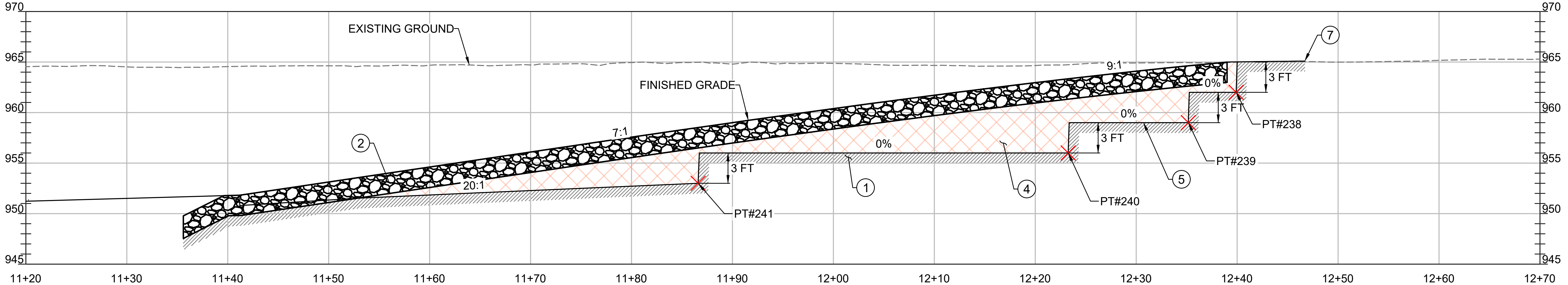


D
C-202
LEVEE SECTION
SCALE 1" = 10' 1H:1V

LEGEND

- EXISTING GROUND
- EXISTING OHW WSE
- FINISHED GRADE
- 🟧 PROPOSED LEVEE FILL
- ▨ PROPOSED BONDING BENCH EXCAVATION
- ▨ PROPOSED ODOT CLASS 200 RIPRAP
- ▨ PROPOSED SUBSURFACE PREPARATION
- ✕ CONSTRUCTION POINT NUMBER

NOTES:
1. PREPARE SUBGRADE TO A DEPTH OF 6 IN AND IN ACCORDANCE WITH SPECIFICATION SECTIONS 31 23 00 AND 32 10 00.
2. INSTALL 24 IN LAYER OF ODOT CLASS 200 RIPRAP UNDERLAIN BY FILTER BLANKET PER DETAIL 2 ON SHEET C-207.
3. LEVEE CREST ELEVATION VARIES. SEE CONSTRUCTION PONT DATA TABLE ON SHEET C-209.
4. PLACE LEVEE FILL PER SPECIFICATION SECTION 31 23 00.
5. EXCAVATE BONDING WITH A MAXIMUM 4 FT HEIGHT AND MINIMUM 3 FT WIDTH.
6. SEE SHEET SHEET C-209 FOR CONSTRUCTION POINT COORDINATES.
7. DAYLIGHT FINISHED GRADE TO EXISTING GROUND.



EXISTING PENDLETON 2A LEVEE PROFILE VIEW
1"=10' (1H:1V)

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK\.SHEET FILES_LEVEE REMOVAL SHEET SET\07 PROPOSED LEVEE SETBACK.DWG
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SEPTEMBER 13, 2005
SENDA OZKAN
EXPIRES: 12/31/2024

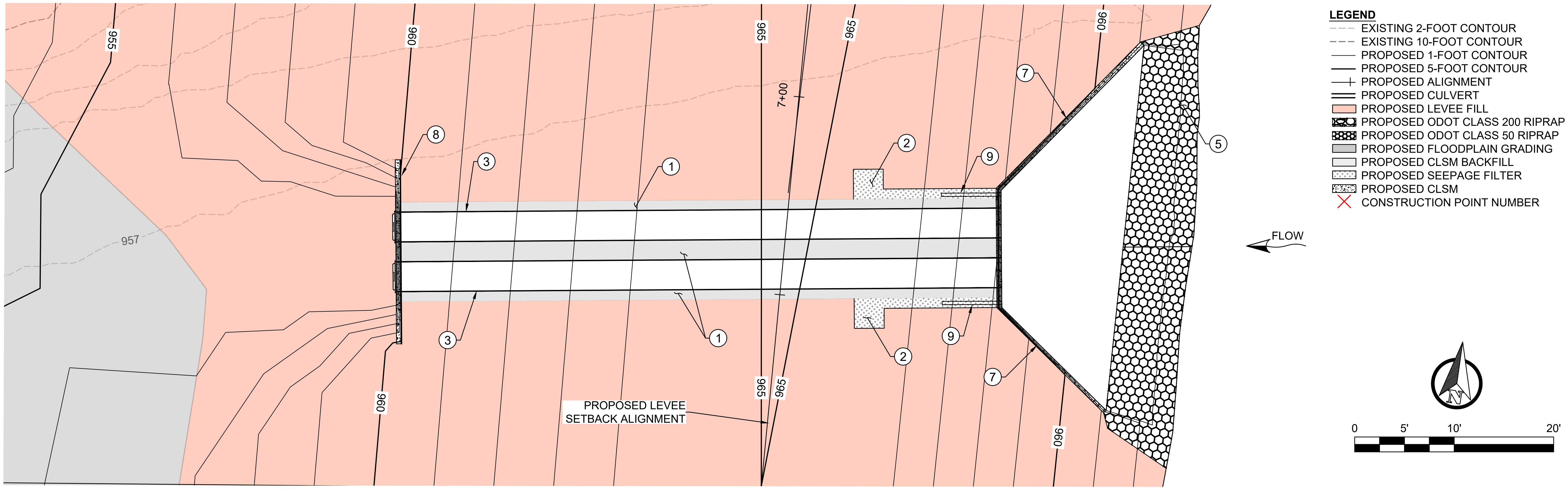
PLAN SHEET SIZE ANSI B (11" X 17")

REV.	DATE	REVISION DESCRIPTION	DRW	ENG	CHK	APP
2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

PROPOSED LEVEE
SETBACK

DWG. NO.: C-205
CREATED: 12/16/24
13 of 19

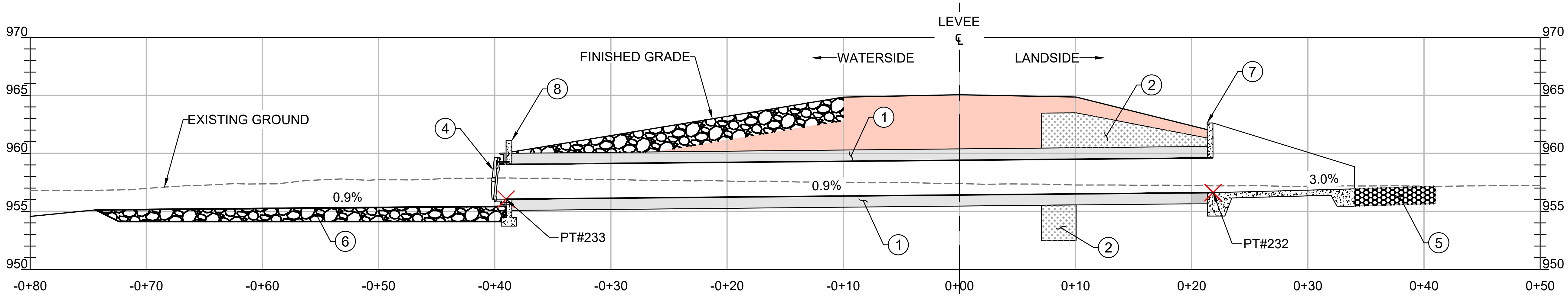


LEGEND
- EXISTING 2-FOOT CONTOUR
- EXISTING 10-FOOT CONTOUR
- PROPOSED 1-FOOT CONTOUR
- PROPOSED 5-FOOT CONTOUR
- PROPOSED ALIGNMENT
- PROPOSED CULVERT
- PROPOSED LEVEE FILL
- PROPOSED ODOT CLASS 200 RIPRAP
- PROPOSED ODOT CLASS 50 RIPRAP
- PROPOSED FLOODPLAIN GRADING
- PROPOSED CLSM BACKFILL
- PROPOSED SEEPAGE FILTER
- PROPOSED CLSM
- ✕ CONSTRUCTION POINT NUMBER

LEVEE SETBACK PLAN VIEW

1" = 10'

NOTES:
1. PLACE CLSM TO THE DIMENSIONS SHOWN AND PER DETAIL A ON SHEET C-207 AND IN ACCORDANCE WITH SPECIFICATION SECTION 03 30 00.
2. INSTALL INTERNAL SEEPAGE FILTER AND DIAPHRAGM AS SHOWN AND PER DETAILS A TO C ON SHEET C-207.
3. INSTALL TWO (2) 62-LF 36 IN Ø CPEP CULVERTS.
4. INSTALL TWO (2) PASSIVE FLAP GATE ON WATER SIDE OUTLET OF CULVERT PIPE PER DETAIL ON SHEET C-208.
5. PROPOSED CLASS 50 RIPRAP UNDERLAIN BY FILTER BLANKET TO THE DIMENSIONS SHOWN. SEE DETAIL 1 ON SHEET C-207.
6. PROPOSED CLASS 200 RIPRAP UNDERLAIN BY FILTER BLANKET. SEE DETAIL 2 ON SHEET C-207.
7. PROPOSED LANDSIDE CULVERT INLET PER DETAILS A TO C ON SHEET C-208.
8. PROPOSED WATERSIDE CULVERT OUTLET PER DETAIL D ON SHEET C-208.
9. PERFORATED PIPE PER INTERNAL SEEPAGE FILTER DETAIL ON SHEET C-207.



LEVEE SETBACK CULVERT PROFILE

1"=10' (1H:1V)

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK\.SHEET FILES_LEVEE REMOVAL SHEET SET\07 PROPOSED LEVEE SETBACK.DWG
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SEPTEMBER 13, 2005
SENDA OZKAN
EXPIRES: 12/31/2024

		PLAN SHEET SIZE ANSI B (11" X 17")				
REV.	DATE	REVISION DESCRIPTION	DRW	ENG	CHK	APP
2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

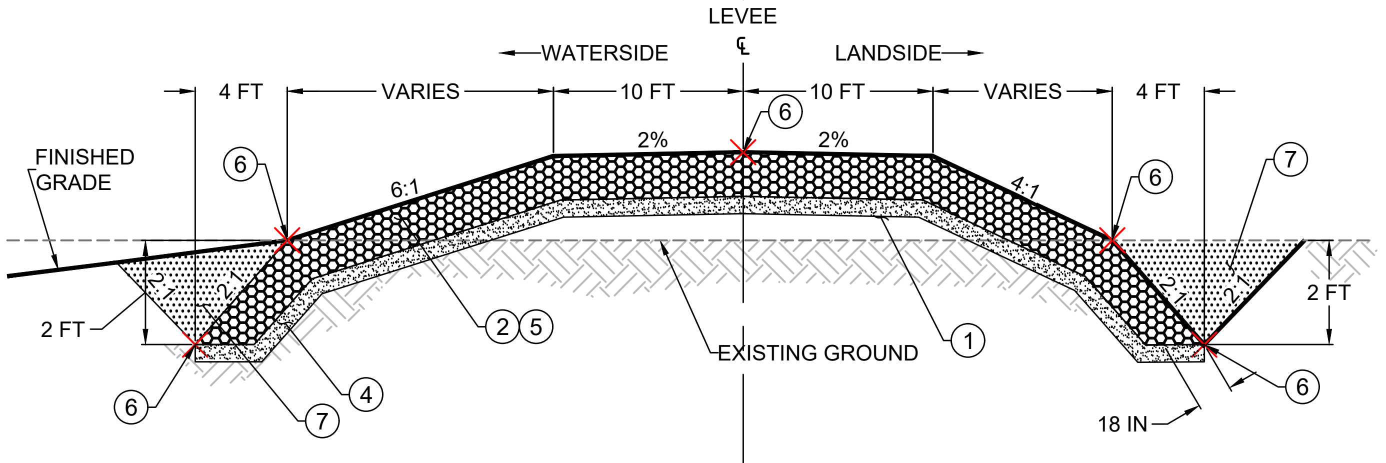
CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

PROPOSED LEVEE
SETBACK

DWG. NO.:
C-206

CREATED:
12/16/24

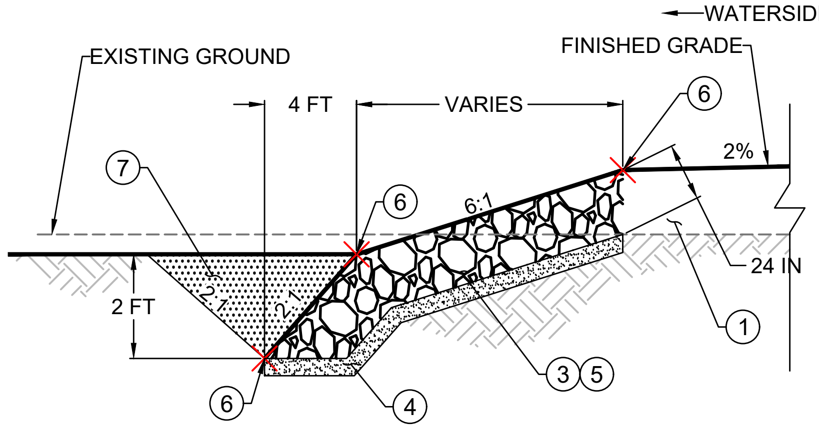
14 of 19



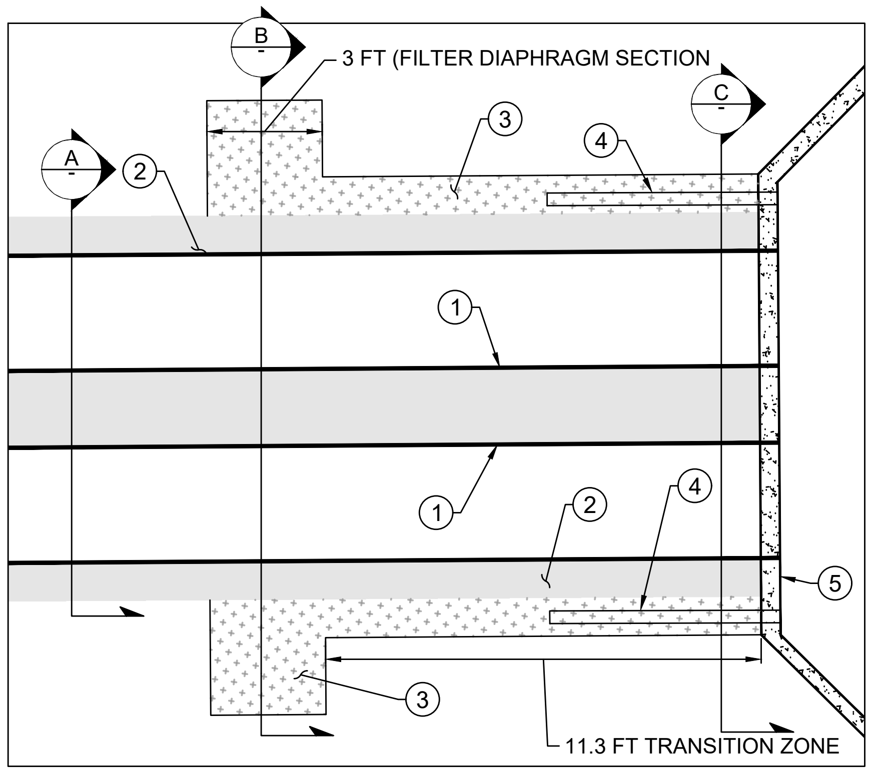
① TYPICAL LEVEE OVERFLOW RELIEF SECTION (STA. 0+25 TO STA. 2+60)
NOT TO SCALE

RIPRAP DETAIL NOTES:

1. PLACE LEVEE FILL PER SPECIFICATION SECTIONS 31 23 00 AND 32 10 00.
2. WHERE SHOWN IN PLAN VIEW, INSTALL 18 IN LAYER OF ODOT CLASS 50 RIPRAP UNDERLAIN BY RIPRAP PROTECTION FILTER BLANKET.
3. WHERE SHOWN IN PLAN VIEW, INSTALL 24 IN LAYER OF ODOT CLASS 200 RIPRAP UNDERLAIN BY RIPRAP PROTECTION FILTER BLANKET.
4. INSTALL RIPRAP PROTECTION FILTER BLANKET TO THE DIMENSIONS SHOWN AND IN ACCORDANCE WITH SPECIFICATION SECTION 31 37 00.
5. TAMP RIPRAP AFTER PLACEMENT TO PREVENT SETTLEMENT / ROCKING OF RIPRAP BOULDERS.
6. CONSTRUCTION POINT TYPICAL LOCATIONS. SEE SHEETS C-202 AND C-206 FOR SPECIFIC CONSTRUCTION POINT DATA.
7. COMPACT LOCALLY SOURCED FLOODPLAIN ALLUVIUM.



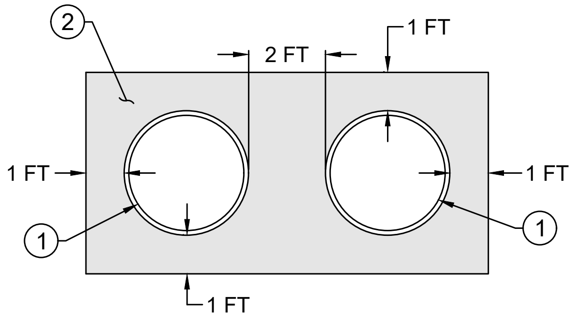
② TYPICAL LEVEE RIPRAP REVETMENT SECTION (STA. 2+60 TO STA. 7+90)
NOT TO SCALE



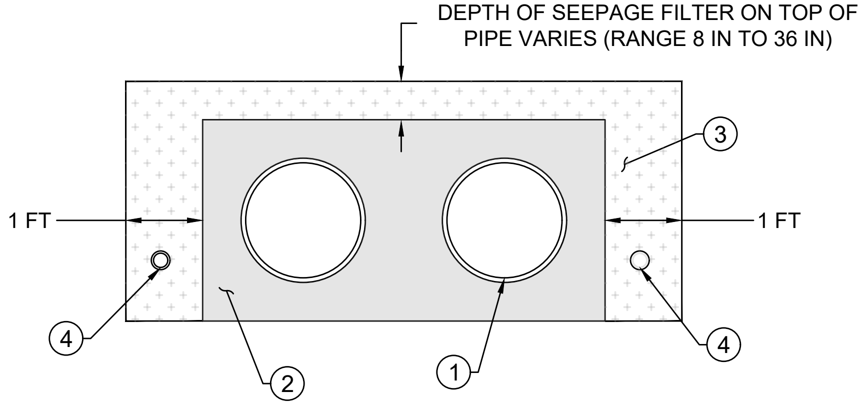
INTERNAL SEEPAGE FILTER PLAN VIEW
1" = 80'

INTERNAL SEEPAGE FILTER DETAIL NOTES:

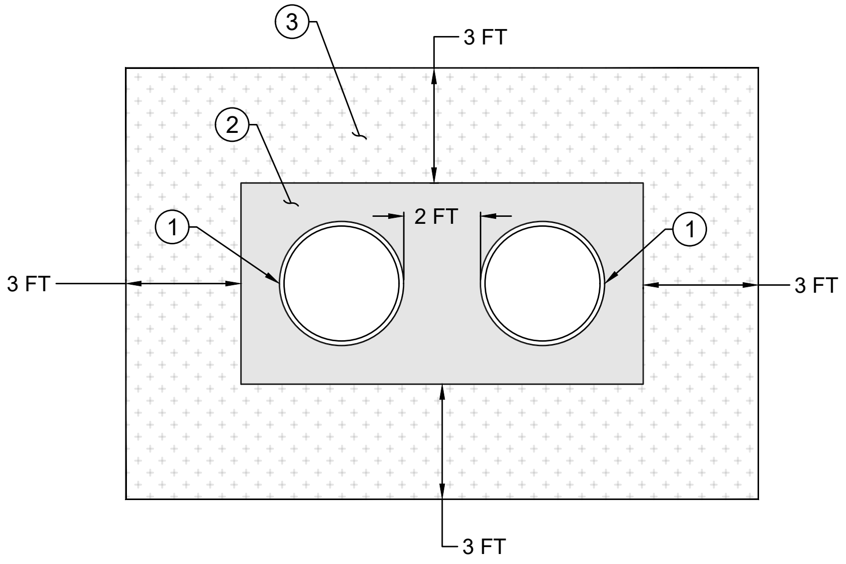
1. INSTALL TWO (2) 62-LF 36 IN Ø CPEP CULVERTS.
2. PLACE CLSM TO THE DIMENSIONS SHOWN AND IN ACCORDANCE WITH SPECIFICATION SECTION 03 30 00.
3. INSTALL INTERNAL SEEPAGE FILTER AND DIAPHRAGM TO THE DIMENSIONS SHOWN AND IN ACCORDANCE WITH SPECIFICATION SECTION 35 05 33.13.
4. 6-FT LENGTH OF 6-IN Ø PERFORATED PVC PIPE WRAPPED WITH GEOTEXTILE SOCK FOR DRAINAGE AND FLAP GATES.
5. LANDSIDE CULVERT HEADWALL.



A CLSM AND CULVERT PIPES SECTION
NOT TO SCALE



C INTERNAL SEEPAGE FILTER AND DRAINAGE PORTS SECTION
NOT TO SCALE



B INTERNAL SEEPAGE DIAPHRAGM SECTION
NOT TO SCALE

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK\SHEET FILES_LEVEE REMOVAL SHEET SET\07 PROPOSED LEVEE SETBACK.DWG
PLOT DETAILS: HARVEY, SPENCER December 16, 2024 4:26 PM

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PLAN SHEET SIZE ANSI B (11" X 17")

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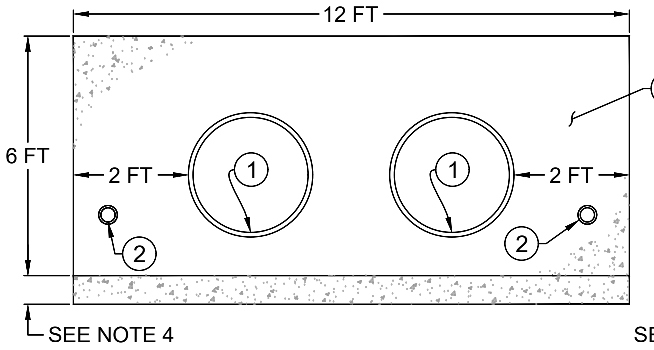
2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

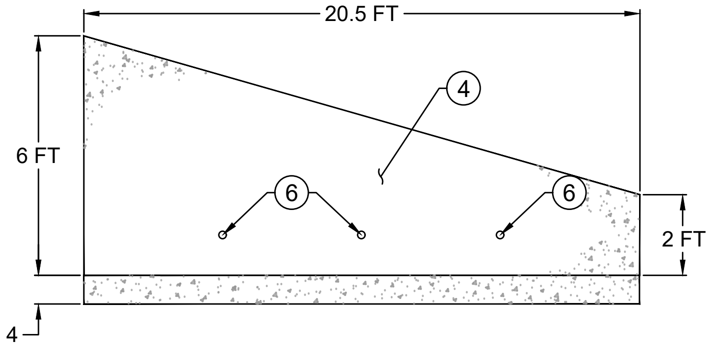
CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

PROPOSED LEVEE
SETBACK DETAILS

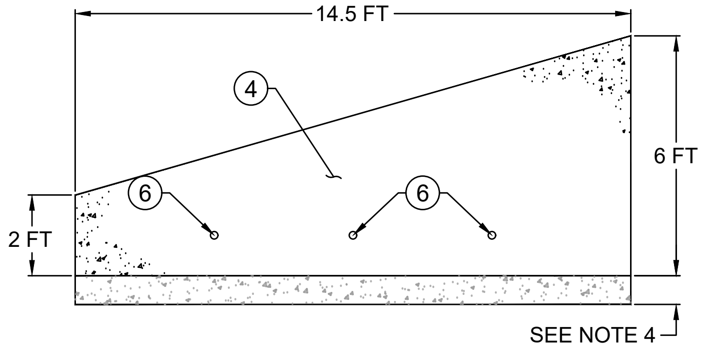
DWG. NO.: C-207
CREATED: 12/16/24
15 of 19



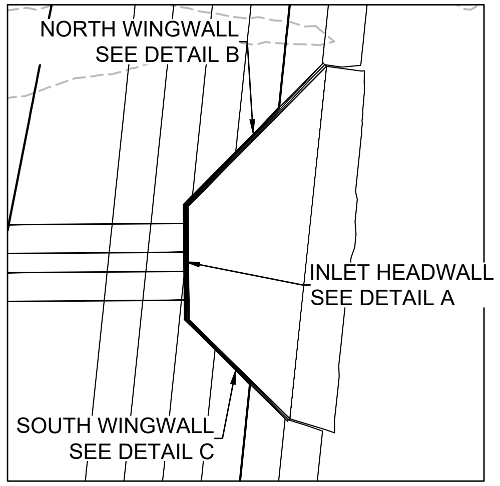
A LANDSIDE INLET PRECAST HEADWALL
NOT TO SCALE



B LANDSIDE INLET NORTH WINGWALL
NOT TO SCALE



C LANDSIDE INLET SOUTH WINGWALL
NOT TO SCALE



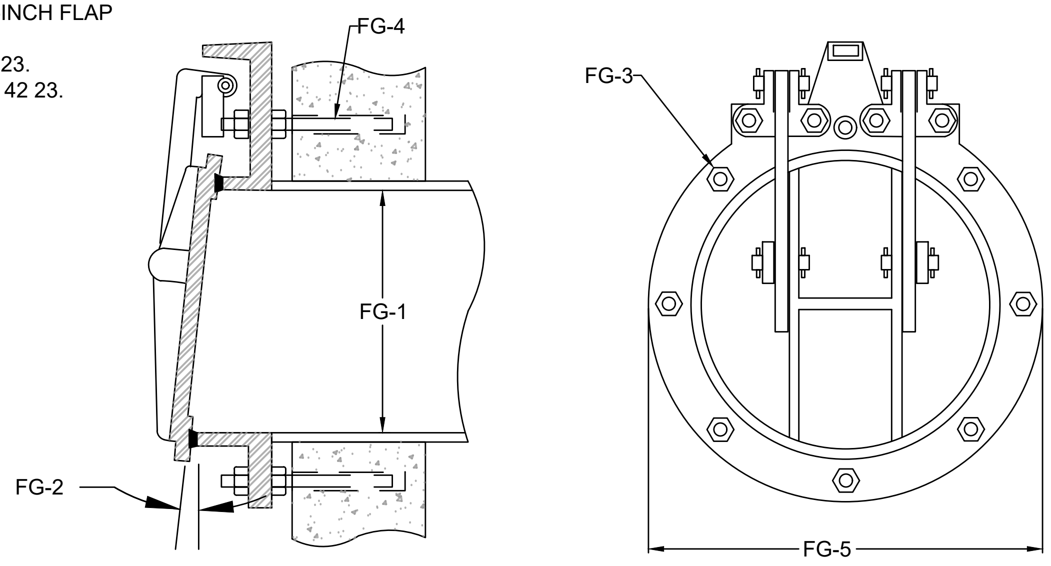
LANDSIDE INLET PLAN VIEW
NOT TO SCALE

PRECAST HEADWALL & WINGWALL DETAIL NOTES:

1. INSTALL TWO (2) 62-LF 36 IN Ø CPEP CULVERTS.
2. INSTALL 6-FT LENGTH OF 6-IN Ø PERFORATED PVC PIPE WRAPPED WITH GEOTEXTILE SOCK AND WITH 4-INCH FLAP GATES FOR DRAINAGE PER DETAIL ON SHEET C-206.
3. INSTALL LANDSIDE CULVERT HEADWALL PER DIMENSIONS SHOWN AND SPECIFICATIONS SECTION 33 42 23.
4. INSTALL ALL HEADWALLS AND WINGWALLS PER DIMENSIONS SHOWN AND SPECIFICATIONS SECTION 33 42 23.
5. HEADWALL AND WING WALL THICKNESS TO BE DETERMINED BY MANUFACTURER.
6. INSTALL 2-IN Ø WEEP HOLE MIN. 8 FT O.C. 1-FOOT ABOVE THE FINISHED GRADE.

PRECAST HEADWALL & WINGWALL GENERAL NOTES:

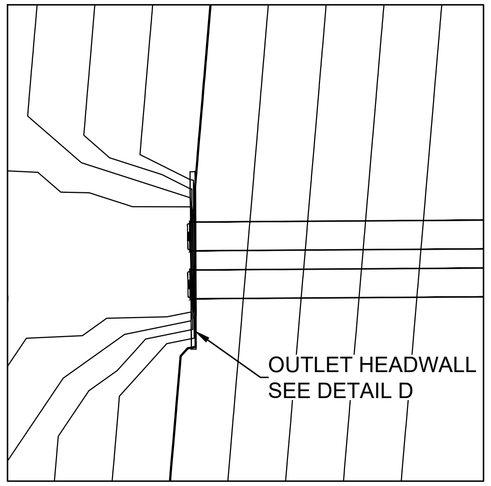
A. WINGWALLS AND HEADWALL DESIGN SHALL BE PRECAST REINFORCED CONCRETE.
B. WINGWALLS CAN BE GRAVITY ANCHOR OR FOOTINGS. MANUFACTURER'S SHOP DRAWINGS SHALL BE APPROVED BY ENGINEER BEFORE ACCEPTANCE.
C. REINFORCING STEEL BARS SHALL HAVE A MINIMUM YIELD STRENGTH OF ASTM GRADE 60 IN ACCORDANCE WITH SPECIFICATIONS SECTION 03 30 00.
D. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE YIELD STRENGTH OF 4,000 PSI.
E. FOUNDATION EXCAVATIONS SHALL BE INSPECTED BY ENGINEER BEFORE PLACEMENT OF WINGWALL.
F. WINGWALL FOOTING WIDTH SHALL BE DETERMINED BASED ON ALLOWABLE SOIL BEARING CAPACITY SHALL BE 2,000 PSF,
G. WINGWALL TO HEADWALL CONNECTION SYSTEM TO BE DESIGNED BY MANUFACTURER.
H. FREE-DRAINING CRUSHED ROCK FOR DRAINAGE FILL SECTION OF CULVERT AND WINGWALL BACKFILL SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 33 05 33.13.



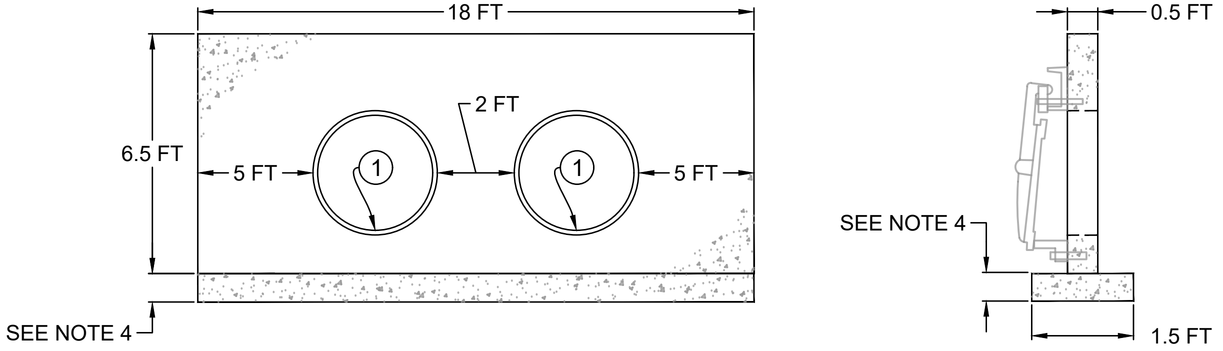
E TYPICAL FLAP GATE DETAIL
NOT TO SCALE

FLAP GATE DIMENSION SCHEDULE

REFERENCE	DESCRIPTION	DIMENSION PER PIPE SIZE	
FG-1	PIPE DIAMETER, INCHES	4	36
FG-2	MINIMUM SEAT ANGLE TO VERTICAL, DEGREES	3.50	5.50
FG-3	NO. OF BOLTS	4	8
FG-4	BOLT DIAMETER, INCHES	3/4	1
FG-5	FRAME DIAMETER, INCHES	9	46



WATERSIDE OUTLET PLAN VIEW
NOT TO SCALE



D WATERSIDE OUTLET PRECAST HEADWALL SECTION AND ELEVATION VIEW
NOT TO SCALE

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REGISTERED PROFESSIONAL ENGINEER
76918PE
OREGON
SEPTEMBER 13, 2005
SENDA OZKAN
EXPIRES: 12/31/2024

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION
CAYUSE · WALLA WALLA · UMATILLA
Treaty of 1855

PLAN SHEET SIZE ANSI B (11" X 17")

REV.	DATE	REVISION DESCRIPTION	DRW	ENG	CHK	APP
2	12/16/24	100% DESIGN	SH	ZH	JA	SO
1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

PROPOSED LEVEE
SETBACK DETAILS

DWG. NO.: C-208
CREATED: 12/16/24
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Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK\SHEET FILES_LEVEE REMOVAL SHEET SET\07 PROPOSED LEVEE SETBACK.DWG
PLOT DETAILS: HARVEY, SPENCER December 16, 2024 4:32 PM

CONSTRUCTION POINT TABLE

POINT #	NORTHING (FT)	EASTING (FT)	ELEVATION (FT)	DESCRIPTION
201	728994.27	8616809.80	958.0	LEVEE TOE
202	729209.57	8616927.54	958.7	LEVEE TOE
203	729374.27	8616970.31	957.8	LEVEE TOE
204	729538.74	8616956.23	956.7	LEVEE TOE
205	729627.66	8616929.39	953.0	LEVEE TOE
206	729686.36	8616912.82	950.7	LEVEE TOE
207	729726.03	8616958.32	956.7	LEVEE TOE
208	729697.24	8617034.00	962.4	LEVEE TOE
209	729652.86	8617048.87	957.5	LEVEE TOE
210	729374.96	8617050.24	959.2	LEVEE TOE
211	729177.00	8616993.07	958.7	LEVEE TOE
212	729009.76	8616868.75	961.1	LEVEE TOE
213	729002.70	8616851.00	961.7	LEVEE TOP
214	729158.71	8616945.83	961.7	LEVEE TOP
215	729182.26	8616960.14	964.2	LEVEE TOP
216	729720.39	8617027.25	965.3	LEVEE TOP
217	729293.64	8617007.21	964.4	LEVEE TOP
218	729413.07	8617019.68	964.6	LEVEE TOP
219	729019.09	8616829.49	957.0	RIPRAP TOE
220	729176.53	8616919.60	956.9	RIPRAP TOE
221	729145.26	8616966.43	956.9	RIPRAP TOE
222	729014.17	8616880.58	958.9	RIPRAP TOE
223	729423.44	8616965.28	955.7	RIPRAP TOE
224	729563.78	8616949.23	954.2	RIPRAP TOE

CONSTRUCTION POINT TABLE

POINT #	NORTHING (FT)	EASTING (FT)	ELEVATION (FT)	DESCRIPTION
226	729638.80	8616921.19	950.5	RIPRAP TOE
227	729750.19	8616910.46	947.0	RIPRAP TOE
228	729751.54	8616979.82	958.7	RIPRAP TOE
229	729713.52	8617008.88	965.0	RIPRAP TOP
230	729426.25	8617009.24	964.5	RIPRAP TOP
231	729621.47	8617032.65	956.6	CULVERT INLET
232	729626.42	8617031.92	956.6	CULVERT INLET
233	729617.55	8616971.70	956.0	CULVERT OUTLET
234	729612.61	8616972.43	956.0	CULVERT OUTLET
235	729696.40	8617010.85	962.0	BENCH TOE
236	729690.01	8617009.17	959.0	BENCH TOE
237	729670.78	8617008.51	956.8	BENCH TOE
238	729708.45	8617005.53	962.0	BENCH TOE
239	729706.06	8617001.44	959.0	BENCH TOE
240	729700.04	8616991.17	956.0	BENCH TOE
241	729681.53	8616959.53	953.0	BENCH TOE
242	729707.21	8617006.12	962.0	BENCH TOE
243	729710.36	8616999.82	959.0	BENCH TOE
244	729718.60	8616983.36	956.0	BENCH TOE
245	729725.10	8616970.37	953.0	BENCH TOE
246	729736.18	8616948.23	950.0	BENCH TOE
247	729705.23	8616975.76	953.0	BENCH TOE
248	729717.32	8616950.02	950.0	BENCH TOE

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OREGON
SEPTEMBER 13, 2005
SENDA OZKAN
EXPIRES: 12/31/2024

PLAN SHEET SIZE ANSI B (11" X 17")

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1	9/9/24	90% DESIGN	SH	ZH	JA	SO

CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

CONSTRUCTION POINTS

DWG. NO.: C-209

CREATED: 12/16/24

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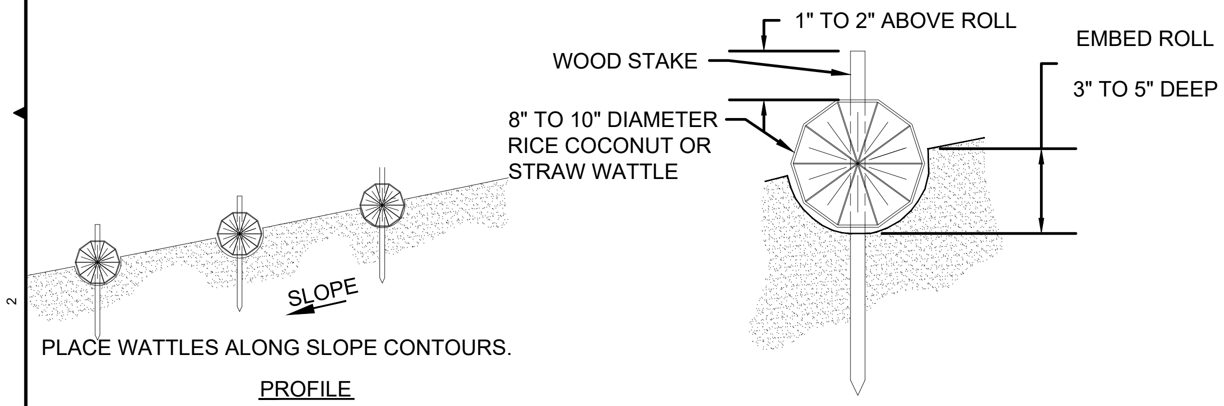
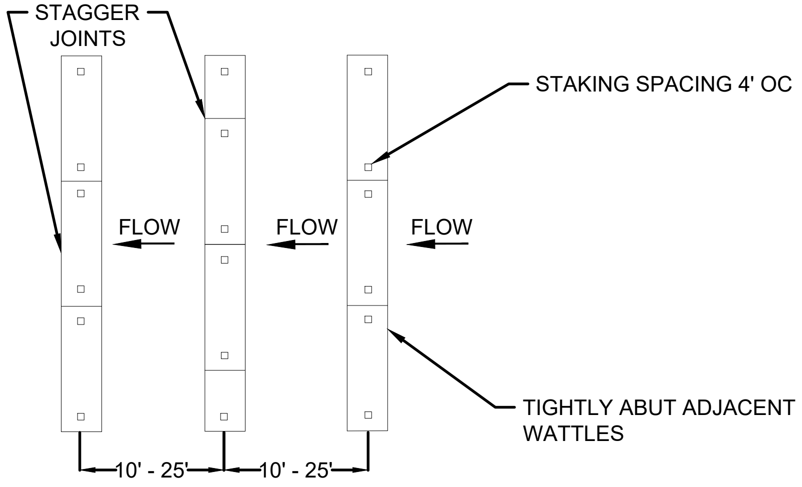


PLACE WATTLES ALONG SLOPE CONTOURS.

PROFILE

SECTION



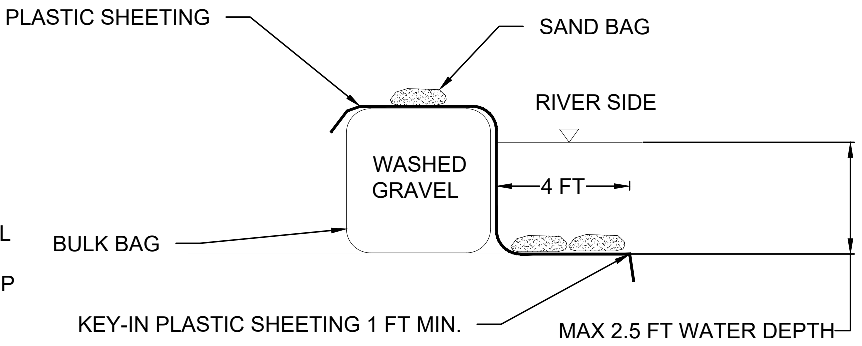
PLAN VIEW

FIBER ROLLS/WATTLES - TYPICAL DETAIL

NTS

FIBER ROLLS/WATTLES NOTES:

1. STAKES SHALL BE 1"X2" WOODEN STAKES.
2. ADDITIONAL STAKES MAY BE INSTALLED ON DOWNHILL SIDE OF WATTLES, ON STEEP SLOPES OR HIGHLY EROSIVE SOILS
3. FIBER ROLLS OR WATTLES TO BE INSTALLED EVERY 10' TO 25'.

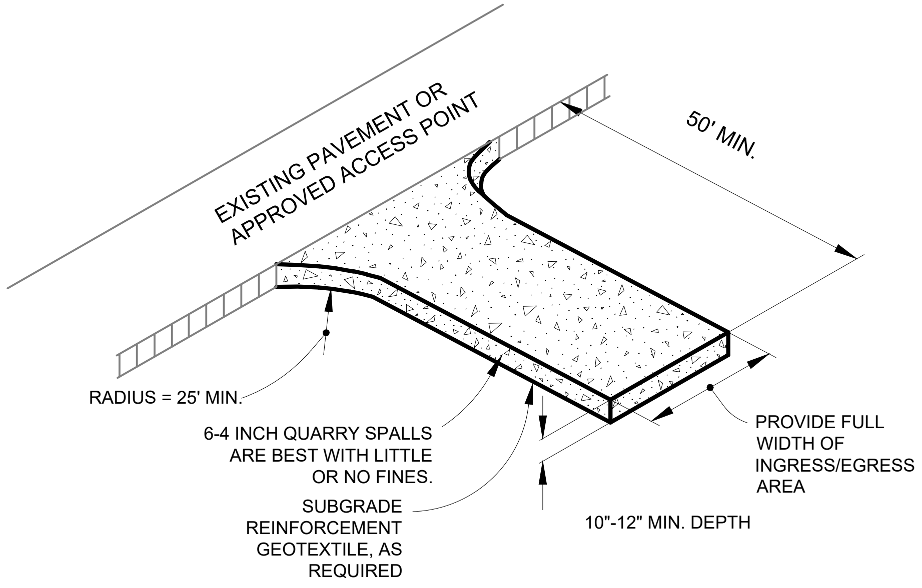


TEMPORARY COFFERDAM SECTION TYPICAL DETAIL

NTS

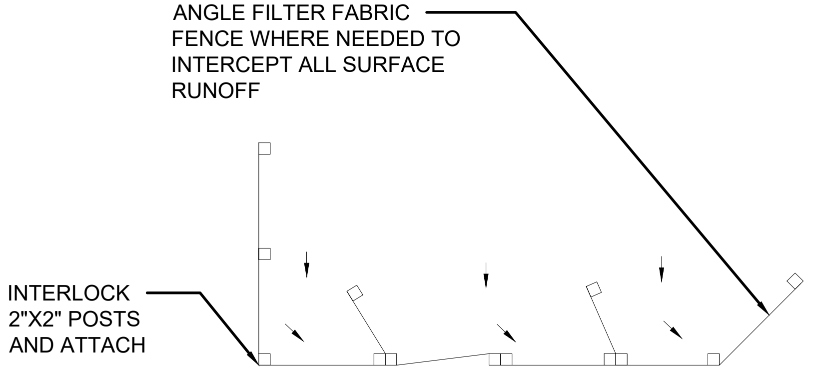
COFFERDAM NOTES:

1. ALL WORK IN CHANNEL SHALL ONLY OCCUR DURING THE APPLICABLE IN-WATER WORK WINDOWS.
2. IN-WATER WORK AREAS SHALL BE ISOLATED BY COFFERDAMS.
3. ISOLATED AREAS REQUIRE FISH SALVAGE ACTIVITIES PRIOR TO THE INITIATION OF CONSTRUCTION.
4. FISH SALVAGE TO BE PERFORMED BY QUALIFIED FISH BIOLOGIST.
5. FILL BULK BAG WITH WASHED GRAVEL.
6. SAND BAGS, ECO-BLOCKS, OR SIMILAR MAY BE SUBSTITUTED FOR WASHED GRAVEL BULK BAGS.

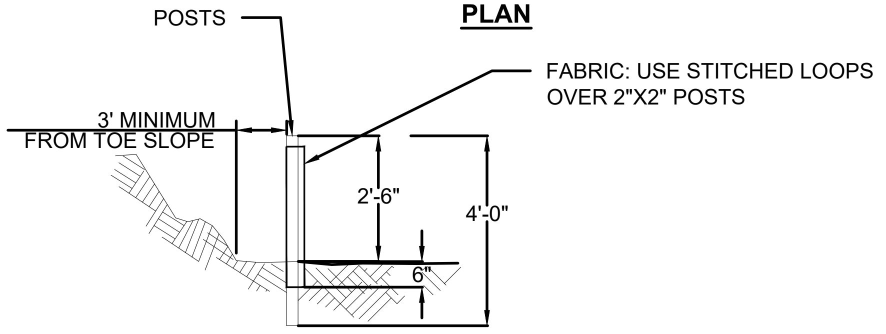


VEHICLE ENTRANCE - TYPICAL DETAIL

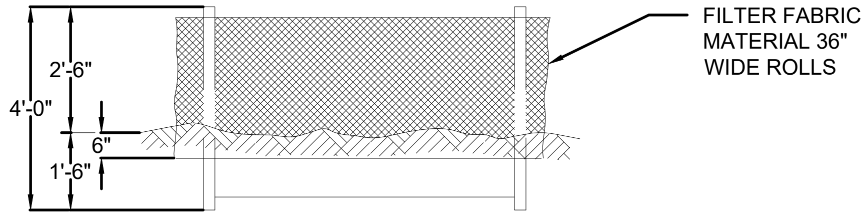
NTS



PLAN



PROFILE



TEMPORARY SILT FENCE TYPICAL DETAIL

NTS

SEDIMENT FENCE NOTES:

1. SEDIMENT FENCE SHALL BE INSTALLED ON A LINE OF EQUAL ELEVATION.
2. BOTTOM EDGE OF SEDIMENT FENCE SHALL BE BURIED MIN 6".
3. POSTS MAY BE 2"X2" FIR, PINE OR STEEL.
4. POSTS TO BE INSTALLED ON UPHILL SIDE OF SLOPE.
5. COMPACT BOTH SIDES OF FILTER FABRIC TRENCH.
6. SEDIMENT SHALL BE REMOVED WHEN ACCUMULATION REACHES 1/3 OF THE MEASURE HEIGHT. SEDIMENT SHALL BE DISPOSED OF TO AN AREA THAT CAN BE PERMANENTLY STABILIZED.

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REGISTERED PROFESSIONAL ENGINEER
769?8PE
OREGON
SEPTEMBER 13, 2005
SENDA OZKAN
EXPIRES: 12/31/2024

PLAN SHEET SIZE ANSI B (11" X 17")

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CTUIR
UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

TESC DETAILS

DWG. NO.: C-210

CREATED: 12/16/24

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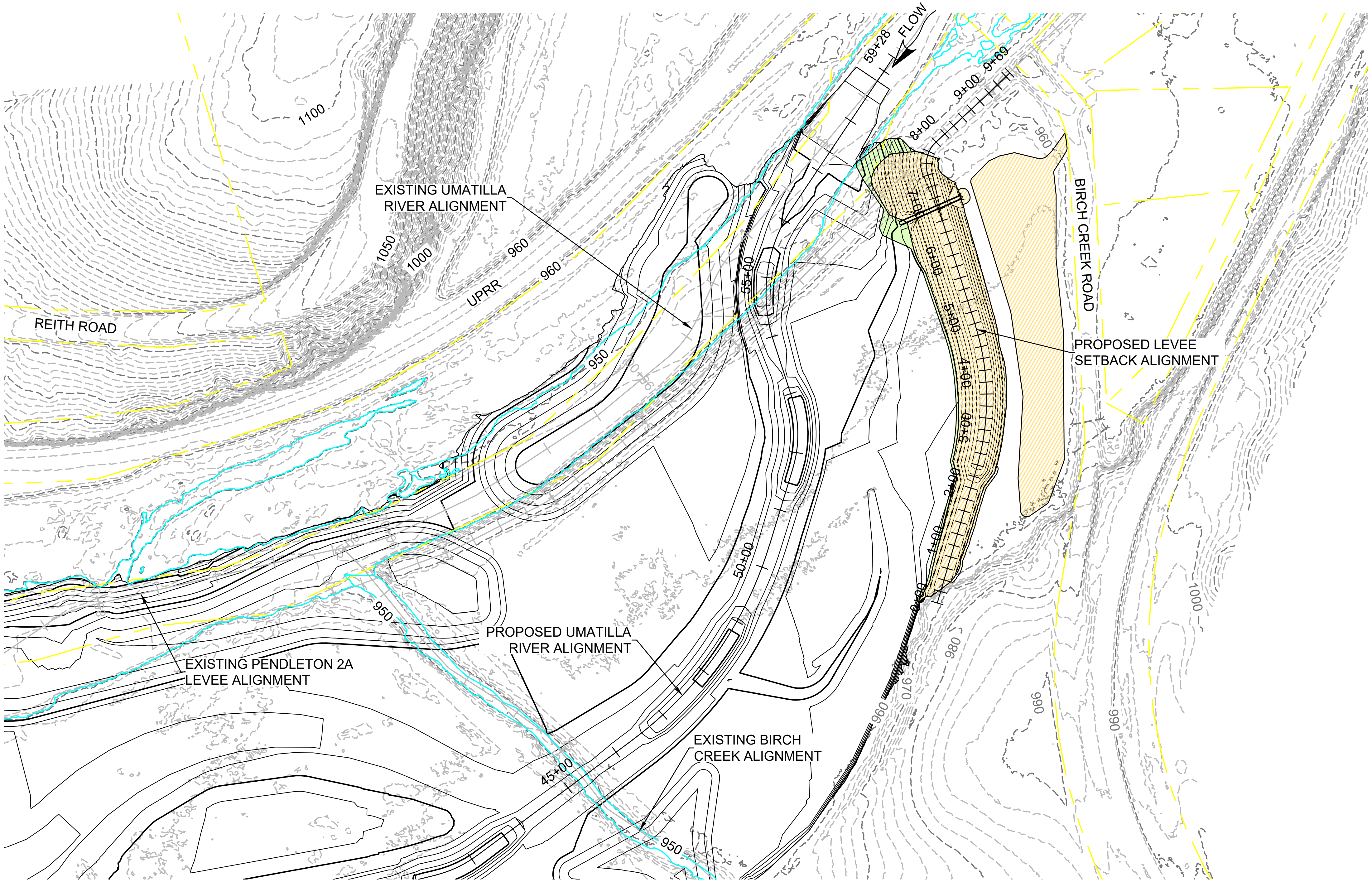

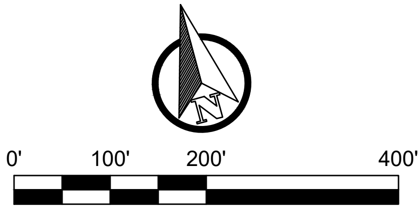

FLOODPLAIN SEED MIX

Acres: 0.2

Quantity: 6 lbs*

Scientific Name	Common Name	Percent Composition
PSEUDOROEGNERIA SPICATA VAR SECAR	BLUEBUNCH WHEATGRASS	20
POA SECUNDA	BIG BLUEGRASS	20
LEYMUS CINEREUS VAR MAGNAR	GREAT BASIN WILDRYE	30
ELYMUS LANCEOLATUS	STREAMBANK WHEATGRASS	20
FESTUCA IDAHOENSIS	IDAHO FESCUE	10

* Quantity based on 30 lbs seed per acre

UPLAND ZONE SEED MIX

Acres: 2.6

Quantity: 78 lbs*

Scientific Name	Common Name	Percent Composition
LEYMUS CINEREUS	GREAT BASIN WILDRYE	25
PSEUDOROEGNERIA SPICATA	BLUEBUNCH WHEATGRASS	25
ELYMUS ELYMOIDES	SQUIRRELTAIL	10
FESTUCA IDAHOENSIS	IDAHO FESCUE	10
KOELERIA MACRANTHA	PRAIRIE JUNEGRASS	10
ACHILLEA MILLEFOLIUM	YARROW	10
LUPINUS POLYPHYLLUS	BIGLEAF LUPINE	10

* Quantity based on 30 lbs seed per acre

NOTES:

1. SEED ALL DISTURBED AREAS. SEE UPLAND ZONE SEED MIX AND FLOODPLAIN SEED MIX TABLES FOR SEED COMPOSITIONS.
2. ADDITIONAL SEEDING AND PLANTING ASSOCIATED WITH PROJECT AREA 2 PROPOSED GRADING TO BE PROVIDED IN SEPARATE DRAWING SET.

LEGEND

- - -	EXISTING 2-FOOT CONTOUR
– – –	EXISTING 10-FOOT CONTOUR
—	EXISTING PROPERTY LINE
—+—	EXISTING ALIGNMENT
—	EXISTING OHW
>- - -<	EXISTING CULVERT
—	PROPOSED 1-FOOT CONTOUR
—	PROPOSED 5-FOOT CONTOUR
>—<	PROPOSED CULVERT
▨	PROPOSED UPLAND SEEDING
🟩	PROPOSED FLOODPLAIN SEEDING

Z:\PROJECTS\194-6817 UMABIRCH IN-STREAM DESIGN\100%\PA 2 - LEVEE SETBACK\.SHEET FILES_LEVEE REMOVAL SHEET SET\09 PLANTING PLAN.DWG
PLOT DETAILS: HARVEY, SPENCER December 13, 2024 3:26 PM ----

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UMABIRCH ENHANCEMENT DESIGN
PROJECT AREA 2 - LEVEE SETBACK

PLANTING PLAN

DWG. NO.: C-211

CREATED: 12/16/24

19 of 19

Attachment 2 – Proposed Construction Specifications

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

UMABIRCH INSTREAM DESIGN AND CONSTRUCTION OVERSIGHT PROJECT

USACE SECTION 408 PENDLETON 2A LEVEE SETBACK DESIGN CONSTRUCTION SPECIFICATIONS

100% DESIGN

Submittal To:

Confederated Tribes of the Umatilla Indian Reservation
Department of Natural Resources
46411 Timíne Way
Pendleton, Oregon 97801

Prepared By:

Tetra Tech, Inc.
19803 North Creek Parkway
Bothell, WA 98011

JULY 2025

TABLE OF CONTENTS

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DIVISION 01 – GENERAL REQUIREMENTS

DIVISION 03 – CONCRETE

DIVISION 31 – EARTHWORK

DIVISION 32 – EXTERIOR IMPROVEMENTS

DIVISION 33 – SITE UTILITIES

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 DESCRIPTION

A. This section provides a brief narrative summary of the contract work. The project is located on the Umatilla River, confluence of Birch Creek and Umatilla River, and Birch Creek. This contract work consists of removing a portion of the existing U.S. Army Corps of Engineer's (USACE) Pendleton 2a Levee and constructing a new levee setback.

The Contractor shall provide all labor, equipment, supervision, transportation, operating supplies and incidentals to perform all work necessary on the areas specified herein. All aspects of the work shall be performed in an organized and systematic manner to assure that services are performed in a timely matter and comply with the technical specifications.

This summary does not provide the technical detail of the work activities but describes the work as a whole and provides an overall perspective to the separate tasks. This section shall be used in conjunction with all the other sections and the Drawings to establish the total work requirements.

1. The levee setback work is a component of a larger habitat restoration project that includes removal of an existing berm, reconstructing a portion of the primary Birch Creek channel including channel fill, constructing new Birch Creek side channels, reconstructing a portion of the primary Umatilla River realigned channel, and constructing new wetlands and wetland ponds. Large woody material (LWM) and boulder habitat structures will be placed in the new side channels, main channel, and floodplain benching. Excess excavation material shall be hauled offsite. Addition of LWM and channel fill will potentially require isolation of work areas from water and fish. The components of the restoration project is detailed in a separate specification document.

B. The project was designed in accordance with the Bonneville Power Administration (BPA) Habitat Improvement Program (HIP) Programmatic Biological Opinion. Refer to the HIP Conservation Notes in the Drawings and the HIP handbook.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. The Contractor is advised that the contract work will consist of the following:

Clearing and Grubbing within Project Area
Installation of Temporary Construction Access Routes
Installation and Maintenance of Construction Area BMPs
Construction and Maintenance of Material Storage Areas
Removal of Portion of USACE Levee
Floodplain benching Grading
Construction of Setback USACE Levee
Realigned Umatilla River Channel Excavation

Finish Grading of Floodplain and Decompaction of Compacted Access Routes and Staging Areas
Installation of Revegetation Materials by Confederated Tribes of the Umatilla Indian Reservation (CTUIR)
Complete Project Area Cleanup, Repairs, Incidentals, and Punchlist Items

Additionally, erosion control measures must be executed to the highest construction industry standards – great care must be taken to prevent excavated soil material from entering the stream system. To ensure integrity of the stream channel and to reduce impacts to water quality and aquatic organisms, floodplain activities will be completed separately from activities in the wetted channel. Activities in the floodplain will occur between May and November, whereas work in the wetted channel, or that requires crossing the wetted channel, will occur between July 1 and September 30, during the Oregon Department of Fish and Wildlife (ODFW) in-water work period. No instream work will be conducted between May and June 30 or between October 1 and the November 30. The Contractor shall notify the CTUIR in writing 10 days before beginning any work activities.

B. For all construction activities, including those within the above listed instream work window, the Contractor shall be responsible for potential turbidity and sediment transport within and downstream of the physical limits of the project.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SUMMARY OF WORK

SECTION 01 14 00
WORK RESTRICTIONS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section provides general Work Restrictions that shall be observed by the Contractor during performance of work for the duration of the Contract.

1.02 CONDUCT OF WORK

A. Restricted Work Periods

  1. Completion of the instream components of the project shall be restricted to the period of July 1 to September 30 during the construction period.

B. Restricted Work Areas

  1. Completion of work adjacent to or on private property will require coordination with the affected landowners.

  2. The Contractor and CTUIR will coordinate the project work schedule in order to notify landowners and stakeholders of when the work activities adjacent to or on the private property will occur.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF WORK RESTRICTIONS

SECTION 01 14 13
ACCESS TO SITE

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the location of the project site and the access routes the Contractor will use during performance of work for the duration of the Contract.

1.02 CONDUCT OF WORK

A. Location of Project Work Site

1. Overall location of the project site is shown on the Drawings.

B. Directions to Project Work Site

1. From Interstate 84 (I-84), take exit 207 toward US-30/Airport/Pendleton City Center. Head southwest on County 1300 Rd/McKennon Rd and continue on County 1300 Rd for 1.5 miles. Turn left onto Birch Creek Rd and continue for 0.6 miles. Access to the site is to the west of Birch Creek Rd immediately south of the Umatilla River Bridge Crossing.

C. Restricted Access Areas

1. Permission to access is granted by the private landowner to the CTUIR. The Contractor shall make arrangements with the CTUIR to access the project site through private land.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF ACCESS TO SITE

SECTION 01 14 20
SITE-SPECIFIC REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section provides general Site-Specific Requirements that shall be observed by the Contractor during performance of work for the duration of the Contract.

1.02 CONDUCT OF WORK

A. Coordination

1. Coordination with agencies, other on-site Contractors, and Owner shall generally be made by Contractor through the Owner's Representative or Engineer as expressed in the Contract Documents to assist Contractor with performance of the work with a minimum of interference and inconvenience. Contractor will access the project site at locations identified on the Drawings and by direct coordination with Owner's Representative management staff.

2. The project site is located on private lands. All activities shall be coordinated with ongoing activities and not interfere with these activities except with written approval of the Owner's Representative or Engineer.

B. Work Hours

1. The Contractor shall propose work hours based on the Contractor's construction schedule to ensure completion of all instream work no later than September 30. The Contractor shall propose extended workdays and/or weekend work if necessary, to meet the time constraints of the appropriate year in-water work period of time. The Contractor's proposed work schedule shall be subject to Owner's Representative or Engineer's approval. Proposed work schedule may not be approved if the Owner's Representative or Engineer is not available to be on site during the proposed work hours.

1.03 GENERAL ACCESS REQUIREMENTS

A. The project site area is closely monitored by Owner's personnel. Contractor's personnel working at the site may be asked for appropriate identification. A list of all employees for the Contractor, suppliers, and vendor Representatives will be provided to the Owner's Representative or Engineer.

B. Irregular or Non-Routine Access

1. Access on an irregular basis and during other than established working hours will require prior approval by Owner's Representative or Engineer.

C. Maintenance of Access

1. Contractor shall not obstruct or interfere with access by others to existing facilities adjacent to the project site during the work under this Contract.

D. Vehicle Parking

   1. Contractor’s vehicles shall only park in approved areas as described by Owner’s staff.

1.04 COORDINATION AND COOPERATION WITH OTHER CONTRACTORS

A. Work by others may be performed in the vicinity of or adjacent to the project site in concurrence with the scheduled performance of the Work under these Contract Documents. Contractor shall coordinate construction work with Owner’s Representative or Engineer.

1.05 CONSTRUCTION SCHEDULE REQUIREMENTS

A. Workflow

   1. The Work shall be planned, scheduled, and performed to complete the Work within the requirements of these Contract Documents and the requirements of appropriate Federal, State, and local agencies. Contractor shall prepare and maintain a construction schedule. Work shall be completed within the timeframe of May 1 and November 30, expected to be 2026, or as directed in the Contract Documents.

B. Construction Sequence

   1. Floodplain Work: May – November
      - Clear and grub proposed temporary access roads.
      - Remove existing levee material above OHM.
      - Separate and stockpile in the staging area or areas directed by Owner’s Representative or Engineer, approved alluvium and riprap for future use.
      - Construct new setback USACE levee to areas above the OHW.
   2. If needed, Active Channel: July 1 – September 30
      - Install isolation measures at upstream and downstream points to isolate inflow from entering work area.
      - Conduct fish salvage, if needed, to remove any stranded fish where necessary as directed by Owner’s Representative or Engineer.
      - Dewater and construct riprap material in the wetted channel as required.
      - Remove flow isolation, final grading and shaping of levee
      - Revegetate decompacted access routes and all disturbed areas.

1.06 PROTECTION OF PROPERTY

A. Contractor shall protect all property within or in the vicinity of the work site. Contractor shall ensure that property is not removed, damaged, destroyed, or prevented from its normal use unless so designated in the Contract Documents. All property adjacent to the work shall be protected including, but not be limited to, protection from construction-generated dust, debris, water, and vibration. Property includes land, utilities, trees, shrubs, landscaping, markers and monuments, natural features, monitoring wells, buildings, structures, site and drainage improvements, and other improvements, whether shown on the Drawings or not. No work shall be conducted in any wetlands or vegetation protection areas shown on the Drawings and restricted areas unless coordinated with and approved by the Owner’s Representative or Engineer.

B. Contractor shall confine operations to within the clearing limits or other areas designated in the contract documents, and prevent the depositing of rocks, excavated materials, stumps, or other debris outside of these limits. Contractor shall retrieve material which falls outside of these limits and dispose of, or incorporate in the work, as directed by the Owner. Contractor shall preserve the scenic and natural environment along this construction project.

C. Contractor shall not allow objectionable material to enter any stream, river, lake, or other body of water. Contractor shall retrieve material which falls in these areas and dispose of, or incorporate in the work, and repair damage to vegetation or structures outside the project limits.

D. Contractor shall not operate equipment or otherwise disturb the natural vegetation and soil beyond the construction limits.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SITE-SPECIFIC REQUIREMENTS

SECTION 01 22 20
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 DESCRIPTION

A. The Bid Items described in this Section correspond with those listed on the Bid Form. Additional bid items requiring no further description may also be included on the form. It is the responsibility of the Contractor to make a thorough investigation of the Contract Drawings and Specifications, and the Site, to determine the scope of work for each bid item.

B. Payment will be made based on the quantities of work as measured in accordance with specified methods of measurement and the prices stipulated in the Bid Form and only for those items listed on the Bid Form. All other items of work shown on the Contract Drawings or required by Specifications shall be considered incidental to the items listed. This method of payment will constitute complete compensation for all work shown on the Contract Drawings and provided in the Specifications or other Subcontract documents, and for all costs of accepting the general risks, liabilities and obligations expressed or implied.

1.02 SCHEDULE OF VALUES

A. Contractor shall prepare and submit a schedule of values at the kickoff meeting for each contracted phase corresponding to the project specification sections and any other major work items to be used as a basis for monthly pay requests. The construction quantities in the schedule of values shall be updated weekly and verified and signed off by both the Contractor and the Owner’s Representative.

B. Contractor shall provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Specification table of contents. Provide multiple line items for subcontract amounts, where appropriate.

C. The quantity to be paid is the quantity shown in the Schedule of Items. The contract quantity will be adjusted for authorized changes that affect the quantity or for errors made in computing this quantity. If there is evidence that a quantity specified as a contract quantity is incorrect, the Contractor shall submit calculations, drawings, or other evidence indicating why the quantity is in error and request, in writing, that the quantity be adjusted. The CTUIR reserves the right to review all Contractor submitted actual quantity measurements for review and payment.

D. Submit copies of the schedule of values to Owner’s Representative at earliest possible date, but no later than 14 calendar days before the date scheduled for submittal of initial pay request.

1.03 PAY REQUESTS

A. Each pay request shall be consistent with previous applications and payments as certified by Owner’s Representative and paid for by Owner.

B. It will be the Contractor's responsibility to prepare a monthly estimate of the percentage of work accomplished on each line item of the approved schedule of values. This estimate shall be submitted to the Owner’s Representative each month as part of the pay request for review not later than the date established at pre-construction conference. The weekly construction quantities updated in the schedule of values that are updated weekly and verified and signed off by the Contractor and the Owner’s Representative shall be used as the basis of the estimate. Owner’s Representative will verify all measurements and monthly estimate and provide for approval to the Owner within 30 calendar days of receiving monthly estimate.

1.04 DESCRIPTION OF BID ITEMS

A. This is a lump sum bid with lump sum and unit price pay items; therefore, the total lump sum price and all lump sum and unit price pay items submitted on the bid form shall constitute full compensation for furnishing all labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, test and reports, and shall include all Contractor costs, overhead, and profit needed to perform all work required for each of the lump sum and unit price items, which will be completed by phase, with each phase contracted separately.

B. Contract quantities will be adjusted only when the variation in the bid items and actual work is of 15 percent or more.

C. Contractor shall give a price per hour for unforeseen work that is encountered during the contract performance and not included in the other sub-items. Hourly work must be authorized in advance by the CTUIR. The CTUIR does not guarantee that any hourly work shall be ordered and reserves the right to reduce or eliminate entirely the work under these items with no adjustment in contract unit price.

D. Mobilization: Payment will be made for mobilization in a lump sum. When 10 percent of the original contract amount is earned from other bid items, 100 percent of the mobilization item may be paid.

E. Payment for lump sum bid items may be made in accordance with the verified monthly estimate of percentage of work accomplished (see 103.B above).

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF MEASUREMENT AND PAYMENT

SECTION 01 25 10
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the process and procedures to be followed by the Contractor and Owner in the event a contract modification is required during project implementation.

B. A contract modification is defined as a change order or amendment to the original contract to add costs to the construction contract for expanding the scope of work or to subtract costs to the construction contract for reducing the scope of work.

1.02 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall keep a copy of the construction contract and bid sheet at the construction site during the entire implementation period.

B. During each weekly progress meeting, the Contractor shall provide a summary of work completed to date, a summary of work to be completed in the next week, and a summary of work to be completed within the next month.

C. During the discussion of work to be completed in the next week and next month provided by the Contractor during the weekly progress meeting, any work activities not included in the current contract shall be identified by the Contractor.

D. After the activities not included in the current construction contract have been identified by the Contractor, the Contractor shall prepare a description of the additional work required and an itemized cost to complete the additional work.

E. The Contractor shall submit the description of work and itemized costs to the Owner's Representative for review.

F. The Contractor shall not proceed with any work not defined in the Contract Documents without review and written approval by the Owner's Representative.

1.03 OWNER'S REPRESENTATIVE REVIEW

A. Upon receipt of the description of additional work and itemized costs, the Owner's Representative will complete a review of the materials.

B. Review of the submitted materials will be completed by the Owner's Representative within 7 days from the date of submittal.

C. If, during the review of the submitted materials, the Owner's Representative has questions or requires additional information to complete his/her review, they will contact the Contractor within 7 calendar days from the date of the submittal.

D. A response to the Contractor's submittal by the Owner's Representative will be required within 7 calendar days from the date of the submittal.

1.04 OWNER’S REPRESENTATIVE APPROVAL

A. After the Owner’s Representative has reviewed the Contractor’s submittal and verifies that the work included in the submittal is not included in the current scope of work, the Owner’s Representative shall approve the submittal.

B. After the submittal has been approved, the Owner’s Representative shall complete a change order or contract amendment to cover the work items in the submittal.

C. Any change order or contract amendment shall be completed by the Owner and ready for signature within 21 calendar days from the date of the submittal.

D. Adhering to the time schedule described above is necessary to keep the project implementation on schedule and prevent the Contractor from completing a critical component of the project.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF CONTRACT MODIFICATION PROCEDURES

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the process and procedures to be followed by the Contractor and Owner for the preparation, submittal, and payment of monthly invoices for completed construction work.

B. During the pre-construction meeting, the Owner's Representative will identify the monthly submittal date for invoices to be submitted by the Contractor. This date will account for submittal, review, approval, and payment processing time to expedite payments to the Contractor.

1.02 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall keep a copy of the construction implementation spreadsheet at the construction site during the entire implementation period. This spreadsheet will show daily progress on schedule of value line items.

B. During each weekly progress meeting, the Contractor shall provide a summary of work completed during the prior week and a total since the last invoice period.

C. At the weekly progress meeting immediately before the monthly submittal date, the Contractor will present a draft invoice to the Owner's Representative. This draft invoice will show the percentage complete of schedule of value items included in the payment request.

D. The total percent complete shown on the draft invoice will be supported by the construction implementation spreadsheet submitted with the draft invoice.

1.03 OWNER'S REPRESENTATIVE'S REVIEW

A. During the weekly progress meetings, the total percentage of work completed recorded by the Owner's Representative and Contractor will be reconciled and approved.

B. Upon verification of the total percent complete, Owner's Representative will sign an invoice approval form and forward the invoice to the CTUIR Accounts Payable Section.

C. The CTUIR Accounts Payable Section will have 2 working days to review and approve or reject the invoice.

1.04 OWNER'S REPRESENTATIVE APPROVAL

A. The Owner's Representative will be expected to attend and participate in the Weekly Progress Meetings and keep current on the project implementation activities.

B. Upon receipt of the approved invoice from the Owner's Representative, the CTUIR Accounts Payable Section shall review the submitted invoice and construction implementation spreadsheet.

C. The CTUIR Accounts Payable Section will have 2 business days to review and approve or reject the invoice after receipt from the Owner's Representative.

D. After approval, the Owner's Representative will prepare all necessary administrative forms to initiate payment processing within the CTUIR Accounts Payable Section.

E. The Owner's Representative will have 3 business days to prepare the necessary administrative forms and secure signatures to initiate the payment process.

1.05 PAYMENT PROCESSING

A. Upon submittal of the administrative forms and Contractor invoice, payment processing will follow the standard operating procedures of the CTUIR Accounts Payable Section.

B. If payment has not been received by the Contractor within 4 business days of the estimated payment date defined in Section 1.01 B., the Owner's Representative will contact the CTUIR Accounts Payable Section to determine the reason for the delay.

C. The Owner's Representative will make every effort possible to resolve any issues that are holding up payment to the Contractor as quickly as possible.

D. In the event that payment is not received by the Contractor within 30 calendar days of the estimated payment date, the Contractor will be allowed to charge interest on the outstanding balance. This interest charge will not be part of the overall construction cost included in the construction contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF PAYMENT PROCEDURES

SECTION 01 31 19.13
PRE-CONSTRUCTION MEETING

PART 1 GENERAL

1.01 DESCRIPTION

A. Not more than 5 business days after a Notice to Proceed has been issued to the Contractor, but earlier if practicable, a mandatory pre-construction meeting will be scheduled by the Owner's Representative or Engineer. This meeting will occur not less than 10 calendar days prior to work commencing.

B. The Owner's Representative or Engineer will preside at the pre-construction meeting.

C. Present to represent the Contractor shall be at least the project Superintendent, a representative with full contract authority to speak for each of their principle subcontractors, and other representatives as he/she may deem appropriate.

D. The Owner's Representative and other invited parties shall be present as required.

E. Proceedings of the meeting will be recorded and distributed to interested parties.

1.02 AGENDA

A. Both Owner's Representative and Contractor shall be prepared to speak to the following:

1. Name and Field Address of Job Superintendent
2. Emergency Phone and/or operator
3. Date of Construction Start
4. Date of Notice to Proceed
5. Notification of Utilities, Concerned Fire, Police, Schools, etc.
6. Coordination with other Contractors
7. Permits: County, City, all Government Agencies as required
8. Inspector: name, authority
9. Field office (location)
10. Submittals
11. Responsibility for lines and grades
12. Periodic progress payments including date for submittal
13. Construction Progress Schedule (bar graph or C.P.M.)

14. Safety Requirements and Special Hazards
15. Insurance and Bonds
16. Traffic Control
17. Construction Signs
18. Drawings revised to conform to construction records
19. Beneficial Occupancy
20. Retention of Contract Records
21. Guarantees and Warranties
22. Testing
23. Progress Meetings
24. Complaint Procedure
25. Job Photos
26. Other Matters Concerning Construction

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF PRE-CONSTRUCTION MEETING

SECTION 01 31 19.23
PROGRESS MEETINGS

PART 1 GENERAL

1.01 DESCRIPTION

A. Weekly Progress Meetings will be held at the job site during construction.

B. The Owner’s Representative or Engineer will preside at Progress Meetings.

C. Proceedings of meeting will be recorded and distributed to interested parties.

1.02 MEETINGS

A. Meetings other than Weekly Progress Meetings (if required) will be scheduled each week at mutually agreed time.

B. Location of meetings: As designated during preconstruction conference.

C. Attendance:

1. Owner’s Representative
2. Engineer
3. Contractor
4. Other Contractors (if any)
5. Subcontractors as pertinent to agenda
6. Safety Representative (Optional)
7. Representatives of Governmental or other Regulatory Agencies (Optional)

1.03 MINIMUM MEETING AGENDA

A. Review and approve minutes of previous meeting.

B. Review work progress since last meeting.

C. Note field observations, problems and decisions.

D. Identify problems which impede planned progress.

E. Identify potential ways to increase construction efficiencies.

F. Develop corrective measures and procedures to regain planned schedule.

G. Revise Construction Schedule as indicated.

H. Plan progress during next work period.

I. Coordinate projected progress with other Contractors.

J. Review submittal schedules, expedite as required to maintain schedule.

K. Maintaining of quality and work standards.

L. Review proposed changes for:

  1. Effect on Construction Schedule

  2. Effect on Completion Date

M. Complete other current business.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF PROGRESS MEETINGS

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DESCRIPTION

A. This Section includes specifications for the general requirements and procedures for preparing and submitting construction information and data for information and review. Other requirements for submittals are specified under applicable Sections of the Specifications.

B. Submittals are as specified throughout the Contract Documents and may not be included in this specification.

1.02 SUBMITTAL REQUIREMENTS

A. Schedule of Submittals: Within 10 calendar days after the effective date of Notice to Proceed, Contractor shall submit a completed submittal schedule and list of products for all items requiring Owner's Representative's or Engineer's review, as follows:

1. Work Plan, Shop Drawing, or other Submittal identification including description of the item. Include name of manufacturer, trade name, and model number, if applicable.
2. Specification section references.
3. Intended submission/resubmission date(s).
4. Order release date.
5. Lead time to delivery/anticipated delivery date(s).
6. Highlight items that require expedited review to meet the project schedule and are on the critical path.

B. These schedules shall be presented in a form that is readily reproducible and shall be updated and sent to Owner's Representative or Engineer on a bi-weekly basis (twice per month). Identify all submittals that are required by the Contract Documents and determine the date on which each submittal will be submitted.

C. Professional Seal Required: Submittals involving engineering expertise, such as excavation support structures, and load calculations, shall be sealed and signed by a Professional Engineer, currently registered in the State of Oregon, for the discipline involved.

D. Review Stamp and Action Block Space: Include a 5-inch square blank space, in the lower right corner, just above the title block, in which Engineer may indicate the action taken.

E. Review Period:

1. Prepare submittals sufficiently in advance so that review may be given before commencement of related work.

2. Allow 10 calendar days after receipt by Owner's Representative or Engineer for review of each submittal.

3. Contractor shall be responsible for determining whether or not certain submittals require longer review periods. Where longer review periods are required, Contractor shall schedule the Work accordingly, so that the Work and construction schedules are not adversely impacted.

F. Submittal Delivery: Ship submittals prepaid or deliver by hand directly to Owner's Representative or Engineer.

G. Transmittal Form: Accompany submittals with the transmittal forms provided by Owner's Representative or Engineer.

H. Changes in Reviewed Submittals: Changes in reviewed submittals will not be permitted unless those approved submittals with changes have been resubmitted and reviewed, in the same manner as the original submittal.

I. Supplemental Submittals: Supplemental submittals initiated by Contractor for consideration of corrective procedures shall contain sufficient data for review. Make supplemental submittals in the same manner as initial submittals.

J. Incomplete submittal packages will be returned without review.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. Contractor's Review:

1. Each submittal shall be reviewed, stamped, and signed as reviewed and approved by Contractor prior to submission.

2. If the submittal is designated to be sent to Owner's Representative or Engineer for information, approval by the designated approval authority shall take place before submission to Owner's Representative or Engineer.

3. Contractor shall coordinate each submittal with the requirements of the Work, placing particular emphasis upon ensuring that each submittal of one trade is compatible with other submittals of that trade and with the submittals of other trades. Ensure submittal is complete with all relevant data required for review.

4. Review of drawings and associated calculations by Engineer shall not relieve Contractor from the responsibility for errors or omissions in the drawings and associated calculations, or from deviations from the Contract Documents, unless submittals containing such deviations were submitted to Engineer and the deviations were specifically called to the attention of Engineer in the letter of transmittal, and approved by Engineer as a Contract change.

5. Contractor's liability in case of deviations in the submittals from the requirements of the Contract Documents is not relieved by Engineer's review of submittals containing deviations, unless Engineer expressly approves the deviations by issuing a Change Order.

6. Contractor shall be responsible for the correctness of the drawings, for shop fits and field connections, and for the results obtained by the use of such drawings.

B. Submittal Quantities: Unless noted otherwise, Contractor shall submit three copies of all submittals. Where permits and licenses and other such documents are obtained in Owner’s name, submit the original and five copies.

C. Distribution of Submittals after Review: Distribute prints or copies of reviewed submittals, bearing Engineer's or designated approval authority's stamp and signature, to affected and concerned subcontractors, suppliers, and fabricators; and to affected and concerned members of Contractor's workforce.

D. Maintain at the site of the work a complete, up-to-date, organized file of all past and current submittals including an index and locating system which identifies the status of each submittal:

1. Assign a sequential number to each submittal.

2. Assign a revision number, using an alphanumeric sequence (e.g., 15, 15A, 15B, etc.) to all resubmittals.

1.04 ENGINEER'S REVIEW

A. Submittals will be reviewed for conformance with requirements of the Contract Documents. Review of a separate item will not constitute review of an assembly in which the item functions. Review will not relieve Contractor from Contractor’s responsibility for accuracy of submittals, for conformity of submittals to requirements of Contract Documents, for compatibility of described product with contiguous products and the rest of the system, or for prosecution and completion of the Contract in accordance with the Contract Documents.

B. Engineer will indicate its reviews of submittals and the action taken by means of its review stamp. The review stamp will be affixed by Engineer, the action block will be marked, and the stamp will be signed and dated.

C. The review-stamp action-block marks will have the following meanings:

1. The mark NO EXCEPTIONS TAKEN means that every illustration and description appears to conform to the respective requirements of the Contract Documents; that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed; and that the submittal need not be resubmitted.

2. The mark EXCEPTIONS AS NOTED - RESUBMISSION NOT REQUIRED means that every illustration and description appears to conform to the respective requirements of the Contract Documents upon incorporation of the reviewer's

corrections, and that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed. Submittals so marked need not be resubmitted unless Contractor challenges the reviewer's exception.

3. The mark EXCEPTIONS AS NOTED - RESUBMISSION REQUIRED means that every illustration and description appears to conform to the respective requirements of the Contract Documents, and that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed after incorporation of the reviewer's corrections and verification by Engineer that the reviewer's corrections have been properly incorporated in the submittal. Resubmission is also required if Contractor challenges the reviewer's corrections.

4. The mark REJECTED means that the submittal is deficient to the degree that the reviewer cannot correct the submittal with a reasonable degree of effort, has not made a thorough review of the submittal, and that the submittal needs revision and is to be corrected and resubmitted.

D. Contractor shall attend meetings as requested by Owner’s Representative or Engineer to address issues related to the review of submittals.

E. Owner’s Representative or Engineer will return submittals to Contractor within 10 calendar days after submittals have been received.

F. Contractor shall include 10 calendar days in its schedule for Owner and other parties to review submittals and re-submittals.

G. No schedule extensions will be permitted for poorly prepared, incomplete, or inaccurate submittals.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL PROCEDURES

A. Contractor’s submittal schedule shall include the following submittals:

TABLE 3.01-1 CONTRACTOR SUBMITTAL SCHEDULE		
	Submittal	**Applicable Specifications**
1	Submittal schedule	Section 01 33 00
2	Construction schedule	Section 01 14 20
3	Contract schedule of values	Section 01 22 20
4	Weed-free material source certification	Section 01 35 43 Section 32 90 00
5	Spill Prevention Countermeasures and Control (SPCC) Plan	Section 01 35 43
6	Oregon Department of Environmental Quality (ODEQ) 1200-C Permit	Section 01 35 43
7	Stormwater Pollution Prevention Plan (SWPPP)	Section 01 35 43
8	Erosion and Sediment Control (ESC) Plan	Section 01 35 43
9	Storm Contingency Plan	Section 01 35 43.02
10	Material Storage/Staging Plan	Contract Drawings, C-201
11	Dewatering and Work Area Isolation Plan	Section 31 23 19
12	Excavation Plan	Contract Drawings, Sheets C-201 to C-211
13	Precast headwall and wingwall shop drawings and associates appurtenances	Section 33 42 33
14	Setback USACE Levee Construction Plan	Contract Drawings, Sheets C-201 to C-211
15	Geotextile Manufacturer Certificate of Compliance	Section 31 05 19.13
16	Riprap submittals	Section 31 37 00
17	CPEP manufacturer’s submittal and associated appurtenances	Section 33 05 33.13
18	Seepage filter material source and gradation mix per	Section 33 05 33.13
19	Seed Certification	Section 32 90 00
20	Surveyor credentials	Section 01 71 23
21	Oregon Department of Forestry (ODF) Notification of Operation	Section 01 35 43
22	Levee fill compaction and quality control test documentation	Section 31 23 00
23	Final Record Drawings	Section 01 78 39

END OF SUBMITTAL PROCEDURES

SECTION 01 35 43
ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes Environmental Protection work required to minimize environmental pollution and damage resulting from Contractor's operations during construction.

1.02 GENERAL REQUIREMENTS

A. Contractor shall perform the work, minimizing environmental pollution and damage as the result of construction operations, in accordance with these Drawings and Specifications and applicable local, state, and federal laws. Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to all life; affect other species of importance to humankind; or degrade the utility of the environment for aesthetic, cultural and/or historical purposes. The control of environmental pollution and damage requires consideration of land, water, and air, and includes management of visual aesthetics, noise, solid waste, biosolids, sludge, as well as other pollutants. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. Contractor shall ensure compliance with this section by Subcontractors.

B. Permits

1. The Owner will obtain permits for Section 7 of the Endangered Species Act, Section 106 of the National Historic Preservation Act, Sections 401 and 404 of the Clean Water Act, and Oregon Department of State Lands Removal-Fill.

2. Contractor shall be responsible for complying with all permit requirements including HIP Terms and Conditions. Contractor shall be responsible for obtaining all other permits as may be required including Oregon Department of Environmental Quality (ODEQ) 1200-C Permit and the Oregon Department of Forestry (ODF) Permit to Use Fire or Power-Driven Machinery. Contractor shall obtain all needed certifications and licenses as required by state and local jurisdictions.

C. Notification

1. Owner’s Representative or Engineer will notify Contractor in writing of any observed noncompliance with the previously mentioned federal, state, or local laws or regulations, permits, and other elements of the environmental protection specifications. Contractor shall, after receipt of such notice, inform Owner’s Representative or Engineer of proposed corrective action and take such action when approved. If Contractor fails to comply promptly, Owner’s Representative or Engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or costs or

damages allowed to Contractor for any such suspensions. Failure of Owner's Representative or Engineer to notify Contractor of noncompliance does not relieve Contractor of full responsibility of maintaining compliance conditions and work methods.

1.03 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

1. SWPPP and ESC Plan

a. The Contractor will secure the project area at the end of every workday in an effort to stabilize the project area to minimize impacts in case a high-water storm event occurs. The Contractor will be required to prepare and implement the SWPPP to keep sediment from entering the channel during rain events.

b. Contractor shall submit a SWPPP and all ESC Plans within 10 calendar days of Notice to Proceed. All erosion control plans shall be approved before work can begin. Plan shall be consistent with the requirements and meet the satisfaction of Owner.

c. ESC Plans shall include all measures necessary to protect resources and improvements. This shall include:

(1) The construction activities and sequence of implementation relating to specific erosion control measures.

(2) The location and type of permanent controls to be implemented during construction.

(3) The location and type of temporary controls to be implemented during construction.

(4) Detailed dewatering plan.

(5) Description of monitoring plan.

2. SPCC Plan

a. Contractor shall submit an SPCC Plan within 10 calendar days of Notice to Proceed. The SPCC Plan shall meet all applicable U.S. Environmental Protection Agency (EPA) requirements, must be certified by a registered Professional Engineer, and will include safe mobile fueling of equipment procedures, including inventory, storage, and handling. The Plan shall describe secondary containment procedures to be used during mobile fueling to protect nearby wetlands and other surface water bodies. Plan shall be consistent with the requirements and meet the satisfaction of Owner

b. The Contractor will be required to prepare an emergency spill containment kit, to be located on the construction site at all times, and prepare a SPCC Plan, addressing prevention and cleanup of accidental spills. If a spill of petroleum product should occur in water, Contractor shall immediately notify the Owner's Representative and appropriate state agencies.

3. ODF Notification of operation

   a. The Contractor shall file a Notification of Operation or Permit to Use Fire or Power Driven Machinery with the ODF before starting the work.

1.04 LAND RESOURCES

A. Contractor shall confine all activities to areas defined by the Drawings and Specifications. Prior to the beginning of any construction, Contractor shall identify the land resources to be preserved within the work area. Except in areas indicated on the Drawings or specified to be cleared, Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, wetlands, and land forms without permission. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized by the Owner's Representative or Engineer. Where such emergency use is permitted, Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, earth, or other material displaced into uncleared areas shall be carefully removed and properly disposed of by Contractor at no additional cost to the Owner.

B. Work Area Limits

   1. Prior to construction, Contractor shall mark the areas that are not to be disturbed under this contract, as identified on the Drawings and by Owner's Representative or Engineer during the pre-construction meeting. Isolated areas within the general work area which are to be saved and protected shall also be marked or fenced. Monuments and markers not scheduled for abandonment on the Drawings and Specifications shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, the markers shall be visible. Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

C. Landscape

   1. Trees, shrubs, vines, grasses, land forms, wetlands, and other landscape features indicated and defined on the Drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques.

D. Unprotected Erodible Soils

   1. Side slopes and back slopes shall be protected as soon as practicable upon completion of rough grading. All earthwork shall be planned and conducted to minimize the duration of exposure of unprotected soils. Clearing of such areas shall progress in reasonably sized increments as needed to use the developed areas as approved by Owner's Representative or Engineer.

E. Disturbed Areas

1. Contractor shall effectively prevent erosion and control sedimentation through approved methods, which shall be included in the ESC Plan, including, but not limited to, the following:

    a. Retardation of runoff and prevention of runoff channelization. Runoff from the construction site or from storms shall be retarded by means of site perimeter silt fencing, straw wattles, fiber rolls, straw bales, and the preservation of a vegetated buffer area around the site, and by any measures required by area-wide Drawings under the Clean Water Act. Straw mulch, wood chips, plastic sheeting, rolled erosion control products (i.e., erosion control blankets or mats), mid-slope sediment fences, fiber rolls, or wattles shall also be employed for temporary soil stabilization if an area is to remain unworked for longer than 1 week.

    b. Erosion and sedimentation control devices. Contractor shall install temporary erosion and sedimentation control features as indicated on the Drawings or directed by the Owner's Representative or Engineer. Erosion and sedimentation control devices shall be checked daily and maintained throughout the duration of the project to prevent sediments from entering the stream channel.

    c. Cleanup of roadways. Contractor shall maintain roads and parking areas traveled by construction equipment free of debris, tracked mud, and spillage. Cleanup of roadways shall be performed daily at a minimum. Any damage to public roadways caused by Contractor's equipment shall be restored at Contractor's expense.

F. Contractor Facilities and Work Areas

1. Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the Drawings or as directed by the Owner's Representative. Temporary movement or relocation of Contractor's facilities shall be made only when approved by the Owner's Representative. Borrow areas, if required, shall be managed to minimize erosion and to prevent sediment from entering nearby waters. Spoil areas shall be managed and controlled to limit spoil intrusion into areas designated on the Drawings and to prevent erosion of soil or sediment from entering nearby waters. Spoil areas shall only be developed with written approval of Owner's Representative or Engineer. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas from despoilment.

1.05 WATER RESOURCES

A. Contractor shall keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters. Monitoring of active streams, wetlands, and tributaries affected by construction shall be Contractor's responsibility.

B. If at any time as a result of project activities fish are observed in distress, a fish kill occurs, or water quality problems develop (including equipment leaks or spills), operations shall cease, and the Owner’s Representative and Engineer shall be notified immediately and the following agency shall be contacted:

   Oregon Department of Fish and Wildlife; Contact: 503-947-6002 and 800-452-0311.

C. The discharge or release of oil or petroleum hydrocarbons into or on the surface of waters of the state is prohibited. If visible oil sheen is observed beyond the limits of the construction activity then all appropriate actions to stop, contain, and cleanup the oil shall be taken.

D. Mobile Equipment Fueling

   1. Contractor shall service all equipment only in the areas approved by the Owner’s Representative. No mobile equipment fueling shall take place over or within 150 feet of the Birch Creek and Umatilla River channels. All equipment fueling shall be conducted using secondary containment to capture potential fuel spills. All mobile equipment fueling locations shall be pre-approved by the Owner’s Representative.

   2. Fuel hoses, oil drums, oil or fuel transfer valves and fittings, and all other equipment, etc., shall be checked daily for drips or leaks, and shall be maintained and stored properly to prevent spills into state waters.

   3. All vehicles carrying fuel will have specific equipment and materials needed to contain or clean up any incidental spills at the project site.

   4. All pumps and generators used in or near streams will have appropriate spill containment structures and/or absorbent pads in place at all times during use.

E. Equipment used for this project shall be well maintained and, to the maximum extent possible, prevented from leaking petroleum-based products that could result in environmental contamination.

   1. All equipment used for instream work will be cleaned of external oil, grease, dirt and mud, prior to arriving at the project site. All equipment will be inspected by the Owner’s Representative before unloading at the site. Any leaks or accumulations of grease will be corrected before entering streams or areas that drain directly into waterways.

   2. All equipment will be fueled outside of stream-adjacent riparian areas and wetland areas. Specific fueling areas may be approved and designated by the CO. When not in use, vehicles and fueling equipment will be stored in a designated staging area. The staging area should be in an area that will not deliver fuel, oil, etc. to streams.

   3. Oil-absorbing floating booms, and other equipment such as pads and absorbent “peanuts” appropriate for the size of the stream, will be available on-site during all phases of construction. For small streams with few pools or slack water, booms may not be effective. Use pads and straw bales to anchor booms if necessary.

Booms will be placed in a location that facilitates an immediate response to potential petroleum leakage.

F. The Contractor is solely responsible for all spills or leaks that occur during the performance of this contract. The Contractor must clean up spills or leaks in a manner that complies with Federal, state, and local laws and regulations and to the satisfaction of the Owner's Representative. Any spills resulting in a detectable sheen on water shall be reported to the EPA National Response Center (1-800-424-8802). Any spills over 25 gallons will be reported to the ODEQ and cleanup will be initiated within 24 hours of the spill. When available provide copies of all spill related clean up and closure documentation and correspondence from regulatory agencies.

G. Washing Water

1. Contractor shall ensure that wash water containing oils, grease, or other hazardous materials resulting from wash down of equipment or working areas shall be contained for proper disposal or treatment and shall not be directly discharged into state waters, storm drains, or any part of the project site.

H. Diversion Operations

1. Construction operations for dewatering and rewatering shall be controlled at all times. Contractor will be responsible for limiting the impacts of water turbidity and contaminants known to be present at the site on habitat for wildlife and on water quality for discharge and downstream use.

2. Contractor shall construct and maintain cofferdams as necessary and as shown on the Drawings to divert and de-water fish isolation areas for all work activities within the wetted channel. Water removed from within the isolated work area shall be routed to an area to an area approved by the Owner's Representative to allow removal of fine sediment and other contaminants. The existing flow downstream from the project area shall be maintained throughout construction. The diversion and dewatering shall remain in place until instream restoration work is complete and Owner's Representative or Engineer approves removal of the system.

3. Rewatering of the isolated work area shall occur slowly and under the direct supervision/approval of the Owner's Representative. This process shall occur over sufficient time as to prevent excessive turbidity downstream of the work area.

I. Fish and Wildlife

1. Contractor shall minimize interference with, disturbance to, and damage of fish and wildlife. Both resident and anadromous fish are present in the project reach on Umatilla River and Birch Creek.

2. Oregon Administrative Rules (OAR) Chapter 340, Division 41 for additional water quality standards and related regulations (OAR 340-041-0036) states that limited duration activities necessary to address an emergency or to accommodate essential dredging, construction, or other legitimate activities and which cause the standard to be exceeded may be authorized provided all practicable turbidity

control techniques have been applied. Based on this OAR, the Owner shall get clearance to exceed State's water quality standards through a permit or certification authorized under terms of section 401 or 404 (Permits and Licenses, Federal Water Pollution Control Act) or OAR 14l-085-0100 et seq. (Removal and Fill Permits, Division of State Lands), with limitations and conditions governing the activity set forth in the permit or certificate.

J. No excavated material shall be placed in the channel bottom that would divert the stream and cause erosion.

1.06 AIR RESOURCES

A. Equipment operation and activities or processes performed by Contractor in accomplishing the specified construction shall be in accordance with the State of Oregon air quality rules and all Federal emission and performance laws and standards. Ambient air quality standards set by the EPA shall be maintained. Monitoring of air quality shall be Contractor's responsibility. All air areas affected by the construction activities shall be monitored by Contractor.

B. Particulates

1. Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials shall be controlled at all times, including weekends, holidays, and hours when work is not in progress. Contractor shall maintain excavations, stockpiles, haul roads, permanent and temporary access roads, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from airborne particulates which would cause the air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type or other methods will be permitted to control particulates in the work area if approved by the Owner's Representative. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs.

C. Hydrocarbons and Carbon Monoxide

1. Hydrocarbons and carbon monoxide emissions from equipment shall be controlled to Federal and State allowable limits at all times.

D. Sound Intrusions

1. Contractor shall keep construction activities under surveillance and controlled to minimize environment damage by noise, in accordance with all applicable Federal, State, and local regulations.

1.07 WASTE DISPOSAL

A. Solid Wastes

1. Solid wastes shall be placed in containers that are emptied on a regular schedule. Handling and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste shall become co-mingled with solid waste. Contractor shall transport solid waste, including clearing debris, off Owner-controlled property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal.

B. Hazardous Materials Used by Contractor

1. Contractor shall take sufficient measures to prevent spillage of any materials of construction containing hazardous and toxic materials during operations (i.e. hydraulic fluid, ethylene glycol, etc.) and shall collect any such spilled materials in suitable containers, observing compatibility. Contractor shall inform Owner’s Representative of any hazardous waste generated during construction and request direction from Owner regarding proper transport and disposal. Spills of hazardous or toxic materials shall be immediately reported to Owner and Engineer. Cleanup and cleanup costs due to spills shall be Contractor’s responsibility.

C. Burning

1. Burning will not be permitted.

1.08 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

A. No archeological sites within Contractor’s work area have been identified. If identified during the course of the work, Contractor shall take precautions to preserve all such resources as they existed at the time they were first pointed out. Contractor shall provide and install protection for these resources and be responsible for their preservation during the life of the contract. If during excavation or other construction activities any previously unidentified or unanticipated resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rocks or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, Contractor shall immediately notify Engineer and Owner’s Representative. While waiting for instructions Contractor shall record, report, and preserve the finds in accordance with the National Historic Preservation Act and 43 Code of Federal Regulations Subtitle A Part 7, Protection of Archeological Resources.

1.09 FIRE CONTROL

A. The Contractor shall immediately extinguish, without expense to the CTUIR, all fires on or in the vicinity of the project which are caused by Contractor's employees, whether set directly or indirectly as a result of Contractor operations. The Contractor may be held liable for all damages and costs of additional labor, subsistence, equipment, supplies, and transportation resulting from fires set or caused by the Contractor's employees or resulting from contract operations.

B. At all times during closed fire season period, as specified by State law, the Contractor shall comply with each of the following provisions to the extent applicable to their operation under the contract.

1. Fire Tools. The Contractor will provide for each employee in the contract area at least one approved handtool of a type appropriate in the contract area, such as shovel, pulaski, or axe. Tools required and furnished under (2) and (4) below, shall count toward fulfillment of the above requirement.

2. Fire Extinguishers and Tools on Mobile or Stationary Equipment. Each unit of powered equipment used in connection with this contract, including automobiles, trucks, tractors, etc., shall be equipped with serviceable tools and fire extinguishers as follows:

   One - fire extinguisher, dry chemical type of not less than 2-1/2 pound capacity with a 4 BC or higher rating.

   One - shovel, round point #0 lady or equal.

   One - axe, 2 pounds or over, 26-inch minimum length, or one pulaski.

   One - water container (at least 1-gallon capacity), not required with stationary equipment.

3. Spark Arresters. Each internal combustion engine shall be provided with a spark arrester or spark-arresting device.

4. Power saws. For each power saw used in connection with this contract, the following will be provided:

   One - shovel, round point #0 lady or equal. Shovel must be immediately available for use.

   One - Fire extinguisher, containing not less than 8 ounces of extinguisher fluid, or a dry chemical powder-type of not less than 1-pound capacity. The extinguisher must be immediately accessible to the saw operator at all times.

5. Smoking. Smoking shall not be permitted within the contract area except on surfaced or dirt roads, at staging areas, within closed vehicles, or at other posted places, and shall never be allowed while working or traveling on foot.

6. Welding. Welding or use of cutting torches will be permitted only in areas that have been cleared or are free of all material capable of carrying fire. Flammable debris and vegetation must be removed from within a minimum of 10 feet radius of all welding and cutting torch operations. A shovel and a 5-gallon standard backpack water container (filled) with handpump attached shall be immediately available for use in the event of a fire start.

1.10 POST-CONSTRUCTION CLEANUP

A. Contractor shall clean up all areas used for construction.

1.11 RESTORATION OF LANDSCAPE DAMAGE

A. Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work areas.

1.12 TRAINING OF CONTRACTOR PERSONNEL

A. Contractor shall advise their personnel regarding all pertinent phases of environmental protection required in the Contract Documents. The training shall include methods of detecting and avoiding pollution, proper fueling techniques at this site, familiarization with pollution standards, both statutory and contractual, and installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental pollution control.

PART 2 PRODUCTS

2.01 FILTER FABRIC FENCE

A. Geotextile

1. Manufacturer’s fabric specifications must be submitted for approval and must be available on-site.
2. Geotextile shall be a woven monofilament or non-woven fabric. Slit-film fabric shall not be used.
3. Apparent opening size (AOS), American Society for Testing and Materials [ASTM] D-4751): 100
4. Water permittivity (ASTM D-4491): 0.02 sec-1 minimum
5. Grab tensile strength (ASTM D-4632): 100 pounds minimum
6. Grab tensile elongation (ASTM D-4632): 30 percent maximum
7. Ultraviolet resistance (ASTM D-4355): 70 percent minimum

B. Posts: 2- by 4-inch wood or steel fence posts

C. Wire Mesh Backing: 14 gauge with 2-inch by 2-inch square openings

2.02 SAND BAGS

A. Sand bags shall be burlap or polypropylene and filled to a minimum weight of 30 pounds.

2.03 EROSION CONTROL BALES, WATTLES, LOGS, AND ROLLS

A. Furnish straw bales tied with either commercial quality baling wire or string. Conform to the following:

1. Furnish certified weed free (native grass seed) straw that is free from mold or other objectionable material. Furnish straw in an air-dry condition suitable for placing with mulch blower equipment.

2. Approximate length 3.5 feet; Shape rectangular; approximate mass 70 pounds

B. Furnish fiber wattles, logs, or rolls of curled excelsior fiber rolled into a cylindrical shape and encased in seamless photodegradable tubular netting. Conform to the following:

   1. Diameter 12 inches min.; Mass 3 pounds per foot min.

C. Furnish straw wattles that are manufactured from weed free straw and wrapped in tubular photodegradable plastic netting made from 85% high density polyethylene, 14% ethyl vinyl acetate and 1% color for ultraviolet (UV) inhibition. Conform to the following:

   1. Diameter 9 inches minimum; Netting strand thickness 0.030 inches; Netting knot thickness 0.055 inches; Mass of netting 0.315 to 0.385 ounces per foot

D. Mulch shall be air-dried, well-seasoned, and free of undesirable seeds, noxious weeds, and all other material detrimental to plant life.

PART 3 EXECUTION

3.01 PERIMETER FILTER FABRIC FENCES

A. Construction

   1. Install prior to other land-disturbing activities.
   2. Silt fence trench: minimum 8 inches wide by 6 inches deep; backfill trench with compacted native soil.
   3. Fence posts: Maximum separation, 6 feet.
   4. Posts: Drive minimum 18 inches into ground.
   5. Fabric: Staple to posts per manufacturer’s recommendations.
   6. Fence: Wire mesh backing.
   7. Alignment: As described on Drawings.
   8. Fence ends: Extend upslope perpendicular to the contour for a distance of at least 6-feet to inhibit flow around the end of the fence.
   9. Fence sections: Overlap at least 10 feet.

B. Maintenance

   1. Inspection: Daily. Repair damage immediately.

2. Sediment removal: If sediment is evident, remove the trapped sediment. Remove accumulated sediment at least daily.
3. Photo-degraded or damaged fabric: Replace.
4. Final site stabilization: Remove fence.

3.02 EROSION CONTROL BALES, WATTLES, LOGS, AND ROLLS

A. Erosion Control Plan

B. Application

1. Prepare the slope before the installation procedure is started.
2. Shallow gullies should be smoothed as work progresses.
3. Dig small trenches across the slope on contour, to place rolls in. The trench should be deep enough to accommodate half the thickness of the roll. When the soil is loose and uncompacted, the trench should be deep enough to bury the roll 1/3 of its thickness because the ground will settle.
4. It is critical that rolls are installed perpendicular to water movement, and parallel to the slope contour.
5. Start building trenches and installing rolls from the bottom of the slope and work up.
6. Construct trenches at contour intervals 25-30 feet (8-10 meters) apart depending on the steepness of the slope. The steeper the slope, the closer together the trenches should be.
7. Lay the roll along the trenches fitting it snugly against the soil. Make sure no gaps exist between the soil and the straw wattle.
8. Use a straight bar to drive holes through the roll and into the soil for the willow or wooden stakes.
9. Drive the stake through the prepared hole, and into the soil. Leave only 1 or 2 inches (25 or 51 millimeters) of the stake exposed above roll.
10. Install stakes at least every 4 feet (1.2 meters) apart along the length of the wattle. Additional stakes may be driven on the downslope side of the trenches on highly erosive or very steep slopes.

B. Maintenance

1. Inspect the rolls and the slopes after rain events and at the frequencies as established in the SWPPP. Make sure the rolls are in contact with the soil.
2. Repair any rills or gullies promptly.

3. Reseed or replant vegetation if necessary, until the slope is stabilized.

3.03 STRAW MULCH

A. Application

1. Disturbed areas that will remain unworked for longer than one week
2. Rate: 3 tons per acre (3 bales per 1,000 square foot, or 3 inches thick)
3. Secure mulch to soil: “Crimp” straw into soil by operating tracked vehicle (or straw crimping equipment) parallel to slope (up and down slope)

B. Maintenance

1. Stockpiled straw: have available on-site sufficient straw to replace 10 percent of covered area.
2. Inspect straw mulch: after each rainfall event, repair by replacing straw and re-crimping.

3.04 NOXIOUS WEED CONTROL

A. In order to prevent the potential spread of noxious weeds into work areas, Contractor shall be required to use weed-free equipment. The following is considered proof of weed-free equipment:

1. The Contractor will be required to clean all equipment prior to entry onto CTUIR lands. This cleaning shall remove all dirt, animal and plant parts and material that could carry invasive species seeds or parts into the work area. Only clean equipment inspected by the CTUIR will be allowed to operate within the work area. The inspection shall be pre-arranged by the Contractor and will occur prior to entering the work area. All subsequent move-ins of equipment shall be treated in the same manner as initial move-in.
2. For the purpose of item (1) above, equipment includes: hand tools, power tools, vehicles, all-terrain vehicles (ATV)/utility task vehicles (UTV), dump trucks, excavators, and all other heavy equipment.

B. Straw/hay bales shall be certified as “weed free”. The source field shall be inspected and certified by the county extension agent from the county that the straw/hay is grown. Each shipment into the work area shall be accompanied by a certification tag stating that it is weed free. The Contractor shall furnish the CTUIR with a statement of certification prior to unloading the bales.

END OF ENVIRONMENTAL PROTECTION

SECTION 01 35 43.20
CARE AND DIVERSION OF WATER

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the dewatering, treatment, discharge, and/or diversion of any water that might be required for performance of contract work. The work includes care and any necessary diversion of water in the vicinity of excavated banks, seepage into excavations, and water potentially generated by Contractor’s project construction methods.

1.02 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

1. Construction Dewatering Water Storage, Treatment, and Discharge System

   a. Contractor shall submit a Dewatering Plan with shop drawings showing design details and layout for the Construction Dewatering, Treatment, and Discharge System, and procedures for operation. These shop drawings shall be submitted within 10 calendar days following Notice to Proceed.

2. Storm Contingency Plan

   a. Contractor shall submit, within 10 calendar days of Notice to Proceed, a Storm Contingency Plan. The Storm Contingency Plan shall detail actions to be taken in the event of an unexpected storm that could cause stormwater to collect and leave the work area.

B. Fish Passage

1. Both resident and anadromous fish utilize the project reach of Birch Creek and the Umatilla River. Upstream and downstream fish passage shall be maintained throughout construction, or as agreed upon with the fisheries co-managers.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF CARE AND DIVERSION OF WATER

SECTION 01 52 00
TEMPORARY CONSTRUCTION FACILITIES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Construction Equipment Parking

1. Contractor shall identify a location within the project work area as an equipment parking area for daily parking and receive approval by the Owner's Representative. This area shall also be used for equipment fueling and daily maintenance and shall meet all criteria listed in Section 01 35 43 ENVIRONMENTAL PROTECTION Subsection 1.06 D, Mobile Equipment Fueling. No daily fueling or maintenance shall be completed outside this designated area.

B. Employee Parking

1. Contractor employees shall park privately owned vehicles in an area designated by the Owner's Representative. This area shall be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements.

1.02 SUBMITTALS

A. None.

1.03 AVAILABILITY AND USE OF UTILITY SERVICES

A. Temporary Water and Electricity

1. No municipal water or electricity will be available at the project site. Contractor shall arrange for drinking water, potable water, and power at the project site as needed and coordinate these needs with the Owner's Representative at the pre-construction meeting.

B. Sanitation

1. Contractor shall provide and maintain within the construction area field-type sanitary facilities. The number of sanitary facilities shall be matched to the maximum number of personnel working at the site as required by Federal, State, and local codes and regulations. Sanitary facilities shall be equipped with a hand-washing station.

1.04 PROTECTION AND MAINTENANCE OF TRAFFIC

A. Contractor shall maintain and protect traffic and parked vehicles on all affected roads and parking lots during the construction period, except as otherwise specifically directed by the Owner's Representative. Measures for notification, any required hauling permits, the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public and Owner personnel shall be protected from damage to person and property. Contractor's traffic on roads selected for hauling material to and from the Site shall interfere as little as possible with public traffic. Contractor shall investigate the adequacy of existing roads and parking lots and the allowable load limit on these roads and parking lots. Contractor shall be responsible for the repair of any damage to roads and parking lots caused by construction operations.

B. Barricades

1. Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to areas such as roads or parking areas is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible, and with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

1.05 CONTRACTOR'S TEMPORARY FACILITIES

A. Administrative Field Offices

1. Contractor shall provide and maintain administrative field office facilities within the construction area as directed by the Owner's Representative.

2. The Contractor shall provide a clean, watertight field office with heat, electric lighting, equipped with drawing rack and drawing display table, all weather automobile access, and parking in a central location on the job site for the use of the Owner's Representative or Engineer if so directed. The field office will provide space for project meetings, with table and chairs to accommodate the appropriate number of persons. The Contractor shall provide access to the field office during normal working hours and other times to be specified by the Owner's Representative or Engineer. The Contractor shall pay all costs to set up the office, supply materials, supply electricity, provide weekly janitorial service, and maintenance for the duration of the project. The Contractor shall not use the field office for the storage of any material, equipment, tools, or supplies.

B. Appearance of Trailers

1. Trailers used by Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair.

C. Security Provisions

1. Adequate outside security lighting shall be provided at Contractor's temporary facilities as needed. Contractor shall be responsible for the security of its own equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF TEMPORARY CONSTRUCTION FACILITIES

SECTION 01 55 13
TEMPORARY ACCESS ROADS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work in this section consists of the installation and removal of temporary access roads into the project work areas. Location of temporary access roads shall be field-fit as directed to protect existing vegetation to the extent practical.

1.02 SUBMITTALS

A. Contractor shall submit a plan showing the proposed location and construction techniques to install the access road based on the Drawings. This plan shall be developed using the equipment weights and proposed usage to ensure the location and construction will support the equipment and anticipated loads over the proposed usage period of the road.

PART 2 PRODUCTS

2.01 FILTER FABRIC

A. Installation of a filter fabric between the native soil and rock road surface may be required in places to keep the materials separate and ease the removal of the rock. If used, filter fabric shall be Mirafi 140NL or approved equal.

2.02 ROCK FOR ACCESS ROADS

A. Rock used for the access roads shall be free of soil and other extraneous materials. Materials used for the road construction shall be either quarry spalls or larger crushed rock.

2.03 TEMPORARY BRIDGES

A. Temporary construction bridges are required at locations as shown on Drawings.

B. Contractor shall submit proposed bridge configuration to Owner’s Representative or Engineer for approval at least a week in advance of installation.

PART 3 EXECUTION

3.01 SITE PREPARATION

A. Site clearing shall be completed within Section 31 10 00 SITE CLEARING

3.02 PRELIMINARY GRADING

A. Once the temporary road alignments have been approved by the Owner’s Representative or Engineer, preliminary grading can be completed. All materials removed during the preliminary grading shall be placed to the side of the temporary roads for use during site restoration upon completion of the project.

3.03 ROAD INSTALLATION

A. Upon completion of the preliminary grading, filter fabric may need to be installed on the temporary roads to ease removal of access road rock. Quarry spalls or large crushed rock will then be placed on the filter fabric to complete the access pad.

B. Compaction of the temporary roads will be completed using a dozer to spread the rock material, dump trucks delivering additional material, or an excavator after the rock is installed.

C. The length of the temporary construction access roads will vary depending on the site conditions and Contractor's proposed schedule and sequence of work.

3.04 TEMPORARY BRIDGE INSTALLATION

A. Bridges to be installed at the locations shown on the Drawings.

B. Bridges to be installed over active flowing water in the stream channel.

C. Bridges to be installed on temporary concrete abutments or on a firm substrate.

3.04 ROAD MAINTENANCE

A. During the use of the temporary access roads, if additional materials are needed to maintain the roads, these materials shall be of the same type that were used to originally construct the roads and pads.

3.05 ROAD REMOVAL

A. Upon completion of the construction, the temporary access roads shall be removed.

B. The Contractor shall remove the quarry spalls or larger crushed rock and haul this material to an off-site location. In addition, all filter fabric used shall be removed and hauled to an off-site location. It is the Contractors responsibility to remove all of the filter fabric and rock from the temporary roads.

C. All compacted access roads shall be subsoiled/scarified during Closeout.

3.06 SITE DECOMPACTION AND REGRADING

A. After the geotextile and rock have been removed from the temporary road alignment, these sites shall be evaluated for the degree of compaction by the Owner's Representative to make sure the disturbed areas will be restored to original conditions to the greatest extent practical for re-establishment of native vegetation.

B. Subsoiling/decompaction to a minimum depth of 18 inches will be required to restore heavily compacted subgrade. Subsoiling shall be performed with a dozer ripper, subsoiling grabble rake (SGR) or subsoiling excavator bucket (SEB) and will leave no clumps larger than 8 inches in diameter when finished. Subsoiling during Closeout shall be approved by the Owner's Representative or Engineer.

C. After the geotextile and rock have been removed from the temporary road alignment, these sites shall be regraded using the materials set aside during the preliminary grading. Finished grade along the road shall be as close to the original grade as possible.

3.07 SITE REVEGETATION

A. Revegetation along the regraded road alignments shall be completed by the Owner and in Section 32 90 00 SEEDING.

END OF TEMPORARY ACCESS ROADS

SECTION 01 71 23
FIELD SURVEYING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work described herein for Field Surveying may be selected for contract separately from the remainder of the specifications. Owner to determine Contractor for described work.

B. Contractor shall provide all materials, items, operations, or methods specified, listed, or scheduled on the Drawings or in the Specifications, including all materials, labor, equipment, and incidentals necessary and required to conduct proper surveys required to stake and layout the work, based on the Drawings and CAD files provided by the Owner’s Representative or Engineer.

C. Contractor shall perform surveys for layout of the work and to document final construction for “Record” Drawings.

1.02 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

1. Survey Data for Record Drawings

   a. Within 14 calendar days of final acceptance, Contractor shall furnish Owner’s Representative or Engineer field survey data documenting the completed construction.

2. Contractor shall provide Surveyor credentials demonstrating active Oregon licensure.

1.03 QUALITY CONTROL

A. All survey, layout, and related work shall be performed to the satisfaction of Owner’s Representative or Engineer.

1.04 PROJECT RECORD DOCUMENTS

A. Upon completion of the work, Contractor shall submit Field Record Documents to Owner’s Representative or Engineer under the provisions of Section 01 78 39 RECORD DRAWINGS.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Contractor shall exercise care during the execution of the work to minimize any disturbance to the landscape in the areas surrounding the work site.

B. Contractor shall have onsite survey and grade control capacity such as total station, GPS, and/or GPS enabled construction equipment.

3.02 INSPECTION

A. Contractor shall verify locations of existing site reference and survey control points prior to starting work. Contractor shall promptly notify Owner's Representative or Engineer of any discrepancies discovered. Contractor shall also verify layouts periodically during construction.

3.03 SURVEY REFERENCE POINTS

A. Survey reference points have been established by prior contract at the site. Contractor shall locate and verify the accuracy of three of these reference points for coordinate location and elevations prior to using them for work performed at the site. If any discrepancies exist in the location of the existing benchmarks, Contractor shall notify Owner's Representative or Engineer prior to performing any site layout activities. Contractor may install additional reference points for his/her convenience at locations approved by Owner's Representative or Engineer. No payment will be made for any additional permanent site control installed by Contractor beyond that specified and permitted herein. Contractor shall protect survey control points prior to starting site work and preserve permanent reference points during construction. Contractor shall not relocate site reference points without prior written approval from Owner's Representative or Engineer.

B. Contractor shall promptly report to Owner's Representative or Engineer the loss, damage, or destruction of any reference point or relocation required because of changes in grades or other reasons. Contractor shall replace dislocated survey control points based on original survey control at no additional cost to Owner. Replacement of dislocated survey control points shall be done by a licensed land surveyor in the State of Oregon. Survey accuracy used to relocate disturbed control points shall be equal to or better than that used to set the original control.

C. Contractor shall be responsible for the accuracy of all surveys performed with their forces, including those of their subcontractors. Any work performed not conforming to the lines, grades, elevations, and locations indicated on the Contract Drawings due to survey error shall be the responsibility of Contractor, and Contractor shall repair or relocate such work to its proper location at no additional cost to Owner.

3.04 SURVEY REQUIREMENTS

A. Contractor shall reference survey and site reference points to the provided control monuments and record locations of survey control points, with horizontal and vertical data, on project Record Documents. Record Drawings shall include the bare earth of all grading activities and location of all installed structures to the tolerances described herein.

B. Contractor shall with its own forces obtain working or construction lines or grades as needed.

C. All control surveys for elevation shall be +0.1 foot and, for horizontal, control angles shall be to the nearest 20 seconds +10 seconds, and measured distances shall be to +0.1 foot. All measurement surveys for elevation shall be to the nearest 0.1 foot +0.05 foot and for horizontal distances shall be to +0.1 foot.

D. Contractor shall provide all materials as required to properly perform the surveys, including, but not limited to, instruments, tapes, rods, measures, mounts and tripods, stakes and hubs, nails, ribbons, other reference markers, and all else as required. All material shall be of good professional quality and in first-class condition.

E. All lasers, transits, and other instruments shall be calibrated and maintained in accurate calibration throughout the execution of the work. A copy of the recent calibration of all instruments will be required and available to the Engineer and Owner.

F. Contractor shall furnish all materials and accessories (i.e., grade markers, stakes, pins, spikes, etc.) required for the proper location of grade points and line.

G. All marks given shall be carefully preserved and, if destroyed or removed without Engineer's or Owner's Representative's approval, they shall be reset, if necessary, at Contractor's expense.

H. Upon completion of surveys for control points, channel location, structure location, fencing location, access roads and embankment, the Contractor's Surveyor will notify the Owner's Representative or Engineer for review of the survey. Upon review and approval of the survey by the Owner's Representative or Engineer, the Contractor will be notified to proceed with implementation.

3.05 SURVEY OF COMPLETED EXCAVATION

A. At the completion of excavation and fill in all areas, Contractor shall survey the extents, elevations, grade breaks, and daylight points of all excavation and fill areas using a grid at a minimum of 25-foot centers plus key grade breaks, to document the final configuration.

3.06 SURVEY OF COMPLETED CONSTRUCTION

A. At the completion of restoration in all areas, Contractor shall survey the floodplain, backfill, levee, using a grid at a minimum of 25-foot centers plus key grade breaks, to document the final configuration, access road to remain in place, and all major structures (such as headwalls, pipe inverts, and wingwalls) in the creek or floodplain.

3.07 PAYMENT AS AN INCIDENTAL

A. The cost to Contractor of all work and delays occasioned by giving lines and grades, or making other necessary measurements, will be considered as having been included in the lump sum price for the work.

END OF FIELD SURVEYING

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the process and procedures to be followed by the Contractor, Engineer, and Owner for the review and acceptance of work during implementation.

B. Review and acceptance of work will be completed when needed during and at the end of construction, including for as-directed and hourly work.

C. Review and acceptance of work will be completed for the completion of earthwork, structures, and channel features as shown on the Drawings.

D. A Record of Review and Acceptance of work will be kept by both the Contractor and Owner's Representative or Engineer at the project site.

1.02 CONTRACTOR'S RESPONSIBILITIES

A. During the weekly construction meetings, the Contractor will provide a summary of work completed and work under way at each of the work sites, including as-directed and hourly work.

B. The Contractor will communicate with the Owner's Representative or Engineer on the status of work completion at each of the work sites.

C. As work approaches completion at each work site, the Contractor will request the Owner's Representative or Engineer to review the work and prepare a punch-list of tasks to be completed at each site.

D. Upon receipt of the punch-list, the Contractor will complete each of the tasks identified by the Owner's Representative or Engineer.

E. Work on the tasks will continue until the Owner's Representative or Engineer accepts the completed work.

1.03 ENGINEER'S REVIEW AND APPROVAL

A. Upon receiving a request from the Contractor, the Owner's Representative will prepare a punch-list of tasks to complete work at each of the work sites.

B. The Owner's Representative will update the completion punch-list regularly to assist the Contractor in completing the work in an efficient manner. This will occur at a minimum of twice per week, more frequently if the task dictates more immediate action.

C. Upon completion of the tasks included on the punch-list, the Owner's Representative or Engineer will approve the work and sign the Record of Review and Acceptance.

D. As work approaches completion of individual components, the Engineer will notify the Owner's Representative on project activities and request an on-site review of the work.

1.04 OWNER'S REPRESENTATIVE APPROVAL

A. The Owner's Representative will be expected to attend and participate in the Weekly Progress Meetings and keep current on the project implementation activities.

B. Upon receipt of the request from the Engineer for an on-site review of the completed work, the Owner's Representative will schedule a time to be on-site to complete the review.

C. After the completion of the review, the Owner's Representative will have the option to approve, approve with conditions, or reject the work completed.

D. When the Owner's Representative approves with conditions or rejects the completed work, the Owner's Representative will have two (2) working days to prepare a punch-list of items to be completed prior to approval. This punch-list will be submitted to the Contractor and the Engineer.

1.05 PROJECT APPROVALS

A. Project approvals will be completed at the end of construction.

B. Upon project approval by the Engineer and Owner's Representative, the construction work will be accepted by the Owner's Representative.

1.06 PROJECT CLEANUP AND REPAIRS

A. Cleanup and repair of work area will be completed when needed during and at the end of construction.

B. The Contractor is expected to keep the project work area clean and prevent the accumulation of trash and debris. Placement of a dumpster at the project trailer with regularly scheduled pickups shall be arranged by the Contractor.

C. Additional cleanup and repair activities shall include but are not limited to road and fence repairs, general maintenance, staging area cleanup and maintenance and construction trailer maintenance.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF CLOSEOUT PROCEDURES

SECTION 01 78 39
RECORD DRAWINGS

PART 1 GENERAL

1.01 DESCRIPTION

A. Field Record Drawings.

1. Field Record Drawings shall be completed and submitted to Owner's Representative or Engineer, within 14 calendar days of final acceptance. All Drawings from the original Contract Drawings set shall be included, including the drawings where no changes were made. Owner's Representative or Engineer will review all field record drawings for accuracy and clarity. The Field Record Drawings will be returned to Contractor if corrections are necessary. Contractor shall make all corrections and shall return the Field Record Drawings within 7 calendar days of receipt.

1.02 SUBMITTALS

A. Field Record Drawings shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 FIELD RECORD DRAWINGS

A. Contractor shall keep at the construction site two complete sets of full-size prints of the Contract Drawings, reproduced at Contractor expense, one for Contractor's use, one for Owner's Representative or Engineer. During construction, both sets of prints shall be marked to show all deviations in actual construction from the Contract Drawings. The color green shall be used to indicate all additions and red to indicate all deletions. The drawings shall show the following information but not be limited thereto:

1. The locations and description of any structures, pipelines, utility lines and other installations of any kind or description known to exist within the construction area and not previously shown on the Contract Drawings. The location includes dimensions and/or survey coordinates for permanent features.

2. The location, orientation, topography and grade of all stream restoration features installed or affected as part of the project construction.

3. All changes or modifications from the original design and from the last inspection.

B. Where Contract Drawings or Specifications allow options, only the option actually used in the construction shall be shown on the record drawings. The option not used shall be deleted.

C. These deviations shall be shown in the same general detail utilized in the Contract Drawings. Marking of the prints shall be pursued continuously during construction to keep them up to date. The resulting field-marked prints and data shall be referred to and marked as “Field Record Drawings,” and shall be used for no other purpose. They shall be made available for inspection by Owner’s Representative or Engineer whenever requested during construction and shall be jointly inspected for accuracy and completeness by Owner’s Representative or Engineer and a responsible Representative of Contractor prior to submission of each monthly pay estimate. Failure to keep the Field Record Drawings current shall be sufficient justification to withhold 10 percent of the final payment until satisfactory drawings are received.

3.02 PAYMENT

A. All costs incurred by Contractor in the preparation and furnishing of Field Record Drawings shall be included in the contract price and no separate measurement or payment will be made for this work. Approval and acceptance of the Field Record Drawings shall be accomplished before final payment is made to Contractor.

END OF RECORD DRAWINGS

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place concrete for:

   1. Inlet structure apron.

   2. Control Low Strength Material (CLSM).

B. Concrete formwork.

C. Concrete reinforcing.

D. Concrete curing.

1.02 REFERENCES

A. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.

B. ACI 306R - Cold Weather Concreting.

C. ACI 308 - Standard Practice for Curing Concrete.

D. ASTM C 33 - Concrete Aggregates.

E. ASTM C 94 - Ready-Mixed Concrete.

F. ASTM C 150 - Portland Cement.

G. ASTM C 260 - Air Entraining Admixtures for Concrete.

H. USACE EM 1110-2-1913 (April 2000).

I. USACE EM 1110-2-2902 (December 2020).

1.03 SUBMITTALS

A. Concrete mix design: Submit mix design for concrete mix to be used on this project. Submittal must be made to and reviewed by the Engineer prior to placement.

1.04 QUALITY ASSURANCE

A. Acquire cement and aggregate from same source for all Work.

B. Conform to ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal.

B. Fine and Coarse Aggregates: ASTM C 33.

C. Water: Clean and not detrimental to concrete.

2.02 ADMIXTURES

A. Air Entrainment: ASTM C 260; “Darex II” manufactured by W.R. Grace and Company or equal.

B. Water-Reducer: ASTM C 494, Type A, “WRDA-82” manufactured by W.R. Grace and Company or equal.

2.03 REINFORCEMENT

A. Reinforcing Steel: ASTM A 615, 60 ksi yield grade; No. 4 deformed billet steel bars, plain.

2.04 FORMWORK

A. Use either wood and plywood faced or preformed steel forms for concrete forming. Apply form release agent as needed to prevent curing concrete from adhering to forms and peeling off concrete structure when removing forms. Diesel fuel shall not be used as a form release agent.

2.05 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C 94.

B. Provide concrete to the following criteria:

1. Compressive Strength (28 days): 4,000 pounds per square inch
2. Slump: 2 to 4 inches.
3. Maximum Water/Cement Ratio: 0.46.

C. Calcium chloride is not permitted in any concrete mixes.

D. Add air entraining agent to normal weight concrete mix for work exposed to exterior conditions.

2.06 CONTROLED LOW STRENGHT MATERIAL

A. Mix and deliver concrete in accordance with ASTM C 94.

B. Provide concrete to the following criteria:

1. Portland Cement:
    a. Per ASTM C150 Type I or II.
    b. 80-100 lbs. per cubic yard.
2. Ambient temperature > 32 degrees Fahrenheit.
3. Fly Ash:
    a. Per ASTM C618 Class F, C or N.
    b. 200-400 lbs. per cubic yard.
4. Sand:
    a. Per ASTM C33
    b. 2000-2000 lbs. per cubic yard
5. Maximum Water/Cement Ratio: 1.3.
6. Air Content:
    a. Per ASTM 260
    b. 10% - 20%
7. Unit Weight of 110 pcf to 126 pcf
8. Shrinkage reducing material:
    a. Bentonite dosed at half the weight of the Portland cement used, or a shrinkage reducing admixture dosed at a rate recommended by the manufacturer

C. Calcium chloride is not permitted in any concrete mixes.

D. Compressive strength no more than 300 psi per AST C39/C1019

E. Add air entraining agent to normal weight concrete mix for work exposed to exterior conditions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Engineer to verify site conditions are suitable for placement of concrete.

B. Verify requirements for concrete cover over reinforcement as shown on drawings.

C. Verify that anchors, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.02 PREPARATION

A. Crushed stone bedding shall be placed as necessary to bring base of formwork up to design elevation.

B. Surface of stone bedding shall be relatively smooth, and bedding shall be tamped to ensure minimal settlement during and after concrete placement.

3.03 PLACING REINFORCEMENT

A. Place, support, and secure reinforcement against displacement.

B. Spaced at 8-inch on-center in both directions.

C. Maintain minimum 2-inch concrete cover around reinforcement as shown on drawings.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304.

B. Notify Engineer or Owner’s Representative minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, and embedded parts are not disturbed during concrete placement.

D. Maintain records of concrete placement. Concrete delivery ticket will be considered satisfactory certification. Ticket shall provide the following information:

1. Mix design, listing materials and quantities of each;
2. Design strength;
3. Admixtures;
4. Date and time batched, delivered, and completed pour;
5. Company name, address, and delivery truck number.

E. If Contractor mixes concrete on-site, they shall provide documentation, verified by lab testing, including the information required above.

3.05 PLACEMENT OF CLSM

A. Pipe shall be placed on two (2) sandbags and leveled to the proper grade. Precast or other types of rigid pads that constitute a point load are unacceptable.

B. CLSM shall be placed under the pipe from one side so that it flows under the pip until it appears on the other side.

   1. CLSM shall be added to both sides of the pipe until it completely fills the space between the pipe and the sides of the trench, to the depths shown in the DRAWINGS.

   2. Rodding, mechanical vibration and compaction of CLSM shall be performed to assist in consolidating the CLSM.

C. When required to prevent uplift, the CLSM shall be placed in two (2) stages as required, allowing sufficient time for the initial set of the first stage before the remainder is placed.

D. CLSM shall be deposited as nearly as practical in its final position and in no way disturb the pipe trench or cause foreign material to become mixed with the CLSM.

E. Soil backfill shall not be placed until the CLSM has reached the initial set.

   1. If backfill is not to be placed over the CLSM within eight (8) hours, a six-inch (6") cover of moist earth shall be placed over the CLSM surface.

   2. If the air temperature is fifty degrees Fahrenheit (50°F) or less, the moist earth cover should be at least eighteen inches (18") thick.

3.06 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.07 FIELD QUALITY CONTROL

A. Provide access to Work and cooperate with Owner’s Representative.

B. If requested by Owner, air testing shall be performed to ensure compliance with requirements as set forth by ACI.

C. At a minimum, concrete shall be visually inspected by Owner’s Representative for appropriate slump and consistent quality.

3.08 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.

B. Repair or replacement of defective concrete will be determined by the Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

END OF CAST-IN-PLACE CONCRETE

SECTION 31 05 19.13
GEOTEXTILES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work in this section consists of furnishing and installing geotextile below proposed riprap inlet/outlet protection and bank/levee revetment areas where shown on the plans and for perforated geotextile sock wrap for drainage.

1.02 REFERENCES

A. Oregon Department of Transportation (ODOT) Standard Specification 2024 Section 00350.41(a), (b), and (d) Geosynthetics Installation.

1.02 SUBMITTALS

A. A minimum of fourteen (14) days prior to scheduled use, Contractor shall submit manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. This submittal shall include copies of manufacturer's quality control test results. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles.

1.03 PROJECT CONDITIONS

A. Packing and Shipping:

1. Geotextile shall be supplied in rolls wrapped individually in relatively impermeable and opaque protective covers.

2. Geotextile rolls shall be marked or tagged with the following information:

    a. Product identification information (Manufacturer’s name and address, brand product code).

    b. Lot number and roll number.

    c. Roll length, width and weight.

B. Storage and protection:

1. Unloading, on-site handling, and storage of the Geotextile are the responsibility of the Contractor.

2. The Contractor shall provide on-site storage area(s) for Geotextile rolls from time of delivery until installation.

3. Store and protect Geotextile from mud, dust, water, exposure to ultraviolet light, heat, and other sources of damage.

C. Preserve integrity and readability of geotextile roll labels.

PART 2 PRODUCTS

2.01 RIPRAP GEOTEXTILE

A. Non-woven geotextile shall consist of continuous filament needle punched non-woven polypropylene, polyethylene or polyamide fabric oriented into a stable network that retains its relative structure during handling, placement, and long-term service. Fabric shall be non-biodegradable; resistant to most soil chemicals and acids and bases in a pH range of 3 to 12; and are protected from ultraviolet degradation. The fabric shall meet the following minimum properties in Table 2.01-1 below:

TABLE 2.01-1
NON-WOVEN GEOTEXTILE PROPERTIES

Property	**Test Method**	**Value**[1]
Mass (oz/yd^2)	ASTM D5261	16 min.
Grab Tensile Strength (lbs)	ASTM D4632	380 min.
CBR Puncture Strength (lbs)	ASTM D6241	1,080 min.
Trapezoidal Tear (lbs)	ASTM D4533	145 min
Elongation (%)	ASTM D4632	50
Apparent Opening Size (U.S. Standard Sieve Size)	ASTM D4751	70-100

(1) Typical or average values

2.02 GEOTEXTILE FOR DRAINAGE

A. Non-woven geotextile shall consist of continuous filament needle punched non-woven polypropylene, polyethylene or polyamide fabric oriented into a stable network that retains its relative structure during handling, placement, and long-term service. Fabric shall be non-biodegradable; resistant to most soil chemicals and acids and bases in a pH range of 3 to 12; and are protected from ultraviolet degradation. The fabric shall meet the following minimum properties in Table 2.02-1 below:

TABLE 2.01-2 NON-WOVEN GEOTEXTILE PROPERTIES		
Property	**Test Method**	**Value[1]**
Grab Tensile Strength, min. in machine and x-machine direction (lbs)	ASTM D5261	16 min.
Grab Failure Strain, in machine and x-machine direction	ASTM D4632	50%
Seam Breaking Strength (if seams are present) (lbs)	ASTM D6241	140 min.
Trapezoidal Tear (lbs)	ASTM D4533	50 min
Elongation (%)	ASTM D4632	50
Apparent Opening Size (U.S. Standard Sieve Size)	ASTM D4751	40-80

(1) Typical or average values

PART 3 EXECUTION

3.01 PREPARATION

A. Contractor shall install the riprap, seepage filter material, Culver inlet headwall and CPEP culvert at locations shown on the Drawings.

3.02 EXCAVATION

A. Contractor shall take any necessary precautions to prevent damage to underlying layers during placement of the Geotextile, i.e. removal of stones or sharp objects from subgrade that could damage the geotextile.

B. Significant holes and depressions (i.e. those that would allow water to pond on the surface) shall be filled prior to geotextile installation.

C. Maximum drop height of rock onto geotextile is 3 feet.

3.03 INSTALLATION

A. Geotextile procurement, transportation, storage, handling and installation shall be the responsibility of the Contractor. Any damaged or unacceptable material shall be replaced at no additional cost to the Owner.

B. Geotextile shall be installed in accordance with manufacturer’s installation specifications.

C. Wrappings protecting geotextile rolls shall be removed less than one hour prior to unrolling the geotextile. After the wrapping has been removed, the geotextile shall not be exposed to direct sunlight for more than 20 days (unless otherwise approved by the Owner's Representative).

D. Unroll geotextile directly onto prepared surface with the long dimension parallel to the direction of surface water flow.

E. Geotextile shall be securely anchored and then rolled in such a manner as to continually keep the geotextile sheet in tension.

F. All seams shall be placed to provide a 2 foot minimum overlap, with the upstream strip overlapping the downstream strip.

G. Do not drive vehicles or equipment directly on the geotextile.

3.04 GEOTEXTILE REPAIRS

A. Carefully remove any soil or other materials that may have penetrated the torn geotextile.

B. Holes or tears in the fabric shall be repaired with a fabric patch made from the same geotextile. Patches shall provide a minimum overlap of 24 inches in all directions and be anchored as necessary. Should any tear exceed 10 percent of the width of the roll, that roll shall be removed from the slope and replaced.

END OF GEOTEXTILES

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work specified in this Section includes, but is not necessarily limited to, the following:

1. Clearing and grubbing.

2. Removing designated trees and protecting from harm any trees or other objects selected to remain by Owner's Representative.

3. Stripping and stockpiling topsoil.

1.02 HISTORICAL ITEMS

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value that may be encountered during site preparation shall remain the CTUIR's property. Upon such discovery or find, Contractor shall immediately notify Engineer and Owner's Representative. While waiting for instructions Contractor shall record, report, and preserve the finds in accordance with the National Historic Preservation Act and 43 Code of Federal Regulations Subtitle A Part 7, Protection of Archeological Resources.

B. Items designated for attention of Owner's Representative if discovered shall be handled as described in Section 01 35 43 ENVIRONMENTAL PROTECTION.

1.03 SUBMITTALS

A. Submit:

1. Procedures and operational sequence for review and acceptance by the Owner's Representative or Engineer include:

    a. Permits for transport and disposal of debris as required.

2. As-built drawings and records in accordance with Section 01 78 39 RECORD DRAWINGS.

1.04 DIMENSIONS AND LAYOUT

A. The Contractor shall be responsible for installing construction fence around the construction area and resetting fencing to accommodate changes in the construction area.

B. All work, materials, methods, and personnel shall be subject to approval by the Owner's Representative or Engineer prior to commencing construction and on a continuous basis throughout construction.

C. The Contractor is responsible for preserving all benchmarks and stakes and replacing any that are displaced or missing as a result of the Contractor's operations.

D. The Contractor shall be responsible for locating all underground utilities prior to beginning any excavation or underground demolition.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. This section describes the requirements for site clearing and grubbing. Construction schedule constraints in performing various portions of the work are provided in Section 01 14 20 SITE-SPECIFIC REQUIREMENTS.

3.02 EROSION/POLLUTION CONTROL

A. Required erosion/pollution control facilities in accordance with Sections 01 35 43.20 CARE AND DIVERSION OF WATER and Section 01 35 43 ENVIRONMENTAL PROTECTION shall be in place prior to beginning the work of this Section.

3.03 EXISTING CONDITIONS

A. Protection of Facilities

1. Protect and maintain benchmarks and survey control points from disturbance during construction.

2. Provide, erect, and maintain temporary construction fencing around the construction area as shown on the Drawings.

3. Control construction traffic entering and leaving construction access gates to protect property.

B. Protection of Existing Improvements:

1. Provide, erect and maintain barricades, coverings, or other types of protection necessary to prevent damage to existing trees, fences, structures or buildings. Restore any improvements damaged by this work to their original condition, as acceptable to the Owner's Representative or Engineer.

3.04 TREE AND SHRUB PROTECTION

A. General:

1. Include barricades and/or fencing and other protection for trees indicated on the Drawings or directed by the Owner's Representative or Engineer to be saved and protected.

2. Maintain existing grade within root protection zone of trees to the edge of the dripline unless otherwise indicated.

3. Grubbing will be performed by cutting the vegetation at ground level while keeping the roots to the extent possible.

3.05 SITE WORK

A. Sprinkle debris with water as necessary to limit dust to lowest practicable level. Do not use excessive water which may cause flooding, contaminated runoff, or icing.

B. Existing utility lines within the project area shall remain in operation throughout the duration of the construction period. Protect and support all lines and meters from damage and movement.

C. Existing utility lines, structures, and meters serving other properties shall remain in operation throughout the duration of the construction period. Protect and support all lines and meters from damage and movement.

D. In the event the Contractor encounters utility lines not shown on the Drawings or otherwise indicated to be saved, removed, or abandoned, the location of such lines shall be marked in the field and the Owner's Representative or Engineer notified.

3.06 CLEARING LIMITS

A. Construction fences and clearing limits for the construction activities are shown on the Drawings.

B. Construction fences and temporary erosion control shall be installed prior to the beginning of site clearing for each construction period.

C. All trees removed within the clearing limits shall be sorted and stockpiled into the following size categories:

1. Diameter 18 inches or greater.
2. Diameter 4 to 10 inches.
3. Diameter less than 4 inches.

D. All shrubs and other wood material shall be collected and stockpiled for use later in the project.

3.07 DEMOLITION

A. Temporary erosion and sedimentation control features shall be in place before demolition.

B. Demolished material shall be treated as salvaged item.

3.08 SALVAGED ITEMS

A. Carefully dismantle and remove salvaged items.

1. The Contractor shall deliver any salvaged items to an approved location designated by the Owner's Representative.

3.09 STOCKPILING OF MATERIALS

A. Topsoil stripping and stockpiling:

   1. Remove grass and vegetation before stripping topsoil.

   2. Strip topsoil to depth of organic material encountered (typically 8 to 12 inches) in a manner to prevent intermingling with underlying subsoil or other clearing/waste materials.

   3. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

   4. Stockpile topsoil materials in designated or approved staging areas away from edge of excavations and without intermingling with subsoil. Grade and shape stockpiles to drain surface water. Cover stockpiles as necessary to prevent windblown dust.

B. The Contractor should have sufficient area on-site to stockpile large wood material for later use in the project.

C. If additional stockpile areas are required to complete the project on schedule, the Contractor will arrange off-site stockpile areas. No additional payments will be made for stockpiling excavated materials off-site.

D. Reusable materials shall be carefully segregated into material sizes defined in Section 3.06.

3.10 DISPOSAL OF MATERIALS

A. Refuse and non-organic trash resulting from site clearing and grubbing shall be disposed of by the Contractor in a manner consistent with all government regulations.

   1. No burning permitted.

   2. Do not leave refuse material on the project site, shoved onto abutting private properties, or buried in embankments or trenches on the project site.

   3. Do not deposit debris in streams, bodies of water, roads, or upon private property except by written consent of the private property Owner.

   4. Maintain haul routes clean and free of debris resulting from work of this Section.

   5. All small trees, limbs, branches, bark and needles shall be buried during backfilling activities.

3.11 CLEAN-UP

A. Upon completion of the work of this Section, remove all rubbish, trash, and debris resulting from operations.

B. Remove equipment and tools; leave the site in a neat and orderly condition acceptable to the Owner’s Representative or Engineer.

END OF SITE CLEARING

SECTION 31 23 00
EXCAVATION AND FILL

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section covers earthwork for existing Pendleton 2a Levee removal and proposed Pendleton 2a Levee setback.

1.02 JOB CONDITIONS

A. Environmental requirements: Construction shall progress only when weather conditions will not detrimentally affect the quality of the finished earthwork. If the atmospheric temperature falls below 35 degrees Fahrenheit in the shade, protect from freezing earthwork or soils-in-cut which require compaction to a specified degree.

B. Protection of adjacent work and existing facilities is the responsibility of the Contractor and must be accomplished. Where open cuts are used in lieu of shoring, the excavation slopes should be made to the angle judged safe by the Contractor's designated competent person responsible for excavations and trenches. Unless shown on the plans, temporary cuts deeper than 3.5 feet shall be no steeper than 1 vertical to 1 horizontal and meet all applicable OSHA regulations. Permanent slopes shall be as shown on the Drawings and in no case be steeper than 1 vertical to 2 horizontal. Cover exposed slopes if erosion or riling threatens.

C. Allowable instream work period will be July 1 to September 30 All in-channel work activities must be completed within this period due to spawning and incubation periods of lamprey, steelhead, and Chinook Salmon in Birch Creek and Umatilla River. Extensions of the in-channel work period may be granted under certain conditions by the ODFW District Office but the Contractor shall not expect an extension due to scheduling conflicts.

1.03 DEFINITIONS

A. Excavation: Area or material removed to provide a suitable base for improvement.

B. Levee Fill: Fill material shall be from floodplain benching excavation area and free of organic and other unsuitable material. Channel fill relates to the proposed existing channel fill locations indicated on the Drawings.

C. Earthwork Compaction: Placement of Levee fill shall be compacted per ODOT compaction requirements in Section 00330.43(a) and (b). See ODOT Section 3.12 for Levee Fill Compaction requirements.

D. Unsuitable excavated material: excavated soil heavy laden with fines and organic material such as peat, decomposing vegetation, soft organic clay, and silts and are completely devoid of sands, gravel, and cobble.

1.04 SUBMITTALS

A. Contractor shall provide documentation of completed levee fill compaction and quality control tests demonstrating passing test results.

1.05 REFERENCES

A. ODOT Standard Specifications for Construction 2024 or most current.

1. Section 00330 – Earthwork
2. Section 00330.12 – Borrow Material
3. Section 00330.42 – Embankment, Fills, and Backfills
4. Section 00330.43 – Earthwork Compaction Requirements

B. USACE

1. USACE EM 1110-2-1913 (April 2000).
2. USACE EM 1110-2-2902 (December 2020).

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. This section describes the requirements for excavation and backfilling. Construction schedule constraints in performing various portions of the work are provided in Section 01 14 20 SITE-SPECIFIC REQUIREMENTS.

B. Refer to Section 31 23 19 CHANNEL DEWATERING, FISH TRANSFER, AND CHANNEL REWATERING for specifications on work area isolation, fish and freshwater mussel salvage, dewatering, and rewatering.

3.02 PROTECTION OF ADJACENT WORK

A. Protection of adjacent work, utilities and other improvements must be accomplished. Properly slope cuts to provide stability. Temporary cuts should be no steeper than one vertical to one horizontal. Permanent slopes should be no steeper than one vertical to two horizontal. Cover exposed slopes if erosion or raveling threatens.

3.03 EQUIPMENT

A. Construction will require numerous types of heavy equipment. This equipment will include but is not limited to medium to large excavators with bucket thumb, front end loaders, off-road dump trucks, and dozers with 6-way blade.

B. Construction of the levee fill and CPEP culvert will require the Contractor to have onsite survey and grade control capacity such as total station, GPS, and/or GPS enabled construction equipment.

3.04 EXCAVATION BELOW EXISTING GRADE

A. Unless otherwise specified, any appropriate method of excavation within the work limits shown may be employed which, in the opinion of the Contractor, is considered best, and meets applicable safety standards. The Contractor shall take whatever precautions are necessary to maintain the undisturbed state of the natural soils at and below the bottom of the excavation.

B. Should the excavation be carried below the lines and grades indicated on the drawings or specified herein because of the Contractor’s operations, the Contractor shall refill such excavated space to the proper elevation as directed by the Owner’s Representative or Engineer. Should foundation materials be disturbed or loosened because of the Contractor’s operations, they shall be removed and the space refilled as directed at no additional cost to the Owner.

C. Rock Excavation is defined as the removal of all material which by actual demonstration, cannot, in the Engineer or Owner’s Representative's judgment, be reasonably excavated with equipment used for common earthwork and equipped with rippers or similar approved equipment. If bedrock is encountered that cannot be removed using the common earthwork equipment or equipment with minimum 125 Horsepower, the grading plan shall be adjusted as approved by the Engineer or Owner’s Representative at no additional cost. The term Rock Excavation shall be understood to indicate a method of removal and not a geological formation.

D. Bonding benches to be excavated to the extents and dimensions shown on the Drawings. Bonding benches to have a 4-foot maximum height and 3-foot minimum width. Construct temporary excavation for benching slopes no steeper than 1.5:1. Slope toe of bonding bench excavation at 20:1 away from the embankment.

3.05 CONTROL OF WATER

A. The Contractor shall follow guidelines contained in Sections 01 35 43 ENVIRONMENTAL PROTECTION and 01 35 43.20 CARE AND DIVERSION OF WATER during all excavation and backfill operations.

B. The Contractor is responsible for complying with all permit conditions related to water in the stream, stormwater, and dust control during the excavation and backfill operations.

3.06 DUST CONTROL

A. The Contractor shall be responsible for providing control of airborne dust and particulates from the work areas. Visible dust shall be limited by water, dust palliative or other approved methods.

B. If water is used for dust abatement, it must be brought in by the Contractor from an outside source. Water may not be used directly from Birch Creek or Umatilla River without prior, written consent of the Owner’s Representative.

3.07 EXCAVATION OF EXISTING PENDLETON 2A LEVEE

A. The existing Pendleton 2a Levee shall be excavated to the extents and dimensions shown on the Drawings.

B. Excavation will begin at the downstream end to prevent working in accumulated seepage flow from upstream.

C. Existing levee riprap material shall be salvaged and stockpiled at a location determined by the Owner's Representative or Engineer.

3.08 EXCAVATION OF FLOODPLAIN BENCHING

A. Floodplain benching shall be excavated to the extents and dimensions shown on the Drawings and shall accommodate the Pendleton 2A Levee Setback final shape and dimension as shown on the plans.

B. Excavation will begin at the downstream end of the benching to prevent working in accumulated seepage flow from upstream.

3.09 EXCAVATED MATERIAL STOCKPILES

A. Excavated material stockpile areas are identified in the Drawings as staging areas.

B. Additional location of the excavated material stockpile sites are to be determined by Owner's Representative or Engineer.

C. Contractor will be responsible for managing the volume, shape, and weather protection for each of the stockpile sites.

D. The Contractor is responsible for keeping the stockpiled material protected to prevent any major erosion off the piles.

E. In the event that sufficient room to store the anticipated excavated volume of material is not available in the identified stockpile sites, the Contractor can propose additional stockpile sites within the project area. Any new stockpile site must be approved by the Owner's Representative or Engineer prior to use by the Contractor.

3.10 SETBACK USACE LEVEE FILL

A. Subgrade Preparation:

1. The subgrade shall be prepared in accordance with the requirements of the construction drawings and the project specifications. The upper organic layer shall be thoroughly cleared, grubbed, and stripped within the fill placement areas. Adequacy of the existing on-site soils to support the design loads shall be verified by Owner's Representative by observing the amount of deflection and/or rutting which takes place under the wheels of construction equipment. Soft areas identified by proof-rolling should be undercut and replaced by compacted levee fill.

2. Scarify prepared subgrade surface to a minimum depth of 6 inches before placement of fill material to provide bonding between fill material and prepared placement areas. The Contractor shall be responsible for preparing the materials for the fill placement, including but not limited to, screening, soil amendment and in-place drying or wetting of the soil as necessary to achieve the density and moisture content requirements during placement of the fill.

B. USACE Levee Fill Classification:

1. Prior to placement, all levee fill materials should be classified as suitable fill by the Owner's Representative. Contractor shall provide representative samples of proposed levee fill material from borrow sources at a minimum frequency of one (1) sample per 500 cubic yards of material. The testing program specified shall be considered the minimum acceptable frequency of testing. Additional testing shall be required whenever a change in material is encountered.

2. Suitable fill materials shall consist of materials classified in accordance with ASTM D 2487 as clayey sand (SC), silty, clayey sand (SC-SM), and silty sand (SM) free from roots and other organic matter; trash, debris; and frozen materials. The levee fill material shall have a plasticity index (PI) less than 30 and a liquid limit (LL) less than 50 in accordance with ASTM D 4318. The levee fill material shall have at least 20 percent of the material passing the U.S. Standard No. 200 sieve.

C. USACE Levee Fill Placement:

1. All levee fill materials shall be placed in maximum 8-inch loose lifts. However, layers less than 8-inches in loose thickness will be required when necessary to obtain the specified density. The maximum size of the particle in the fill should not exceed 4-inches (in any dimension).

D. USACE Levee Fill Compaction:

1. Levee fill materials shall be compacted to at least 95% of Modified Proctor density (ASTM D1557) at -2% to +2% of optimum moisture content. Fill materials shall be compacted with a minimum of five (5) passes of a sheepsfoot vibratory roller weighing 10,000 lbs minimum or with construction equipment approved by the Owner's Representative. At the end of each day, the exposed surface of the levee fill and subgrade shall be protected from adverse weather conditions. Any surface which is smooth shall be scarified prior to placement of a subsequent lift. Fill materials placed along slopes should be benched into the existing slopes as shown on the construction drawings. Subgrade of benches shall be prepared in accordance with levee fill subgrade preparation specified in this Section. As necessary, levee fill shall be placed and compacted to elevations above the proposed final grade, and then cut down to proposed final grades to achieve a dense, uniform surface that meets compaction specifications.

E. USACE Levee Fill Quality Control:

1. Levee fill material classification testing shall be performed as specified in this Section.

2. After the completion of construction of the levee fill, a survey shall be performed to verify all final grades are achieved. The tolerance for the setback USACE levee fill shall be within 0-ft to + 0.1-ft of design final grade.

3. Contractor shall notify Owner's Representative for appropriate scheduling of USACE levee fill quality control testing.

4. The following field quality control tests shall be performed:

TABLE 3.10-1 TESTING FREQUENCY FOR LEVEE CONSTRUCTION QUALITY CONTROL	
TEST	**FREQUENCY**
Field Density (ASTM D2922)	9 per Acre per Lift, or 1 per 300 LF of Levee (whichever is greater)
Field Moisture Content (ASTM D3017)	9 per Acre per Lift, or 1 per 300 LF of Levee (whichever is greater)

5. Questions concerning the accuracy of any single test shall be addressed by retesting in the same general location. Rework lifts that fail to meet density or moisture testing. Rework includes:

   a. Defining rework area(s)
   b. Discing
   c. Moisture conditioning
   d. Recompacting
   e. Retesting

6. Notify Owner’s Representative when rework area(s) are ready for retest. Rework area that fails retesting shall be reworked until it meets the specification, or failing material removed and replaced at no additional cost to Owner.

3.11 TEMPORARY ACCESS ROAD DECOMISSIONING/FLOODPLAIN DECOMPACTION

A. Demolish and decompact the temporary access road sections identified in the Drawings by restoring to approximate original ground contours. Remove any piping or structures, if found, and all associated fill material, down to “natural ground”. Finish slopes to provide gradual transitions in slope adjustments without noticeable breaks.

B. Any hardened road segment or surface area identified on the Drawings, or as directed in the field, shall be decompacted to promote water infiltration and establish vegetation. This work shall consist of loosening all of the soil in the existing roadbed or staging area to a depth of 18 inches (minimum) and a clod size no larger than 8 inches or as shown on the plans. All roadway materials shall be removed from the downhill side of the road and placed on the uphill or cut side of the road. The roadway fill material shall be excavated down to the natural hillslope material. The sides of the road prism shall be blended to match the natural ground elevation to avoid trapping water. The excavation shall match the existing slope and contours of the local existing grade.

C. Place available slash and wood material on the recontoured area, arranged to facilitate later clump planting of vegetation during revegetation as directed by the Owner’s Representative.

D. Refer to HIP Conservation Notes on the Drawings and Section 01 55 13 TEMPORARY ACCESS ROADS for additional requirements.

3.12 FINAL GRADING AND CLEAN-UP

A. All irregularities shall be made smooth except for natural surface roughness, washouts shall be filled, slopes made uniform, slightly rounded at top and bottom, and the entire area of the fill compacted and completed to the required lines, grades and cross-sections within 1$^{/1}$0th-foot above or below the established grade.

B. When final surfaces have been established, the Contractor shall protect the surfaces from erosion, raveling or any type of degradation, especially on surfaces that will be lined.

C. Temporary access roads shall be subsoiled/scarified during closeout.

D. Place available slash and wood material on the recontoured area, arranged to facilitate later clump planting of vegetation during revegetation as directed by the Owner’s Representative.

E. Refer to HIP Conservation Notes Section 01 55 13 TEMPORARY ACCESS ROADS for additional requirements.

F. When work is completed, the Contractor shall place all surplus material including stumps, trees, and brush, in the floodplain. The Contractor shall leave the premises in condition acceptable to the Owner’s Representative or Engineer.

END OF EXCAVATION AND FILL

SECTION 31 23 19
CHANNEL DEWATERING, FISH TRANSFER, AND CHANNEL REWATERING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Work in this section consists of the installation and removal of a streamflow diversion systems that may be needed to isolate the stream channel during the installation riprap material.

1.02 SUBMITTALS

A. The Contractor shall provide a list of materials and equipment proposed for use during this component of the work. In addition, the Contractor shall submit the Manufacturer's data on a bypass pipe, if deemed necessary, for use during the project.

B. The Contractor shall submit a dewatering and work area isolation plan for pre-approval to CTUIR at least 10 days prior to beginning work.

PART 2 PRODUCTS

2.01 DIVERSION STRUCTURE

A. The Contractor shall use a sheetpile, sandbag/stone, or other approved streamflow diversion structures, or a side-channel to re-route or dewater the portion of stream for in-water construction, with fish isolated from the installation of the diversion structure, as shown in the Drawings and as expressed in the HIP Terms and Conditions.

B. The Contractor shall provide material for instream temporary diversion measures such as block nets, silt fencing, floating booms, sandbags, and/or other suitable means. Instream temporary diversion shall be implemented at locations and at a duration only if approved by Engineer or Owner's Representative. The structure should include plastic liner or fine mesh silt fence to reduce the amount of fines entering the free flowing portion of the river. Block net mesh sizes and other diversion materials shall be in accordance with the National Marine Fisheries Service standards and as expressed in the HIP Terms and Conditions.

PART 3 EXECUTION

3.01 GENERAL

A. All channel dewatering system shall be approved by the Owner, installed, and operational before any work in the channel can begin.

B. All instream activities must be completed after the channel has been diverted and all fish can pass through the diverted stream channel.

C. Refer to the HIP Conservation Notes in the Drawings if any fish salvage operation is required. Construction work in the immediate vicinity of fish salvage will be delayed, typically for 2 to 24 hours but longer in some cases.

D. Turbid water or sediment must not be released into the channel downstream.

E. If any bypass pumping is approved by Engineer or Owner’s Representative, the Contractor shall also provide pumps with adequate pump capacity, hoses, and personnel as backup to the temporary stream flow bypass system in the event the system becomes non-operational, as may be required during construction when flow rates in the existing channel exceed the design capacity of the gravity bypass, or to maintain a dry work area when installing riprap material. Pumps and hoses may also be used to pump seepage flow through the cofferdam into the bypass pipeline to keep water out of the work area. Turbid water shall be discharged to an approved area with sufficient capacity to allow for slow infiltration and remain disconnected from active flow channel. The Contractor shall monitor pumping operation at all times.

Any pumping operation shall use a fish screen that is in accordance with the National Marine Fisheries Service standards. Pump intake screens shall be sized to prevent fish from being entrained into the pump intake or from being impinged on the intake screen. The screen face should be oriented parallel to flow for best screening performance. The screen shall be designed and used such that it can be submerged with at least one-screen-height-clearance above and below the screen.

F. Upon removal of the temporary stream diversion, the disturbed area shall be re-graded to match surrounding topography and reseeded, if needed, as specified in Section 32 90 00 SEEDING.

3.02 FISH TRANSFER

A. Refer to the HIP Conservation Notes in the Drawings if fish transfer is deemed necessary.

B. Fish salvage operations will be conducted by CTUIR staff and their partners, not the Contractor. Contractor shall provide at least three (3) days advance notice before dewatering or isolating any work area. Dewatering and rewatering shall be done in carefully controlled stages as expressed in the Drawings and the HIP Terms and Conditions for the purpose of inducing volitional movement out of the work area and of salvaging fish. Close coordination will be necessary with the Owner’s Representative during this operation. Dewatering will take place as early in the morning as possible. No work will occur within the surrounding area until the fish salvage effort is complete. Construction work in the immediate vicinity of fish salvage will be delayed, typically for 2 to 24 hours but longer in some cases.

3.03 CHANNEL REWATERING

A. Upon activating the new main channel, the new main channel will be slowly re-watered, including pre-washing and pumping the turbid water to an approved floodplain location with no turbid water returns to the creek, and incrementally increasing flow in the new main channel over a period of hours to prevent loss of surface flow downstream and to prevent a sudden increase in stream turbidity. During re-watering, the site will be monitored to prevent stranding of aquatic organisms below the construction site. Rewatering will be completed under the direct supervision of the Owner’s Representative. Refer to the HIP Conservation Notes in the Drawings.

END OF CHANNEL DEWATERING, FISH TRANSFER, AND CHANNEL REWATERING

SECTION 31 37 00
RIPRAP

PART 1 GENERAL

1.01 DESCRIPTION

A. Work in this section consists of furnishing, as needed, and installing riprap culvert inlet protection, habitat boulder structures, and bank/levee protection.

1.02 SUBMITTALS

A. Contractor shall submit manufacturer's certificate of compliance with this project's specifications for the riprap to be imported from an offsite borrow source.

1.03 QUALITY ASSURANCE

A. Inspection of the riprap imported from an offsite source shall be made by the Engineer or Owner's representatives. Riprap not meeting requirements outlined in this Section shall be rejected.

PART 2 PRODUCTS

2.01 CHANNEL RIPRAP

A. Riprap material used shall be in accordance with Oregon Department of Transportation (ODOT) Standard Specifications Section 00390 (English Units), and the class/size of riprap labeled in the Drawings and meet the following gradation class:

TABLE 2.01-1
STANDARD RIPRAP CLASSES

Riprap Class	**D_{50} (feet)**	**W_{50} (lbs)**	**D_{100} (feet)**	**D_{100} (lbs)**
50	0.56	15	0.83	50
200	0.93	70	1.32	200

B. All rock will be dense sound, clean, rough angular, and durable stone. Crushed stones will consist of broken stone and will be free from segregation, seams, cracks, and other defects tending to destroy its resistance to weather. Thickness of a single rock shall not be less than one-third its length. Rounded rock will not be accepted unless authorized by the Engineer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Contractor shall install the riprap at locations shown on the Drawings.

3.02 EXCAVATION

A. Excavation for the installation of riprap shall be completed as part of the channel construction included in Section 35 01 50.10 CHANNEL CONSTRUCTION.

3.03 GEOTEXTILE

A. Installation of geotextile under riprap is not included in this Section. See Section 31 05 19.13 GEOTEXTILES.

3.04 MATERIAL DELIVERY

A. Contractor shall schedule delivery of the riprap material so that it does not interfere with the construction of the levee, or installation of the stream channel materials, or placement of the habitat features. Contractor shall coordinate installation such that the riprap does not become contaminated with soil when moved around the construction site.

3.05 PLACEMENT

A. Large rocks shall be placed within the habitat structures using an excavator with a bucket thumb. Rocks shall be placed individually within the habitat structure areas.

B. Riprap above geotextile shall be placed in a manner that does not damage, punch holes in, or tear the geotextile below. Place riprap to produce a reasonably well graded mass of stone with minimum practicable percentage of voids. Place by method preventing segregation of various sizes of stone. Rearrange or shape material after placement and add additional material if sections indicate inadequate depth or inadequate voids as determined by Owner’s Representative. Larger stones shall be well distributed throughout mass and finished riprap areas shall be free from pockets of small stones and clusters of large stones. Fill holes or open spots to produce well graded protection.

END OF RIPRAP

SECTION 32 90 00
SEEDING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work in this section consists of furnishing all labor, equipment, and materials to establish ground cover and grass as noted on the Drawings. Any substantive variance to this specification due to unforeseen conditions encountered on the site, weather conditions, seed availability, other construction activities, etc. must be approved by the Owner’s Representative.

B. Areas outside the limit of disturbance shall be protected from damage by Contractor. Any disturbance of trees, shrubs, grass, ground cover, or wetland areas outside the limit of disturbance shown on the Drawings shall be restored by the Contractor.

1.02 SUBMITTALS

A. Prior to use on the site, Contractor shall submit to Owner’s Representative or Engineer certification of the seed mix as outlined by the State of Oregon Department of Agriculture “Rules for Seed Certification.”

B. Prior to use on the site, Contractor shall furnish to Owner’s Representative or Engineer a statement signed by the Manufacturer certifying that each lot of seed has been tested by a recognized seed testing laboratory within six months of the date of delivery to the site.

PART 2 PRODUCTS

2.01 SEED

A. Seed mix shall conform to the standards for “Certified” grade seed or better as outlined by the State of Oregon Department of Agriculture “Rules for Seed Certification.” Mulch and seed mix must be certified as weed-free. The county extension agent or soils scientist will be consulted for approval of seed mixes and sources of certified weed-free mulch.

B. Seed mix shall be obtained from local sources to ensure plants are adapted to local climate and soil chemistry.

C. The seed mix and rate of application shall be as indicated in Table 2.01-1 and Table 2.01-2.

D. The rate of application shall be 30 pounds pure live seed per acre.

E. Seed that has become wet, moldy, or otherwise damaged in transit or storage shall not be accepted.

F. Seeding shall occur in Riparian Areas, Upland Areas and Wetland Areas shown on the Drawings.

TABLE 2.01-1 RIPARIAN SEED MIX AND COMPOSITION		
COMMON NAME	**SCIENTIFIC NAME**	**COMPOSITION (% OF MIX)**
Bluebunch Wheatgrass	*Pseudoroegneria Spicata Var Secar*	20
Big Bluegrass	*Poa Secunda*	20
Great Basin Wildrye	*Leymus Cinereus Var Magnar*	30
Streambank Wheatgrass	*Elymus Lanceolatus*	20
Idaho Fescue	*Festuca Idahoensis*	10

TABLE 2.01-2 UPLAND SEED MIX AND COMPOSITION		
COMMON NAME	**SCIENTIFIC NAME**	**COMPOSITION (% OF MIX)**
Great Basin Wildrye	*Leymus Cinereus*	25
Bluebunch Wheatgrass	*Pseudoroegneria Picata*	25
Squirreltail	*Elymus Elymoides*	10
Idaho Fescue	*Festuca Idahoensis*	10
Prairie Junegrass	*Koeleria Macrantha*	10
Yarrow	*Achillea Millefolium*	10
Bigleaf Lupine	*Lupinus Polyphyllus*	10

2.02 TACKIFIER

A. Tackifier shall be used as a tie-down for the seed mixture.

B. Tackifier shall be derived from natural organic plant sources containing no growth or germination inhibiting materials. Tackifier shall hydrate in water and readily blend with other slurry materials. Tackifier shall be noxious weed free and nontoxic to aquatic and terrestrial animals, soil microorganisms, and vegetation.

C. Apply tackifier at the Manufacturer’s recommended rate.

2.03 FERTILIZER

A. Fertilizer shall not be used on this project.

2.04 WATER

A. Water shall be the responsibility of Contractor, unless otherwise noted. Water shall not contain elements toxic to plant life.

2.05 HYDROSEEDING APPARATUS

A. Use of a hydroseeding device for spreading seed and tackifier shall be capable of uniformly distributing the material at the Manufacturer’s specified rate for that product.

2.06 EROSION CONTROL MATTING

A. Use of any Rolled Erosion Control Product to control erosion or protect young plants shall conform to Section 01 35 43 ENVIRONMENTAL PROTECTION.

B. Grade areas to be seeded to achieve the finished grades and grading drainage patterns indicated on the Drawings. Grading shall be accomplished in accordance with the requirements of Section 35 01 60 STREAM RESTORATION and Section 01 52 00 TEMPORARY CONSTRUCTION FACILITIES. Blend new surfaces to existing areas.

C. The ground to be seeded shall be free of large clods or rocks, roots and other material that may interfere with the work and subsequent maintenance operations. Hand picking may be required.

D. The Rolled Erosion Control Product shall be installed in accordance with the requirements of Section 01 35 43 ENVIRONMENTAL PROTECTION.

E. Seeding shall not commence until Owner’s Representative or Engineer has accepted the condition of the prepared areas.

3.02 APPLICATION

A. Weather Limitations:

1. Seeding operations shall not be permitted when wind velocities exceed 15 miles per hour;

2. Seed shall be sown only when the soil is moist and in proper condition to induce growth. No seeding shall be done when the ground is unduly wet, or otherwise not in a tillable condition; and

3. Seeding shall only be completed from August 15 until December 1, preferably between October and November or as directed by Owner’s Representative. Seeding at other times of the year shall only be completed with written permission from Owner’s Representative or Engineer.

B. Hydroseeding

1. Seed shall be added to water and thoroughly mixed at the rates specified.

2. The seed and water shall be thoroughly mixed to produce a homogeneous slurry.

3. While the soil is still loose and moist, the seed and water slurry shall be uniformly broadcast under pressure over the nominated area at a rate of 30 pounds per acre using a hydroseeding apparatus.

4. Carefully regulate the flow rate and go over the area twice, applying half the seed with each application. The first application shall be from east to west and the second from north to south to ensure uniformity.

C. Watering:

1. Newly seeded areas shall not be watered to force seed germination, but only to sustain growth.

2. Vegetated areas shall be watered so as to provide optimum growth conditions for the establishment of the seed mix species.

3. Start watering within 5 working days after completing the seeded area, or once the seeds have germinated.

4. Run-off and puddling shall be prevented.

D. Maintenance

1. Maintain the seeded areas in a satisfactory condition until final acceptance by Owner's Representative or Engineer.

2. Maintenance shall include:

    a. Watering vegetated areas where the establishment of the seed mix does not appear to be developing satisfactorily; and

    b. Filling and leveling where erosion has washed an area away.

3. If in the opinion of the Owner's Representative or Engineer, repeat hydroseeding or repair is necessary due to Contractor's negligence, carelessness or failure to provide maintenance, then the work shall be at Contractor's sole expense.

4. Repeat hydroseeding or repair required due to factors determined by Owner's Representative or Engineer to be beyond the control of Contractor shall be paid for under the appropriate contract pay items.

3.03 APPLICATION

A. Contractor retains all ownership and responsibility for seeding until written acceptance by Owner's Representative or Engineer.

B. Owner's Representative or Engineer will accept the seeding when:

1. The application or installation is complete;

2. Documentation is complete;

3. Verification of the adequacy of all repairs, including associated vegetation, is complete; and

4. The required written seed certification documents have been received by Owner's Representative or Engineer.

END OF SEEDING

SECTION 33 05 33.13
CORRUGATE-WALL, SMOOTH INTERIOR HDPE GRAVITY PIPE

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes construction of high-density polyethylene pipe for storm drainage culverts including appurtenances. Construction shall include surface preparation, trench excavation, shoring, dewatering, lay, align, and join pipe, installation of appurtenances, bedding and backfilling, surface restoration, and other related work.

1.02 REFERENCES

A. Abbreviations and Acronyms

1. CPEP – Corrugated Polyethylene Pipe

B. Reference Standards

1. ASTM D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

2. ASTM D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

3. ASTM D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

4. ASTM D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.

5. ASTM F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.

1.03 SUBMITTALS

A. Details of fittings and specials shall be furnished for approval by Engineer.

B. Contractor shall submit to Engineer for approval Shop Drawings showing the exact dimension of the joints including the permissible tolerances for each size of pipe being furnished and the size, type and locations of gasket materials. Approval of the joint detail DRAWINGS shall not relieve Contractor of any responsibilities to meet all of the requirements of these Specifications, or of the responsibility for correctness of Contractor's details.

1.04 QUALITY ASSURANCE

A. Manufacturer:

   1. Experienced in the design, manufacture, and commercial supplying of the specific material for a minimum period of five (5) years.
   2. Experienced in the design, manufacture, and commercial supplying of the

specific size of pipe for a period of one (1) year.

    3. Certify to above minimum experience requirements.

B. All HDPE pipe and fittings shall be from a single manufacturer. All HDPE pipe to be installed may be inspected at the factory for compliance with these SPECIFICATIONS by an independent testing laboratory provided by the Owner. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of these plant inspections of all pipe approved, plus the cost of inspection of a reasonable amount of disapproved pipe, will be borne by the Owner.

C. Inspection of the pipe shall also be made by the Engineer or other representatives of the Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the job.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Responsibility for Material:

    1. Shipping: Material shall be shipped so to not cut, kink, or otherwise damage pipe during transport.

    2. Contractor shall be responsible for all materials intended for the Work that are delivered to the construction site and accepted by Contractor. Payment shall not be made for materials found to be defective or damaged in handling after delivery and acceptance. Defective or damaged materials shall be removed and replaced with acceptable materials at Contractor's expense.

    3. Contractor shall be responsible for the safe and proper storage of such materials.

        a. Limit stacking of pipe to a height that will not cause excessive deformation of bottom layers of pipes under anticipated temperature conditions.

        b. Where necessary, because of ground conditions, store pipe on wooden sleepers, spaced suitably and of such widths as not to allow deformation of pipe at point of contact with sleeper or between supports.

        c. Keep pipe shaded from direct sunlight prior to installation in the trench.

B. Pipe Acceptance:

    1. In addition to any deficiencies not covered by the applicable ASTM Specifications, pipe, which has any of the following visual defects, will not be accepted.

        a. Cracks, bubbles, pinholes, inclusions or occlusions, which, because of their nature, degree, or extent, detrimentally affect the strength and serviceability of the pipe.

C. Pipe Handling:

    1. Pipe and accessories furnished by Contractor shall be delivered to, unloaded, and distributed at the site by Contractor. Each pipe shall be unloaded adjacent

to or near the intended laying location.

2. Pipe fittings, specials, valves, and appurtenances shall be unloaded and stored in a manner that precludes shock or damage. Such materials shall not be dropped.
3. Pipe shall be handled to prevent damage to the pipe ends or to any coating or lining. Pipe shall not be skidded or rolled against adjacent pipe. Damaged coatings or lining shall be repaired or replaced by Contractor, at Contractor's expense in accordance with the recommendations of the manufacturer and in a manner satisfactory to Engineer. Physical damage to the pipe or accessory shall be repaired or replaced by Contractor at Contractor's expense, and in a manner satisfactory to Engineer.

D. Gasket Storage: All gaskets shall be stored in a cool place, preferably at a temperature of less than seventy degrees Fahrenheit (70°F.), and in no case shall the gaskets be stored in the open or exposed to the direct rays of the sun.

PART 2 PRODUCTS

2.01 CPEP PIPE

A. General: HDPE pipe, which does not conform to ASTM D3350, ASTM D 4976, ASTM F667, ASTM F894, ASTM F2306, or ASTM F2562 or to any other requirement specified herein, shall not be approved for installation.

B. Allowable Pipe diameters for this specification shall be thirty-six (36) inches unless approved by Engineer and Owner.

C. Allowable ASTM Specifications: All material, manufacturing operations, testing, inspection, and making of HDPE pipe shall conform to the requirements of the appropriate allowable ASTM Standard Specifications, latest revision thereof, listed in Article References.

D. Marking:

1. The following shall be clearly marked on both the interior and exterior surface of the pipe:
    a. Class and size.
    b. Date of manufacture.
    c. Name or trademark of manufacturer.
    d. Deflection angle for bends.

E. Diameter of Pipe: The diameter indicated on the Drawings shall mean the inside diameter of the pipe.

F. Wall Thickness and Class of Pipe:

1. The wall thickness shall comply with the appropriate ASTM Specification and the class of pipe designated on the Drawings.
2. HDPE pipe and fittings shall have a smooth interior and corrugated exterior. 36-inch pipe shall meet the requirements of AASHTO M294 Type S. The pipe shall have a full circular cross-section with annular corrugations. Pipe shall be

produced to constant internal diameters.

3. Pipe and fittings shall be made of high-density, high-molecular weight polyethylene material meeting the requirements of cell classification 324420C or higher in accordance with ASTM D3350. Clean rework material generated by the manufacturer’s own production may be used so long as the pipe or fittings produced meet all the requirements of this Specification.

G. Joints:

1. Watertight joints shall be accomplished by rubber gasket, in accordance with ASTM D3212.
2. Gaskets shall be closed-cell synthetic, expanded rubber meeting the requirements of ASTM D1056, Grade 2A2 or made of polyisoprene meeting ASTM F477. Gaskets shall be installed on the connection by the pipe manufacturer.
3. Lubricant shall have no detrimental effect on the gasket of on the pipe.
4. Integral bell and spigot gasketed joints shall be designed so that when assembled, the elastomeric gasket, contained in a machined groove on the pipe spigot, is compressed radially in the pipe bell to form a positive seal. The joint shall be designed to avoid displacement of the gasket when installed in accordance with the manufacturer’s recommendations.

2.02 FLAP GATE

A. General: Contract shall install a metal flap gate the outlet of CPEP culvert pipe to permit flow towards the outlet and prevent back flow to the interior drainage area and include the following features:

1. Configured for headwall mounting.
2. Cast Iron frame and cover. Galvanized steel angle links and bolts.
3. Double hinged and feely rotating.
4. Frame batter of 5 degrees.
5. Connected to the CPEP with a watertight seal and in accordance with SPECIFICATIONS SECTION CORRUGATE-WALL, SMOOTH 2.01 above.
6. Shall withstand up to 20 feet of head.

2.03 SEEPAGE FILTER MATERIAL

A. Seepage filter material designed in accordance with Section 5.5.9.3 of USACE EM 1110-2-2902a and USACE 1110-2-1901 for seepage diaphragm and transitions shall be placed to the extents and dimension shown on the Drawings and shall conform the specifications for ASTM C33 or ODOT equivalent and in accordance with the following ASTM C33 gradation:

TABLE 2.03-1

Sieve Size	**% Passing**
3/8 inch	100
No 4	95 - 100
No 8	80 - 100
No 16	50 – 85
No 30	25 - 60
No 50	5 - 30
No 100	0 - 10
No 200	0 - 5

PART 3 EXECUTION

3.01 GENERAL

A. The pipe and pipe coatings shall be inspected by Engineer for damage or defects before being placed in the trench. Damaged or defective pipe shall not be installed.

B. All pipes, which do not meet the requirements of PART 2 of this section, will be rejected and replaced at Contractor’s expense.

C. Contractor shall install storm sewer pipe of the type, diameter, load class, wall thickness, and protective coating that is shown on the Drawings.

D. Proper equipment, implements, tools, and facilities shall be provided and used by Contractor for safe and convenient installation of the type of pipe being installed.

3.02 SURFACE PREPARATION

A. Within Easement, Cultivated, Landscaped, or Agricultural Area:

1. All vegetation, such as brush, sod, heavy growth of grass or weeds, decayed vegetable matter, rubbish and other unsuitable material within the area of excavation and trench side storage shall be stripped and disposed of in accordance with the requirements of Section 31 10 00, Site Clearing.

2. Topsoil shall be removed to a depth of eight (8) inches or the full depth of the topsoil, whichever is less. Topsoil shall be removed from the area to be excavated and stockpiled, or Contractor may elect to import topsoil to replace that lost during excavation.

3.03 DEWATERING

A. All pipe trenches and excavation for structures and appurtenances shall be kept free of water during pipe laying, placing CLSM, and other related work. The method of dewatering shall provide for a dry foundation at the final grades of excavation in accordance with Section 31 23 19, Channel Dewatering. Water shall be disposed of in a manner that does not inconvenience the public or result in a menace to public health. Pipe trenches shall contain enough backfill to prevent pipe flotation before dewatering is discontinued. Dewatering shall continue until such time as it is safe to allow the water to rise in the excavation.

3.04 INSTALLATION

A. General: Precautions shall be taken to prevent foreign material from entering the pipe before or while it is being placed in the line. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. The open ends of pipe shall be closed with a watertight plug, or with other devices approved by Engineer, at times when pipe laying is not in progress.

B. Pipe:

1. Pipe shall be installed in accordance with the manufacturer’s recommendations for installing the type of pipe used, unless otherwise shown on the Drawings.
2. Pipelines shall be laid to the grades and alignment shown on the Drawings or staked by Engineer. Variation from the prescribed grade and alignment shall not exceed one-tenth (0.10) foot, and the rate of departure from, or return to, the established grade or alignment shall be not more than one (1) inch in ten (10) feet, unless approved by Engineer. No deviation from grade shall cause a depression in the sewer invert that could retain fluids or solids. Any pipe which is not in true alignment, or which shows undue settlement after laying shall be taken up and re-laid at Contractor’s expense.
3. Lift or roll pipe to protect coating. Do not drag over gravel or rock. Avoid striking rocks or hard objects when lowering into trench.
    a. Pipe on which coatings have been damaged may be rejected at the site of the Work regardless of previous approvals.

C. Pipe Fittings:

1. Pipe fittings shall be laid so as to form a close concentric joint with the adjoining pipe to avoid sudden offsets of the flowline. Pipe sections shall be joined together in accordance with the manufacturer’s recommendations.
2. Pipe fittings and appurtenances shall be carefully lowered into the trench with suitable tools or equipment to prevent damage to the pipe and protective

coatings and linings; pipe and accessory materials shall not be dropped or dumped into the trench.

D. Gaskets: No gaskets that show signs of deterioration, such as surface cracking or checking, shall be installed in a pipe joint. The neoprene gaskets used, when the air temperature is ten degrees Fahrenheit (10°F) or lower shall be warmed to temperature of sixty degrees Fahrenheit (60°F) for a period of thirty (30) minutes before being placed on the pipe.

E. Obstructions not shown on the Drawings may be encountered during the progress of the WORK. Should such an obstruction require an alteration to the pipe alignment or grade, Engineer will have authority to order a deviation from the Drawings, or Engineer may arrange for the removal, relocation, or reconstruction of any structure which obstructs the pipeline.

3.05 BEDDING AND BACKFILL FILLING

A. Select bedding and backfill material may be required and shall be so shown on the DRAWINGS. Select bedding materials shall conform to the designated gradation requirements in Section 31 23 33, Trenching and Backfilling.

B. Bedding material shall be placed under and around all pipes as shown on the DRAWINGS. Bedding shall be placed in a manner that will minimize separation or change in its uniform gradation. Bedding shall be distributed in six-inch (6") maximum layers over the full width of the trench and simultaneously on both sides of the pipe. Special care shall be taken to ensure full compaction under the haunches and joints of the pipe.

C Backfill compaction shall not be attained by inundation or jetting, unless approved in writing by Engineer. Backfill material shall be uniformly compacted the full depth of the trench.

3.06 FLAP GATE INSTALLATION

A. Contractor shall follow manufacturer’s recommendations on installing the flap gate on CPEP.

B. Flap gate shall be mounted with the concrete headwall and CPEP configuration as shown on the drawings.

3.07 SEEPAGE FILTER INSTALLTION

A. Contractor shall prevent contamination of drains and filters by runoff containing sediment, dust, construction traffic, and mixing with nearby fine-grained materials during placement and compaction. Drain and filter material may be kept at an elevation higher than the surrounding fine-grained materials during construction to prevent contamination by sediment-carrying runoff.

B. Contractor shall prevent segregation, particularly well-graded filters, during handling and placement.

C. Proper in-place density is usually required to be no less than 80-percent relative density. Granular materials containing little or no fines should be saturated during compaction to prevent “bulking” (low density) which can result in settlement when overburden materials are placed and the drain is subsequently saturated by seepage flows.

D. Contactor shall place seepage filter material in control lifts such that the thickness of layers should ensure designed discharge capacity and continuity of the filter.

E. Installation of geotextile for seepage filter underdrain under riprap is not included in this Section. See Section 31 05 19.13 GEOTEXTILES.

END OF CORRUGATE-WALL, SMOOTH INTERIOR HDPE GRAVITY PIPE

SECTION 33 42 23
PRECAST HEADWALLS AND WINGWALLS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes construction of precast concrete for inlets and outlets for storm drainage culverts including appurtenances. Construction shall include surface preparation, excavation, shoring, dewatering, lay, align, and join pipe, installation of appurtenances, bedding and backfilling, surface restoration, and other related work.

1.02 REFERENCES

A. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.

B. ACI 306R - Cold Weather Concreting.

C. ACI 308 - Standard Practice for Curing Concrete.

D. ASTM A153/A153M - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

E. ASTM C 33 - Concrete Aggregates.

F. ASTM C 94 - Ready-Mixed Concrete.

G. ASTM C 150 - Portland Cement.

H. ASTM C 260 - Air Entraining Admixtures for Concrete.

I. ASTM C877 - External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections

J. USACE EM 1110-2-1913 (April 2000).

K. USACE EM 1110-2-2902 (December 2020).

1.03 SUBMITTALS

A. Concrete mix design: Submit mix design for concrete mix to be used on this project. Submittal must be made to and reviewed by the Engineer prior to manufacture and delivery to Project site.

B. Shop Drawings:

1. Headwalls and Wingwalls

   a. Detailed drawings of units, member, and all components, showing dimensions and sections of each.

b. Sop drawings shall show complete details and substantiating calculation of the method and material the Contractor proposed to use, including quantities, dimensions, and location of sleeves, anchors, brackets, inserts, reglets, reinforcing steel lift devices, accessories, and methos of securing in forms.

c. Provide the following information on the shop drawing submittal:

   1) Product type and description

   2) Class of concrete

   3) Concrete mix design (only for cast-in-place)

   4) Connection/jointing material used

   5) Manufacturer recommendations for storage, handling, and installation.

d. Shop Drawings and calculations shall be stamped and signed by a Structural Engineer registered in the State of Oregon.

2. Product Data

   a. Provide a product data sheet for the following:

      1) Pipe Runners

      2) Mortar

      3) Epoxy

      4) Jointing Material

      5) Any bonding material

C. Information Submittals:

   1. Certificates:

      a. Provide the manufacturer’s certificate of compliance that their product meets the physical testing requirements of this specification, SECTION 33 05 33.13 CORRUGATE-WALL, INTERIOR HDPE GRAVITY PIPE, and SECTION 03 30 00 CAST-IN-PLACE CONCRETE for the materials referenced which may include, but are not limited to:

         1) Concrete mix design and reinforcing

         2) Mortar

1.04 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, and store units in a manner that will prevent damage.

B. Shipping: Material shall be shipped so to not cut, kink, or otherwise damage pipe during transport.

C. Contractor shall be responsible for all materials intended for the Work that are delivered to the construction site and accepted by Contractor. Payment shall not be made for materials found to be defective or damaged in handling after delivery and acceptance. Defective or damaged materials shall be removed and replaced with acceptable materials at Contractor’s expense.

D. Store precast units at the site in a manner that will prevent cracking, distortion, stains, or damage. Support precast units at their normal support points.

E. Precast headwall and wingwall Acceptance:

  1. In addition to any deficiencies not covered by the applicable the Project Drawings and Specifications which has any of the following visual defects, will not be accepted.

    a. Cracks, spalling, honeycombing, exposed rebar, and general visually distressed or damaged concrete.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Streel: Comply with applicable require of the SECTION 03 30 00 CAST-IN-PLACE CONCRETE 2.03 Reinforcing.

B. Portland Cement Concrete:

  1. Comply with applicable require of the SECTION 03 30 00 CAST-IN-PLACE CONCRETE 2.04 Concrete Mix.

C. Anchors, lift devices, and accessor: provide concrete inserts, reglets, anchors, brackets, and fasteners as indicate or require for fabrication and installation work. All items shall be galvanized in accordance with ASTM A153/A153M or ASTM A123/A123M, as applicable. Contractor shall select the lift devices and is responsible for their performance and for any damage resulting from the use of faulty or inferior devices. Lift devices shall not be visible on exposed face of precast members.

D. All joints between precast concrete wingwall and headwalls sections shall be made watertight by using external sealing band conforming to requirements of ASTM C877

D. Where cast-in-place concrete is poured against a precast concrete unit, preformed rubber hydrophilic waterstop with adhesive back shall be installed on the precast side of the joint prior to the pour. Waterstop shall be Adeka Ultra Seal MC-2010M or equivalent. Follow manufacturer’s recommended installation procedure.

2.02 FRABICATION

A. Requirements and Standards.

1. Manufacture precast concrete units in accordance with PCI MNL-116 and applicable requirement of ACI 318/3318R.
2. Form shall be accurately construction to produce member to dimension, shape, and configuration indication on the project drawings.
3. Concrete reinforcement, lifting reinforcement, and concrete inserts and anchorage devices shall be placed and secured against movement as require.
4. Concrete shall be placed and consolidated to shape, configuration, and dimensions indication on the project drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine all parts of the supporting structure and the conditions under which the precast concrete units are to be erected and installed. Verify the locations of anchors to pre- determine the accuracy of the installation of each member.

3.02 ERECTION/INSTALLATION

A. Transport and erect precast concrete units m accordance with PCI MNL-116 and as specified herein.

B. Erect precast concrete units and accurately install in place with mechanical hoisting equipment more than adequate for the loads

C. Maintain precast concrete unit in upright position at all times. Handle unit only by indicated lifting devices or cushioned pads, and in a manner that will not overstress or damage the unit.

D. Erect precast concrete units in accordance with indicated erection tolerances and the requirements of ACI 117. Comply with erection sequences indicated. Position units to avoid eccentric application of forces, and make complete and uniform contact with bearing surfaces.

E. Provide anchorage and attachment welding and bolting, as indicated, in accordance with PCI MNL-116. Provide touch-up painting of field welds and abraded steel surfaces.

F. At completion, units shall be plumb, level, and square, true to line, with angles and edges parallel with related building lines.

3.03 HEADWALLS AND WINGWALLS

A. Precast reinforced concrete headwall and wingwalls shall be installed as shown on the Construction Drawings, according to manufacturer's recommendations.

B. Joint sealers shall be used as specified for a water-tight installation.

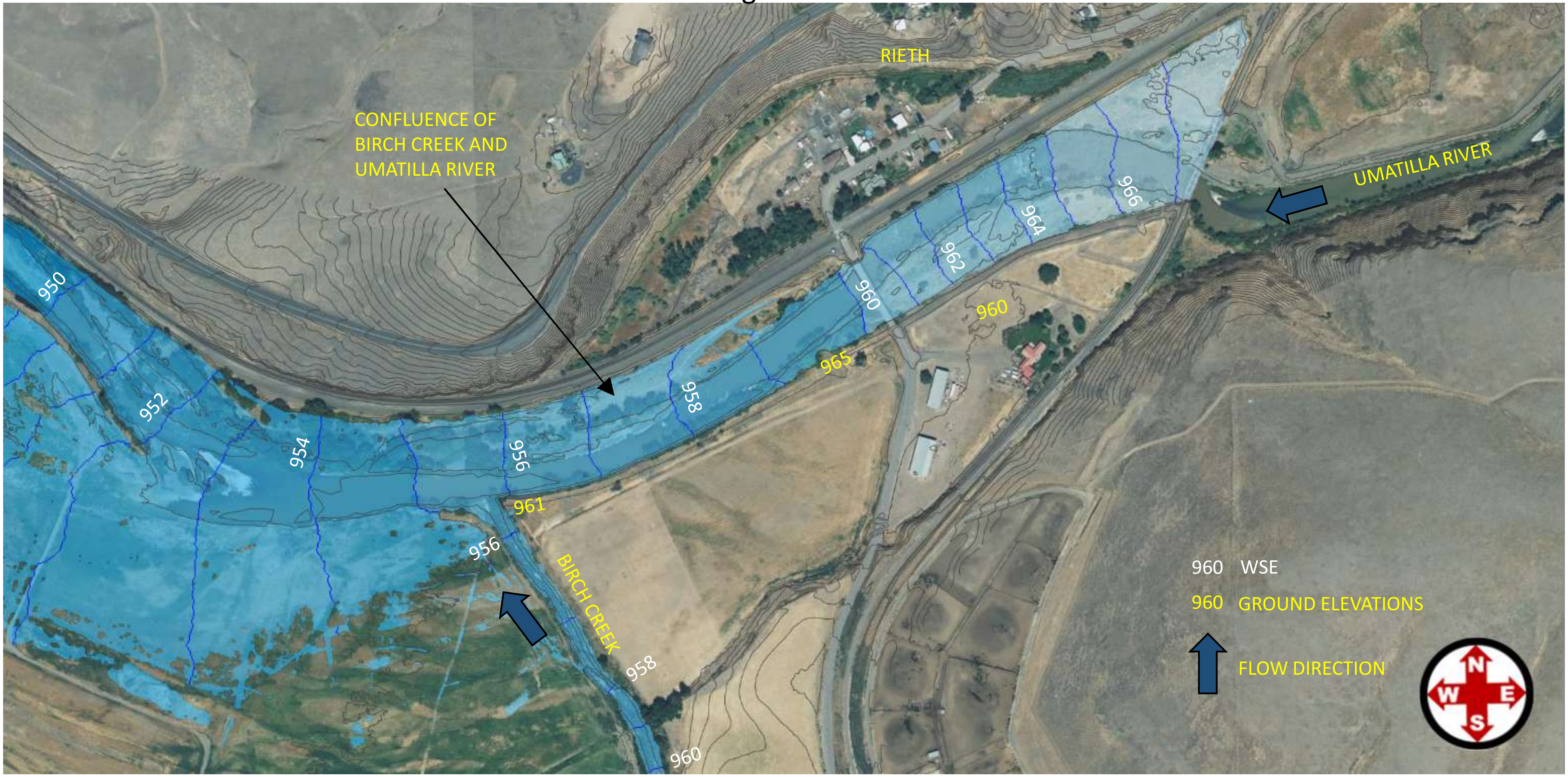
C. Precast reinforced concrete headwall and wingwalls shall be in place and plumb prior to pouring associated appurtenant structures. Dowel extensions shall be cast into the structures as a means of anchorage.

D. Precast reinforced headwall and wingwalls shall not be backfilled until the installation has been inspected and approved. Structures backfilled prior to approval shall be uncovered and re-backfilled at the Contractor's expense.

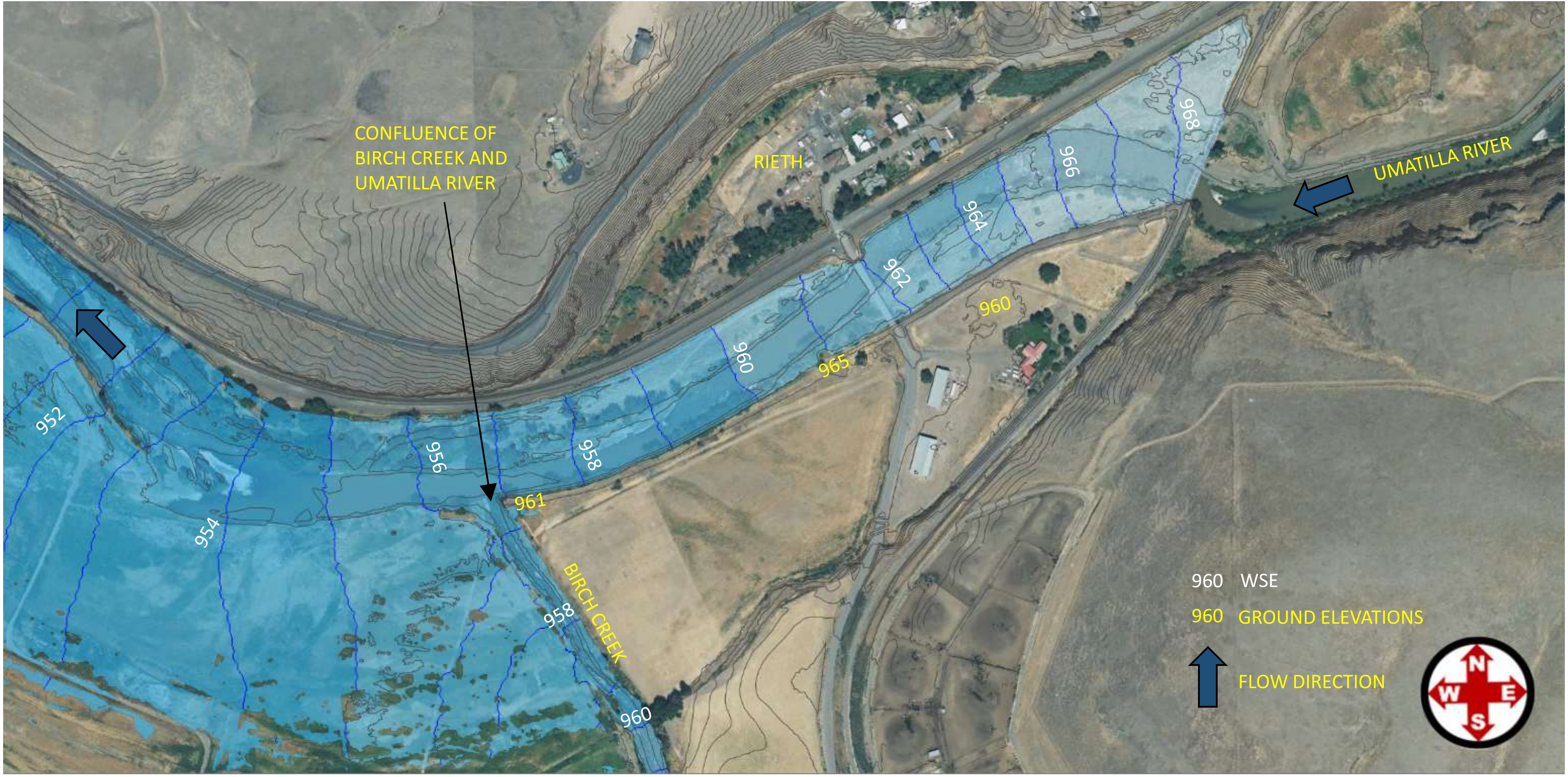
END OF PRECAST HEADWALLS AND WINGWALLS

Attachment 3 – Without-Project Conditions Sensitivity Analysis

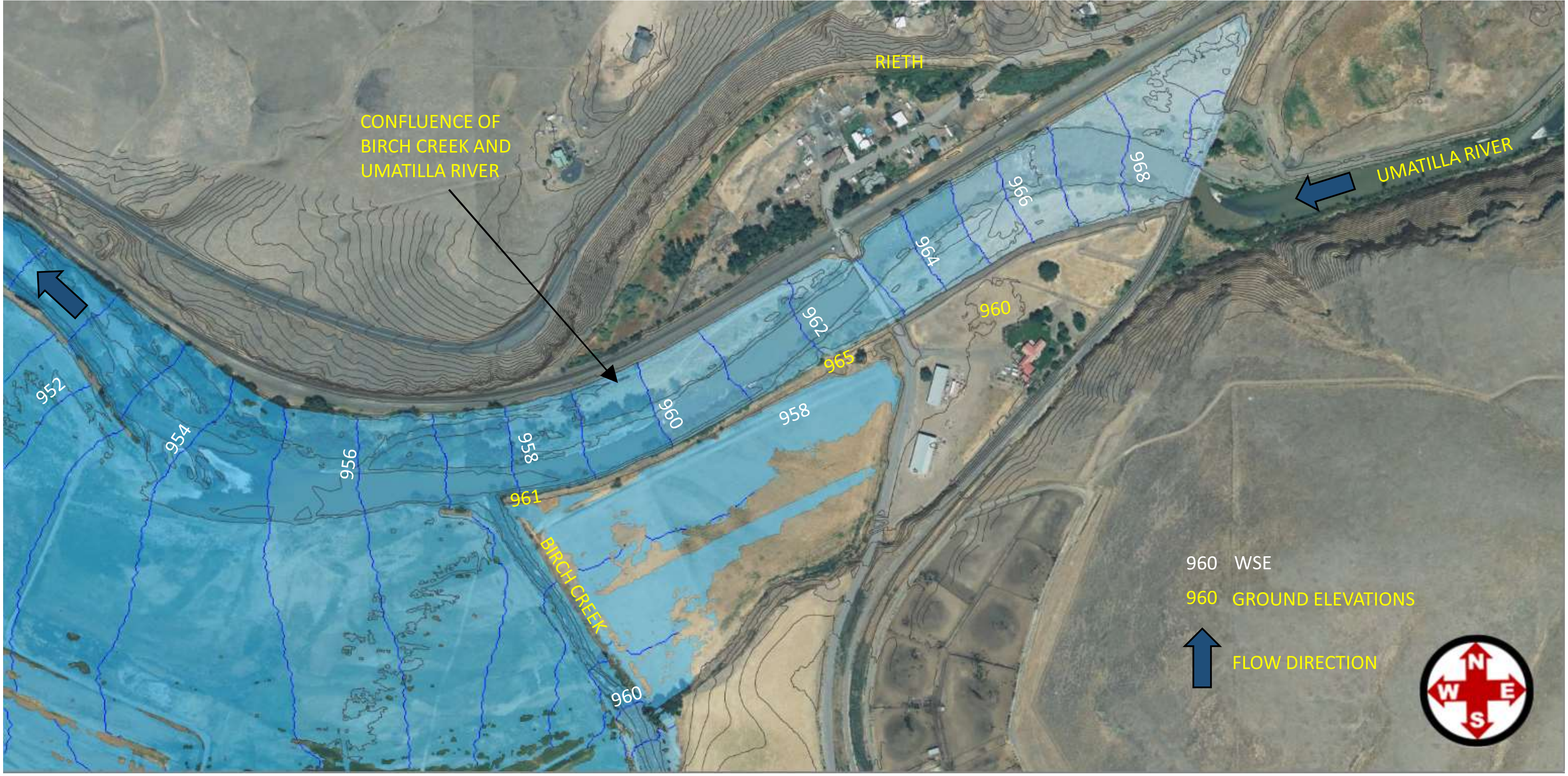
Without-Project Authorized Flood
Lower Roughness



Without-Project Authorized Flood Design Roughness

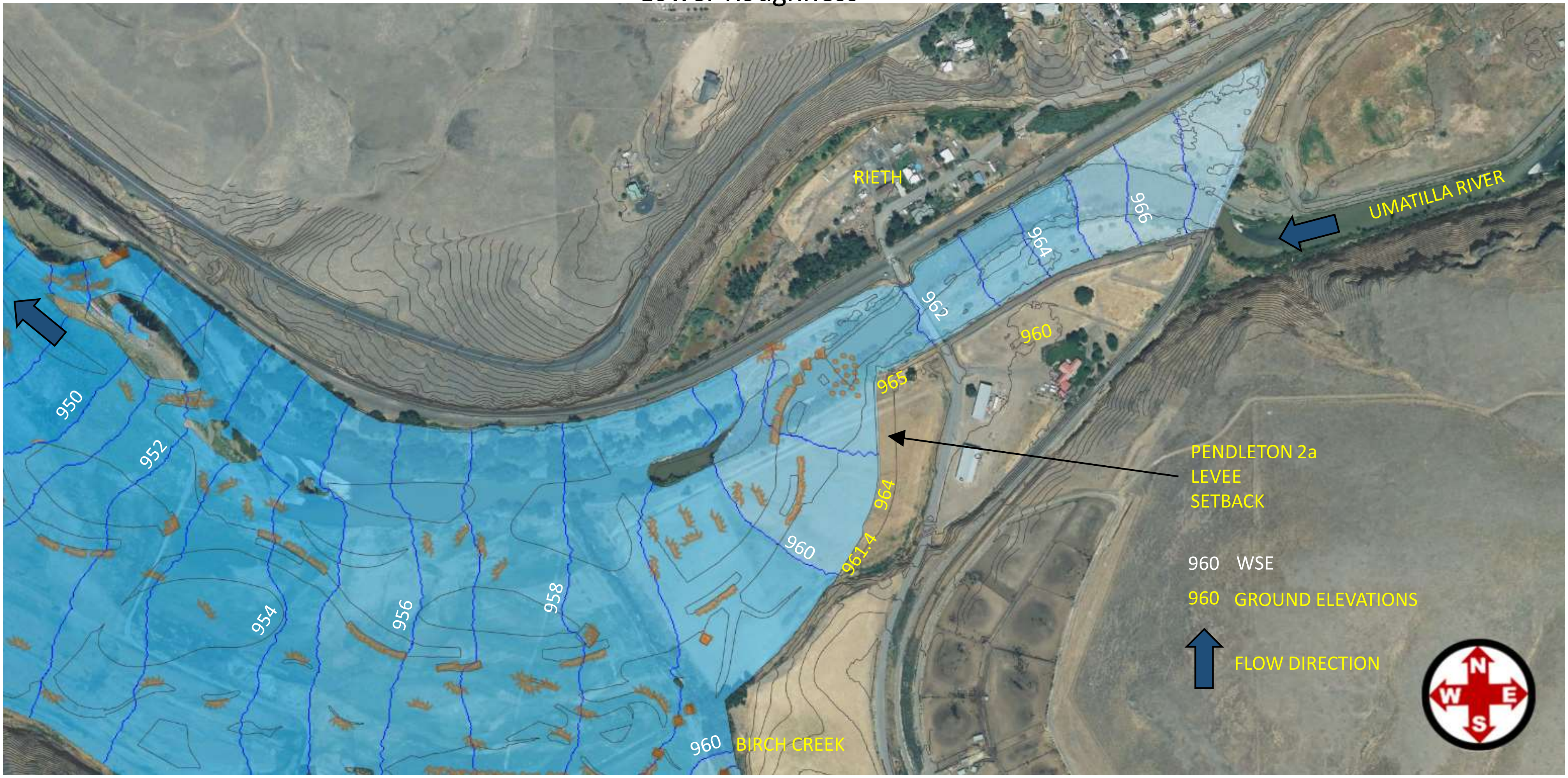


Without Project Authorized Flood
Higher Roughness

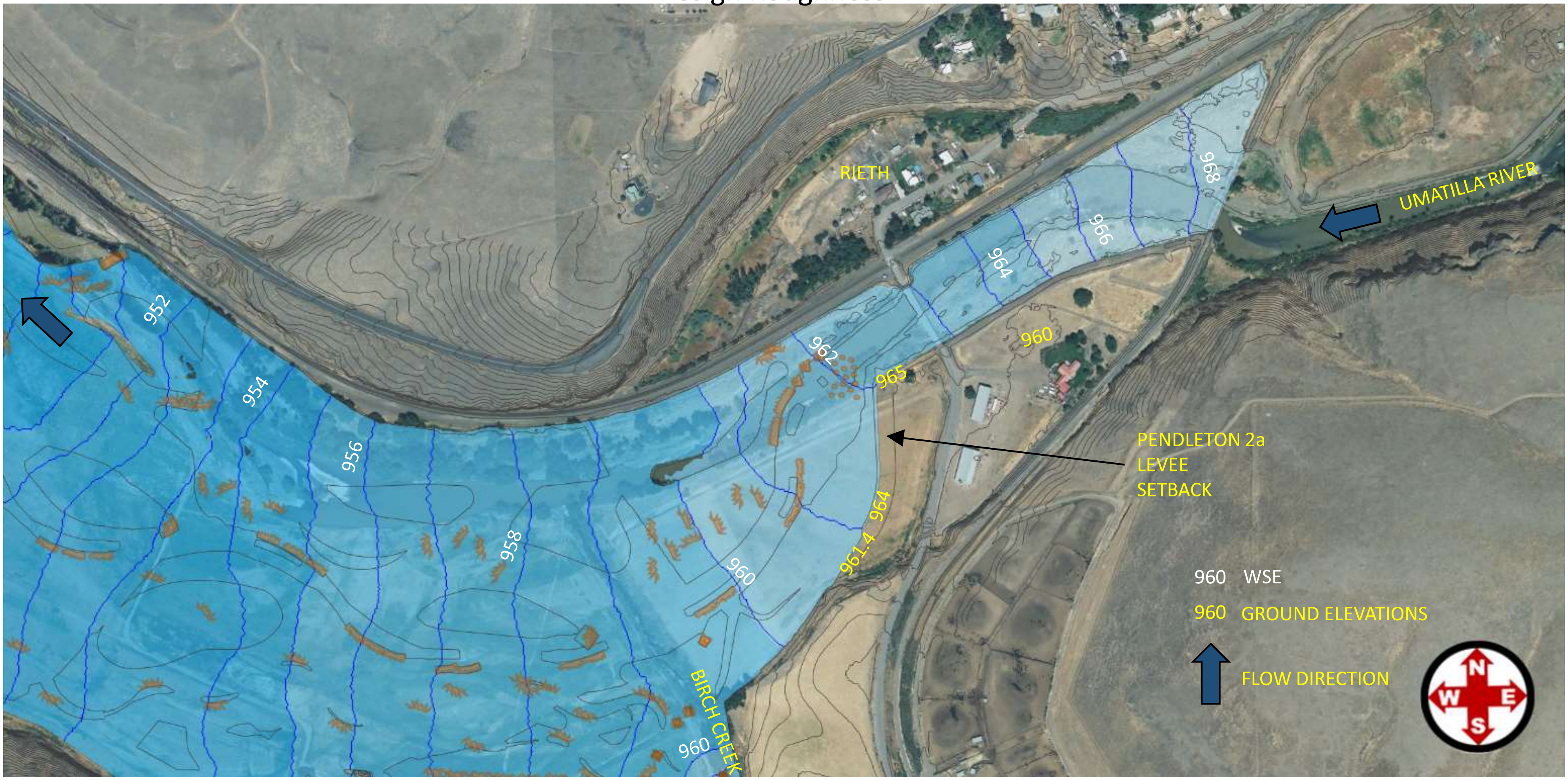


Attachment 4 – With-Project Conditions Sensitivity Analysis

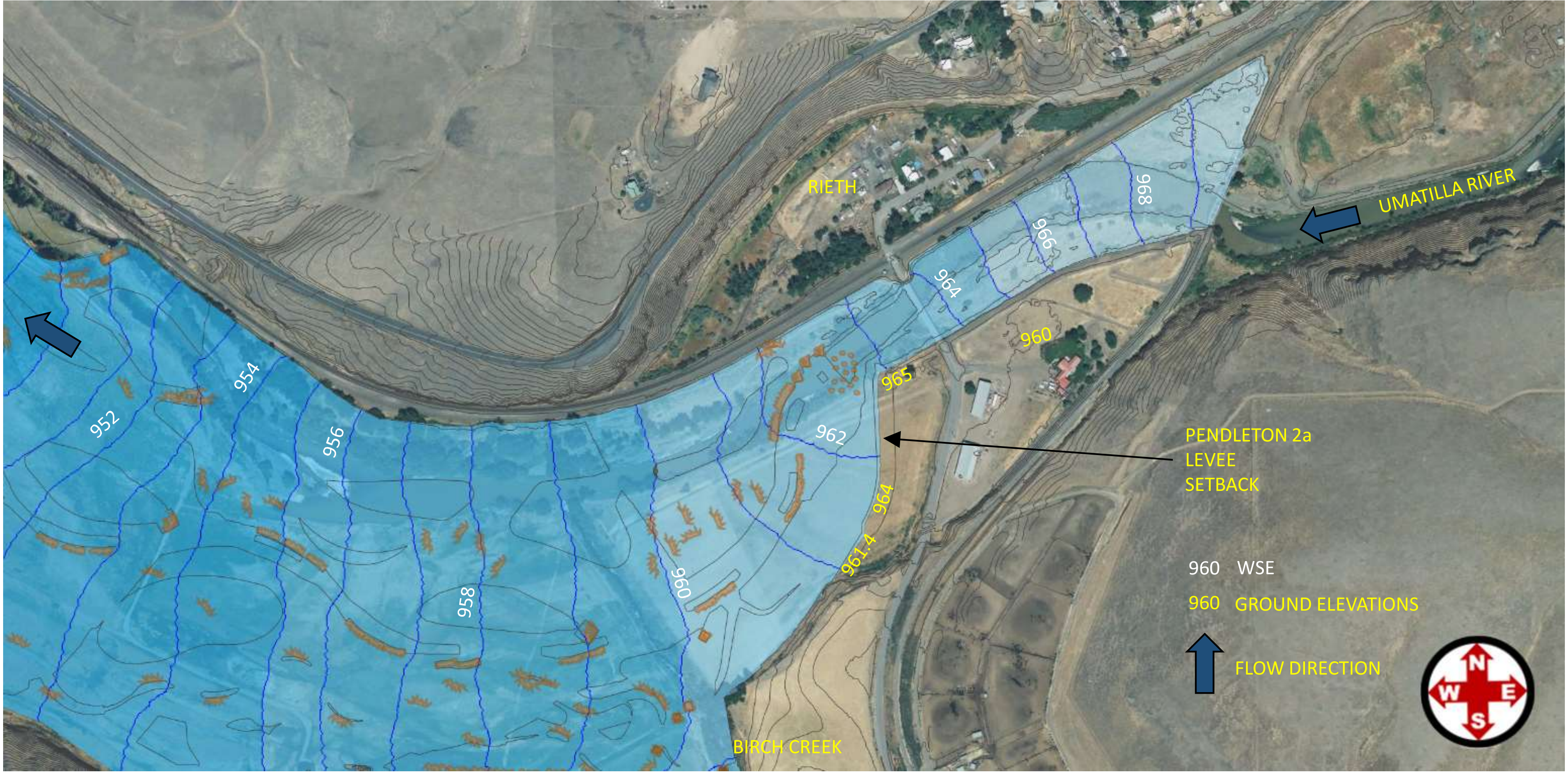
With-Project Authorized Flood
Lower Roughness



With-Project Authorized Flood
Design Roughness



With-Project Authorized Flood
Higher Roughness



VOLUME 3

TETRA TECH

TECHNICAL MEMORANDUM

To:	United States Army Corps of Engineers
Cc:	Confederated Tribes of the Umatilla Indian Reservation
From:	Jeremy Andrews, PE, and Chris James, CWM, CERP (Tetra Tech, Inc.)
Date:	December 16, 2024
Subject:	Volume 3 – Pendleton 2a Levee Setback Interior Drainage Analysis

1. Introduction

This technical memorandum is being provided by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Tetra Tech, Inc. (Tetra Tech) to the U.S. Army Corps of Engineers (USACE). It is intended to be a continuance of the USACE Section 408 process and review of UmaBirch In-Stream Design and Construction Oversight Project (the Project). The Project has been identified by the USACE as request #FY19-NO46 and is linked to the nationwide permit NWP-2019-489. The Project is associated with the USACE Pendleton 2a Levee which is listed in the USACE National Levee Database as System ID# 500500041 (USACE, 2022). The purpose of the Project is to restore floodplain connectivity and natural riverine processes, while maintaining the function of the Pendleton 2a Levee. The USACE Section 408 review is requested because the Project proposes to setback a portion of the Pendleton 2a Levee downstream of Birch Creek Road located near Rieth, Oregon, in order to achieve the purpose of the Project.

This technical memorandum provides the interior drainage analyses necessary to determine the authorized use of the Pendleton 2a Levee. The analysis is in support of the United USACE Section 408 review of the Project. The Project is located on the Umatilla River from river mile (RM) 48.7 to RM 49.7 and Birch Creek from RM 0.0 to RM 0.3. The Project is part of a larger series of project’s being proposed by the CTUIR and Bonneville Power Administration (BPA) located downstream on the Umatilla River and upstream on Birch Creek. To provide a phased construction approach based on funding, hydrology and geomorphology, and anticipated environmental permitting requirements, all project actions being proposed by the CTUIR and BPA, have been separated into four distinct project areas. Of these project areas, the USACE Pendleton 2a Levee is located within Project Area 2 (PA 2).

This technical memorandum is Volume 3 of 7. Combined, the volumes assist in documenting the historic conditions, existing data, and analyses necessary to demonstrate that the proposed Project will not adversely impact the Pendleton 2a Levee system. Specific to Volume 3 and guided by the results from Volume 2 – Hydrologic and Hydraulic Analyses, the interior drainage analyses demonstrates that the Pendleton 2a Levee setback design as proposed (see Attachment 1 of Volume 2), shall not adversely impact the interior drainage area to the east of the Project. As the Umatilla River experiences flooding conditions, the proposed setback design includes gravity drains through the Pendleton 2a Levee setback that are equipped with check valves to prevent floodwaters from entering the with-Project interior drainage area west.

2. Purpose

The purpose of this technical memorandum is to document the supporting engineering methods and calculations of the interior drainage analyses performed to confirm that the adjacent property to the east of the Project is not impacted by the Pendleton 2a Levee proposed setback design and maintains existing drainage characteristics. See Figure 2-1 below for an illustration of the Project overview related to the interior drainage analyses. The engineering analyses and design components covered in this technical memorandum are outlined below:

- Determine the design precipitation depth;
- Estimate upstream uncontrolled discharge during the 100-year recurrence interval;
- Determine seepage impacts for without- and with-Project conditions;
- Perform hydrologic modeling to determine hydraulic model inputs from precipitation, uncontrolled discharge, and seepage;
- Perform hydrologic and hydraulic modeling and evaluate results of without-Project conditions;
- Perform hydrologic and Hydraulic modeling and evaluate results of with-Project conditions; and
- Compare modeling results between without- and with-Project conditions.
- Design the thermoplastic pipes as the primary outlets

2.1 Background

The Project proposes modifications to a section of the existing Pendleton 2a Levee located along the south bank of the Umatilla River. The Pendleton 2a Levee (segment ID: 5004430001) is identified in the USACE National Levee Database as part of the Pendleton Zone 2 Flood Damage Reduction (FDR) Project, which is a federally authorized and constructed, and non-federally operated and maintained levee system (USACE, 2022). Volume 1 – Pendleton 2a Levee Setback Existing Data Review and Levee Reconstruction Analysis and Volume 2 – Hydrologic and Hydraulic Analyses provide detailed information regarding the historic (i.e., 1959 levee) and current conditions, without- and with-Project condition hydraulic analyses, and proposed levee setback and floodplain reconstruction designs, respectively, associated with the Pendleton 2a Levee system. Utilizing these sources, the USACE guidance and supporting material (see Section 2.2 below), and following the methodology described in Section 3 below, hydrologic modeling was completed for the without- and with-Project conditions in order to effectively complete the interior drainage analysis (see Sections 4 and 5 below).

2.2 USACE Materials

The guidance and supporting USACE materials utilized in this analysis include:

- EM 1110-2-1413
- ER 1110-2-1150
- EM 1110-2-2902a

Throughout this technical memorandum, the interior drainage analyses reference the following volumes:

- Volume 1 – Pendleton 2a Levee Setback Existing Data Review and Levee Reconstruction Analysis
- Volume 2 – Pendleton 2a Levee Setback Hydrologic and Hydraulic (H&H) Analyses
- Volume 4 – Pendleton 2a Levee Setback Design and Analysis

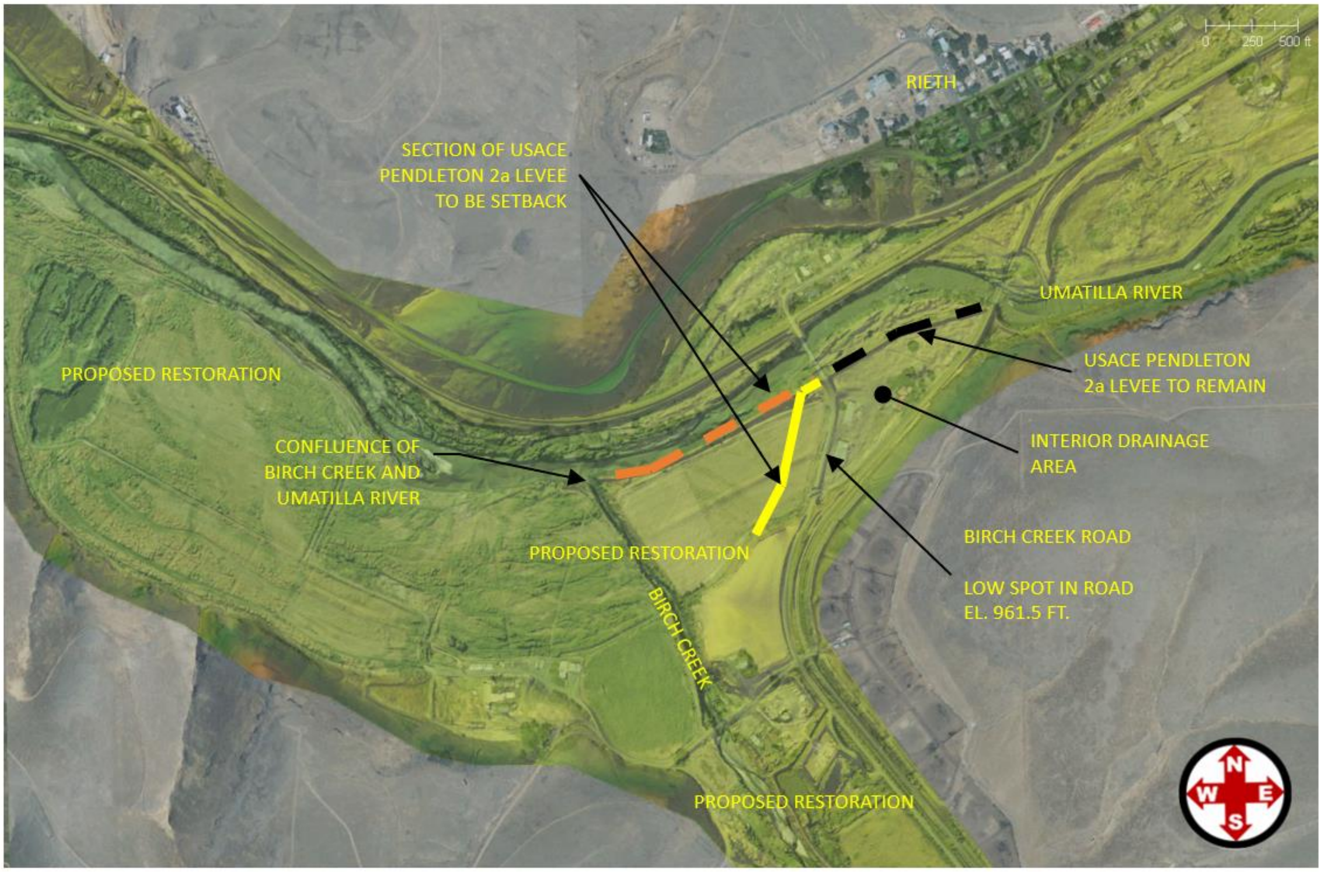


Figure 2-1. Interior Drainage Analysis Project Overview

3. Methodology

The authorized flood for the USACE Pendleton 2a Levee has been estimated as the 27-year recurrence interval for the Umatilla River at approximately 16,400 cubic feet per second (cfs) (see Volumes 1 and 2). Although several recurrence intervals were considered and evaluated in the overall Project design, the 100-year recurrence interval was identified to be used for the interior drainage analysis. Therefore, as a conservative estimate this analysis focused on the 100-year recurrence interval and the 100-year 24-hour storm event to evaluate and compare the without- and with-Project interior drainage conditions.

The interior drainage analysis was evaluated with hydrologic and hydraulic modeling. The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) curve number (CN) method was selected for the hydrologic model calculation settings. The CN describes the runoff condition within a drainage area and is calculated based on land cover and soil type conditions (USDA, 2004). A CN was identified to represent each contributing area of the entire drainage area and then a weighted CN is calculated as a composite condition. Lastly, the time of concentration was calculated and represents the time takes for water to travel from the most distant point within a drainage area to the outlet (USDA, 2004). The NRCS TR-55 method was used to calculate the time of concentration and includes both sheet flow and shallow concentrated flow (USDA, 2004).

Hydrologic model inputs for the inflow hydrograph include the precipitation depth, storm type/distribution, and the NRCS CN method parameters. Additionally, recent flooding events have identified an uncontrolled discharge from upstream flooding of the interior drainage area (discussed in detail in Section 4.2). The hydrologic model was used to estimate the uncontrolled discharge to be added as inflow within the interior drainage area. Finally, seepage impacts/rates were estimated utilizing the results of the Project design H&H analysis (Volume 2) and the findings of the geotechnical engineering desktop study (Volume 4). The seepage rate analysis was conducted using Darcy's law (USACE, 1986; USDA, 2010). Per EM 1110-2-1901, Darcy's Law is applicable for the subsurface materials encountered and construction materials anticipated. The range of validity of Darcy's law for the internal seepage calculations are discussed in EM 1110-2-1901 (USACE, 1986). The lower bound of validity is applicable to linear flow in low permeability soils, while the upper bound of validity is applicable between laminar flow at low velocities and turbulent flow at high velocities with velocity fluctuations in well-drained higher permeability soils. All parameters were inserted into the hydrologic model to perform stormwater runoff simulations and calculate the total flow from runoff occurring within the interior drainage area.

The hydraulic model used in Volume 2 was also used to evaluate the interior drainage analysis. Interior drainage area runoff results from the hydrologic model (precipitation, seepage, and estimated uncontrolled discharge) were inserted as an upstream inflow boundary condition at the east end of the interior drainage area. Hydraulic model simulations were performed to evaluate the interior drainage analysis of the without- and with-Project conditions. Unless specified, all elevations herein reference the North American Vertical Datum of 1988 (NAVD 88).

4. Hydrologic Analysis

A hydrologic analysis was performed to adequately estimate the inflow to be used in the hydraulic model for the interior drainage analysis. Three forms of inflow were examined and include the 100-year 24-hour precipitation depth, seepage impacts/rates resulting from 100-year recurrence interval floodwaters on the Umatilla River and Birch Creek creating hydraulic loading on the USACE Pendleton 2a Levee and the USACE Pendleton 2a Levee proposed setback design, and uncontrolled discharge from upstream flooding. The subsequent sections describe the hydrologic analysis.

4.1. Precipitation Depth

The interior drainage analysis included hydrologic model simulations of the 100-year 24-hour storm event. The NRCS has developed rainfall distribution curves that can be used in conjunction with the total rainfall depth from a precipitation event to simulate a design storm. The City of Pendleton Stormwater Master Plan (MSA, 2015) uses the NRCS Type 2 distribution to simulate summer storms in Pendleton, Oregon (see Figure 4-1). Due to the proximity of the Project site to Pendleton, Oregon, the NRCS Type 2 design storm was selected for the interior drainage analysis.

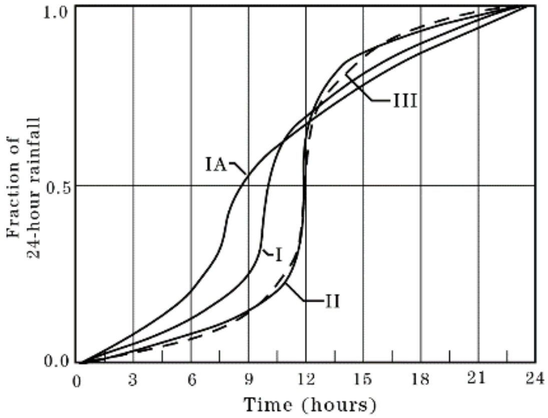


Figure 4-1. NRCS Design Storm Curves (USACE, 2000)

Two sources providing rainfall depth estimates at the Project location for the 100-year 24-hour storm event were identified, as shown in Table 4-1. Ultimately, the upper end of the depth range provided by Shaefer et al. (2008) was used in the interior drainage model as this represented the upper end of potential rainfall depths for the design storm. Figure 4-2 displays the rainfall depth estimates from Shaefer et al. (2008).

Table 4-1. Design Storm Precipitation Depths

Design Storm	NOAA (1973) Rainfall Depth (inches)	Schaefer et al. (2008) Rainfall Depth (inches)[1/]
100-year, 24-hour	1.8	2.0-2.5

1/ Rainfall depths have been interpreted using the maps provided in Shaefer et al. (2008), reproduced in Figures 4-2 through 4-6 below.

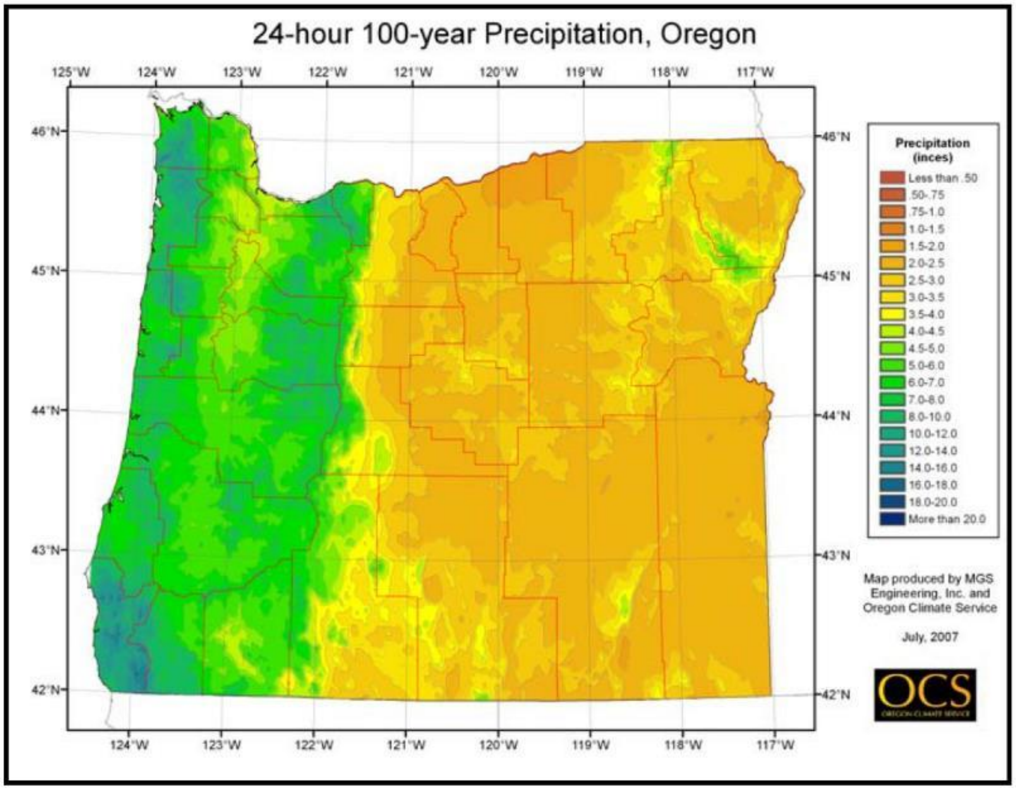


Figure 4-2. 100-year, 24-hour precipitation depths for Oregon (Schaefer et al., 2008)

4.2. Seepage

Volumes 2 and 4 of this Section 408 Request #FY19-NO46 Submittal were utilized to estimate the without- and with-Project seepage impacts/rates to be included in the hydraulic model. Without- and with-Project design hydraulic modeling results indicated that hydraulic loading occurs along the USACE Pendleton 2a Levee and the proposed Pendleton 2a Levee setback. The NRCS Web Soil Survey (WSS) (USDA, 2022) application was utilized in Volume 4 to estimate the permeability of the soils that make up the existing USACE Pendleton 2a Levee. The Project assumes that similar soils will be utilized to construct the USACE Pendleton 2a Levee Setback, therefore the soil properties between the without- and with-Project conditions remain the same. Table 4-2 below defines the soil properties.

Table 4-2. NRCS Soil Property Summary

Surficial Soil	Map Unit Symbol	Depth to Bedrock (inches)	Drainage Classification	Permeability rate (inches/hour)
Anderly silt loam	6D	20 to 40	excessively drained to well drained	0.57 to 1.98
Freewater gravelly silt loam	28A	80	excessively drained to well drained	0.57 to 1.98

The interior drainage seepage analysis evaluates the total seepage rate along the line-of-protection for the interior drainage area. For this analysis, seepage is defined as inflow into the ponding area which occurs through or under the line-of-protection. Seepage is not considered a major contributor to flow rates within the interior drainage area as external river stages in the Umatilla River do not remain high for prolonged periods. However, a seepage rate analysis was conducted using Darcy's law (USDA, 2010) and is represented by:

$$Q = k * i * A$$

Where:

Q = seepage flow rate, cubic-feet-per-second (cfs)
k = hydraulic conductivity of the levee material, inches-per-hour (in/hr)
i = hydraulic gradient between exterior river and interior pond, feet-per-feet (ft/ft)
a = cross sectional area of the median which flow occurs, square feet (ft^2)

The levee material is a gravelly silty loam and has a hydraulic conductivity of 1.98 (in/hr) (USDA, 2022). A hydraulic conductivity of 2.0 (in/hr) was used in the calculations. The hydraulic gradient is the difference in height between to exterior water surface and the interior ponding elevation divided by the lateral length of levee separating the two elevations. The cross-sectional area is based on the length of line-of-protection multiplied by the difference in height between to exterior water surface and the interior ponding elevation.

Based on the with- and without-Project hydraulic modeling results, seepage calculations were performed in locations of maximum hydraulic gradient with an assumed protection for the entire existing levee and levee setback length. Seepage calculations indicated a maximum seepage rate of 0.09 cfs for the without- Project conditions and a maximum seepage rate of 0.07 cfs for the with-Project conditions. Detailed seepage calculations are provided as Attachment 1, a summary of the results is tabulated below. Seepage rates were inserted into the hydrologic model as inflow into the interior drainage area.

Table 4-3. With-Project Seepage Calculations

Drainage Area	k (in/hr)	i (ft/ft)	a (ft^2)	Q (cfs)
With-Project East	2.0	0.17	11,850	0.09
With-Project West	2.0	0.17	8,800	0.07

4.3. Uncontrolled Discharge

In February 2020, the Umatilla River basin experienced an estimated flooding event of at least a 100-year recurrence interval, causing flood waters to release into the interior drainage area from upstream sources, see Figures 4-3 and 4-4. The floodwaters entered though the railroad embankment located upstream of the interior drainage area, flooding the interior drainage area and overtopping Birch Creek Road. Tetra Tech estimated the uncontrolled discharge utilizing the hydrologic model based on visual representation of Figures 4-3 and 4-4, the existing terrain for storage, and the existing outlets (existing drainage culverts and Birch Creek Road [modeled as broad crested weir with an invert elevation of 261.5 ft.]). Model simulations were performed with estimates for the uncontrolled discharge until approximately 0.5' of floodwater depth was flowing over Birch Creek Road with a WSE of approximately 262 ft. A value of 105 cfs was selected as the estimated uncontrolled discharge from upstream sources, see Section 4.4.

Figure 4-3. Uncontrolled Release of Floodwaters Upstream of the Interior Drainage Area

Figure 4-4. Uncontrolled Release of Floodwaters at Location of Habitable Structure

4.4. Without-Project Hydrologic Modeling

The without-Project interior drainage area, identified interior buildings, existing hydraulic structures, and the approximate location of the uncontrolled discharge from upstream floodwater are depicted in Figure 4-5. A total of 10.5 acres (outlined in white in Figure 4-5) of drainage area contributes to the existing gravity culverts that drain to the west underneath Birch Creek Road. The drainage area does not include the uncontrolled release of upstream floodwaters.

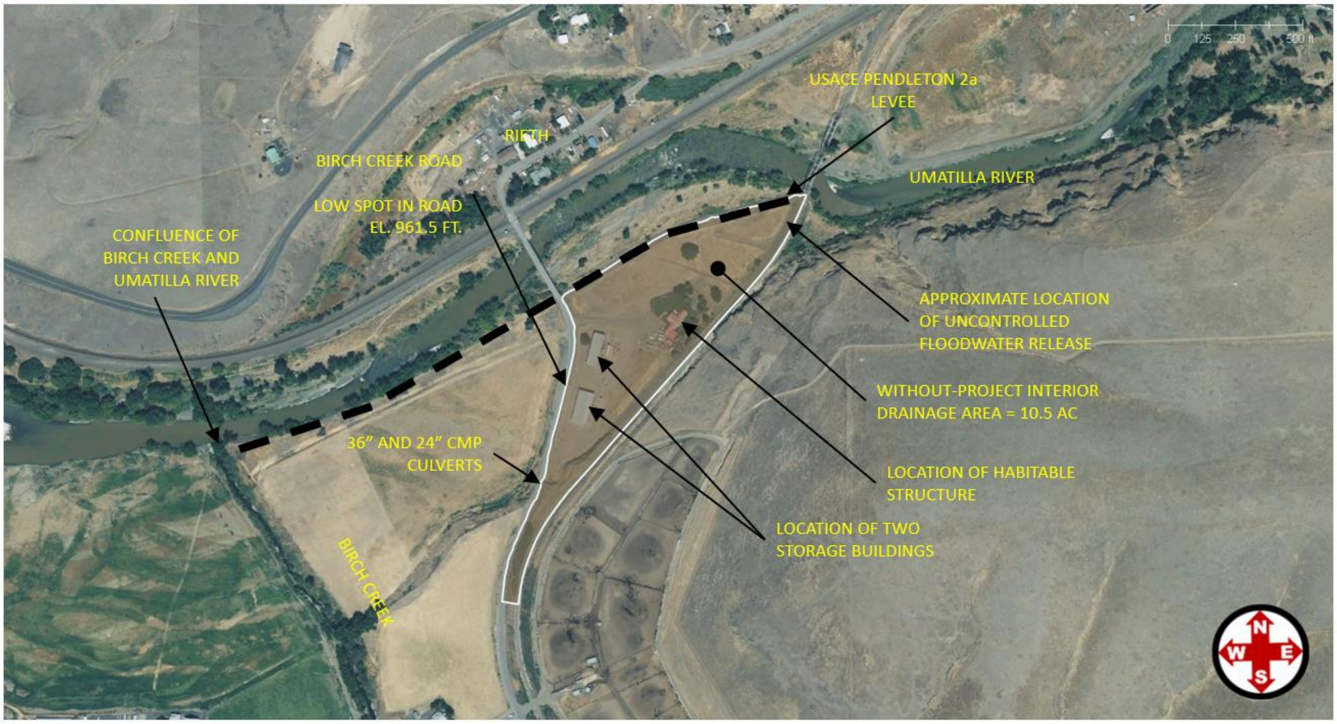


Figure 4-5. Without-Project Interior Drainage Area, Buildings, and Hydraulic Structures

There are three identified buildings within the without-Project interior drainage area—two are storage buildings and the third is a habitable building. The interior drainage area naturally slopes to the south and west towards two existing culverts. The two existing culverts are located to the southwest (Figure 4-5), are oriented underneath Birch Creek Road, and consist of one 36-inch corrugated metal pipe (CMP) culvert and one 24-inch CMP culvert.

A HydroCAD model was generated to evaluate the inflow hydrograph to be used as input to the without-Project hydraulic model. HydroCAD is a hydrologic modeling software that analyzes inflow hydrographs and routes them through management systems utilizing a series of nodes (i.e., subcatchments, ponds, and reaches) to represent a drainage area (HydroCAD, 2022). Utilizing the H&H analyses of the design (see Volume 2) and the methodology described above (Section 3 above), a HydroCAD model was created to represent the interior drainage area located to the south of the Pendleton 2a Levee and east of Birch Creek Road to evaluate the stormwater inflow for the without-Project conditions. The without-Project interior drainage area parameters are defined in Table 5-1 and the time of concentration calculated values are shown in Table 5-2.

Table 4-4. Without-Project Interior Drainage Area Characteristics

Area (acres)	CN	Description
2.5	93	Paved roads with open ditches, 50% impervious, Hydrologic Soil Group D
8.0	89	<50% grass cover, Poor, Hydrologic Soil Group D

Table 4-5. Without-Project Interior Drainage Area Time of Concentration

Method	Time of Concentration (Minutes)
Sheet	16.8
Shallow Concentrated	17.6

A subcatchment node was created to represent the interior drainage area, while a pond node was created to represent the storage and without-Project outlet configuration. Storage was entered into the model utilizing the Project terrain (Volume 1). Contour elevation, surface area, and perimeter data were entered into the model to represent the storage behind the without-Project outlet configuration. The without-Project outlet configuration is shown in Table 4-6.

Table 4-6. Without-Project Interior Drainage Area Outlet Configuration

Outlet	Description		Value (ft)
Primary Outlets	36-in CMP	Length	68.2
		Inlet Invert El.	958.0
		Outlet Invert El.	957.8
	24-in CMP	Length	68.2
		Inlet Invert El.	959.3
		Outlet Invert El.	959.5
Secondary Outlet	Broad Crested Weir (Birch Creek Road)	Length	180
		Breadth	22
		Crest El.	961.5

After all the drainage area parameters and outlet configurations were inserted into the model, the inflow hydrograph was calibrated. The inflow hydrograph includes the stormwater runoff resulting from the design precipitation depth (Section 4.1), the without-Project seepage rate (Section 4.2), and the estimated uncontrolled discharge from upstream flooding (Section 4.3). A baseflow of 105.09 cfs was inserted as inflow from the seepage calculations and the estimated uncontrolled discharge from upstream flooding. A schematic of the HydroCAD model is provided as Figure 4-6.

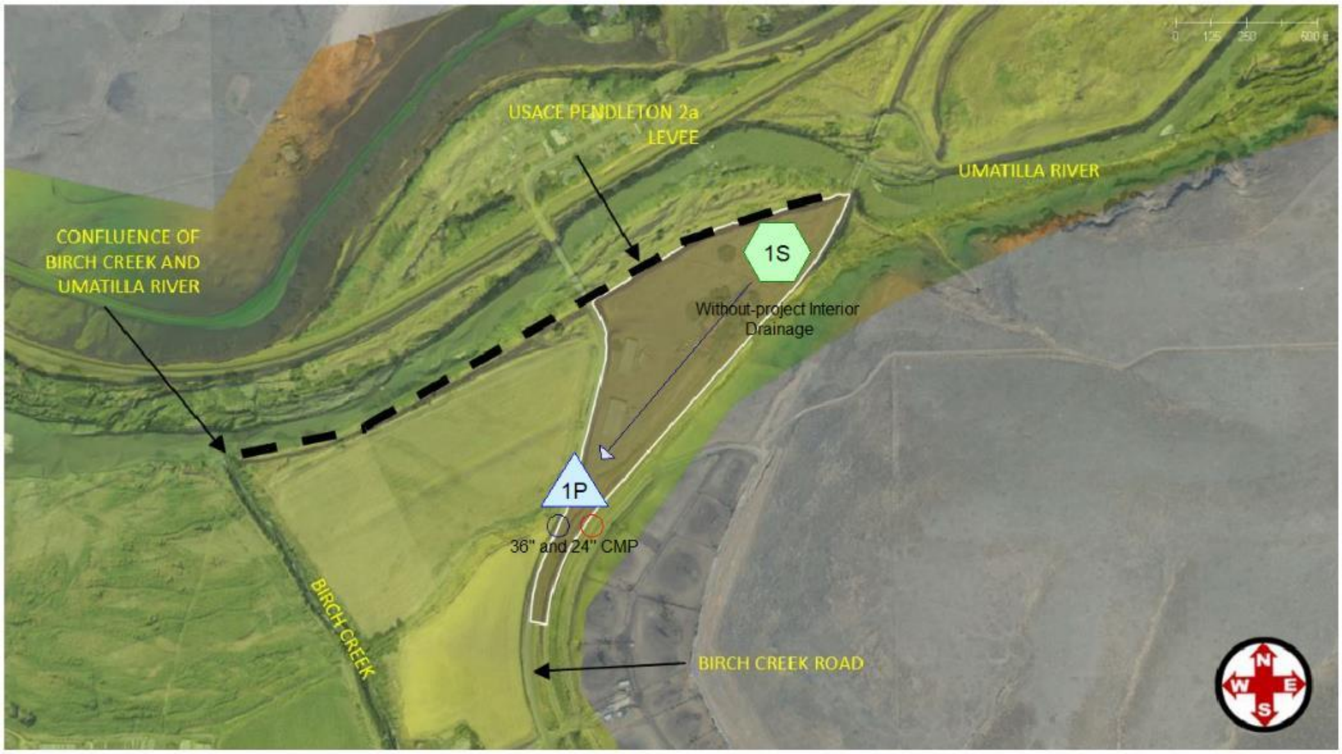


Figure 4-6. Without-Project HydroCAD Model Schematic

4.4.1 Results

Results of the HydroCAD model are shown below in Figure 4-7. The inflow and outflow hydrographs represent the resulting interior drainage area inflow and outlet configuration outflow, respectively. Primary inflow is routed through the culverts (31.9 cfs) as secondary outflow overtops Birch Creek Road by approximately 0.5 ft. (83.9 cfs) for a total inflow of 117.9 cfs and a peak elevation of 961.95 ft. The resultant inflow hydrograph was added as an upstream boundary condition in the without-Project hydraulic model (Section 5.1). Detailed HydroCAD model output is provided as Attachment 2.

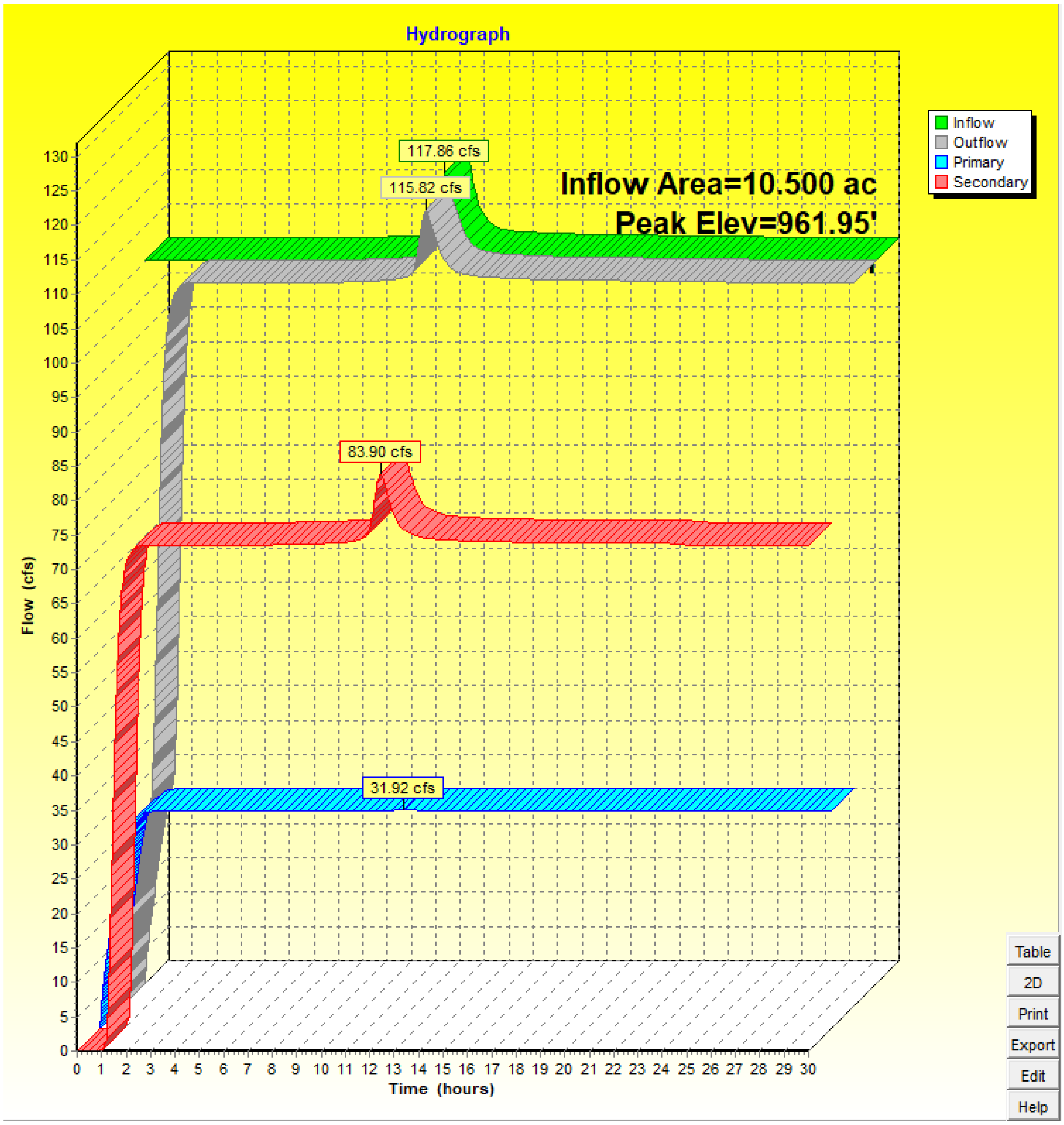


Figure 4-7. Without-Project HydroCAD Model Results

4.5. With-Project Hydrologic Modeling

A separate HydroCAD model was created to represent with-Project conditions. The Project design includes a Pendleton 2a Levee proposed setback as shown in Figure 4-8, below.

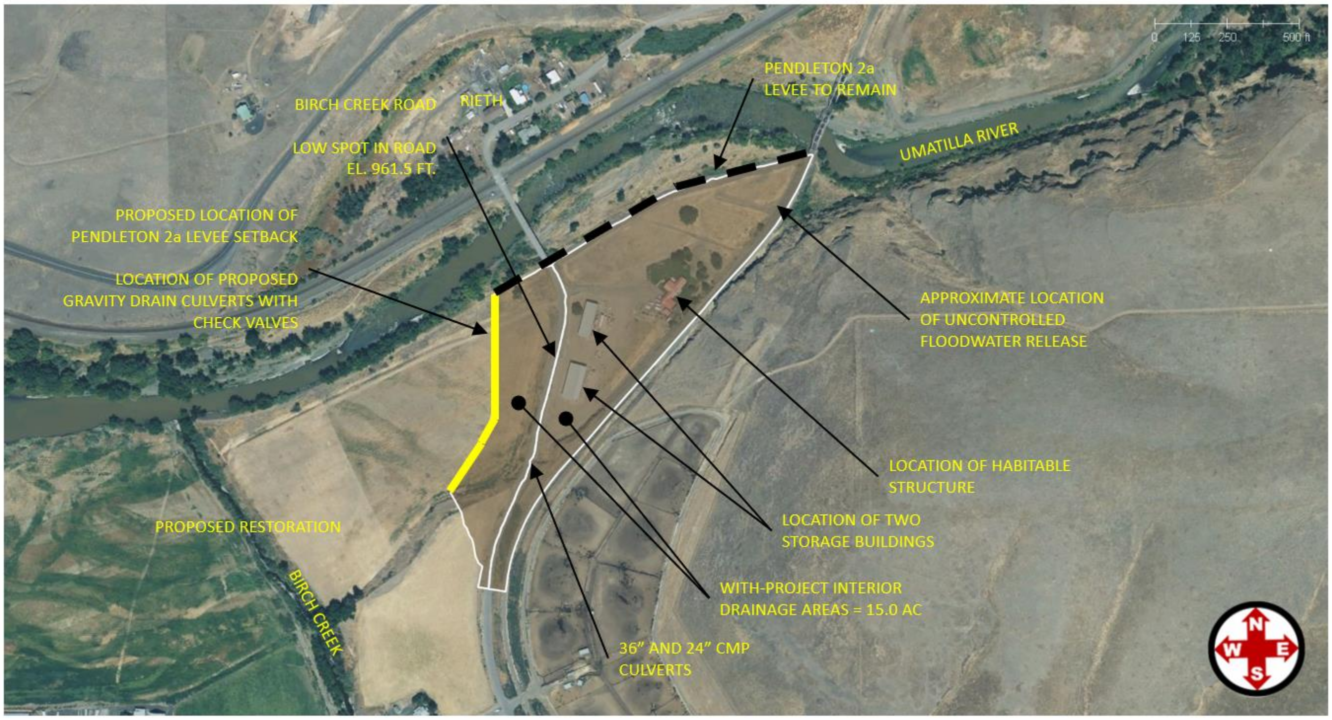


Figure 4-8. With-Project Interior Drainage Areas, Buildings, and Hydraulic Structures

The with-Project conditions create two interior drainage areas hydraulically connected by the existing culverts and Birch Creek Road. The with-Project interior drainage areas represent the combined interior drainage areas outlined in white in Figure 4-8. The with-Project USACE Pendleton 2a Levee proposed setback includes two 36-inch smooth-interior corrugated plastic pipe (CPP) gravity drain culverts each equipped with a check valve on the outlet to prevent floodwaters from the Umatilla River from entering the with-Project interior drainage area. The with-Project interior drainage increased from 10.5 acres (without-Project conditions) to 15.0 acres (with-Project conditions). The with-Project interior drainage area parameters are defined in Table 5-4 and the time of concentration calculated values are shown in Table 4-7.

Table 4-7. With-Project Interior Drainage Area Characteristics

Area (acres)	CN	Description
3.0	93	Paved roads with open ditches, 50% impervious, Hydrologic Soil Group D
12.0	89	<50% grass cover, Poor, Hydrologic Soil Group D

Table 4-8. With-Project Interior Drainage Area Time of Concentration

Method	Time of Concentration (Minutes)
Sheet	39.0
Shallow Concentrated	21.8

A subcatchment node was added to the with-Project HydroCAD model to represent the additional with-Project interior drainage area, and the pond node was updated from the without-Project condition to include total storage between the two drainage areas and the with-Project outlet configuration. Storage was entered into the model utilizing the Project terrain (Volume 1). Contour elevation, surface area, and perimeter data were entered into the model to represent the storage behind the with-Project interior drainage area outlet configuration. The with-Project interior drainage area outlet configuration is tabulated below in Table 4-9.

Table 4-9. With-Project Interior Drainage Area West Outlet Configuration

Outlet	Description		Value (ft)
Primary Outlets	36-in CPP	Length	70.0
		Inlet Invert El.	956.6
		Outlet Invert El.	956.05
	36-in CPP	Length	70.0
		Inlet Invert El.	956.6
		Outlet Invert El.	956.05
Secondary Outlet	Custom Weir (Overtopping Relief Section)	Length	190
		Breadth	22
		Crest El.	961.4

After all the drainage area parameters and outlet configurations were inserted into the with-Project model, the inflow hydrograph was calibrated. The inflow hydrograph includes the stormwater runoff resulting from the design precipitation depth (Section 4.1), the without-Project seepage rate (Section 4.2), and the estimated uncontrolled discharge from upstream flooding (Section 4.3). A baseflow of 105.07 cfs was inserted as inflow from the seepage calculations and the estimated uncontrolled discharge from upstream flooding. A schematic of the HydroCAD model is provided as Figure 4-9.

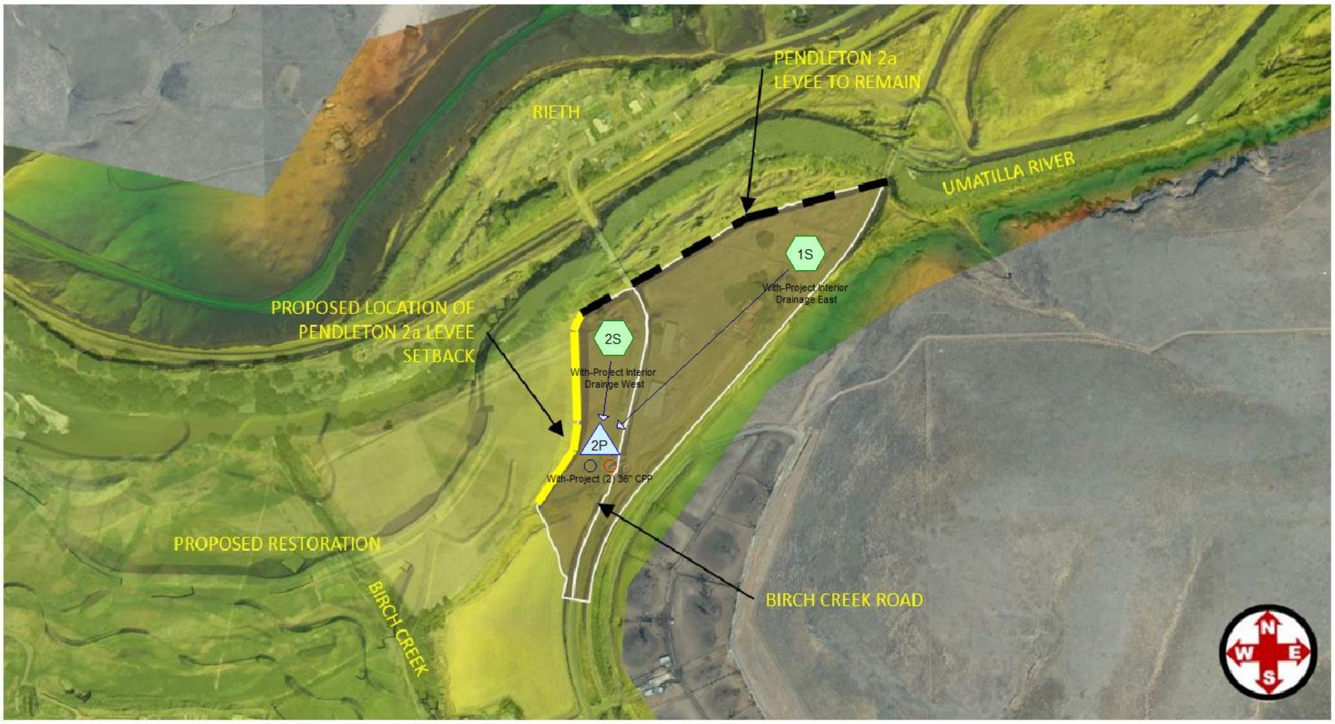


Figure 4-9. With-Project HydroCAD Model Schematic

4.5.1 Results

Results of the HydroCAD model are shown below in Figure 4-10. The inflow and outflow hydrographs represent the resulting with-Project interior drainage area inflow and outlet configuration outflow, respectively. Primary inflow is not routed as the check valves are activated to prevent floodwaters from the Umatilla River from entering into the with-Project drainage area from the west. Secondary outflow overtops the overtopping relief section of the setback levee by 0.5 ft. (121.9 cfs). The with-Project interior drainage area receives a total inflow of approximately 123.6 cfs. The resultant inflow hydrograph was added as an upstream boundary condition in the with-Project hydraulic model (Section 5.2). Detailed HydroCAD model output is provided as Attachment 2.

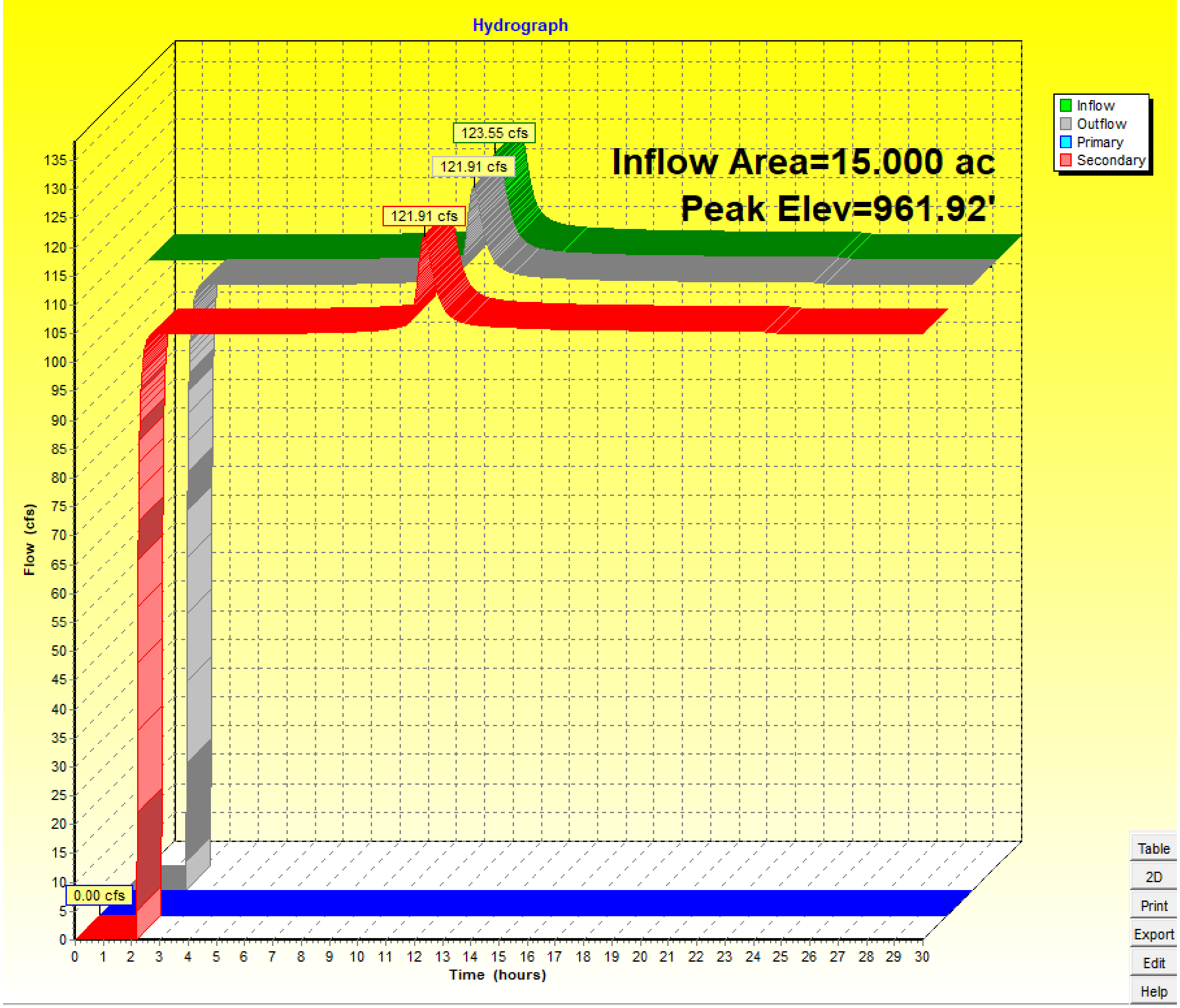


Figure 4-10. With-Project Interior Drainage Area East HydroCAD Model Results

5. Hydraulic Modeling

The hydraulic model discussed in Volume 2 was utilized to evaluate the interior drainage analysis. Results of the hydrologic modeling performed above were inserted into the without-Project and with-Project hydraulic models as upstream boundary conditions within each interior drainage area, respectively. Results were compared between the models to evaluate the impacts from the Pendleton 2a Levee proposed setback design. The subsequent sections describe the hydraulic modeling performed for the interior drainage analysis.

5.1. Without-Project Hydraulic Modeling and Results

The without-Project hydraulic model includes the following inflow hydrographs as upstream boundary conditions.

Table 5-1. Umatilla River and Birch Creek Peak Flows

Return Period (years)	Peak Flow (cfs)		
	Umatilla River	Birch Creek	Without-Project Interior Drainage
100	22,300	3,800	105.09

2-D model flow analyses were performed to evaluate the without-Project conditions, Figure 5-1 below depicts the results of the without-Project hydraulic modeling.

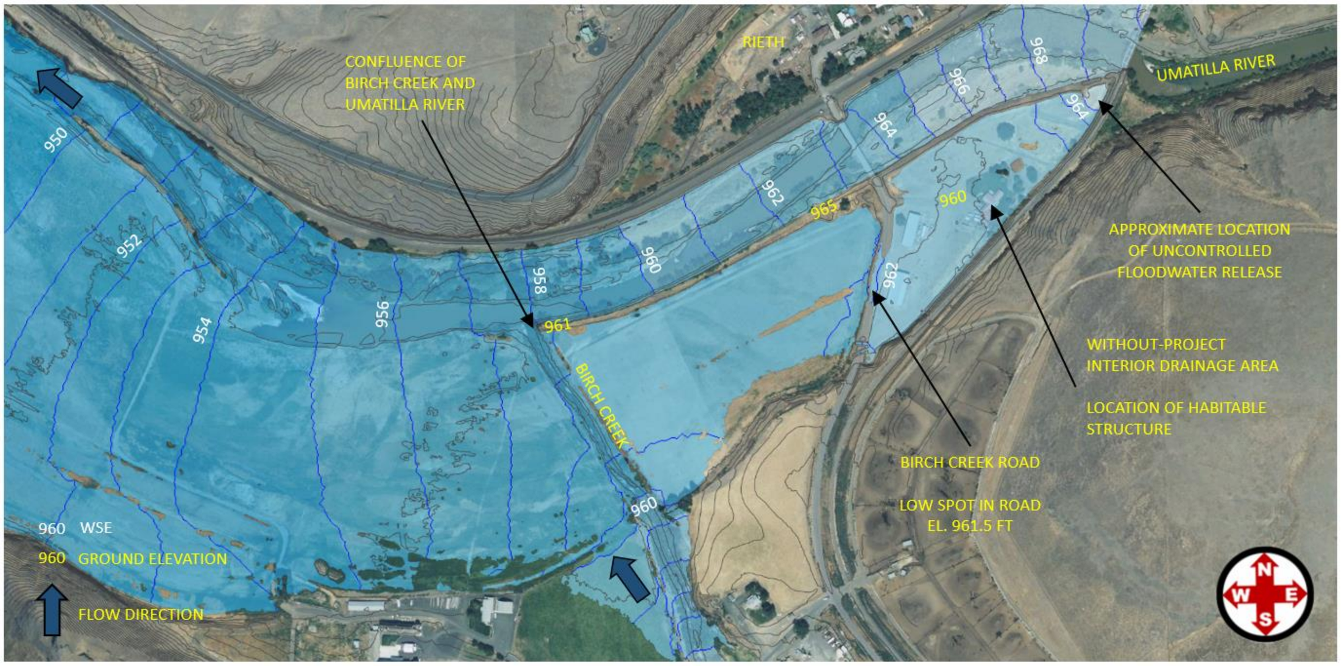


Figure 5-1. Without-Project Interior Drainage Hydraulic Modeling Results

5.2. With-Project Hydraulic Modeling and Results

The with-Project hydraulic model included the following inflow hydrographs as upstream boundary conditions.

Table 5-2. Umatilla River and Birch Creek Peak Flows

Return Period (years)	Peak Flow (cfs)		
	Umatilla River	Birch Creek	Without-Project Interior Drainage
100	22,300	3,800	105.07

2-D model flow analyses were performed to evaluate the with-Project conditions, Figure 5-2 below depicts the results of the without-Project hydraulic modeling.

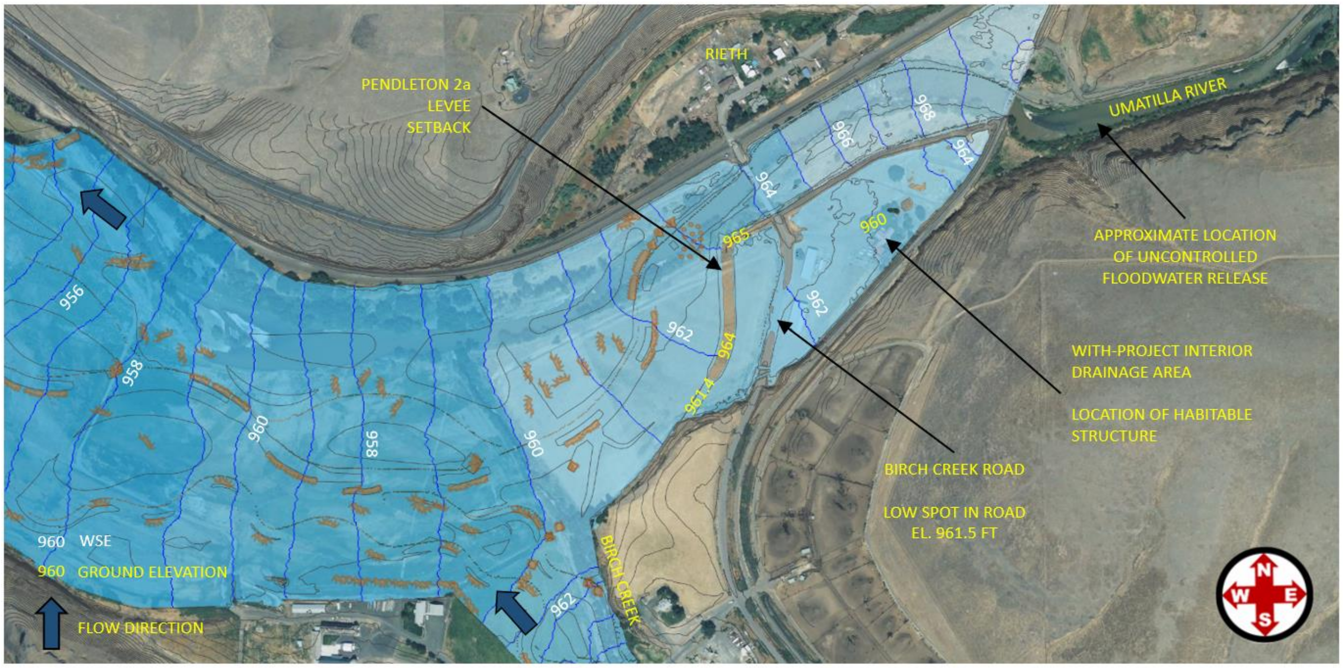


Figure 5-2. With-Project Interior Drainage Hydraulic Modeling Results

6. Primary Outlet Structural Design

Pipe “design” refers to the process of determining the capacity of a pipe to resist all design loads without failure during its service life and is not intended to address the actual design associated with the manufacturing of pipe materials. Through this process the appropriate pipe for a given material type is chosen once the factored loads and applicable resistance criteria have been established (USACE 2020). The structural design methodology of pipes follows the guidance outlined in the 8th edition of the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications (AASHTO 2018). The LRFD method is a limit state design methodology where loads acting on a structure are increased by load factors, and the strength (or load carrying capacity) of the structure is reduced by resistance factors for a series of specific limit states (failure conditions) (USACE 2020). The factors are intended to account for potential deviations in actual loads and strength properties for the structure being designed.

The structural design of thermoplastic pipe must be evaluated for both service and strength limit states. The only service limit state evaluated is associated with deflection (USACE 2020). Three strength-based limit states must be satisfied for the structural design of thermoplastic pipe: thrust, global/localized buckling, and combined strain (USACE 2020). Section properties required to assess both the service and strength limit states for thermoplastic pipe should be determined from cut sections of pipe or obtained from the pipe manufacturer.

The proposed primary outlets for the Pendleton 2a Levee setback are two 36-inch diameter corrugated polyethylene (thermoplastic) pipes with flap gates on the river side outlets. The structural properties, assumptions, calculations, and evaluation of the pipes are detailed in Attachment 3 – Pipe Design, and the results are summarized in Table 5-3 Thermoplastic Pipe Design Results below.

Table 5-3. Thermoplastic Pipe Design Results

Limit State	Limit Conditions	Limit Criteria	Computed Results	Check
Service - Deflection	Total deflection due to loading must not exceed the allowable deflection	≤1.8 in	0.378 in	Ok
Strength - Thrust	Thrust strain shall not exceed compression strain limit	≤0.037 in/in	0.00312 in/in	Ok
Strength – Global/localized buckling	Buckling strain shall not exceed computed capacity	≤0.377 in/in	0.00214 in/in	Ok
Strength – Combined Strain	The sum of axial and bending strain shall not exceed long term strain limit of pipe material	Tension, ≤ 0.025 in/in	0.00796 in/in	Ok
		Compression, ≤ 0.0555 in/in	0.0132 in/in	Ok

7. Conclusion

Results of the interior drainage analysis indicates that the Pendleton 2a Levee proposed setback design shall not adversely impact the interior drainage area to the east of the Project. As the Umatilla River experiences flooding conditions, the design includes gravity drains through the Pendleton 2a Levee proposed setback equipped with check valves to prevent floodwaters from entering the with-Project interior drainage area from the west. The uncontrolled discharge from upstream flooding into the interior drainage area overtops Birch Creek Road and the overtopping relief section of the proposed levee setback and does not increase flooding to the habitable structure located within the interior drainage area of Birch Creek Road. Resulting WSEs from the hydraulic modeling results indicate a slight decrease of 0.01 ft. from the without- to with-Project conditions, as shown on Figures 5-1 and 5-2 above.

8. References

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9. Attachments

Attachment 1 – Seepage Calculations

Attachment 2 – Without- and With-Project HydroCAD Results

Attachment 3 – Thermoplastic Pipe Design Results

Attachment I – Seepage Calculations

TETRA TECH

PROJECT Pendleton 2a Levee Setback Interior Drainage Analysis
Project Number
SUBJECT Seepage Calculations
Scale NA

Designed By	Date	Checked By	Date	Sheet No:
CM	2/2/2024	JA	2/2/2024	1 of 2

Objective:	Determine Seepage Rates for the Without-Project Conditions
References:	Darcy's Law

Define Input Parameters

Hydraulic Conductivity; k =	2.0	in/hr	Based on NRCS Soil Properties
River (Exterior) WSE =	968.0	ft	Based on 2D Hydraulic Modeling Results
Pond (Interior) WSE =	963.0	ft	Based on 2D Hydraulic Modeling Results
Width of Line of Protection =	30.0	ft	Based on 2D Hydraulic Modeling Results
Hydraulic Gradient; i =	0.17	ft/ft	Based on 2D Hydraulic Modeling Results
Length of Line of Protection =	2370.0	ft	Based on Length of Levee
Cross Sectional Area =	11850.0	ft^2	Based on Area of the Median Which Flow Occurs

Calculate Seeapge Rate

Q = k * i * A
Where:
Q = seepage flow rate, cubic-feet-per-second (cfs)
k = hydraulic conductivity of the levee material, inches-per-hour (in/hr)
i = hydraulic gradient between exterior river and interior pond, feet-per-feet (ft/ft)
a = cross sectional area of the median which flow occurs, square feet (ft^2)

Conclusion

Q = 0.0909 cfs

TETRA TECH	PROJECT	Pendleton 2a Levee Setback Interior Drainage Analysis			Project Number
	SUBJECT	Seepage Calculations			Scale NA
	Designed By CM	Date 2/2/2024	Checked By JA	Date 2/2/2024	Sheet No: 2 of 2

Objective:	Determine Seepage Rates for the With-Project Conditions
References:	Darcy's Law

Define Input Parameters

Hydraulic Conductivity; k =	2.0	in/hr	Based on NRCS Soil Properties
River (Exterior) WSE =	968.0	ft	Based on 2D Hydraulic Modeling Results
Pond (Interior) WSE =	963.0	ft	Based on 2D Hydraulic Modeling Results
Width of Line of Protection =	30.0	ft	Based on 2D Hydraulic Modeling Results
Hydraulic Gradient; i =	0.17	ft/ft	Based on 2D Hydraulic Modeling Results
Length of Line of Protection =	1760.0	ft	Based on Length of Levee
Cross Sectional Area =	8800.0	ft^2	Based on Area of the Median Which Flow Occurs

Calculate Seeapge Rate

Q = k * i * A

Where:

Q = seepage flow rate, cubic-feet-per-second (cfs)

k = hydraulic conductivity of the levee material, inches-per-hour (in/hr)

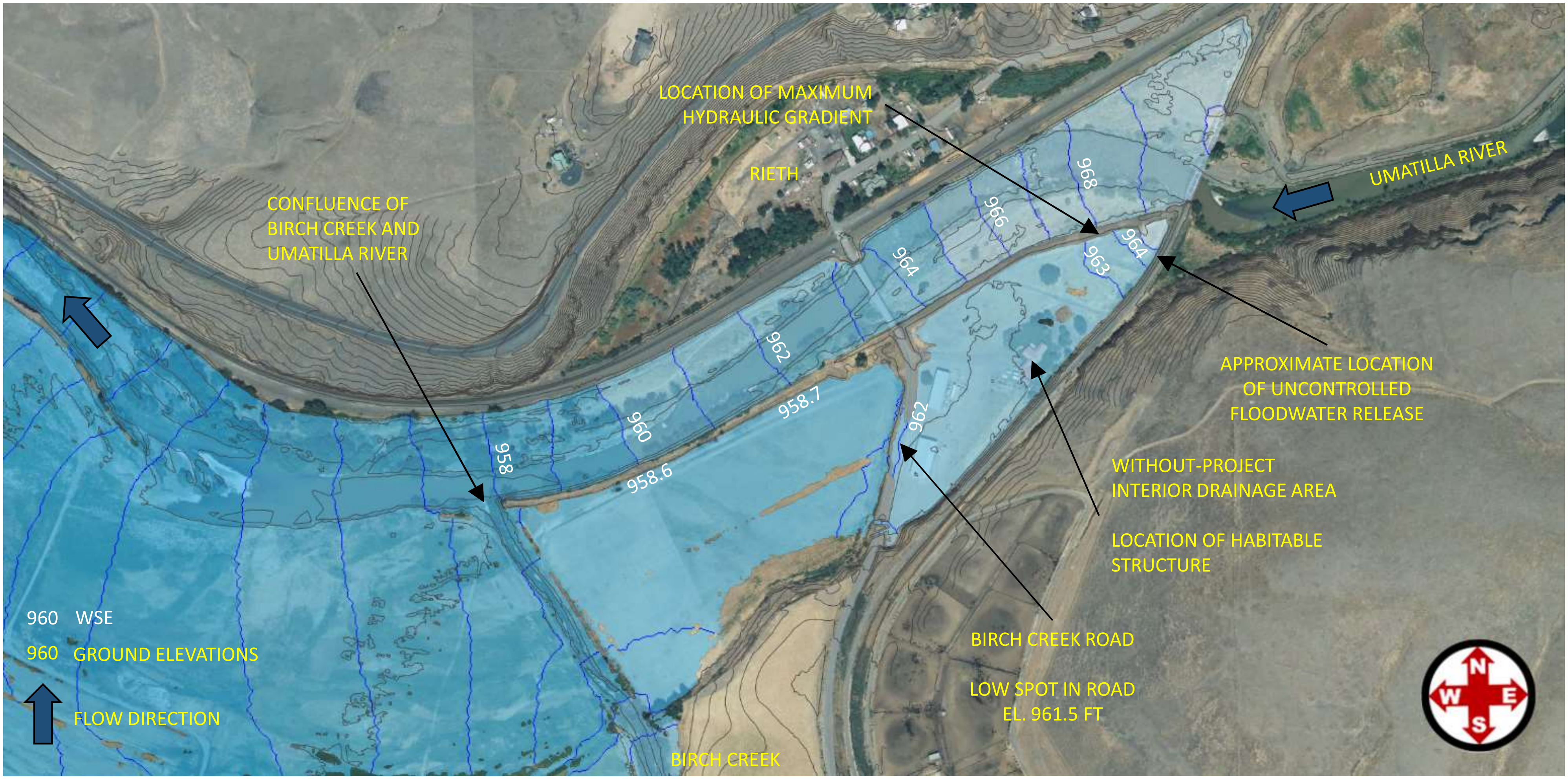
i = hydraulic gradient between exterior river and interior pond, feet-per-feet (ft/ft)

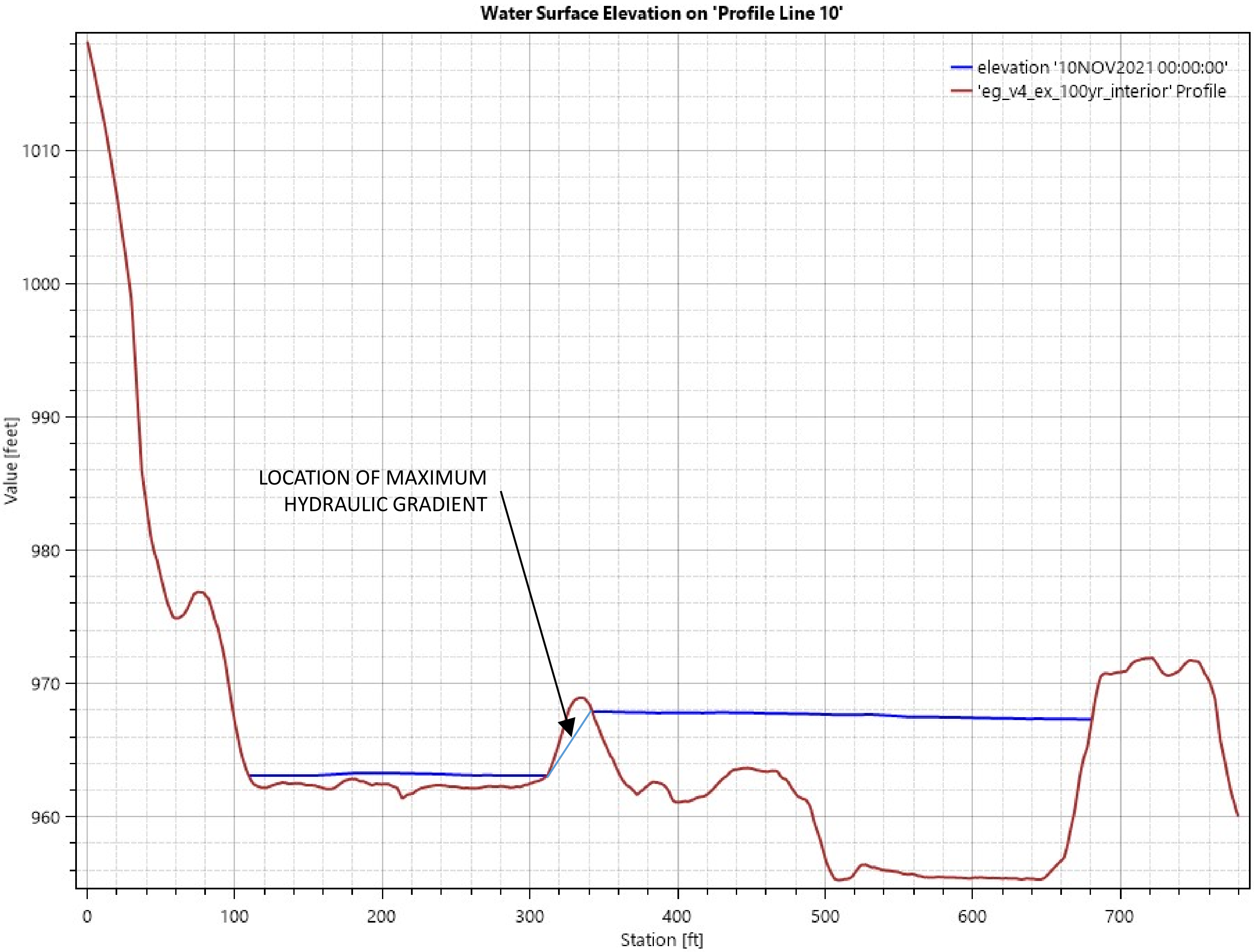
a = cross sectional area of the median which flow occurs, square feet (ft^2)

Conclusion

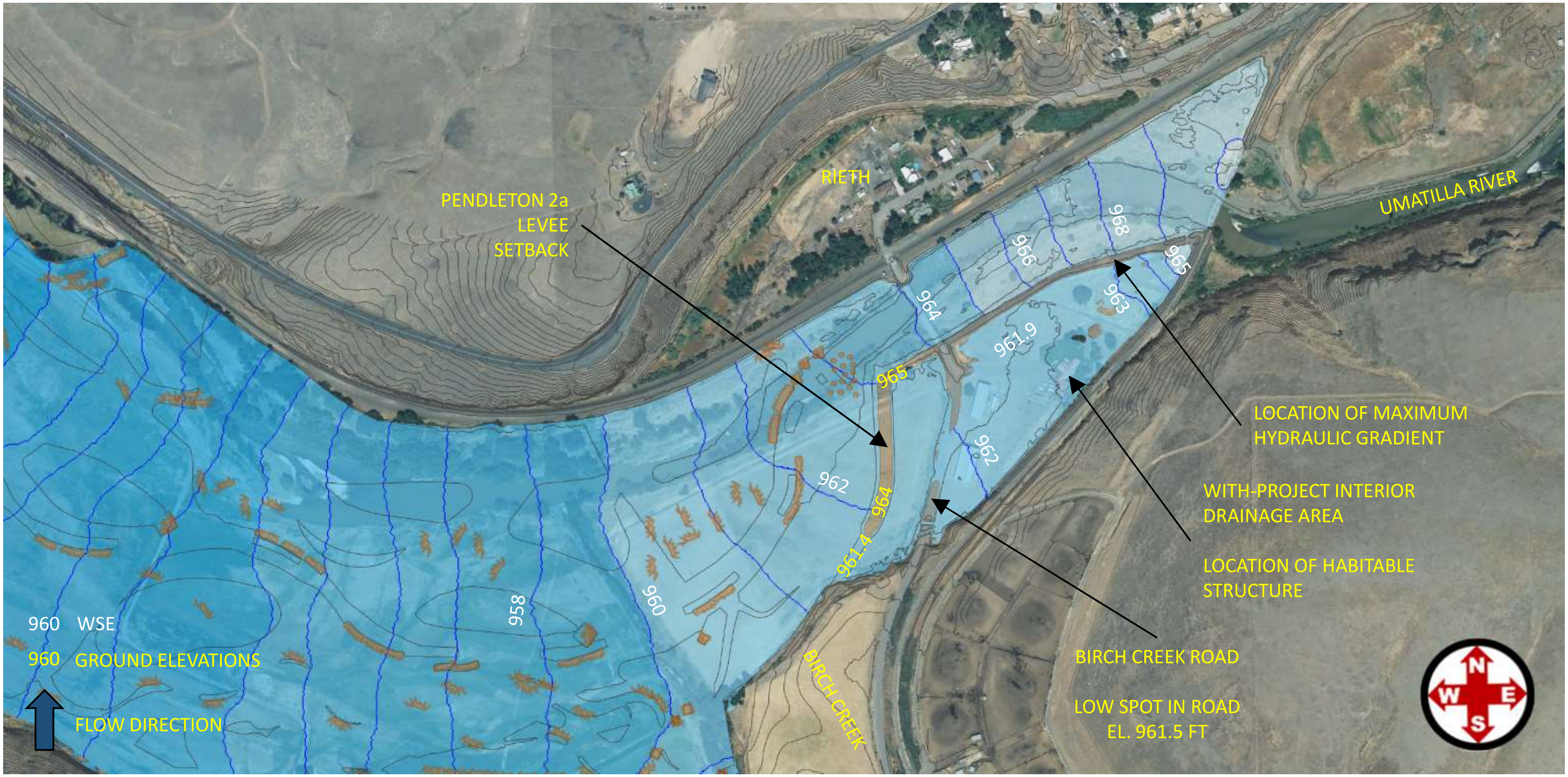
Q = 0.0675 cfs

Without-Project Seepage 100-Year




Water Surface Elevation on 'Profile Line 10'
elevation '10NOV2021 00:00:00'
'eg_v4_ex_100yr_interior' Profile
Value [feet]
1010
1000
990
980
970
960
Station [ft]
0
100
200
300
400
500
600
700
LOCATION OF MAXIMUM
HYDRAULIC GRADIENT

With-Project Seepage 100-Year



PENDLETON 2a
LEVEE
SETBACK

LOCATION OF MAXIMUM
HYDRAULIC GRADIENT

WITH-PROJECT INTERIOR
DRAINAGE AREA

LOCATION OF HABITABLE
STRUCTURE

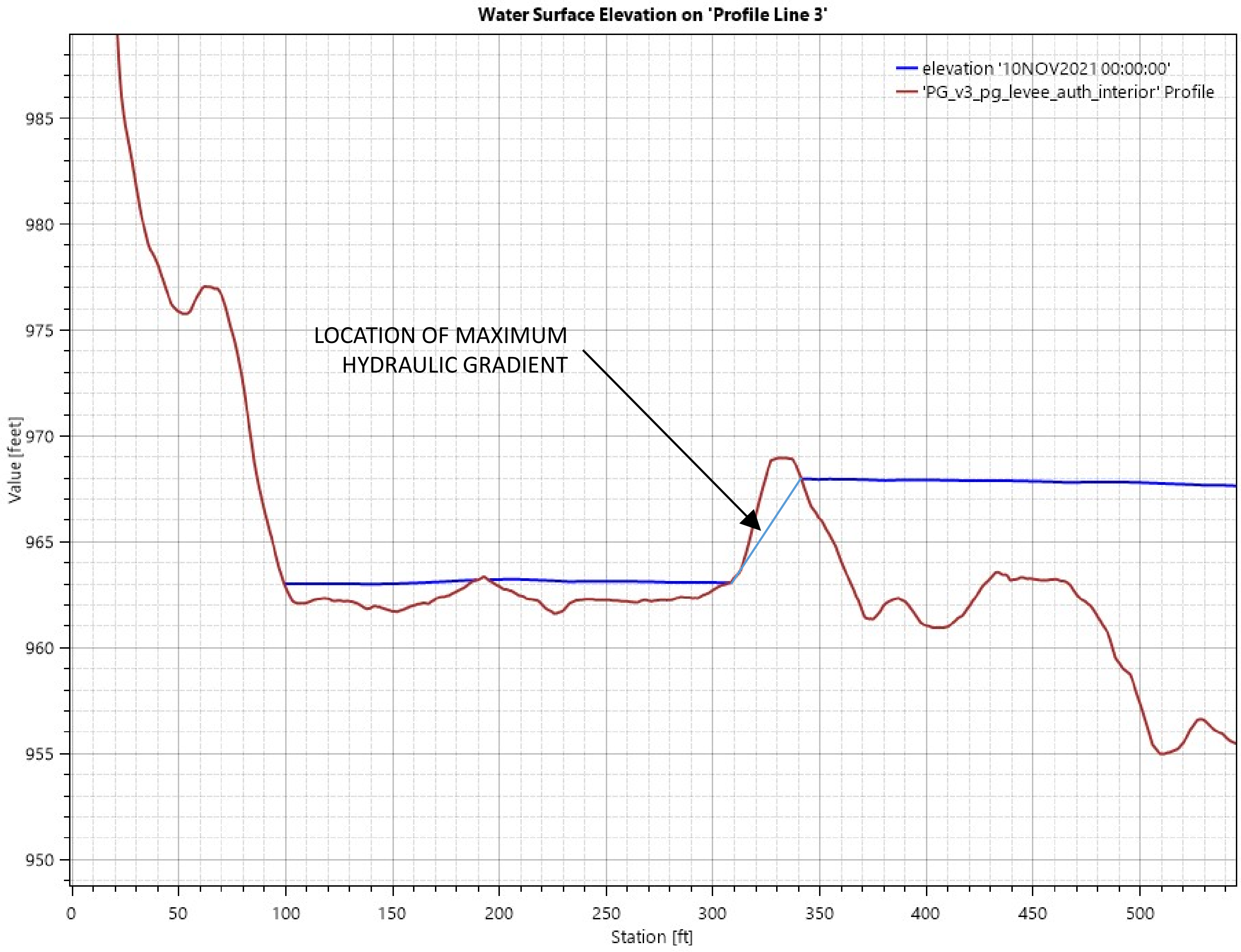
BIRCH CREEK ROAD

LOW SPOT IN ROAD
EL. 961.5 FT

960 WSE

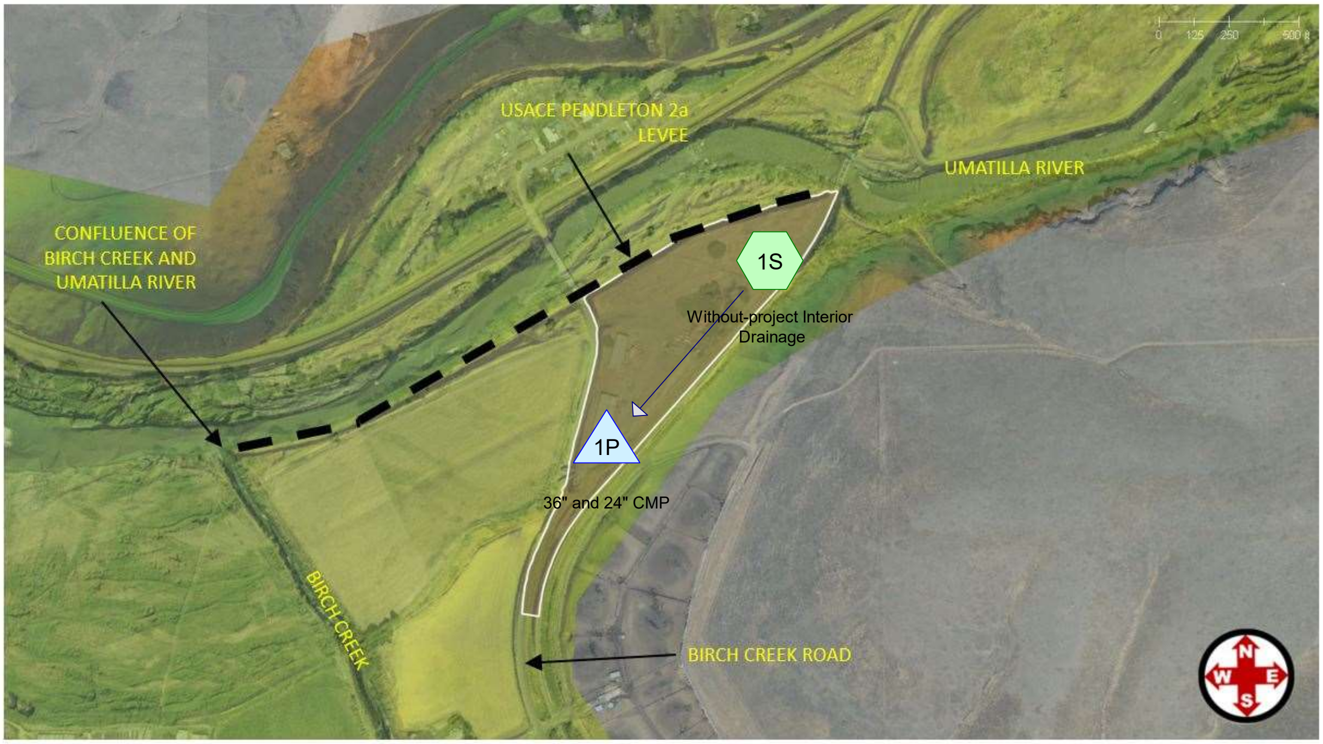
960 GROUND ELEVATIONS

FLOW DIRECTION



Water Surface Elevation on 'Profile Line 3'
elevation '10NOV2021 00:00:00'
'PG_v3_pg_levee_auth_interior' Profile
LOCATION OF MAXIMUM
HYDRAULIC GRADIENT
Value [feet]
985
980
975
970
965
960
955
950
0
50
100
150
200
250
300
350
400
450
500
Station [ft]

Attachment 2 – Without- and With-Project Conditions HydroCad Modeling Results



Subcat
Reach
Pond
Link

Routing Diagram for Without-Project Interior Drainage Analysis_90
Prepared by Tetra Tech, Printed 1/30/2024
HydroCAD® 10.20-2g s/n 03991 © 2022 HydroCAD Software Solutions LLC

```
                    Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points x 2
                    Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
          Reach routing by Dyn-Stor-Ind method  -  Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Without-project     Runoff Area=10.500 ac   11.90% Impervious   Runoff Depth=1.53"
                                 Flow Length=1,298'   Tc=34.3 min   CN=90   Runoff=12.77 cfs  1.340 af

Pond 1P: 36" and 24" CMP           Peak Elev=961.95'  Storage=10.837 af   Inflow=117.86 cfs  261.980 af
             Primary=31.92 cfs  76.835 af   Secondary=83.90 cfs  174.468 af   Outflow=115.82 cfs  251.303 af
```

Summary for Subcatchment 1S: Without-project Interior Drainage

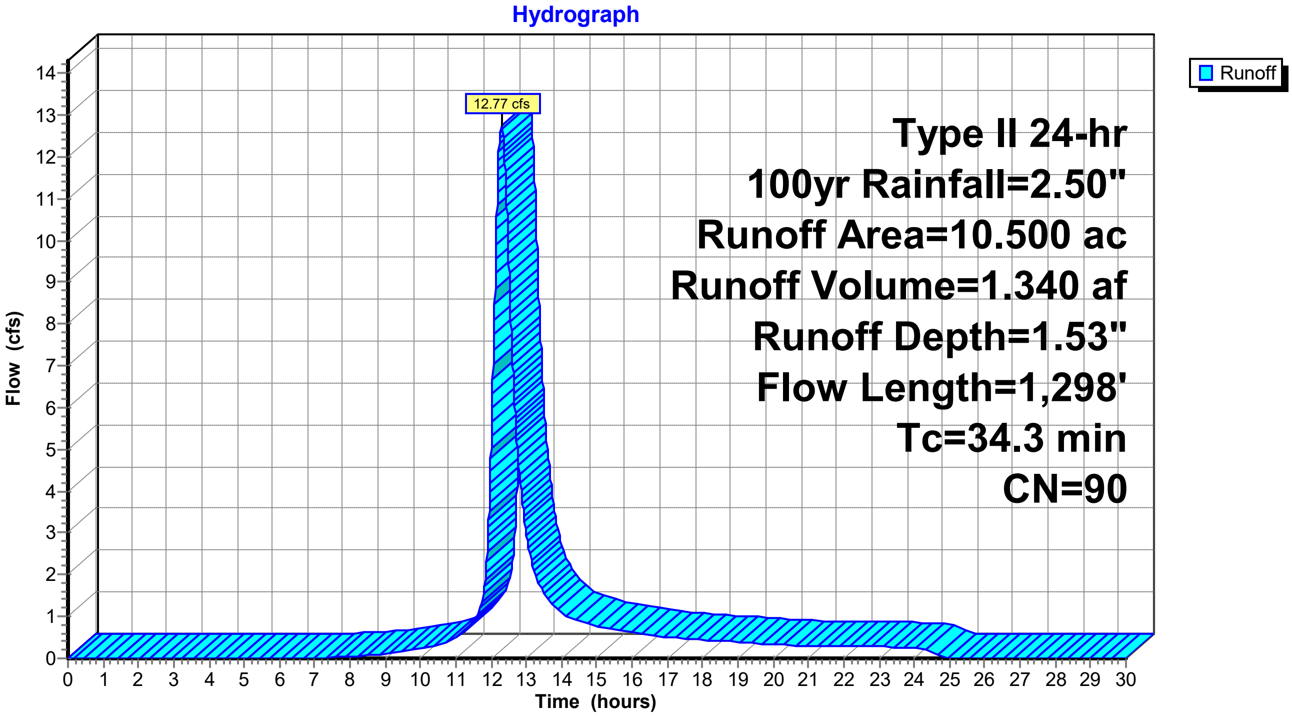
Runoff = 12.77 cfs @ 12.30 hrs, Volume= 1.340 af, Depth= 1.53"
Routed to Pond 1P : 36" and 24" CMP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 100yr Rainfall=2.50"

Area (ac)	CN	Description
2.500	93	Paved roads w/open ditches, 50% imp, HSG D
8.000	89	<50% Grass cover, Poor, HSG D
10.500	90	Weighted Average
9.250		88.10% Pervious Area
1.250		11.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	300	0.0133	0.30		**Sheet Flow,** Fallow n= 0.050 P2= 1.50"
17.5	998	0.0040	0.95		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
34.3	1,298	Total			

Subcatchment 1S: Without-project Interior Drainage



Summary for Pond 1P: 36" and 24" CMP

Tailwater set at a water surface elevation of 959 ft. as a result of the without-project hydraulic modeling of the Umatilla River and Birch Creek during the 100-year recurrence interval.

Added uncontrolled release of river water that seeps through railroad embankment, estimated at 105 cfs.

```
Inflow Area =      10.500 ac,  11.90% Impervious,  Inflow Depth >299.41"    for  100yr event
Inflow      =     117.86 cfs @  12.30 hrs,  Volume=       261.980 af,  Incl. 105.09 cfs Base Flow
Outflow     =     115.82 cfs @  12.44 hrs,  Volume=       251.303 af,  Atten= 2%,  Lag= 8.4 min
Primary     =      31.92 cfs @  12.44 hrs,  Volume=        76.835 af
Secondary =        83.90 cfs @  12.44 hrs,  Volume=       174.468 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 961.95' @ 12.44 hrs   Surf.Area= 6.361 ac   Storage= 10.837 af

Plug-Flow detention time= 73.4 min calculated for 251.176 af (96% of inflow)
Center-of-Mass det. time= 36.4 min ( 936.1 - 899.7 )

Volume        Invert    Avail.Storage   Storage Description
   #1         958.00'       41.737 af   Custom Stage Data (Irregular) Listed below (Recalc)

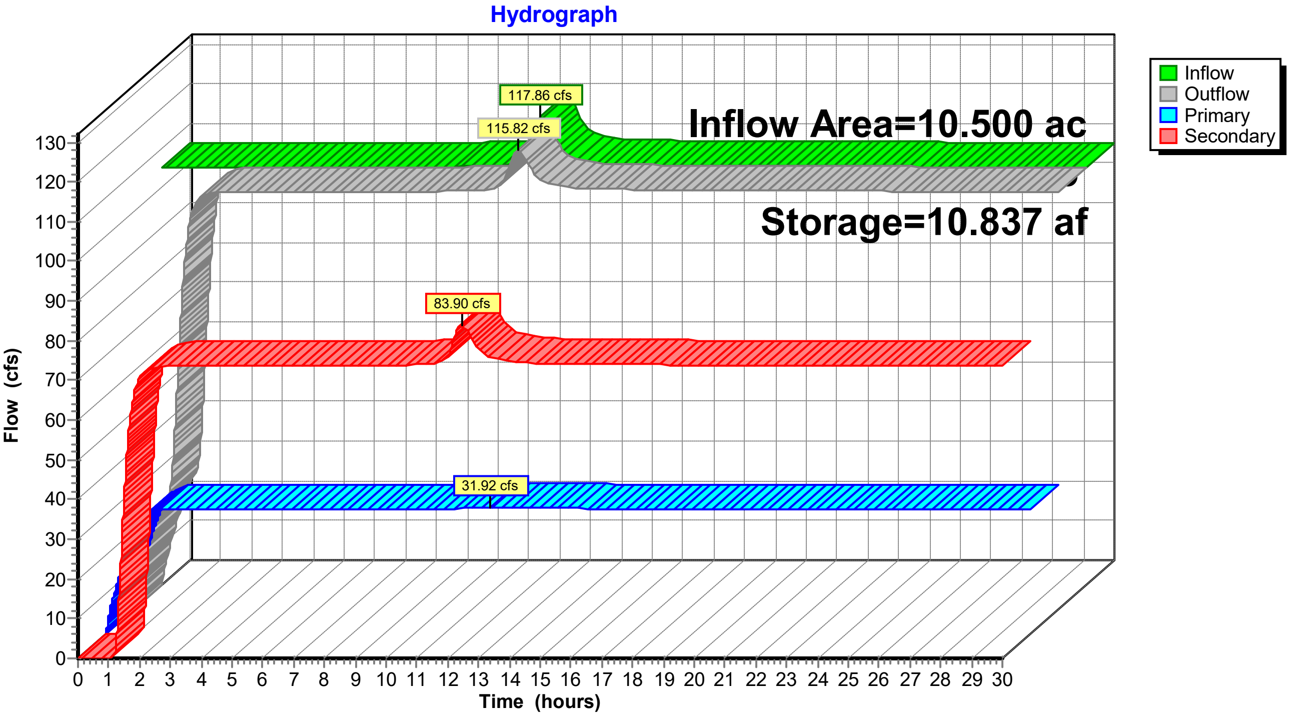
 Elevation     Surf.Area      Perim.        Inc.Store       Cum.Store        Wet.Area
    (feet)       (acres)      (feet)      (acre-feet)     (acre-feet)         (acres)
    958.00         0.000         0.0            0.000           0.000           0.000
    960.00         2.954     2,938.7            1.969           1.969          15.777
    962.00         6.467     3,265.9            9.195          11.164          19.488
    964.00         7.878     3,081.3           14.322          25.486          21.634
    966.00         8.376     3,123.3           16.251          41.737          22.131

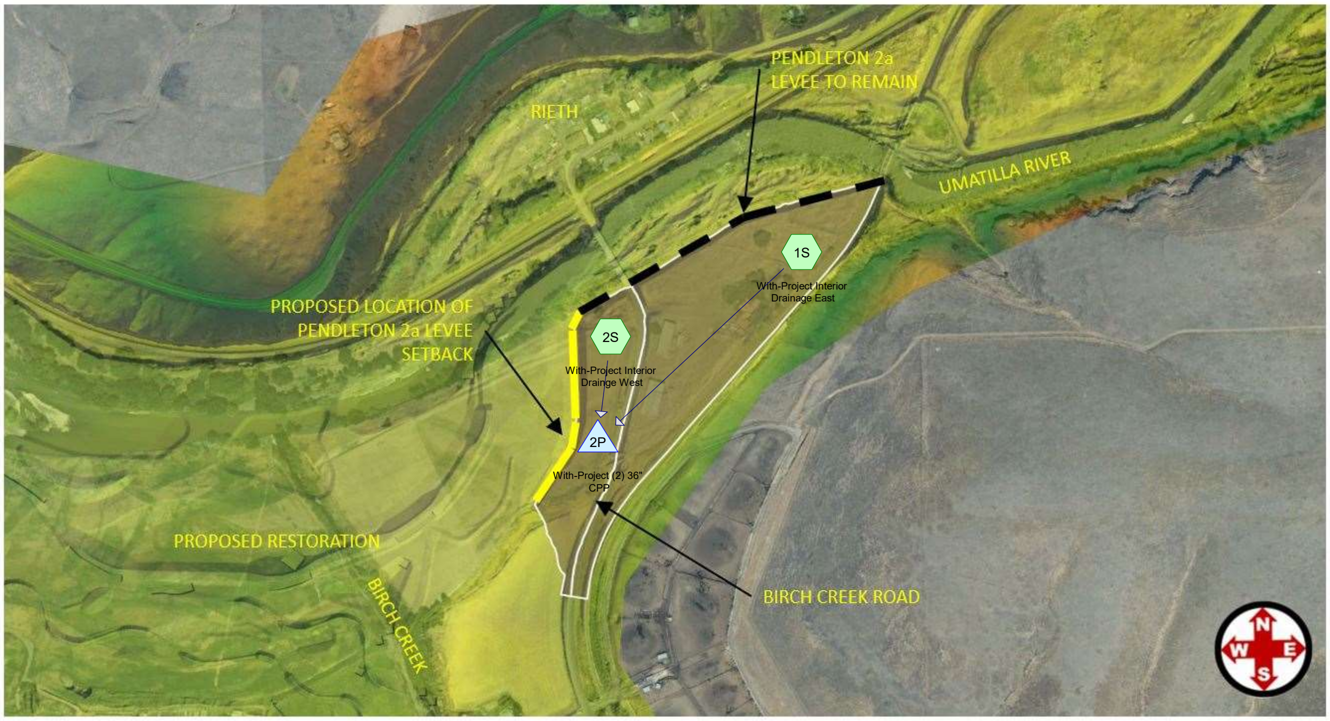
Device   Routing           Invert   Outlet Devices
   #1    Primary          958.63'   36.0"  Round CMP_Round  36"  w/ 7.2" inside fill
                                    L= 68.2'   CMP, mitered to conform to fill,  Ke= 0.700
                                    Inlet / Outlet Invert= 958.03' / 957.76'   S= 0.0040 '/'   Cc= 0.900
                                    n= 0.025  Corrugated metal,  Flow Area= 6.06 sf
   #2    Primary          960.30'   24.0"  Round CMP_Round  24"  w/ 10.0" inside fill
                                    L= 68.2'   CMP, mitered to conform to fill,  Ke= 0.700
                                    Inlet / Outlet Invert= 959.28' / 959.47'   S= -0.0028 '/'   Cc= 0.900
                                    n= 0.025  Corrugated metal,  Flow Area= 1.90 sf
   #3    Secondary        961.50'   Birch Creek Road, Cv= 2.62 (C= 3.28)
                                    Head (feet)  0.00  0.10  0.20  0.30  0.40  0.50
                                    Width (feet)  0.00  50.10  101.80  144.30  164.30  179.00

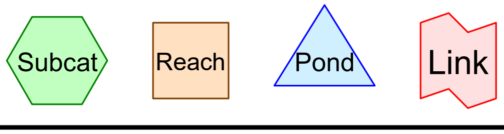
Primary OutFlow  Max=31.92 cfs @ 12.44 hrs  HW=961.95'   (Free Discharge)
├─1=CMP_Round  36"  (Barrel Controls 27.12 cfs @ 4.47 fps)
└─2=CMP_Round  24"  (Barrel Controls 4.80 cfs @ 2.52 fps)

Secondary OutFlow  Max=83.90 cfs @ 12.44 hrs  HW=961.95'   (Free Discharge)
└─3=Birch Creek Road  (Weir Controls 83.90 cfs @ 1.82 fps)
```

Pond 1P: 36" and 24" CMP







Routing Diagram for With-Project Interior Drainage Analysis_90
Prepared by Tetra Tech, Printed 1/30/2024
HydroCAD® 10.20-2g s/n 03991 © 2022 HydroCAD Software Solutions LLC

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: With-Project Interior Runoff Area=10.500 ac 11.90% Impervious Runoff Depth=1.53"
Flow Length=1,298' Tc=34.3 min CN=90 Runoff=12.77 cfs 1.340 af

Subcatchment 2S: With-Project Interior Runoff Area=4.500 ac 5.56% Impervious Runoff Depth=1.45"
Flow Length=550' Tc=26.5 min CN=89 Runoff=6.14 cfs 0.546 af

Pond 2P: With-Project (2) 36" CPP Peak Elev=961.92' Storage=19.631 af Inflow=123.55 cfs 262.476 af
Primary=0.00 cfs 0.000 af Secondary=121.91 cfs 242.996 af Outflow=121.91 cfs 242.996 af

Summary for Subcatchment 1S: With-Project Interior Drainage East

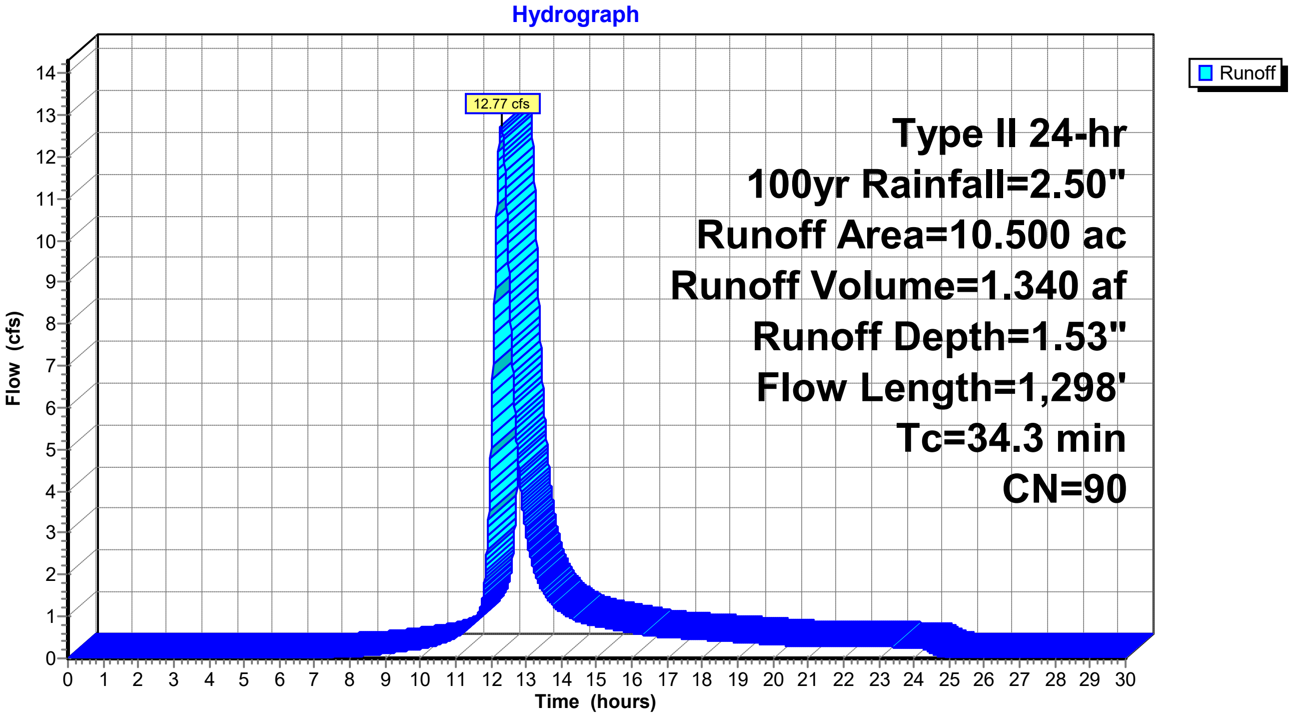
Runoff = 12.77 cfs @ 12.30 hrs, Volume= 1.340 af, Depth= 1.53"
Routed to Pond 2P : With-Project (2) 36" CPP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 100yr Rainfall=2.50"

Area (ac)	CN	Description
2.500	93	Paved roads w/open ditches, 50% imp, HSG D
8.000	89	<50% Grass cover, Poor, HSG D
10.500	90	Weighted Average
9.250		88.10% Pervious Area
1.250		11.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	300	0.0133	0.30		**Sheet Flow,** Fallow n= 0.050 P2= 1.50"
17.5	998	0.0040	0.95		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
34.3	1,298	Total			

Subcatchment 1S: With-Project Interior Drainage East



Summary for Subcatchment 2S: With-Project Interior Drainge West

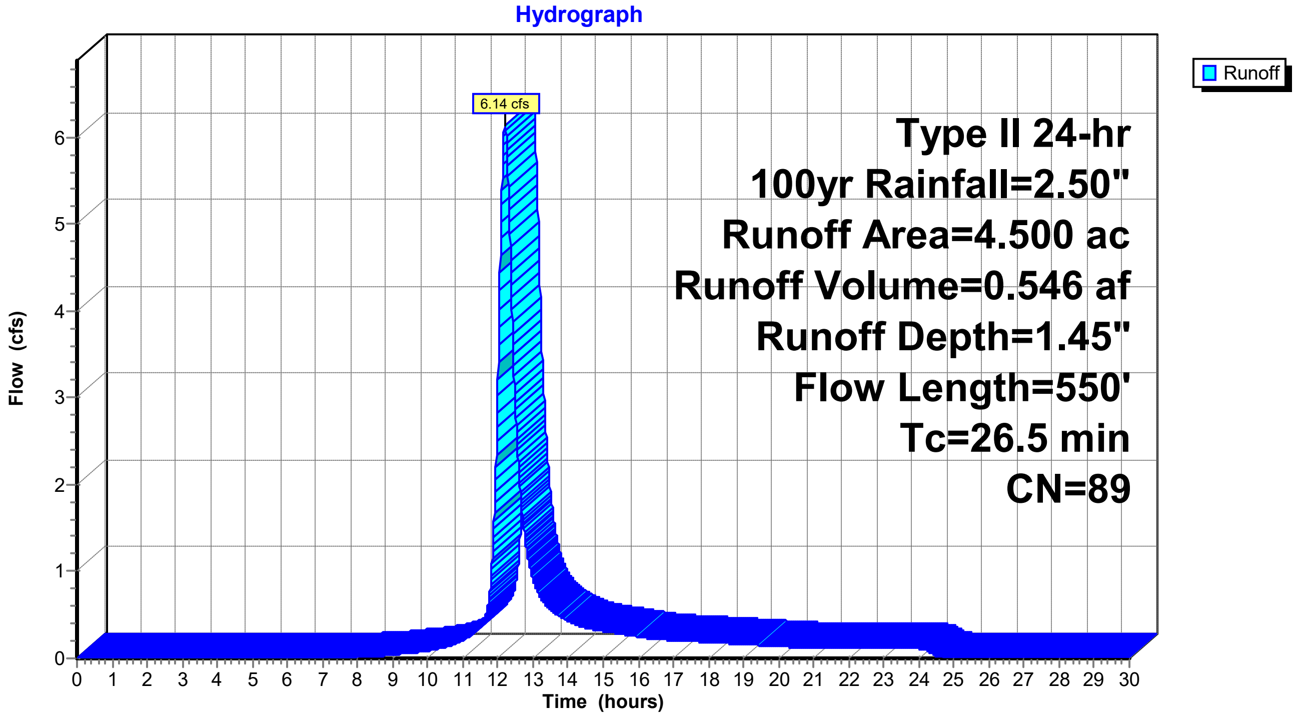
Runoff = 6.14 cfs @ 12.20 hrs, Volume= 0.546 af, Depth= 1.45"
Routed to Pond 2P : With-Project (2) 36" CPP

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 100yr Rainfall=2.50"

Area (ac)	CN	Description
4.000	89	<50% Grass cover, Poor, HSG D
0.500	93	Paved roads w/open ditches, 50% imp, HSG D
4.500	89	Weighted Average
4.250		94.44% Pervious Area
0.250		5.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.2	300	0.0067	0.23		**Sheet Flow,** Fallow n= 0.050 P2= 1.50"
4.3	250	0.0092	0.96		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
26.5	550	Total			

Subcatchment 2S: With-Project Interior Drainge West



Summary for Pond 2P: With-Project (2) 36" CPP

Discharge multiplier set at 0 for the gravity culverts to represent 100-year Umatilla River and Birch Creek flooding conditions with equipped check valves closed.

Inflow Area = 15.000 ac, 10.00% Impervious, Inflow Depth >209.98" for 100yr event
Inflow = 123.55 cfs @ 12.26 hrs, Volume= 262.476 af, Incl. 105.07 cfs Base Flow
Outflow = 121.91 cfs @ 12.36 hrs, Volume= 242.996 af, Atten= 1%, Lag= 6.2 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to nonexistent node 3L
Secondary = 121.91 cfs @ 12.36 hrs, Volume= 242.996 af
Routed to nonexistent node 3L

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 961.92' @ 12.36 hrs Surf.Area= 9.239 ac Storage= 19.631 af

Plug-Flow detention time= 133.9 min calculated for 242.953 af (93% of inflow)
Center-of-Mass det. time= 66.8 min (966.4 - 899.6)

Volume	Invert	Avail.Storage	Storage Description
#1	956.70'	20.335 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

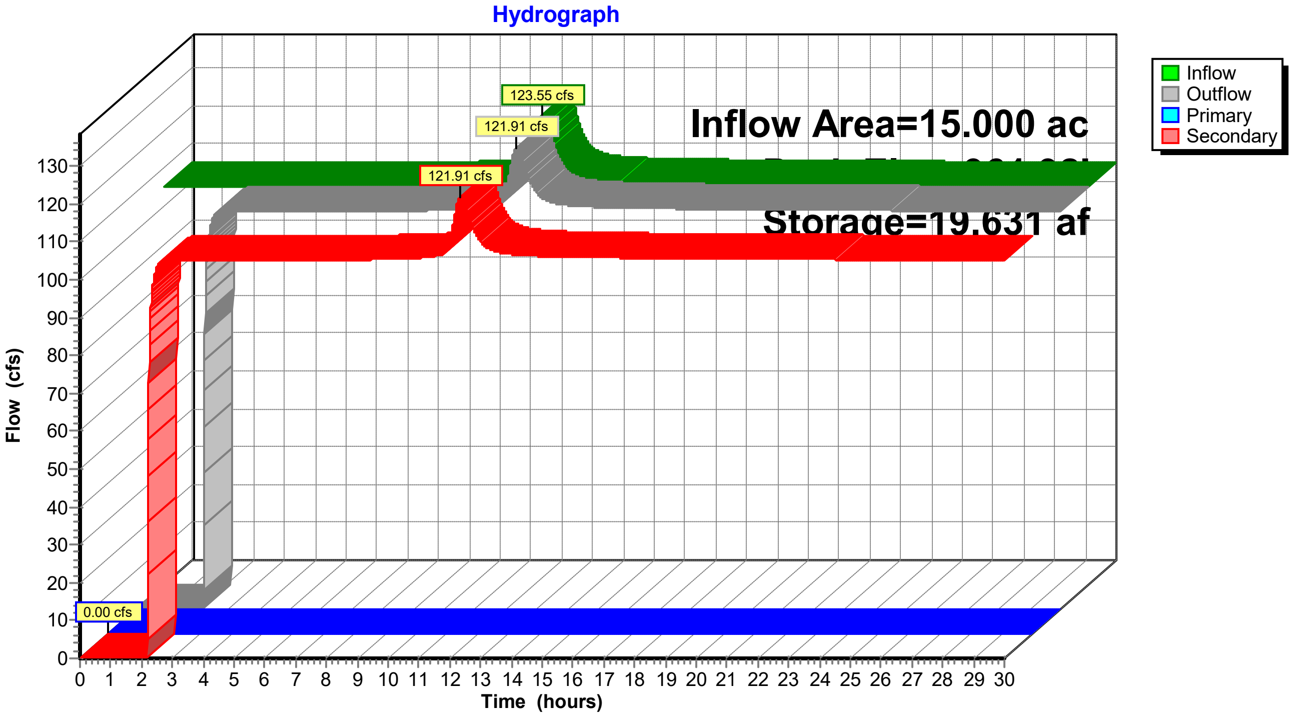
Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
956.70	0.000	0.0	0.000	0.000	0.000
958.00	0.610	946.0	0.264	0.264	1.635
959.00	2.270	3,644.0	1.352	1.617	24.258
960.00	5.230	5,427.0	3.649	5.265	53.805
961.00	7.830	5,342.0	6.486	11.752	55.482
962.00	9.360	4,994.0	8.584	20.335	62.054

Device	Routing	Invert	Outlet Devices
#1	Primary	956.60'	**36.0" Round Gravity Culverts X 0.00** L= 70.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 956.60' / 956.05' S= 0.0079 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 7.07 sf
#2	Secondary	961.40'	**Pendleton 2a Levee Setback, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.60 Width (feet) 180.00 190.00

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=957.41' TW=961.85' (Fixed TW Elev= 961.85')
↑—**1=Gravity Culverts** (Controls 0.00 cfs)

Secondary OutFlow Max=123.21 cfs @ 12.36 hrs HW=961.92' TW=961.85' (Fixed TW Elev= 961.85')
↑—**2=Pendleton 2a Levee Setback** (Weir Controls 123.21 cfs @ 1.27 fps)

Pond 2P: With-Project (2) 36" CPP



Attachment 3 – Thermoplastic Pipe Design Results

BY JSA DATE 12/4/2024 SHEET 1 OF 10

CHKD. BY JV & NS DATE 12/09/2024 & 12/12/24 CHARGE NUMBER 194-1045-0003

CLIENT CTUIR

SUBJECT USACE Levee Pendleton 2a Setback Culvert Calculation

Design Requirements for thermoplastic pipe summary:

Service limit state:

Deflection: total deflection (Δ_t) due to loading must not exceed the allowable deflection (Δ_A)

$\Delta_t \leq \Delta_A$

0.378 inches ≤ 1.8 inches

deflection check is OK, see step 7 below for details.

Strength-based limit state:

Thrust: $\varepsilon_{US} \leq \phi_T * \varepsilon_{yc}$

0.00312 in/in ≤ (1.0) · (0.037 in/in) = 0.037 in/in

check is OK for thrust strain limit, see steps 4.3 below for details.

Global/localized buckling: $\varepsilon_{UC} \leq \phi_{bck} * \varepsilon_{bck}$

0.00214 in/in ≤ (0.67) *(0.56 in/in) = 0.377 in/in

global buckling strain check is OK, see step 5.3 below for details.

Combined Strain: εf – min(εUC, εUS) ≤ ϕf * εyt

0.00796 ≤ 0.025

εf + max(εUC, εUS) ≤ ϕT * (1.5 * εyc)

0.0132 ≤ 0.0555

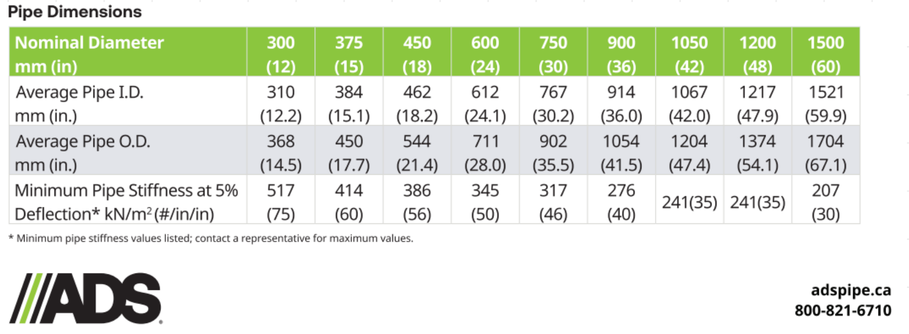
combined strain check for compression is OK, see step 6.3 below for details.

Embankment information:

- Depth of embankment fill over top of pipe (H_E) = 5.4 feet
- Depth of water above springline of pipe (Hw) = 0 feet
- Embankment unit weight (γs) = 125 lb/ft3
- Poisson's ratio for embankment material (v) = 0.35
- Constrained soil modulus (Ms) = 20 kip/in2

Pipe geometric design properties (36-inch nominal diameter) based on the average of 3 pipe manufactures:

1) ADS HP Storm Pipe, 36" ID:



Pipe Dimensions

Nominal Diameter mm (in)	300 (12)	375 (15)	450 (18)	600 (24)	750 (30)	900 (36)	1050 (42)	1200 (48)	1500 (60)
Average Pipe I.D. mm (in.)	310 (12.2)	384 (15.1)	462 (18.2)	612 (24.1)	767 (30.2)	914 (36.0)	1067 (42.0)	1217 (47.9)	1521 (59.9)
Average Pipe O.D. mm (in.)	368 (14.5)	450 (17.7)	544 (21.4)	711 (28.0)	902 (35.5)	1054 (41.5)	1204 (47.4)	1374 (54.1)	1704 (67.1)
Minimum Pipe Stiffness at 5% Deflection* kN/m² (#/in/in)	517 (75)	414 (60)	386 (56)	345 (50)	317 (46)	276 (40)	241(35)	241(35)	207 (30)

* Minimum pipe stiffness values listed; contact a representative for maximum values.

ADS

adspipe.ca
800-821-6710

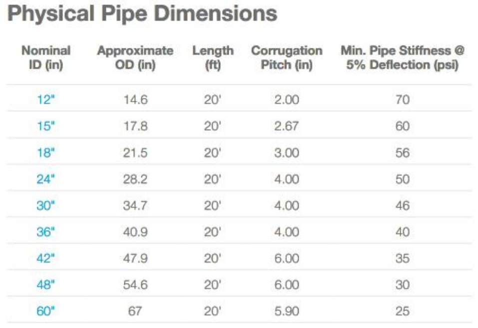
2) Pacific Pipe:

Dual-Wall (Type S) Plain End

Specification Chart

Nominal Inside Diameter (Inches)	Outside Diameter (Inches)	Minimum Wall Stiffness (psi)	Minimum Wall Thickness (Inches)	Lengths (Feet)	Weight (lbs./ft.)	Solid, Perforated or Both	Perforation Class 1,2 or Both*
8	9.4	50.0	0.025	20	1.6	Both	Class 2 Slotted
10	11.8	50.0	0.025	20	2.5	Both	Class 2 Slotted
12	14.9	50.0	0.035	20	3.3	Both	Both
15	17.5	42.0	0.040	20	4.9	Both	Both
18	21.5	40.0	0.050	20 & 30	6.5	Both	Both
24	27.9	34.0	0.060	20 & 30	11.4	Both	Both
30	35.7	29.0	0.060	20 & 30	15.0	Both	Both
36	42.1	22.5	0.070	20 & 30	19.6	Both	Both

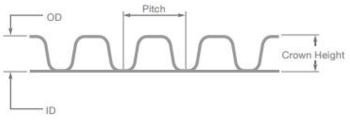
3) Prinsco Pipe:



Physical Pipe Dimensions

Nominal ID (in)	Approximate OD (in)	Length (ft)	Corrugation Pitch (in)	Min. Pipe Stiffness @ 5% Deflection (psi)
12"	14.6	20'	2.00	70
15"	17.8	20'	2.67	60
18"	21.5	20'	3.00	56
24"	28.2	20'	4.00	50
30"	34.7	20'	4.00	46
36"	40.9	20'	4.00	40
42"	47.9	20'	6.00	35
48"	54.6	20'	6.00	30
60"	67	20'	5.90	25

Pipe Cross Section



- Outside diameter (Do) = average (41.5, 42.1, 40.9 inches) = 41.5 inches = 3.46 feet
- Inside diameter (Di) = 36.0 inches
- Diameter to centroid (D) = 38.2 inches
    - The centroid diameter, D, is the diameter at the pipe corrugation geometric centroid and is determined from the geometric centroid of one corrugation period, calculated as Di + 2yv, 36+2*1.1=38.2 inches.
- Radius to centroid of pipe wall (R) = D/2=19.1 inches

Corrugation Effective Area:

$$Aeff = Ag - \frac{\Sigma(wi - b_{e,i})ti}{\omega}$$

Where,

Aeff =corrugation effective area per unit length of pipe for local bucking resistance in2/in
Ag =corrugation gross area per unit length of pipe, in2/in
wi =clear width between adjoining elements of corrugation element I, in
be,I =effective width of corrugation element, I, calculated according to equation 7.4, in
ti =thickness of corrugation element, i, in.
ω =period of corrugation, in
be,I = iwi
I =effective width factor of corrugation element, i, calculated according to equation below

$$\rho i = \frac{1-\left(\frac{0.22}{\lambda i}\right)}{\lambda i} \leq 1$$

$\lambda = slenderness\ factor\ of\ corrugation\ element, i, calculated\ according\ to\ \ the\ equation\ below$

$$\lambda i = \left(\frac{wi}{ti}\right) * \sqrt{\frac{\varepsilon yc}{ki}} \geq 0.673$$

ε_{yc} = pipe material compression strain limit, in./in. and
ki = plate buckling edge support coefficient for corrugation element, i.

For elements supported by an adjoining element at both ends, ki = 4. For elements supported by an adjoining element at only one end (e.g., free-standing ribs), ki = 0.43. For elements with stiffeners, ki should be calculated as described herein.

Idealization of Corrugation with Curved Elements

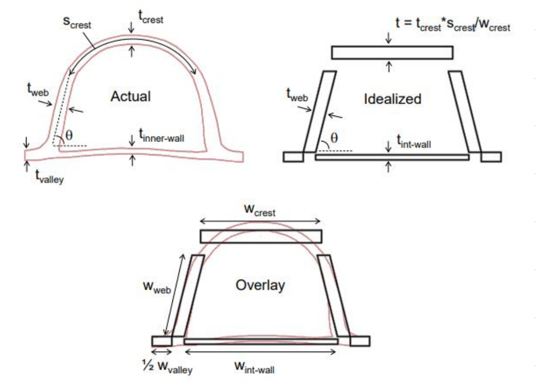


Figure 7.12: Example idealization of corrugation with curved crest

Element	ε_{yc}	ki	ti	wi	Ag	λi	ρi	be,i	(Wi-be,i)*ti
Interior Wall	0.037	4	0.07	2.7	0.189	3.710	0.254	0.685	0.1411
½ valley	0.037	4	0.09	0.65	0.059	0.695	0.984	0.639	0.0010
½ Valley	0.037	4	0.09	0.65	0.059	0.695	0.984	0.639	0.0010
Web Left	0.037	4	0.07	2.4	0.168	3.297	0.283	0.679	0.1205
Web Right	0.037	4	0.07	2.4	0.168	3.297	0.283	0.679	0.1205
Crest	0.037	4	0.07	1.7	0.119	2.336	0.388	0.659	0.0729

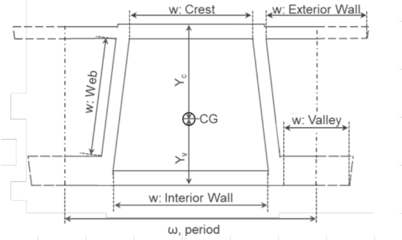
$$\Sigma Ag = 0.761$$

$$\Sigma(\mathrm{Wi} - \mathrm{be,i}) * \mathrm{ti} = 0.4567$$

$$Aeff = Ag - \frac{\Sigma(wi - b_{e\ ,i})ti}{\omega} = 0.761 - \frac{0.4567}{4} = 0.6468$$

In this formula, the overall moment of inertia (I) is calculated by summing the moment of inertia of each element about its own centroid plus the product of the element's cross-sectional area (A) and the square of the distance from the element's own centroid to the centroid of full cross section (d). The key here is that the area of each individual element contributes to the overall moment of inertia by the square of the distance from it's own centroid to the centroid of section.

$$I_{X-X} = \sum \left(I_{x-x} + Ad^2 \right)$$



Element	Ti	Wi	Area	Ix	d	I+Ad2
Interior Wall	0.07	2.7	0.189	0.000	1.070	0.216
½ valley	0.09	0.65	0.059	0.000	1.060	0.066
½ Valley	0.09	0.65	0.059	0.000	1.060	0.066
Web Left	0.07	2.4	0.168	0.081	0.280	0.094
Web Right	0.07	2.4	0.168	0.081	0.280	0.094
Crest	0.07	1.7	0.119	0.000	1.620	0.312

- Moment of inertia Ip = $\Sigma(\mathrm{I} + Ad^2)$= 0.848 in4

Pipe material design properties:
- Short-term modulus of elasticity (Eps) = 175 kip/in2
- Long-term modulus of elasticity (Epl) = 28 kip/in2
- Tensile limiting strain for combined strain (εyt) = 0.025 in/in
- Factored compressive strain limit (ε_{yc}) = 0.037 in/in

Miscellaneous factors:
- Plate buckling coefficient (k) = 4.0
- Bedding coefficient (Kb) = 0.1
- Deflection lag factor (DL) = 1.5
- Coefficient for thrust variation at the crown (K2c) = 0.6
- Coefficient for thrust variation at the springline (K_{2s}) = 1.0

Applicable load factors and modifiers:
- Earth load factor (γ_{EV}) = 1.3
- Live load factor (γ_{LL}) = 1.75
- Combined redundancy and importance load modifier (η_{ri}) = (1.05) · (1.05) = 1.1
- Installation factor (K_E) = 1.5

Resistance factors:
- Thurst (φT) = 1.0
- Soil stiffness (φs) = 0.9
- Flexure (φf) = 1.0
- Global buckling (φbck) = 0.67

Step 1. CALCULATE PIPE STIFFNESS (PS)

$$PS = \frac{Eps * Ip}{0.149 * Ro^3} = \frac{175{,}000 * 0.848}{0.149 * 19.35^3} = 137.5\ \frac{lb}{in^2}$$

Step 2. DETERMINE LOADS ACTING ON PIPE

2.1 Soil prism Pressure

$$Psp = (H_E + 0.11 * Do) * \gamma s \qquad \text{since } Hw < 0.5 * Do$$
$$Psp = (5.4 + 0.11 * 3.5) * 125 = 723.1\ lb/ft^2 = 5.02\ lb/in^2$$

2.2 Hydrostatic Water Pressure

$P_w = 0$ since the ground water level is below the spring line of the pipe

2.3 Live Load

Hint-w = interaction depth of wheels on single axle, ft ;
Hint-a = interaction depth of consecutive heavy axles on a single truck, ft;
sw = wheel center spacing on single axle (across vehicle) = 6 ft for AASHTO vehicles;
sa = axle center spacing (along vehicle) = 14 ft for AASHTO
wt = width of ground surface tire contact area = 1.67 ft for AASHTO vehicles;
lt = length of ground surface tire contact area, = 0.83 ft for AASHTO vehicles;
Di = inside diameter of pipe, ft; and,
LLDF = live load distribution factor = 1.15.

$$\text{Hint} - \text{w} = \frac{\text{SW} - \text{WT} - 0.06\text{Di}}{\text{LLDF}}$$

$$Hint - w = \frac{6 - 1.67 - 0.06 * 3}{1.15} = 3.6'$$

$$\text{Hint} - \text{a} = \frac{\text{Sa} - \text{Lt}}{\text{LLDF}}$$

$$Hint - a = \frac{14 - 0.83}{1.15} = 11.45'$$

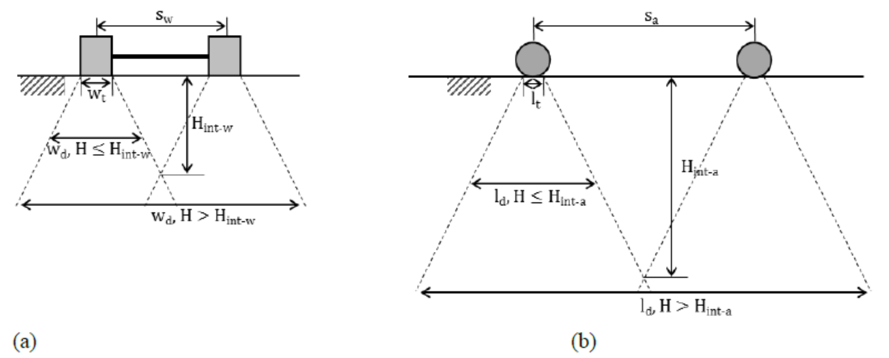


Figure 7.16: Live load distribution through soil fill for wheels on a (a) single axle, and for (b) two axles

The distributed width, w_d, and length, l_d, of the live load at depth are calculated as based on the depth of fill. When the fill depth, *H*, is less than the interaction depths, $H_{int\text{-}w}$ and $H_{int\text{-}a}$, the length and width of the live load distribution area at depth, l_d and w_d, respectively, are calculated

$$L_d = L_t + LLDF * H$$

$$W_d = W_t + LLDF * H + 0.06 * D_i$$

Wd = distributed width of live load pressure at top of pipe, ft;
ld = distributed length of live load pressure at top of pipe, ft; and,
H = height of fill above top of pipe, ft (m). 5.4 ft.

When the fill depth, H, is greater than the wheel interaction depth, Hint-w, the width of the live load distribution area at depth is calculated according to:

$$Wd = Wt + Sw + LLDF * H + 0.06 * \ Di$$

Where the fill depth, H, is greater than the axle interaction depth, Hint-a, the length of the live load distribution area at depth is calculated according to

$$Ld = Lt + Sa + LLDF * h$$

$$\mathrm{H = 5.4\ ft > (Hint - w = 3.6') \ \& < (Hit - a = 11.45'), so\ use}$$

$$L_d = L_t + LLDF * H$$

$$L_d = 0.83 + 1.15 * 5.4 = 7.0'$$

$$Wd = Wt + Sw + LLDF * H + 0.06\, Di$$

$$Wd = 1.67 + 6 + 1.15 * 5.4 + 0.06 * \ 3 = \ 14.1'$$

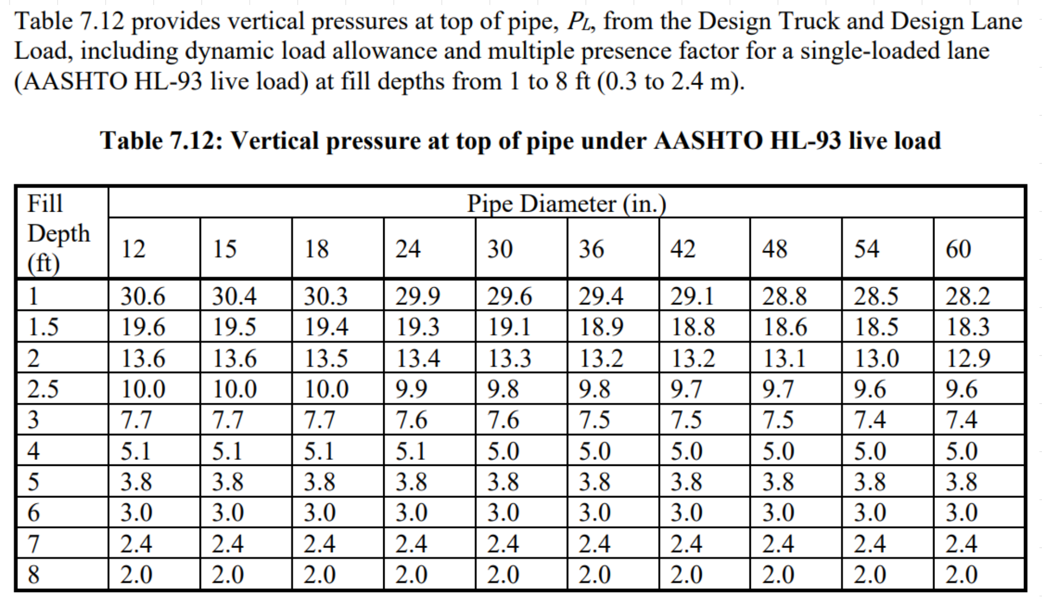


Table 7.12 provides vertical pressures at top of pipe, P_L, from the Design Truck and Design Lane Load, including dynamic load allowance and multiple presence factor for a single-loaded lane (AASHTO HL-93 live load) at fill depths from 1 to 8 ft (0.3 to 2.4 m).

Table 7.12: Vertical pressure at top of pipe under AASHTO HL-93 live load

Fill Depth (ft)	Pipe Diameter (in.)									
	12	15	18	24	30	36	42	48	54	60
1	30.6	30.4	30.3	29.9	29.6	29.4	29.1	28.8	28.5	28.2
1.5	19.6	19.5	19.4	19.3	19.1	18.9	18.8	18.6	18.5	18.3
2	13.6	13.6	13.5	13.4	13.3	13.2	13.2	13.1	13.0	12.9
2.5	10.0	10.0	10.0	9.9	9.8	9.8	9.7	9.7	9.6	9.6
3	7.7	7.7	7.7	7.6	7.6	7.5	7.5	7.5	7.4	7.4
4	5.1	5.1	5.1	5.1	5.0	5.0	5.0	5.0	5.0	5.0
5	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
6	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
7	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
8	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

H=5.4’ and at 5’ Pl = 3.8 psi and at 6’ Pl=3.0 psi, hence at 5.4’ of fill Pl = 3.3 psi

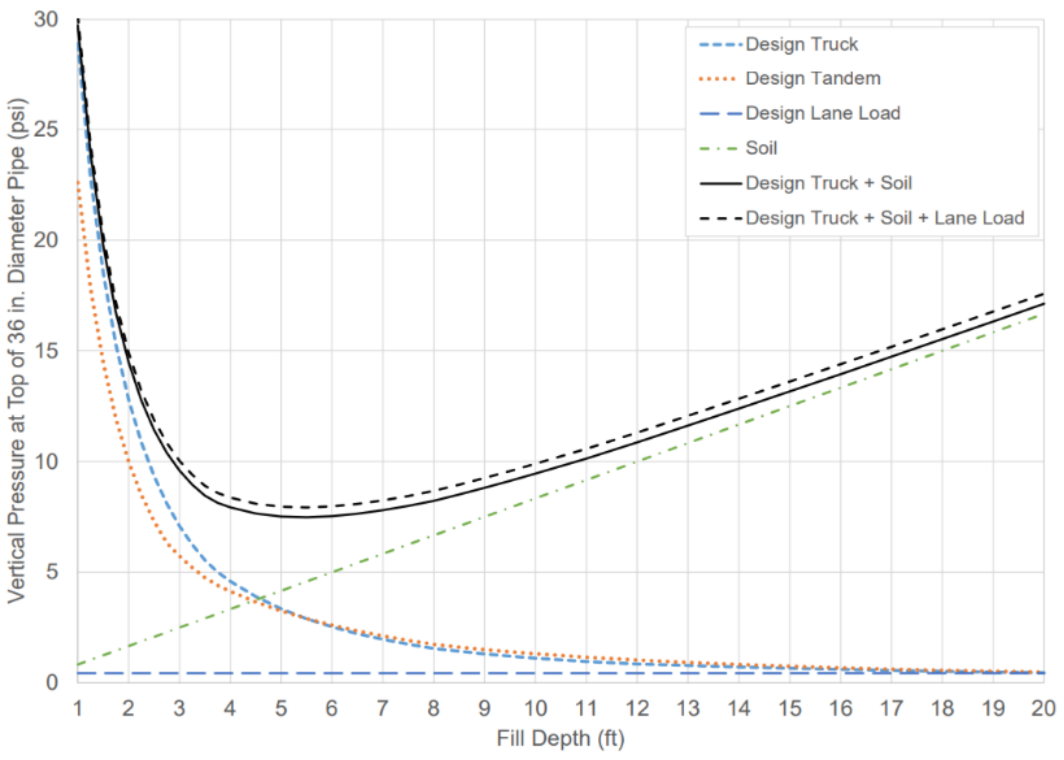


Figure 7.17: Vertical pressures at top of 36 in. (90-cm) diameter pipe

3.0 Calculate Thrust In Pipe:

3.1 Hoop Stiffness Factor

$$Sh = \frac{\partial s * Ms * R}{Epl * Ag} = \frac{0.9 * 20{,}000 * 19.1}{28{,}000 * 0.761} = 16.13$$

3.2 Vertical Arching factor (VAF)

$$VAF = 0.76 - 0.71 * \left(\frac{Sh-1.17}{Sh+2.92}\right) = 0.76 - 0.71 * \left(\frac{16.13-1.17}{16.13+2.92}\right) = 0.20$$

3.3 *Service Thrust Loads*

$$Tsc = (K2c * VAF * Psp + Pl * Cl * F1 * F2) * \frac{Do}{2}$$

Cl = Ld/Do = 7.0/3.5 = 2.1 = Use CL=1 (Must be less than or equal to 1.0)
F1= Max (0.75*Do/ld, 15/Di, 1.0) = 1.0
F2= 0.95/(1+.6*Sh) = 0.09

$$Tsc = (0.6 * 0.2 * 5.02 + 3.3 * 1 * 1 * 0.09) * \frac{41.5}{2} = 18.7\ \frac{lbs}{in}$$

$$Tss = (1.0 * 0.2 * 5.02 + 3.3 * 1 * 1 * 0.09) * \frac{41.5}{2} = 27.0\ \frac{lbs}{in}$$

3.4 Calculate Factored thrust Loads

$$Tuc = (\eta ri * (\gamma ev * Ke * K2c * VAF * Psp + \gamma w * Pw) + \ \eta ll * \gamma ll * Pl * Cl * F1 * F2) * \frac{Do}{2}$$

Pw = 0, assumes water below spring line

$$Tuc = (1.1 * (1.3 * 1.5 * 0.6 * 0.2 * 5.02 + 0) + (1.1 * 1.75 * 3.3 * 1 * 1 * .09) * \frac{41.5}{2}\ = 38.7\frac{lb}{in}$$

$$Tus = (\eta ri * (\gamma ev * Ke * K2s * VAF * Psp + \gamma w * Pw) + \ \eta ll * \gamma ll * Pl * Cl * F1 * F2) * \frac{Do}{2}$$

$$Tus = (1.1 * (1.3 * 1.5 * 1.0 * 0.2 * 5.02 + 0) + (1.1 * 1.75 * 3.3 * 1 * 1 * .09) * \frac{41.5}{2}\ = 56.6\frac{lb}{in}$$

4.0 Check Thrust strain limit state

4.1 Service thrust strain

The service compressive strain at the crown of the pipe due to thrust (εSC) is calculated using AASHTO Equation 12.12.3.10.1c-2 as follows:

$$\varepsilon sc = \frac{Tsc}{1000 * Aeff * Epl} = \frac{18.7}{1000 * 0.6468 * 28} = 0.001033\frac{in}{in}$$

The service compressive strain at the spring line of the pipe due to thrust (εSS) is calculated using the same equation as follows:

$$\varepsilon ss = \frac{Tss}{1000 * Aeff * Epl} = \frac{26.9}{1000 * 0.6468 * 28} = 0.001491\frac{in}{in}$$

4.2 Calculate factored thrust strain

The factored compressive strain at the crown of the pipe due to thrust (εUC) is calculated using AASHTO Equation 12.12.3.10.1c-1 as follows:

$$\varepsilon uc = \frac{Tuc}{1000 * Aeff * Epl} = \frac{38.7}{1000 * 0.6468 * 28} = 0.00214\frac{in}{in}$$

The factored compressive strain at the spring line of the pipe due to thrust (εUS) is calculated using the same equation as follows:

$$\varepsilon us = \frac{Tus}{1000 * Aeff * Epl} = \frac{56.6}{1000 * .744 * 28} = 0.00312\frac{in}{in}$$

4.3 Check Factored Thrust strain against limit

The maximum factored thrust strain (εUS) calculated in the previous sub-step must not exceed the factored compression strain limit for the pipe wall material as per AASHTO Equation 12.12.3.10.1d-1 as follows:

$$\varepsilon_{US} \leq \phi T \cdot \varepsilon yc$$

0.00312 in/in ≤ (1.0) · (0.037 in/in) = 0.037 in/in check is OK for thrust strain limit

Step 5 Check Global Buckling Strain Limit State

5.1 Determine the correction factor for backfill

Using AASHTO Equation 12.12.3.10.1e-3, determine the value for Rh for input into buckling equation.

$$Rh = \frac{11.4}{11 + \left(\frac{D}{12 * He}\right)} = \frac{11.4}{11 + \left(\frac{38.2}{12 * 5.4}\right)} = 0.984$$

5.2 Determine the correction factor for backfill

The global buckling strain capacity (εbck) is computed using AASHTO Equation 12.12.3.10.1e-2 as follows: Cn = calibration factor for nonlinear effects = 0.55;

$$\varepsilon bck = \frac{1.2 * Cn * (Epl * Ip)^{\frac{1}{3}}}{Aeff * Epl} * \left(\frac{\varphi S * Ms * (1 - 2v)}{(1 - v)^2}\right)^{\frac{2}{3}} * Rh$$

$$\varepsilon bck = \frac{1.2 * 0.55 * (28 * 0.848)^{\frac{1}{3}}}{0.6468 * 28} * \left(\frac{0.9 * 20 * (1 - 2 * 0.35)}{(1 - 0.35)^2}\right)^{\frac{2}{3}} * 0.984 = 0.56 \frac{in}{in}$$

5.3 Compare Factored Global Buckling Strain Capacity vs Factored Global

$$\varepsilon_{UC} \leq \varphi bck \cdot \varepsilon bck$$

0.00214 in/in ≤ (0.67) *(0.56 in/in) = 0.377 in/in global buckling strain check is OK

Step 6 Check Combined Bending and Thrust Limit

6.1 Determine Deflection Criteria

The maximum allowable deflection (Δ_A) is 5 percent of the inside diameter of the pipe which is computed as follows:

$$\Delta_A = 0.05 * 36.0 \text{ inches} = 1.80 \text{ inches}$$

The allowable deflection due to bending deformation (Δ_f) is computed using AASHTO Equation 12.12.3.10.2b-4 as follows:

$$\Delta_f = \Delta_A - (\varepsilon_{SS} * D) = 1.80 - (0.00129 * 38.2 \text{ inches}) = 1.75 \text{ inches}$$

6.2 Calculate the Factored Flexural Strain

The initial step is to determine the shape factor (D_f) by linear interpolation or extrapolation of AASHTO Table 12.12.3.10.2b-1 for the calculated pipe stiffness (calculated in D6 Step 1) coupled with the pipe embedment material and compaction level. Using linear extrapolation, a value of 2.83 for the shape factor is estimated for this pipe and embedment scenario.

The next step is to calculate the factored flexural strain (ε_f) using AASHTO Equation 12.12.3.10.2b-3 as follows:

$$\varepsilon f = \gamma ev * Df * \left(\frac{c}{R}\right) * \left(\frac{\Delta f}{D}\right) = 1.1 * 2.83 * \left(\frac{1.35}{19.1}\right) * \left(\frac{1.75}{38.2}\right) = 0.0101 \frac{in}{in}$$

Where: c = distance from neutral axis to inner or outer most fiber (maximum) (1.35 in)

6.3 Check the Combined Strain for Tension and Compression

The combined axial and bending strain where flexure causes tension must satisfy AASHTO Equation 12.12.3.10.2b-1 as follows:

$$\varepsilon f - \min(\varepsilon UC, \varepsilon US) \leq \varphi f \cdot \varepsilon yt$$

$$0.0101 - 0.00214 \leq 1.0 * 0.025$$

$$0.00796 \leq 0.025 \text{ combined strain check for tension is OK}$$

$$\varepsilon f + \max(\varepsilon UC, \varepsilon US) \leq \varphi T \cdot (1.5 \cdot \varepsilon yc)$$

$$0.0101 + 0.00312 \leq (1.0) \cdot (1.5 \cdot 0.037)$$

$$0.0132 \leq 0.0555 \text{ combined strain check for compression is OK}$$

Step 7 Check Deflection Criteria

The total deflection (Δ_t) due to loading must not exceed the allowable deflection (Δ_A) for the pipe. The total deflection due to loading is calculated using AASHTO Equation 12.12.2.2-2 as follows:

$$\Delta\mathrm{t} = \left[\frac{KB * (Dl * P_{sp} + Cl * Pl)Do}{1000\left[\frac{Epl * Ip}{R^3} + 0.061 * Ms\right]}\right] + \max(\varepsilon sc, \varepsilon ss) * D$$

$$\Delta\mathrm{t} = \left[\frac{0.1 * (1.5 * 5.02 \ + 3.3) * 41.5}{1000\left[\frac{28 * 0.848}{19.1^3} + 0.061 * 20\right]}\right] + 0.001491 * 38.2 = 0.378 \; inches$$

Next, compare the total deflection due to loading against the allowable deflection computed previously in order to satisfy AASHTO Equation 12.12.2.2-1 as follows:

$$\Delta_t \leq \Delta_A$$

0.378 inches ≤ 1.8 inches deflection check is OK

Step 8 Handling and Installation Requirements

The calculation for the handling and installation requirements involves computing the flexibility factor (FF) for the selected pipe and comparing against the allowable limit (FL = 95 in/kip). FF is computed using AASHTO Equation 12.12.3.6-1 as follows:

$$FF = \frac{Di^2}{Eps * Ip} = \frac{36^2}{175 * .848} = 8.73\frac{in}{ki}$$

FL = 95.0 in/kip as per AASHTO Section 12.5.6.3

11.25< 95.0 flexibility limit check is OK

VOLUME 4

TETRA TECH

TECHNICAL MEMORANDUM

To:	United States Army Corps of Engineers
Cc:	Confederated Tribes of the Umatilla Indian Reservation
From:	Senda Ozkan, PhD, PE, Jeremy Andrews, PE, and Chris James, CWM, CERP (Tetra Tech, Inc.)
Date:	July 1, 2025
Subject:	Volume 4 – Pendleton 2a Levee Proposed Setback Design and Analysis

1. Introduction

This technical memorandum is being provided by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Tetra Tech, Inc. (Tetra Tech) to the U.S. Army Corps of Engineers (USACE). It is intended to be a continuance of the USACE Section 408 process and review of UmaBirch In-Stream Design and Construction Oversight Project (the Project). The Project has been identified by the USACE as request #FY19-NO46 and is linked to the nationwide permit NWP-2019-489. The Project is associated with the USACE Pendleton 2a Levee which is listed in the USACE National Levee Database as System ID# 500500041 (USACE, 2022). The purpose of the Project is to restore floodplain connectivity and natural riverine processes, while maintaining the function of the Pendleton 2a Levee. The USACE Section 408 review is requested because the Project proposes to setback a portion of the Pendleton 2a Levee downstream of Birch Creek Road located near Rieth, Oregon, in order to achieve the purpose of the Project.

This technical memorandum provides a desktop study of the available geotechnical data, a geotechnical field investigation report, and geotechnical design analysis necessary to evaluate the stability of the Pendleton 2a Levee proposed setback. The review and analysis are in support of the USACE Section 408 review of the Project (see Volume 2 for specific Project details). The Project is located on the Umatilla River from river mile (RM) 48.7 to RM 49.7 and Birch Creek from RM 0.0 to RM 0.3. The Project is part of a larger series of projects being proposed by the CTUIR and Bonneville Power Administration (BPA) located downstream on the Umatilla River and upstream on Birch Creek. To provide a phased construction approach based on funding, hydrology and geomorphology, and anticipated environmental permitting requirements, all project actions being proposed by the CTUIR and BPA, have been separated into four distinct project areas. Of these project areas, the USACE Pendleton 2a Levee is located within Project Area 2 (PA 2).

This technical memorandum is Volume 4 of 7. Combined, the volumes assist in documenting historic conditions, existing data, and analyses necessary to demonstrate that the proposed Project will not adversely impact the Pendleton 2a Levee system. Specific to Volume 4, guided by the results from the previous volumes, and informed by the findings of the geotechnical desktop study (Section 3) and field investigations presented within (Section 4 and Attachment 1), the geotechnical design analysis demonstrates that the with-Project conditions meet the requirements of the design criteria for slope stability, seismic stability and seepage (Section 5). USACE provided comments on Revision 1 (dated April 26, 2024) and Revision 2 (dated April 23, 2025) of this technical memorandum and requested additional slope stability and seepage analyses with the water surface elevation at the top of the levee representing the levee overtopping condition. These analyses were incorporated into Section 5.

2. Purpose

The purpose of this technical memorandum is to document geotechnical design analysis using data provided through geotechnical investigations completed in 2023 to confirm the stability of the Pendleton 2a Levee proposed setback. The specific stability analyses include evaluating the with-Project condition (defined as proposed Project conditions with a levee setback). In December 2021, representatives of the USACE, BPA, CTUIR, and Tetra Tech met to discuss the Pendleton 2a Levee and the scope of work for the Project and Section 408 review process. As a part of that meeting, and to support the Section 408 process, the USACE requested that the CTUIR and Tetra Tech reconstruct the historical Pendleton 2a Levee (see Volume 1) and utilize that information to evaluate the without- and with-Project conditions. This technical memorandum utilizes the information from the previous volumes and information from the geotechnical desktop study and field investigations, to evaluate existing geotechnical conditions and evaluate with-Project conditions in order to confirm the stability of the Pendleton 2a Levee proposed setback.

2.1 Background

The Project proposes modifications to a section of the existing Pendleton 2a Levee located along the south bank of the Umatilla River. The Pendleton 2a Levee (segment ID: 5004430001) is identified in the USACE National Levee Database as part of the Pendleton Zone 2 Flood Damage Reduction (FDR) Project, which is a federally authorized and constructed, and non-federally operated and maintained levee system (USACE, 2022). Volume 1 – Pendleton 2a Levee Setback Existing Data Review and Levee Reconstruction Analysis; Volume 2 – Hydrologic and Hydraulic Analyses; and Volume 3 – Interior Drainage Analysis provide detailed information regarding the historic (i.e., 1959 levee) and current conditions; without- and with-Project condition hydraulic analyses; without-and with-Project interior drainage analyses; and proposed levee setback and floodplain reconstruction designs, respectively, associated with the Pendleton 2a Levee system. Utilizing these analyses and sources, the USACE guidance and supporting material (see Section 2.2 below), along with the geotechnical desktop study, and geotechnical field investigation, a geotechnical design analysis was completed in order to confirm the stability of the Pendleton 2a Levee proposed setback.

2.2 USACE Materials

The guidance and supporting USACE materials utilized in this analysis include:

- EM 1110-2-1913: Design and Construction of Levees
- EM 1110-2-1902: Slope Stability
- ETL 1110-2-569: Design Guidance for Levee Underseepage
- ER 1110-2-1806: Earthquake Design and Evaluation for Civil Works Projects

Throughout this technical memorandum, the geotechnical design analyses reference the following volumes:

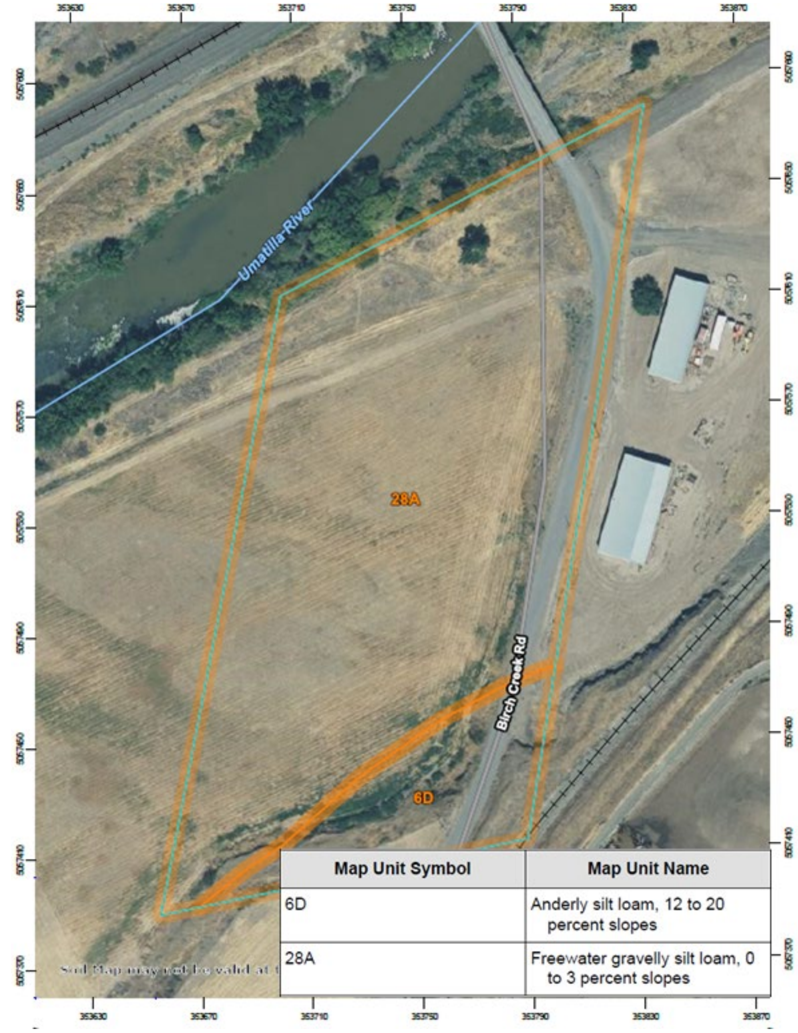
- Volume 1 –Existing Data Review and Levee Reconstruction Analysis
- Volume 2 – Hydrologic and Hydraulic Analyses
- Volume 3 – Interior Drainage Analysis
- Volume 6 – Operation and Maintenance Manual
- Volume 7 – Pendleton 2a Levee Proposed Setback Risk Assessment

3. Geotechnical Desktop Study

The geotechnical desktop study included a review of the USACE construction drawings for the existing Pendleton 2a Levee, geologic maps obtained from various agencies, Natural Resources Conservation Service (NRCS) Soil Survey maps, United States Geological Survey (USGS) data, Oregon Department of Geology and Mineral Industries (DOGAMI) data, and other relevant information. This section presents a discussion of the geological and geotechnical data relevant to the Project.

3.1 Surface Geology

The United States Department of Agriculture (USDA) soil survey data was utilized to review the surface geology (USDA, 2022). The USDA soil survey map of the Project area is shown in Figure 3-1.



Map Unit Symbol	Map Unit Name
6D	Anderly silt loam, 12 to 20 percent slopes
28A	Freewater gravelly silt loam, 0 to 3 percent slopes

Figure 3-1. USDA Soil Survey Map

The surficial soil on approximately eighty-six (86) percent of the site consists of freewater gravelly silt loam (28A), very gravelly loam, and extremely gravelly sand with slopes varying from 0 to 3 percent. The parent material is indicated as mixed and very gravelly alluvium. Depth to restrictive features (e.g., weathered rock, bedrock) is indicated as varying from 20 to 40 inches. The remainder of the site (14 %) consists of anderly silt (6D) with a slope varying from 12 to 10 percent. The parent material is indicated as loess. Depth to restrictive features (e.g., lithic bedrock) is indicated as more than 80 inches. The overall site drainage class is classified as excessively drained to well drained, and the capacity of the most limiting layer to transmit water is indicated as having moderately high to high permeability (K_{sat}) varying between 0.57 to 1.98 inches/hour. The soils are not subject to ponding. Depth to the water table is indicated as more than 80 inches (USDA, 2022).

3.2 Bedrock Geology

The reconnaissance geologic map of the Pendleton quadrangle (Walker, 1973) and preliminary geologic map of Umatilla County, Oregon (McConnell, 2006) were reviewed to evaluate the bedrock geology at the Project. The reconnaissance geologic map indicates that the site is underlain by alluvium (Qal), unconsolidated fluviatile gravel, sand, and silt as shown in Figure 3-2 (Hogenson, 1964). The preliminary geologic map of Umatilla County, Oregon indicates that Project consists of alluvial deposits (Qa) of Holocene and Pleistocene origin as shown in Figure 3-3.

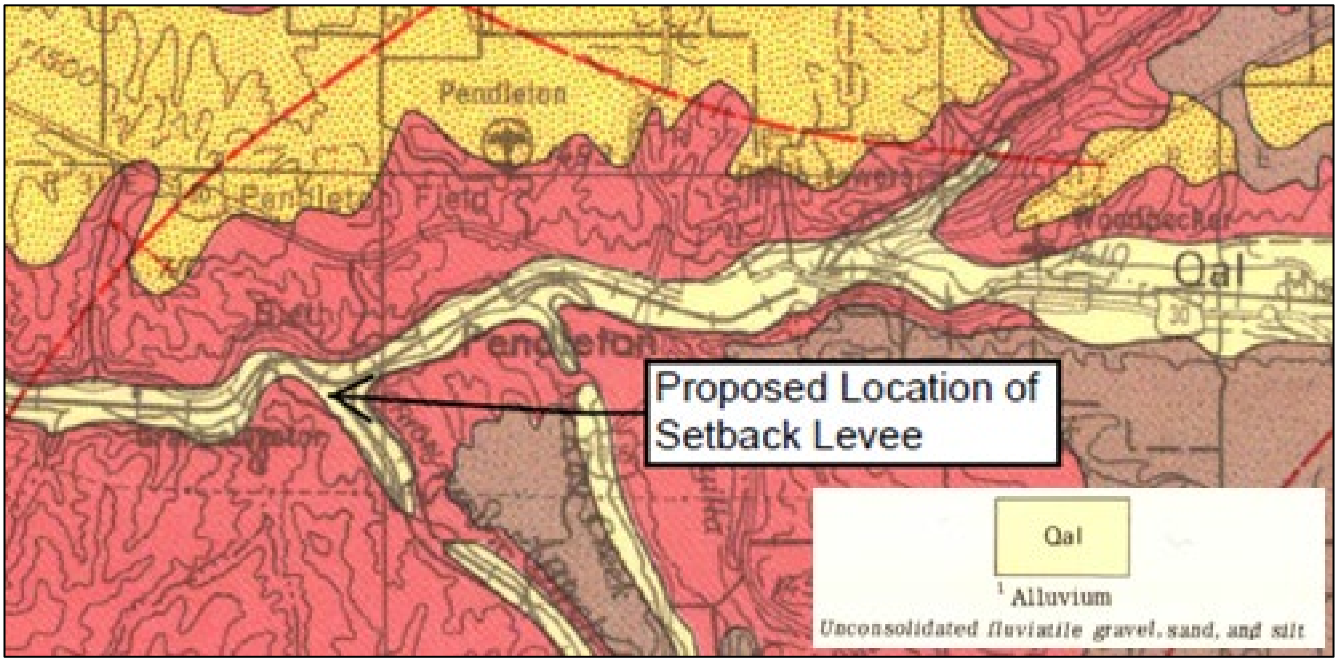


Figure 3-2. Project Area Geologic Map (Walker, 1973)

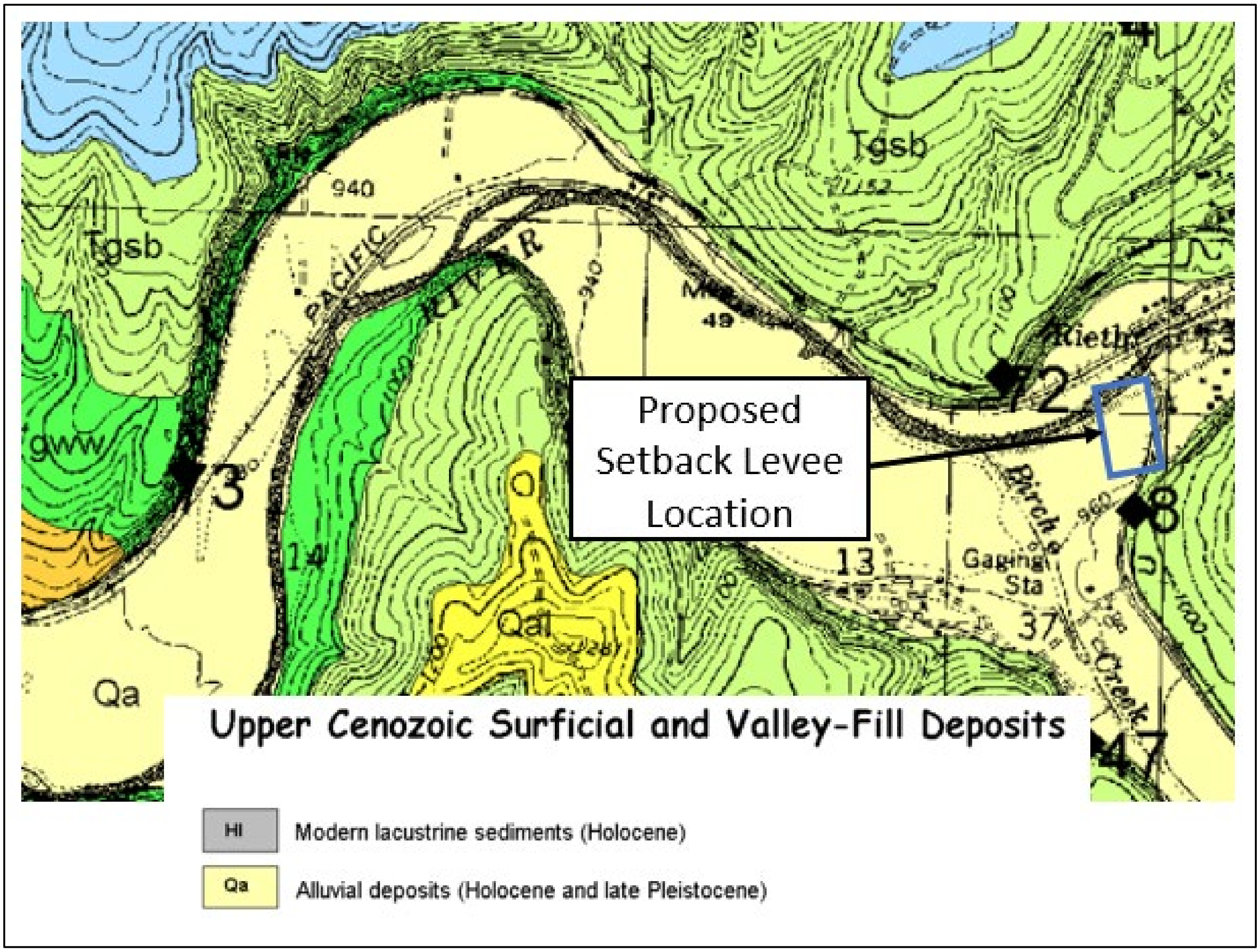
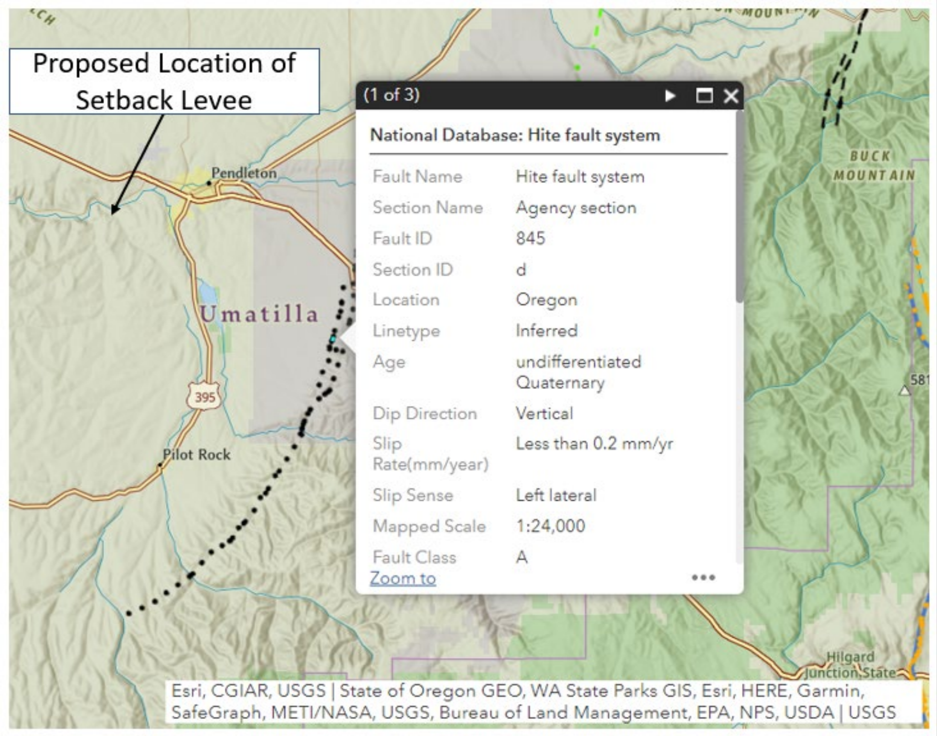


Figure 3-3. Project Area Geologic Map (McConnell, 2006)

3.3 Natural Hazards

3.3.1 Earthquake

According to the Quaternary Faults and Fold Database of the United States (USGS, 2003), the nearest active fault to the Project is the Hite fault system (Figure 3-4 below). The Hite fault system is a complex zone of faulting that parallels the northeast-trending western flank of the Blue Mountains uplift in northeastern Oregon and southeastern Washington; the fault system may overlie the suture zone between accreted terranes in the Blue Mountains and the stable craton (USGS, 2003). It is late quaternary fault categorized as fault Class A with a vertical dip direction, a slip rate of less than 0.2 millimeter/year, and a fault length of 140 kilometers. No known faults exist on or immediately adjacent to the site. However, the Statewide Geohazards Viewer (DOGAMI, 2022) indicates that expected earthquake shaking near the Project is strong as shown below in Figure 3-5.



National Database: Hite fault system

Fault Name	Hite fault system
Section Name	Agency section
Fault ID	845
Section ID	d
Location	Oregon
Linetype	Inferred
Age	undifferentiated Quaternary
Dip Direction	Vertical
Slip Rate(mm/year)	Less than 0.2 mm/yr
Slip Sense	Left lateral
Mapped Scale	1:24,000
Fault Class	A

Figure 3-4. Nearest Fault Map (USGS, 2003)

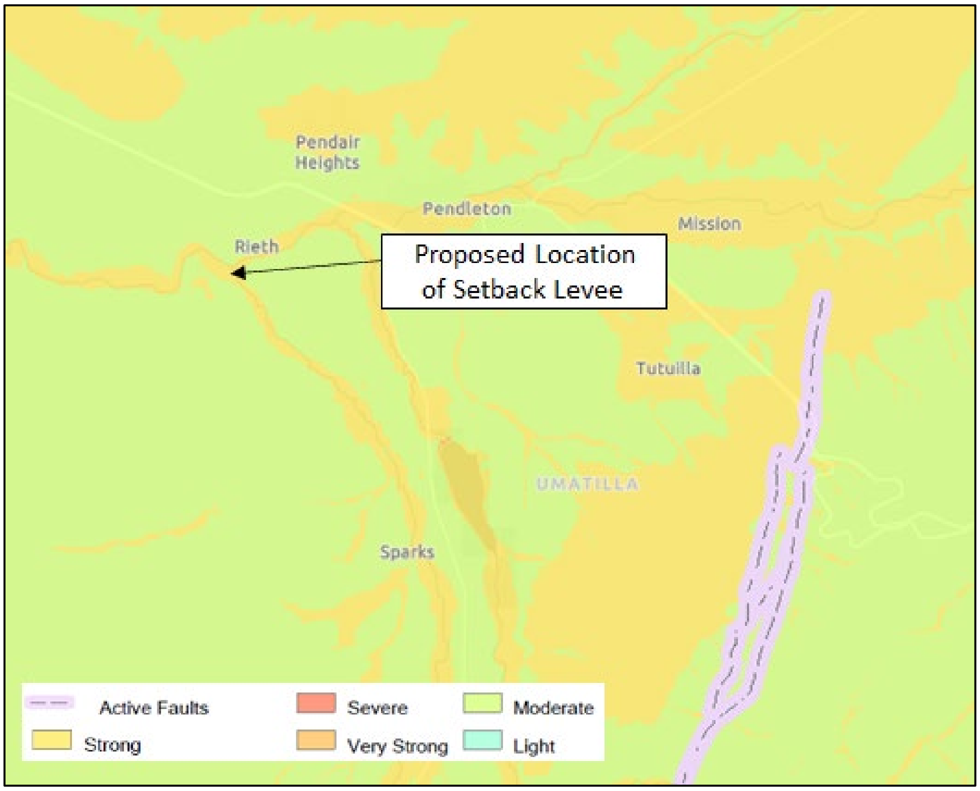


Figure 3-5. Expected Earthquake Shaking Map (DOGAMI, 2022)

3.3.2 Liquefaction

Liquefaction is a phenomenon associated with earthquakes during which loose, sandy to silty, water saturated, or nearly saturated soils behave like fluids. As seismic waves pass through these soil layers, the structure of the soil distorts and void spaces between soil particles (pores) collapse, causing deformation and ground failure. According to Statewide Geohazards Viewer, the Project is moderately susceptible to liquefaction (DOGAMI, 2022). The liquefaction hazard map of the Project is shown below in Figure 3-6.

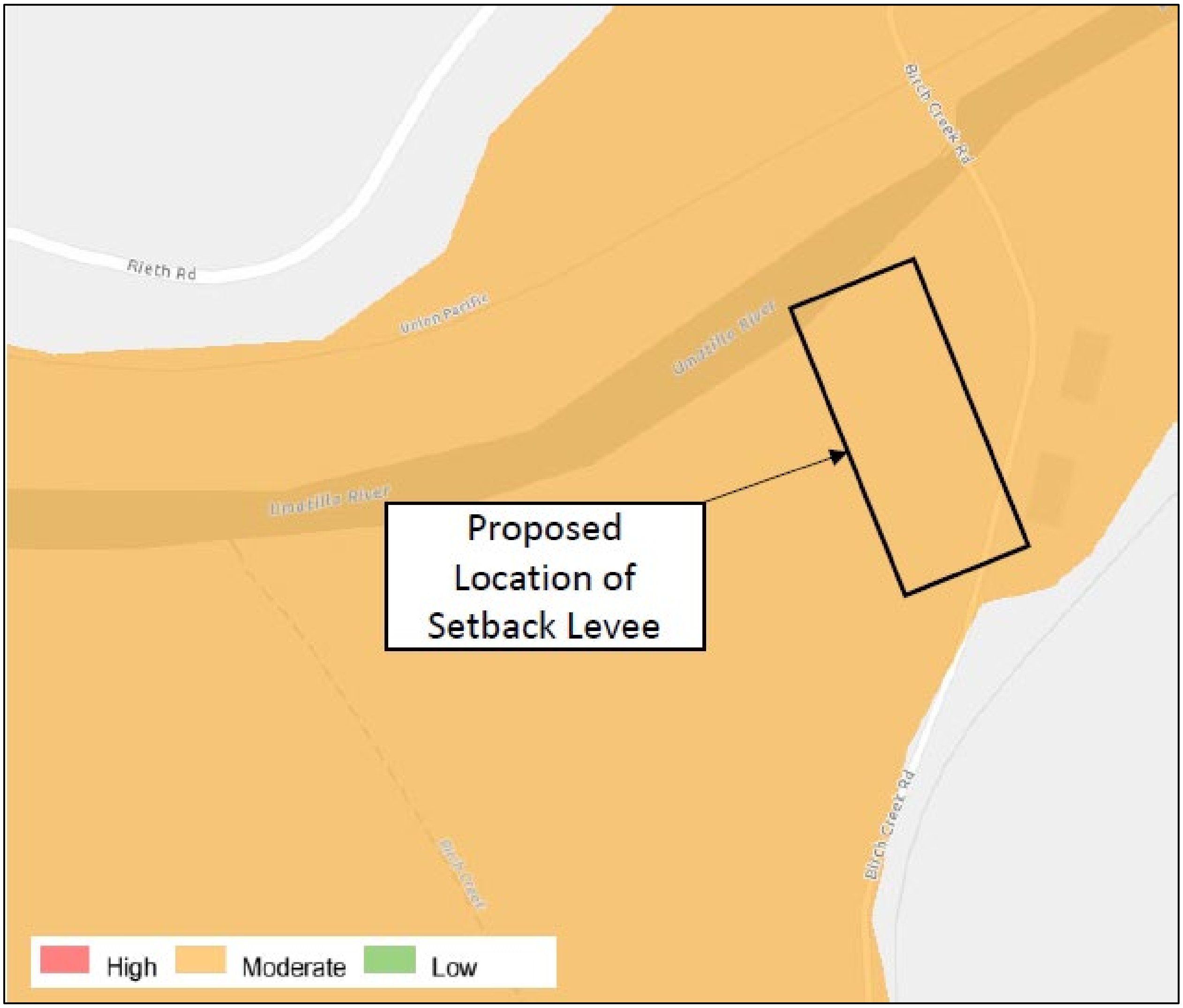


Figure 3-6. Liquefaction Susceptibility Map (DOGAMI, 2022)

3.3.3 Landslide Susceptibility

According to the Statewide Geohazards Viewer (DOGAMI, 2022), the Project is located in an area of low to moderate landslide susceptibility. The landslide hazard map of the Project is shown below in Figure 3-7.

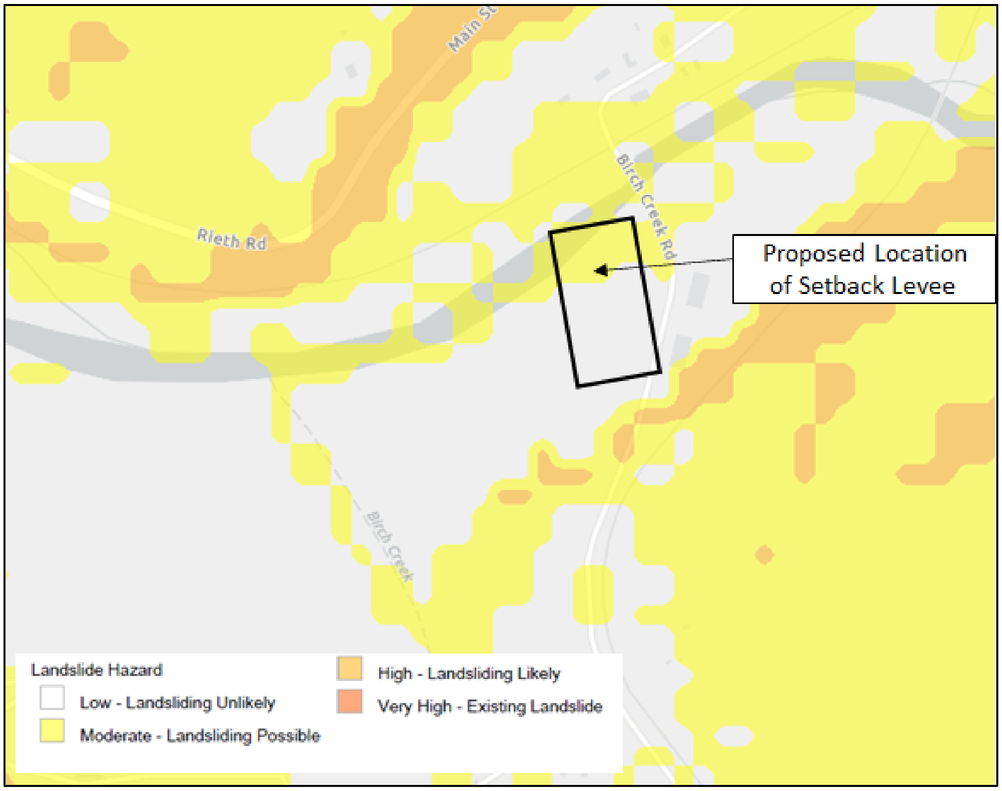


Figure 3-7. Landslide Susceptibility Map (DOGAMI, 2022)

3.4 Other Geotechnical Data

Levee and revetment construction drawings for the existing Pendleton 2A Levee include soil stratigraphy information near the proposed construction site indicating that bedrock was found at shallow depths varying from approximately 14 to 21 feet below the fill/top of the existing levee (USACE, 1959). The soil stratigraphy included silt (organics, roots) and poorly graded gravel/silty gravel overlaying the bedrock classified as GP, GM per Unified Soil Classification System (USCS). The groundwater surface was shown approximately 12 feet below the top of the existing levee, as recorded in 1957. The design high water surface was indicated as 3 feet below the top of existing levee.

No geotechnical boring logs were identified in the vicinity of the Project area during the desktop study. Tetra Tech performed a test pit investigation in 2019 (Tetra Tech, 2019) within the floodplain area of PA 2. Test pit #5 is approximately 1,200 feet from the Pendleton 2a Levee proposed setback location. Test pit #5 was excavated 8 feet below ground surface and consisted of topsoil (organic silt/peat) and silty gravel (GM). Groundwater was not observed during excavation of test pit #5.

3.5 Conclusion of Desktop Study

This desktop study concludes that limited geotechnical and geological data are available for the Project. The site is located near an active fault with strong susceptibility to earthquake shaking. The site has moderate susceptibility to liquefaction and has low to moderate susceptibility to landslide.

To complete the with-Project (Pendleton 2a Levee proposed setback) design based on the design criteria, a geotechnical field investigation was completed in 2023.

4. Geotechnical Field Investigation

Tetra Tech drafted the Umatilla Birch Geotechnical Drilling Program Plan as part of the overall UmaBirch In-Stream Design and Construction Oversight Project to collect site-specific data for Pendleton 2a Levee proposed setback design. The Plan was approved by USACE in September 2023 (Tetra Tech, 2023). The geotechnical field investigation was completed in October 2023 based on the approved Drilling Plan by Carlson Geotechnical, a division of Carlson Testing, Inc. (Carlson Geotechnical, 2023). The investigation consisted of four drilled borings advanced to depths ranging from about 10 to 16½ feet below ground surface. Soil samples were collected from the boring and laboratory tests were performed to characterize subsurface conditions and determine soil design parameters. The Geotechnical Investigation Report is included in Attachment 1. The findings of the report and the recommendations were utilized in the geotechnical design analysis.

After completion of the geotechnical investigation, for the 90% design, the southern end of the levee was adjusted to the west based on the interior drainage hydraulic modeling results to accommodate interior drainage area to the east of the Project. See Figure 5-1 below for the 90% design alignment and the location of the four drill boring locations. The findings from the borings indicate consistent stratigraphy and representative of the subsurface conditions of the design alignment.

The geotechnical investigation explored subsurface conditions, depth to bedrock, groundwater levels, and recommended design parameters for the geotechnical analysis. A qualitative evaluation of seismic hazards at the site, including earthquake-induced liquefaction, landslides, and surface rupture due to faulting or lateral spread, was also provided. The site-specific conditions in the geotechnical investigation report provided more details than the desktop study review in Section 3.3 above. In general, based on the lack of saturated soil conditions at the site, the soils encountered within the drilled areas are considered non-liquefiable. Where groundwater was encountered, it was typically encountered within the Gravelly Alluvium. The Gravelly Alluvium encountered at these depths was typically medium dense in terms of relative density and therefore considered non-liquefiable. Based on review of geologic mapping, the presence of relatively shallow basalt bedrock, liquefiable conditions are not anticipated at depths below those explored during the field investigation.

Although the site is situated in historic seismic activity area, no known faults exist on or immediately adjacent to the site. Therefore, the risk of surface rupture at the site due to faulting is considered low. Surface rupture due to lateral spread can occur on sites underlain by liquefiable soils that are located on or immediately adjacent to slopes steeper than about 3 degrees (20H:1V), and/or adjacent to a free face, such as a streambank or the shore of an open body of water. During lateral spread, the materials overlying the liquefied soils are subject to lateral movement downslope or toward the free face. Based on the relatively level topography at the site and the non-liquefiable nature of the soils at the site, the risk of damage associated with lateral spread is considered to be negligible.

5. Geotechnical Design Analysis

The evaluations completed for the geotechnical design analysis included slope stability, seismic stability, and seepage analyses. The current analysis results indicate that the Pendleton 2a Levee proposed setback complies with the design criteria, as summarized in Table 5-1.

Table 5-1. Geotechnical Design Analyses

Design Element	Design Guideline/Considerations per the USACE EM 1110-2-1913 [1/]	Analyses Results
Slope Stability	• Case 1, End of Construction: Factor of safety (FS) of 1.3 • Case 2, Sudden Drawdown: FS 1.0 to 1.2 • Case 3, Long-Term Steady Seepage: FS = 1.4 • Case 4, Earthquake: FS = 1.1	• Meets or exceeds design guideline
Seepage	• Exit gradient less than 0.5 foot/foot	• Meets or exceeds design guideline [2/]

[1/] Per the USACE, levees 10 feet or less in height and built of good material resting on proven foundations may not require extensive stability analysis. For these cases, practical considerations such as type and ease of construction, maintenance, seepage, and slope protection criteria control the stability of levees.

[2/] See discussion in Section 5.3.

5.1 Design Criteria

This section provides levee engineering design elements and criteria.

Level of protection: Authorized flood water surface elevation and freeboard as constructed in 1959 (see Volumes 1 and Volume 2).

Levee section:

- Crown width: The USACE EM 1110-2-1913 recommends a minimum of 10 to 12 feet to provide access for normal maintenance operations and floodfighting operations. The proposed top width of the Pendleton 2a Levee proposed setback is 20 feet to facilitate construction equipment and vehicle access.
- Side slopes: A slope of two horizontal to one vertical (i.e., 2H:1V slope) is generally accepted as the steepest stable slope that can be constructed and can accommodate stability of any riprap layers. A 3H:1V slope is the steepest slope that can be conveniently traversed with conventional mowing equipment and walked on during inspections. The proposed side slope of the Pendleton 2a Levee proposed setback is in the range of 4H:1V to 6H:1V to ensure stability and allow maintenance and vehicle access.
- Freeboard: The proposed levee height will provide 3 feet of freeboard above the predicted authorized flood crest as constructed in 1959, except the interior drainage overtopping relief section portion of the levee (see Volume 3).

Erosion Protection: Demonstrate that no appreciable erosion of the levee embankment is expected during the flood, and that the anticipated erosion will not result in instability of levee. Materials will be sized based on the hydraulic forces and geotechnical characteristics. Based on the hydraulic modeling of the with-Project conditions (Volume 2), rock armoring for erosion protection will be required at the entire west face of the levee. Erosion protection of the side slopes will be provided through vegetation cover.

Embankment and Foundation Stability: The minimum required slope stability factors of safety (FS) as recommended by the USACE EM 1110-2-1913 are 1.3 at the end of construction, 1.0 to 1.2 for rapid drawdown, 1.4 for long-term steady seepage, and 1.1 for earthquake conditions. Seepage analyses should demonstrate that seepage during loading conditions associated with the base flood will not jeopardize embankment or foundation stability.

Levees of 10 feet or less in height and levees built from suitable material resting on proven foundations may not require extensive stability analysis. For these cases, practical considerations such as type and ease of construction, maintenance, seepage, and slope protection criteria control the stability of levees.

The USACE EM 1110-2-1913 states that earthquake loadings are not normally considered in analyzing the stability of levees because of the low probability of earthquakes coinciding with periods of high water. Levees constructed of loose, cohesionless materials or founded on loose, cohesionless materials are particularly susceptible to failure due to liquefaction during earthquakes. Based on the geotechnical field investigation, liquefiable conditions are not anticipated. The risk of surface rupture at the site due to faulting is considered low and the risk of damage associated with lateral spread is considered to be negligible. As a result, slope stability analyses with earthquake loadings were performed based on end of construction conditions to verify the stability of the levee.

Settlement: The USACE EM 1110-2-1913 notes that many districts overbuild a levee by a given percent of its height to accommodate anticipated settlement of the foundation and the levee itself. Common allowances are 0 to 5 percent for compacted fill, 5 to 10 percent for semi-compacted fill, and 15 percent for un-compacted fill. It is anticipated that the majority of the settlement will occur during the construction of Pendleton 2a Levee proposed setback. Based on the results of the geotechnical investigation and anticipated levee fill heights, maximum anticipated settlement is anticipated to be 1 inch.

Levee Vegetation: The USACE EM 1110-2-1913 recommends vegetation cover to control dust and provide erosion protection. Levee vegetation will be designed in coordination with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Fisheries Program-Umatilla River Basin Department of Natural Resources (see Volume 2).

Risk Assessment: Changes in channel stability, hydraulic effects on upstream and downstream reaches and on the floodplain within the Project area, changes to flood hazards, and stream channel responses associated with the proposed levee will be assessed. The risk assessment is discussed in further detail in Volume 7.

5.2 Slope Stability Analysis

Static slope stability analyses were performed using Slide2 (Rocscience, 2021), a commercially available computer program for the general solution of slope stability problems by two-dimensional limit equilibrium methods. Slide2 provides analyses and results that comply with the USACE guidelines in EM 1110-2-1913 and ETL 1110-2-1902. The calculation of the FS against instability of a slope can be performed using one of the critical surface search methods for circular or non-circular slip surfaces including Bishop, Janbu, Spencer, or GLE / Morgenstern-Price.

Slide2 features techniques for generation of potential failure surfaces for determination of the critical surfaces and their corresponding factors of safety. Slope stability evaluations were based on the Morgenstern-Price method considering constant function and a circular arc type failure surface. Finite element seepage analysis is built into the Slide2 program where pore pressure generated during the seepage analysis is incorporated into the slope stability analysis.

5.2.1 Design Soil Parameters

Subsurface and Pendleton 2a Levee proposed setback soil parameters were developed based on the results of the geotechnical investigation and are included in the Geotechnical Investigation Report included in Attachment 1. The design parameters are summarized in Table 5-2.

Table 5-2. Design Soil Parameters

Soil Type	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Effective Friction Angle (Degree)	Effective Cohesion (psf)	Hydraulic Conductivity (feet/sec)
Fine-Grained Sandy Alluvium (ML, CL)	100	110	26	0	6.6e-06
Medium Dense to Dense Coarse-Grained Sandy Alluvium (SC, SM)	120	130	36	0	1.3e-04
Medium Dense to Very Dense Gravelly Alluvium (GW-GM, GP-GM, GM)	130	135	38	0	3.3e-04
Levee Embankment Fill (FILL)	115	125	34	0	3.3e-05
Basalt Bedrock (RX)	145	145 [1/]	50	0	3.3e-07
Riprap (FILL)	120	120 [1/]	40	0	1.6e-02

[1/] For basalt bedrock, it is assumed that the water table will have no effect on unit weight. For riprap, the material is assumed to be free draining. Therefore, saturated unit weight is assumed to be the same as the dry/moist unit weight for these materials and modeled in Slide2 software accordingly.

5.2.2 Pendleton 2a Levee Proposed Setback Sections

Stability analyses were performed at three levee cross-sections. The plan view and the sections are shown in Figures 5-1 through 5-4 below.

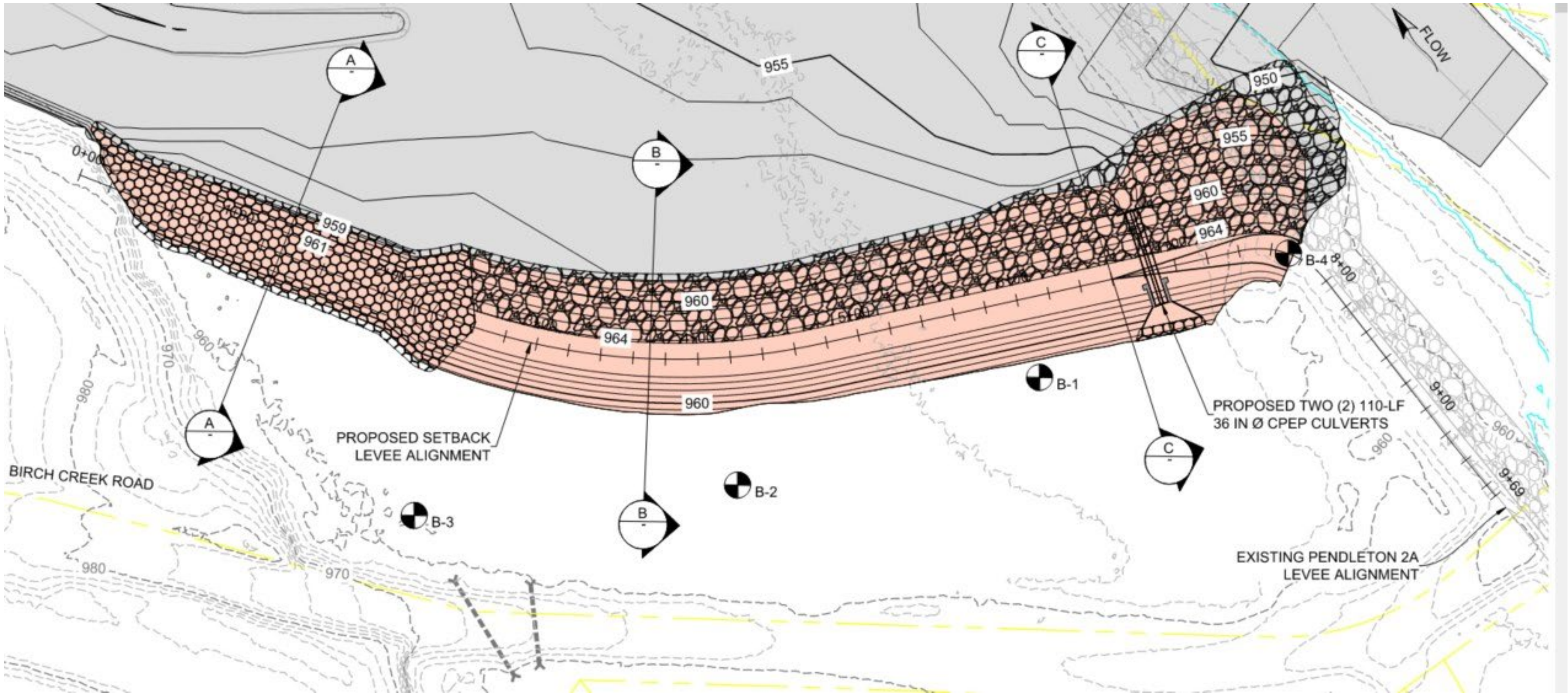


Figure 5-1. Plan view of Sections A, B, and C

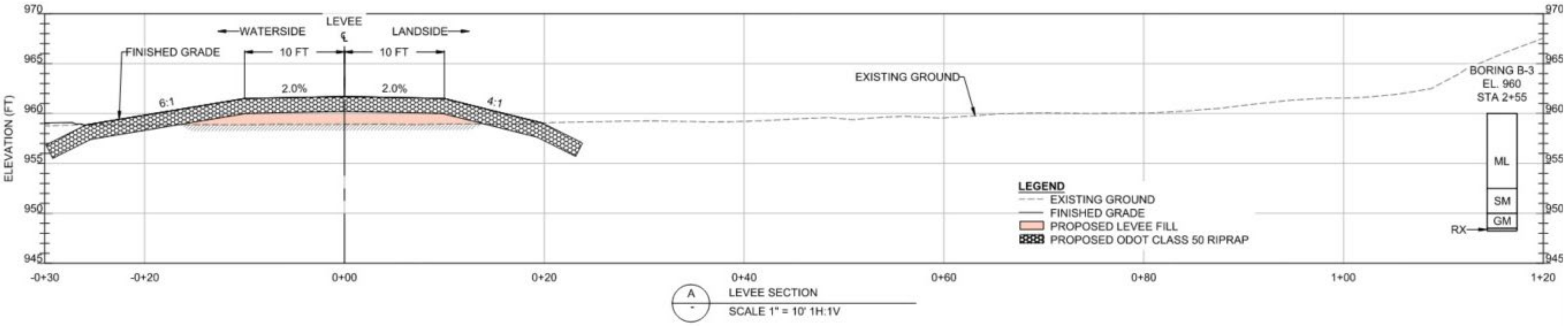


Figure 5-2. Section A Profile

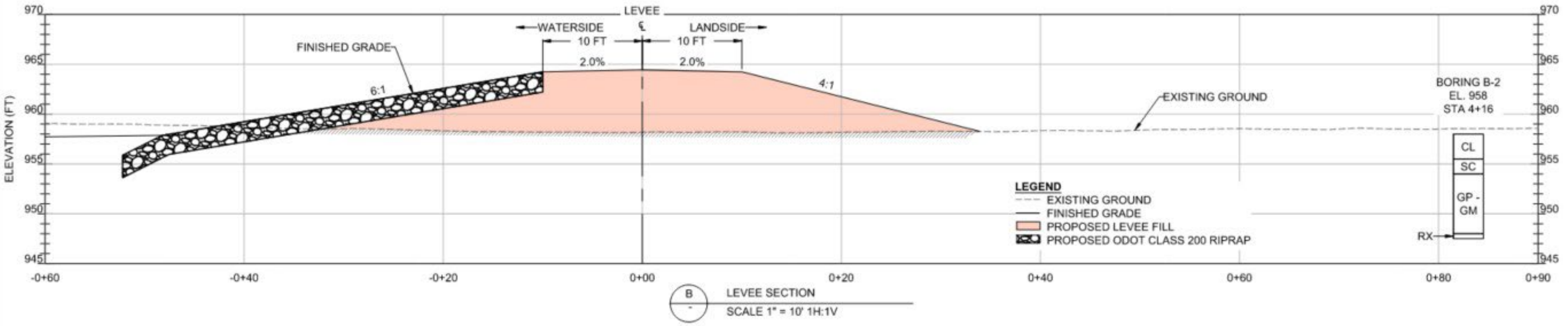


Figure 5-3. Section B Profile

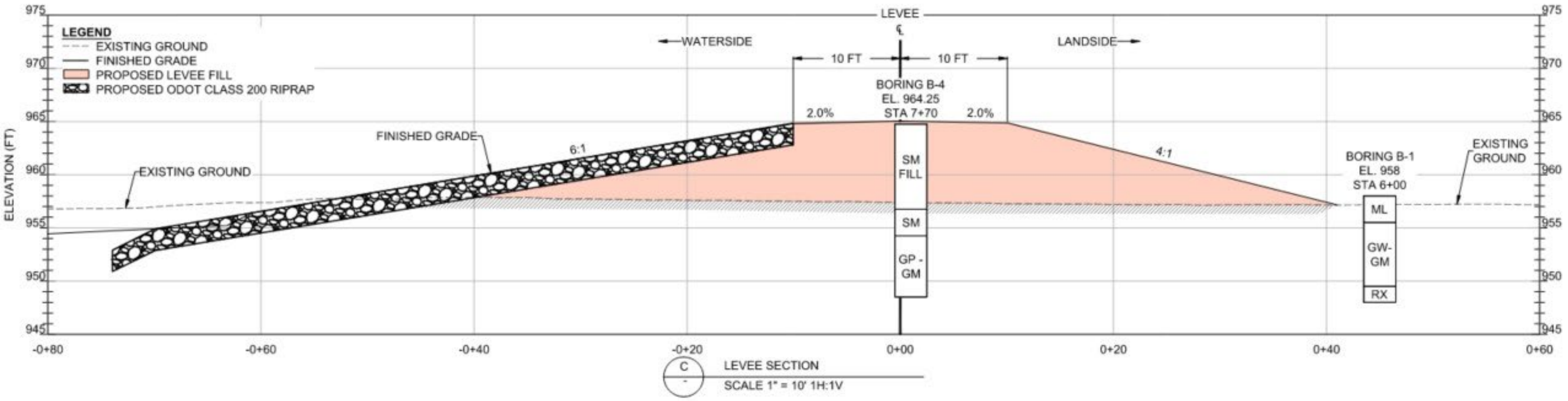


Figure 5-4. Section C Profile

5.2.3 Analysis Scenarios and Results

The following stability analysis scenarios were evaluated:

- Case 1 – End of Construction
- Case 2 – Rapid (Sudden) Drawdown
- Case 3 – Steady Seepage
- Case 4 – Seismic (Earthquake)

The Case 1 analysis was performed to check the global stability of the levee at the end of construction where no standing water is present at either side of the levee. The depth to the water table is indicated as more than 80 inches in the USDA soil survey (USDA, 2022). During the geotechnical investigation, groundwater was observed to vary from EL. 950 to EL. 949.3 at the proposed levee and was generally encountered in the Medium Dense to Very Dense Gravelly Alluvium layer.

Case 2 analyzed a rapid (sudden) drawdown condition at the levee. A rapid drawdown case represents the condition where the flood stage saturates a major part of the upstream embankment portion and then falls faster than the soil can drain. Per EM 1110-2-1902, materials with values of permeability greater than 10^{-4} cm/sec ($3.2x10^{-6}$ ft/sec) can be assumed to drain during drawdown, and, accordingly, drained strengths (effective stresses) were used. For the initial water condition, the water surface elevation (WSE) at riverside is approximately 961.0, 961.3, and 962.0 feet for Sections A, B, and C, respectively, and the WSE is assumed to be at the ground surface on the landside. For the final water condition, the WSE is assumed be at the ground surface at both the riverside (up to the design flood height) and the landside.

Case 3 analyzed the greatest hydraulic gradient through the levee, which occurs when the WSE at riverside is approximately 961.0, 961.3, and 962.0 feet for Sections A, B, and C, respectively, and no water is present on the landside. Case 3 analysis represents the condition when the water remains at or near full flood stage long enough so that the embankment becomes fully saturated, the phreatic surface is fully developed, and a condition of steady seepage occurs.

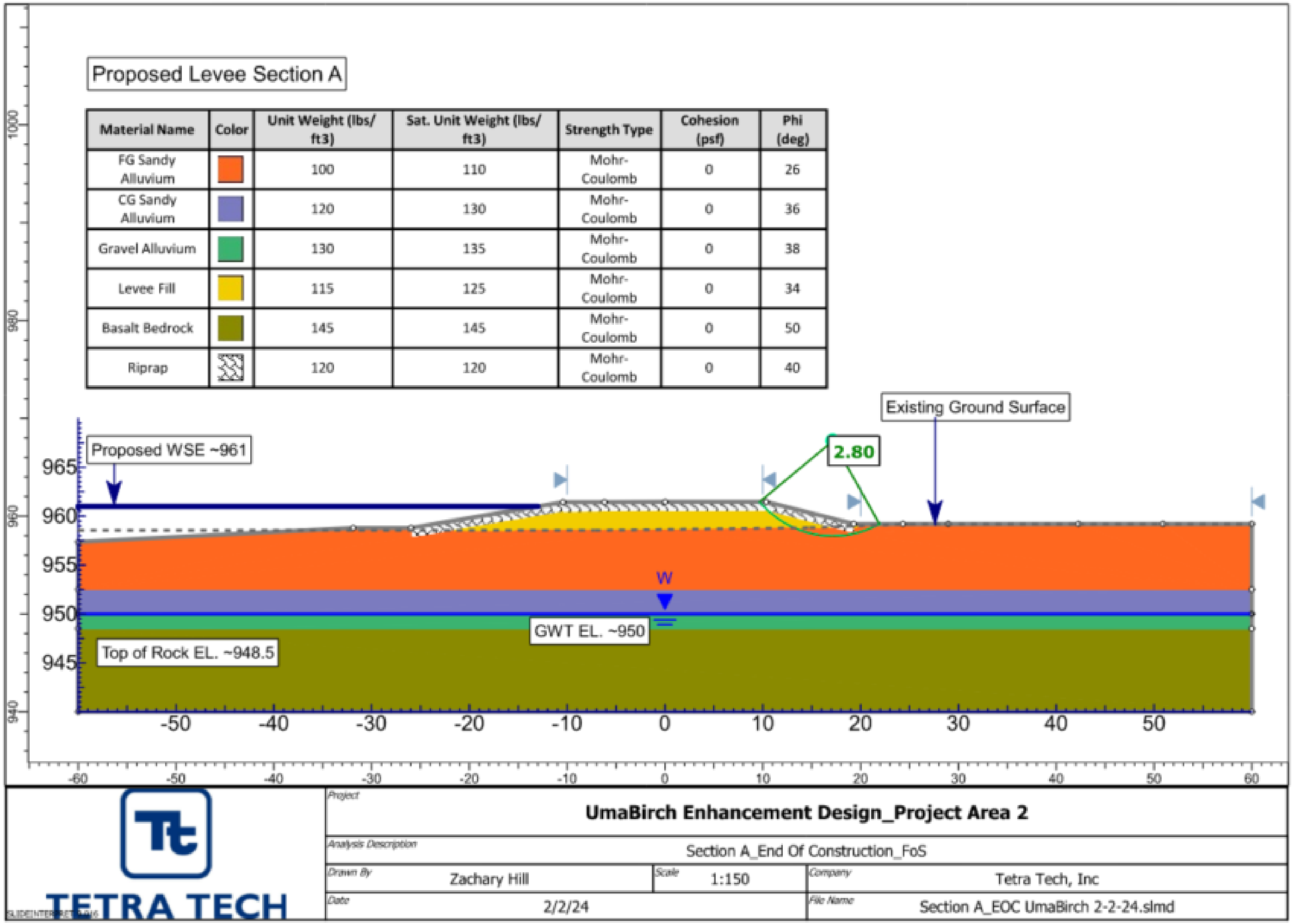
Case 4 earthquake loadings were analyzed as discussed in Section 5.1. The seismic loading was conducted using a design peak ground acceleration (PGA) of 0.161g, which was obtained for the levee location from the Seismic Hazards by Location calculator on the Applied Technology Council (ATC) website (ATC, 2024). This PGA corresponds to an earthquake with a 2 percent probability of exceedance in 50 years, equivalent to 2500-year return period. Per ER 1110-2-1806, a seismic coefficient equal to ⅔ PGA (0.107g) was applied to the slope stability model.

Slope stability analysis results performed for Case 1 through Case 4 are summarized in Table 5-3 and detailed in Figures 5-5 to 5-28 below. These results indicate that the levee would remain stable at these conditions.

Table 5-3. Summary of Slope Stability Analyses Results

Section	Analysis Location	Case 1 End of Construction (FS)	Case 2 Rapid Drawdown (FS)	Case 3 Steady Seepage (FS)	Case 4 Seismic (FS)
A	Riverside	3.51	1.66	3.33	2.12
	Landside	2.80	1.98	1.80	1.87
B	Riverside	3.31	1.94	2.71	2.00
	Landside	2.39	1.88	1.47	1.64
C	Riverside	4.39	2.45	3.61	2.65
	Landside	3.12	2.67	2.51	2.10

Further analyses were performed to check the stability of the levee under a scenario when the WSE is at the top of the levee representing overtopping conditions as requested by the USACE. This scenario was analyzed for Section A under rapid drawdown case, which has the most critical FS as shown in Table 5-3. The results for Section A indicate that levee would remain stable with a 1.93 at landside and FS of 1.60 at riverside during overtopping as shown in Figures 5-29 and 5-30 below. Another overtopping scenario was analyzed for Section B and Section C under steady seepage case as requested by the USACE based on the comments on Revision 2 (dated April 23, 2025) of this technical memorandum. The results at landside for Section B and Section C indicate that the levee would remain stable with a FS of 1.01 and 2.30, respectively, during overtopping as shown in Figures 5-31 and 5-32 below.



Proposed Levee Section A

Material Name	Color	Unit Weight (lbs/ ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project: UmaBirch Enhancement Design_Project Area 2

Analysis Description: Section A_End Of Construction_FoS

Drawn By: Zachary Hill

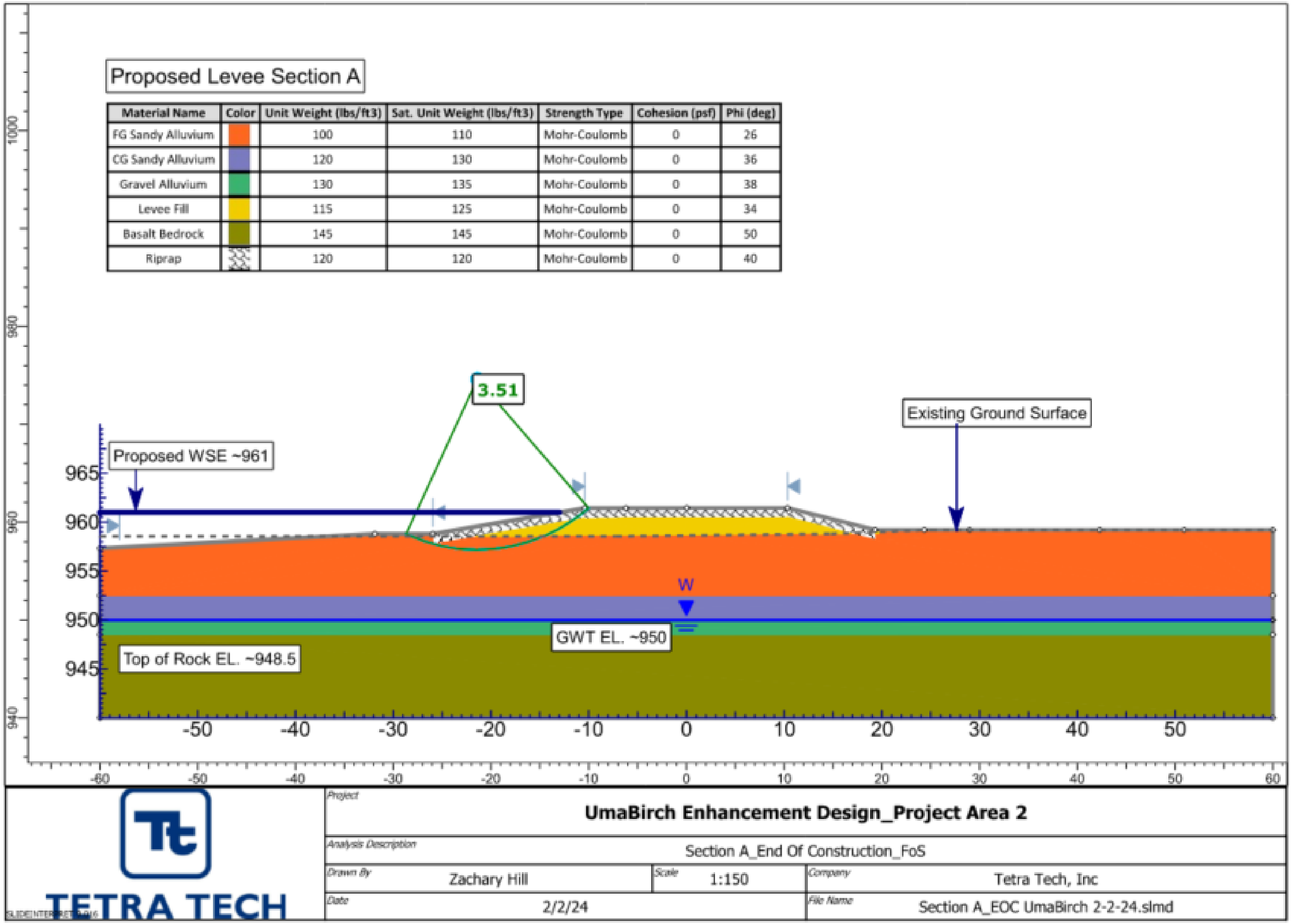
Scale: 1:150

Company: Tetra Tech, Inc

Date: 2/2/24

File Name: Section A_EOC UmaBirch 2-2-24.slmd

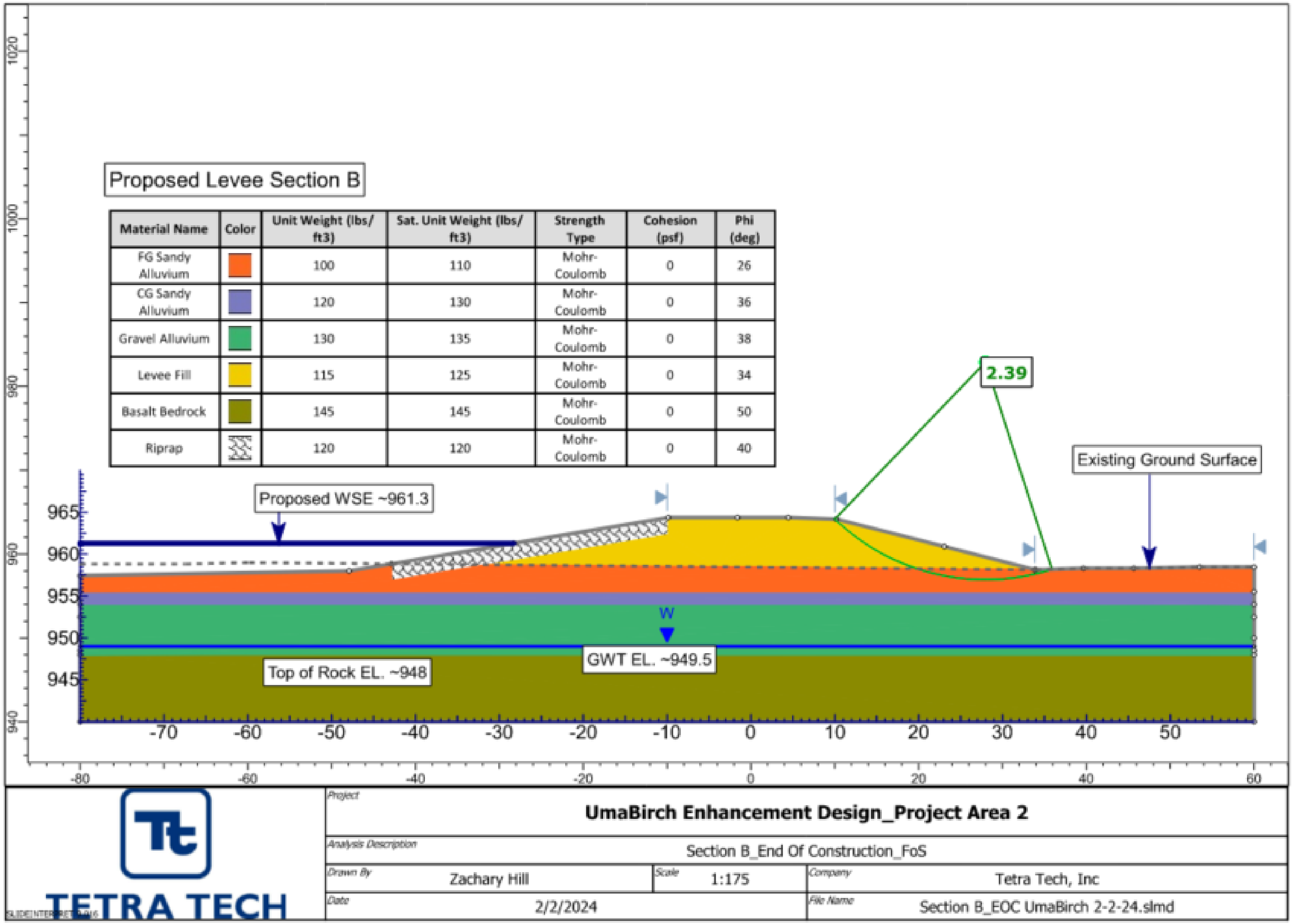
Figure 5-5. Case 1: Section A End of Construction Slope Stability Analysis – Landside



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project: **UmaBirch Enhancement Design_Project Area 2**
Analysis Description: Section A_End Of Construction_FoS
Drawn By: Zachary Hill
Scale: 1:150
Company: Tetra Tech, Inc
Date: 2/2/24
File Name: Section A_EOC UmaBirch 2-2-24.slmd

Figure 5-6. Case 1: Section A End of Construction Stability Analysis – Riverside

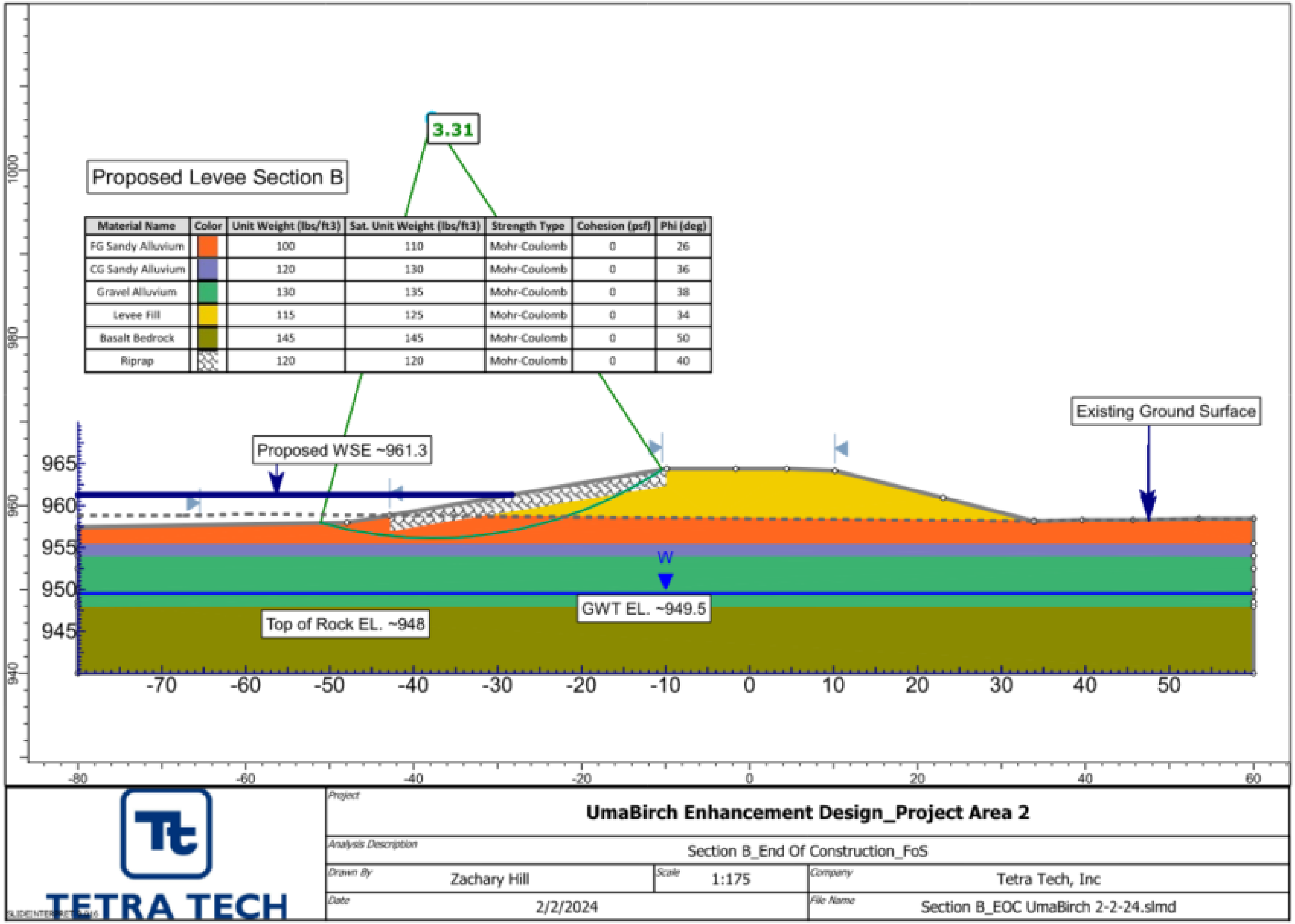


Proposed Levee Section B

Material Name	Color	Unit Weight (lbs/ ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	■	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project: UmaBirch Enhancement Design_Project Area 2
Analysis Description: Section B_End Of Construction_FoS
Drawn By: Zachary Hill
Scale: 1:175
Company: Tetra Tech, Inc
Date: 2/2/2024
File Name: Section B_EOC UmaBirch 2-2-24.slmd

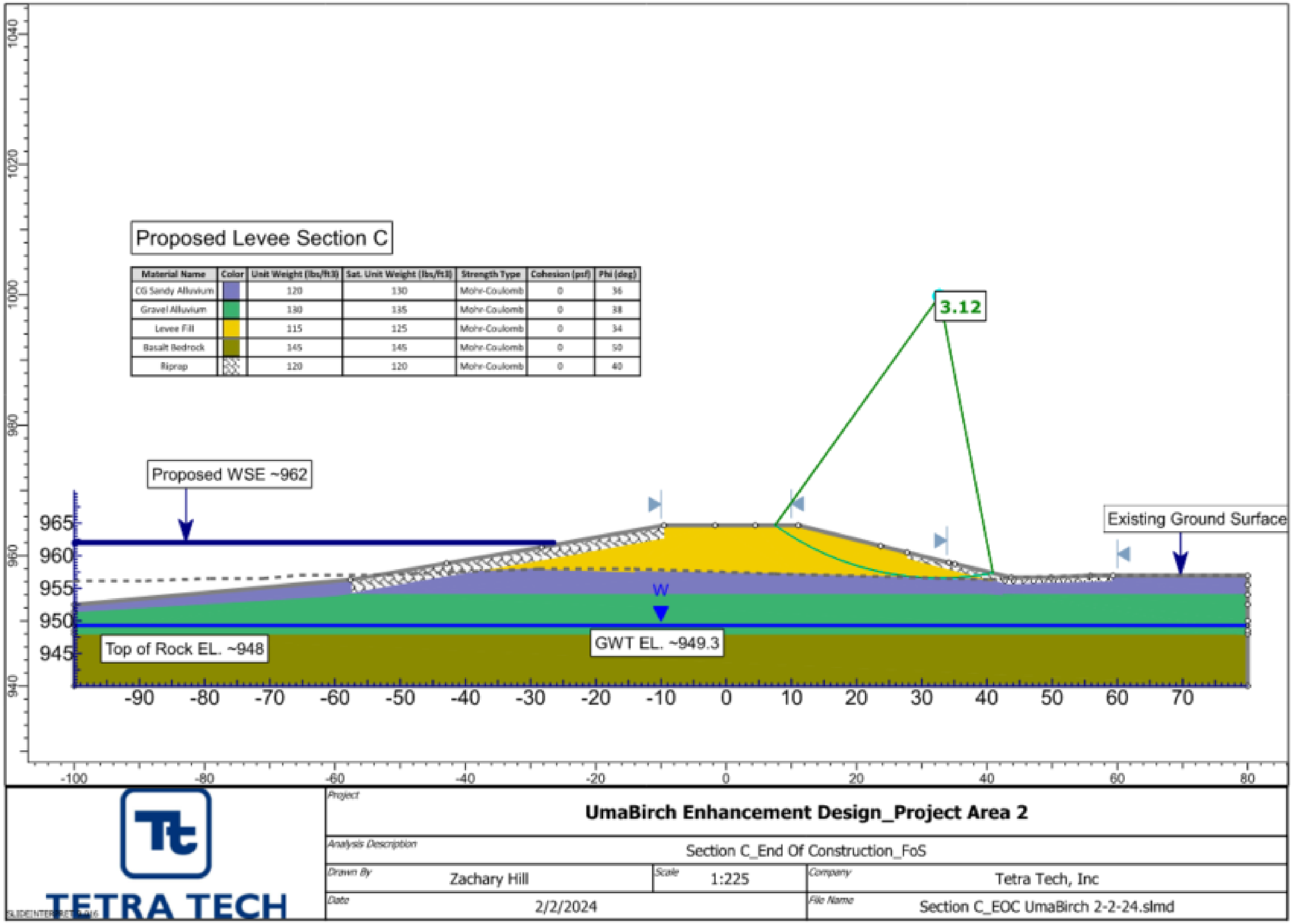
Figure 5-7. Case 1: Section B End of Construction Slope Stability Analysis – Landside



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project: UmaBirch Enhancement Design_Project Area 2
Analysis Description: Section B_End Of Construction_FoS
Drawn By: Zachary Hill
Scale: 1:175
Company: Tetra Tech, Inc
Date: 2/2/2024
File Name: Section B_EOC UmaBirch 2-2-24.slmd

Figure 5-8. Case 1: Section B End of Construction Slope Stability Analysis – Riverside



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project: UmaBirch Enhancement Design_Project Area 2

Analysis Description: Section C_End Of Construction_FoS

Drawn By: Zachary Hill

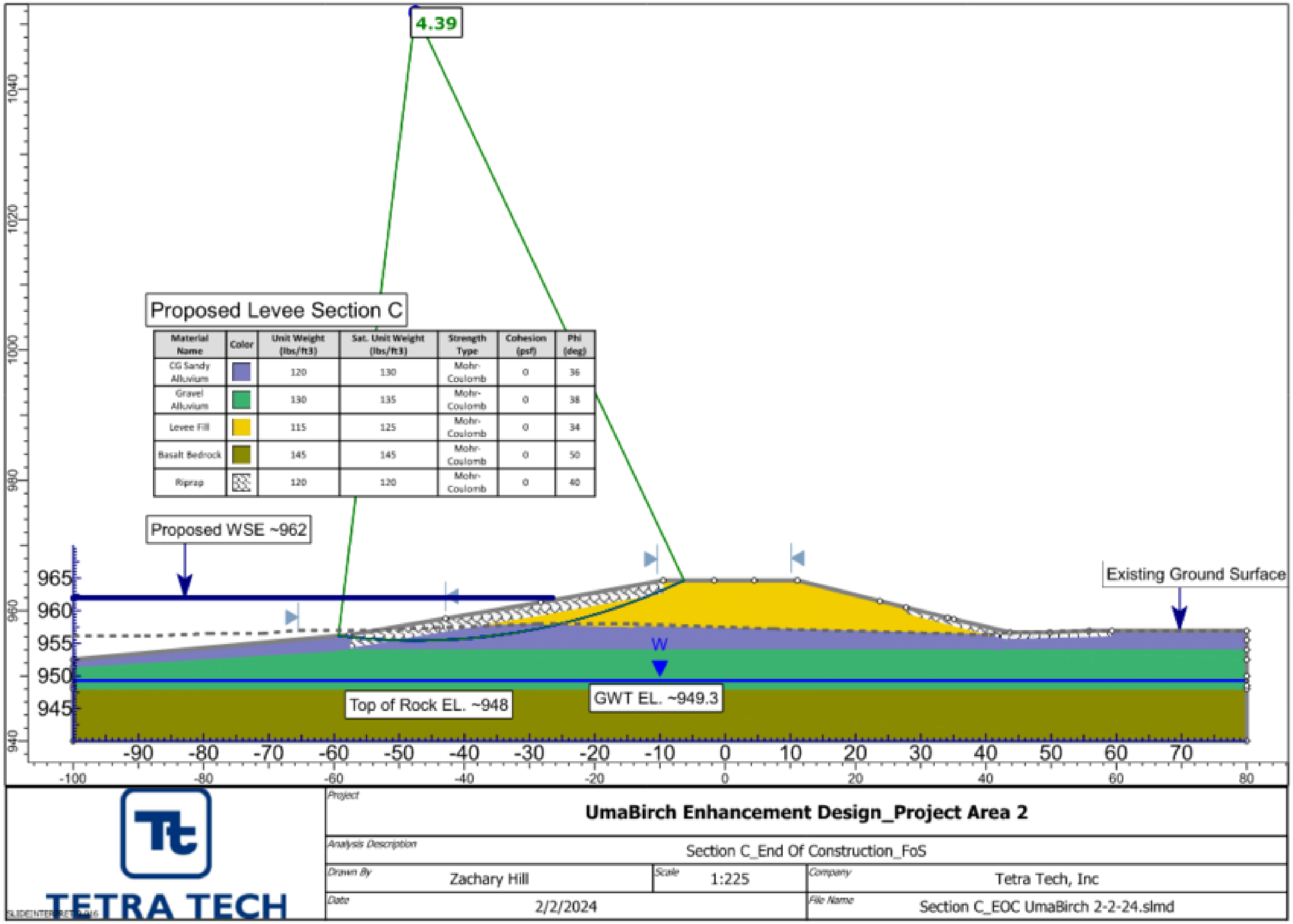
Scale: 1:225

Company: Tetra Tech, Inc

Date: 2/2/2024

File Name: Section C_EOC UmaBirch 2-2-24.slmd

Figure 5-9. Case 1: Section C End of Construction Slope Stability Analysis – Landside



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
CG Sandy Alluvium	🟦	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project **UmaBirch Enhancement Design_Project Area 2**

Analysis Description Section C_End Of Construction_FoS

Drawn By Zachary Hill

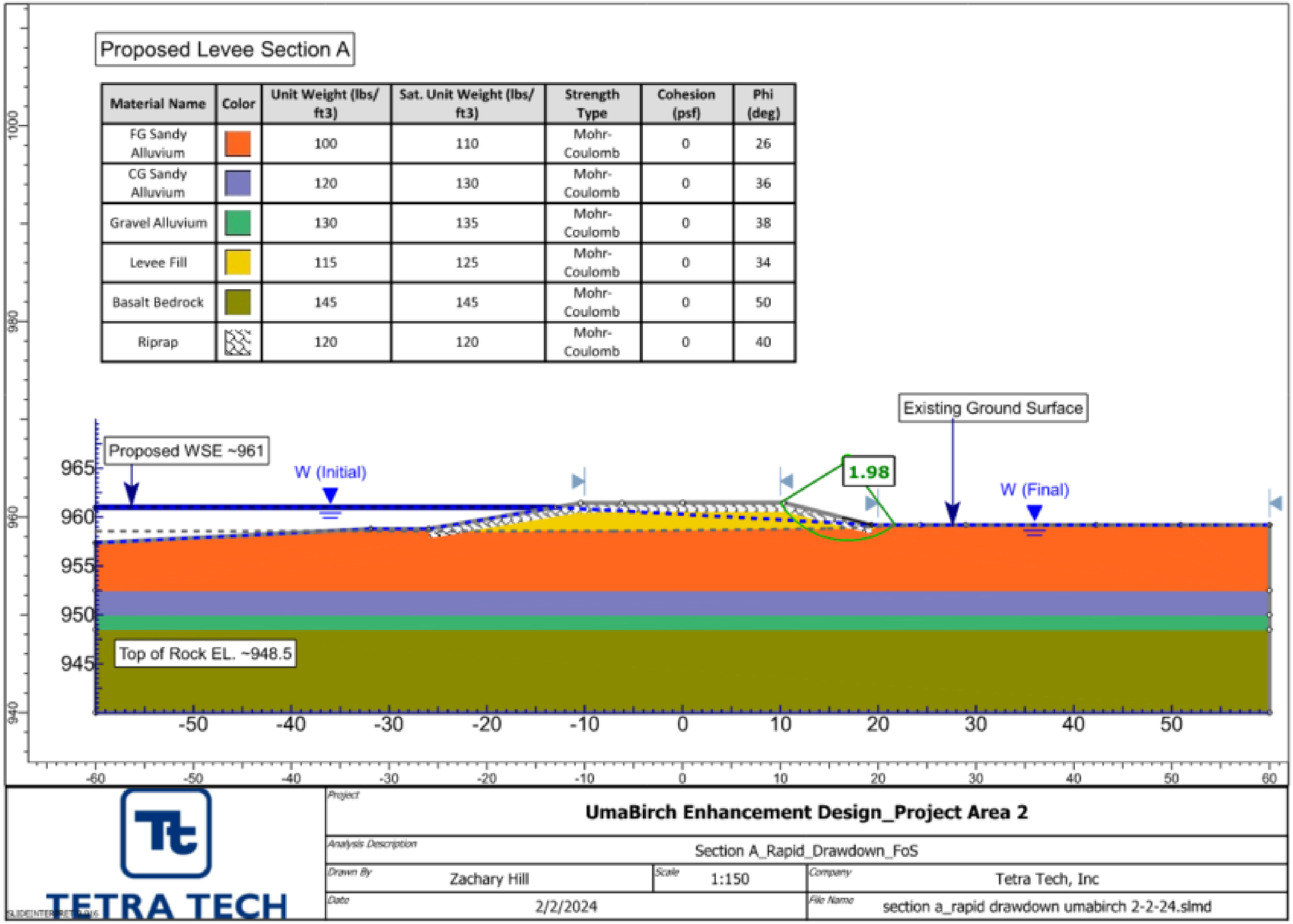
Scale 1:225

Company Tetra Tech, Inc

Date 2/2/2024

File Name Section C_EOC UmaBirch 2-2-24.slmd

Figure 5-10. Case 1: Section C End of Construction Slope Stability Analysis – Riverside



Proposed Levee Section A

Material Name	Color	Unit Weight (lbs/ ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project: **UmaBirch Enhancement Design_Project Area 2**

Analysis Description: Section A_Rapid_Drawdown_FoS

Drawn By: Zachary Hill

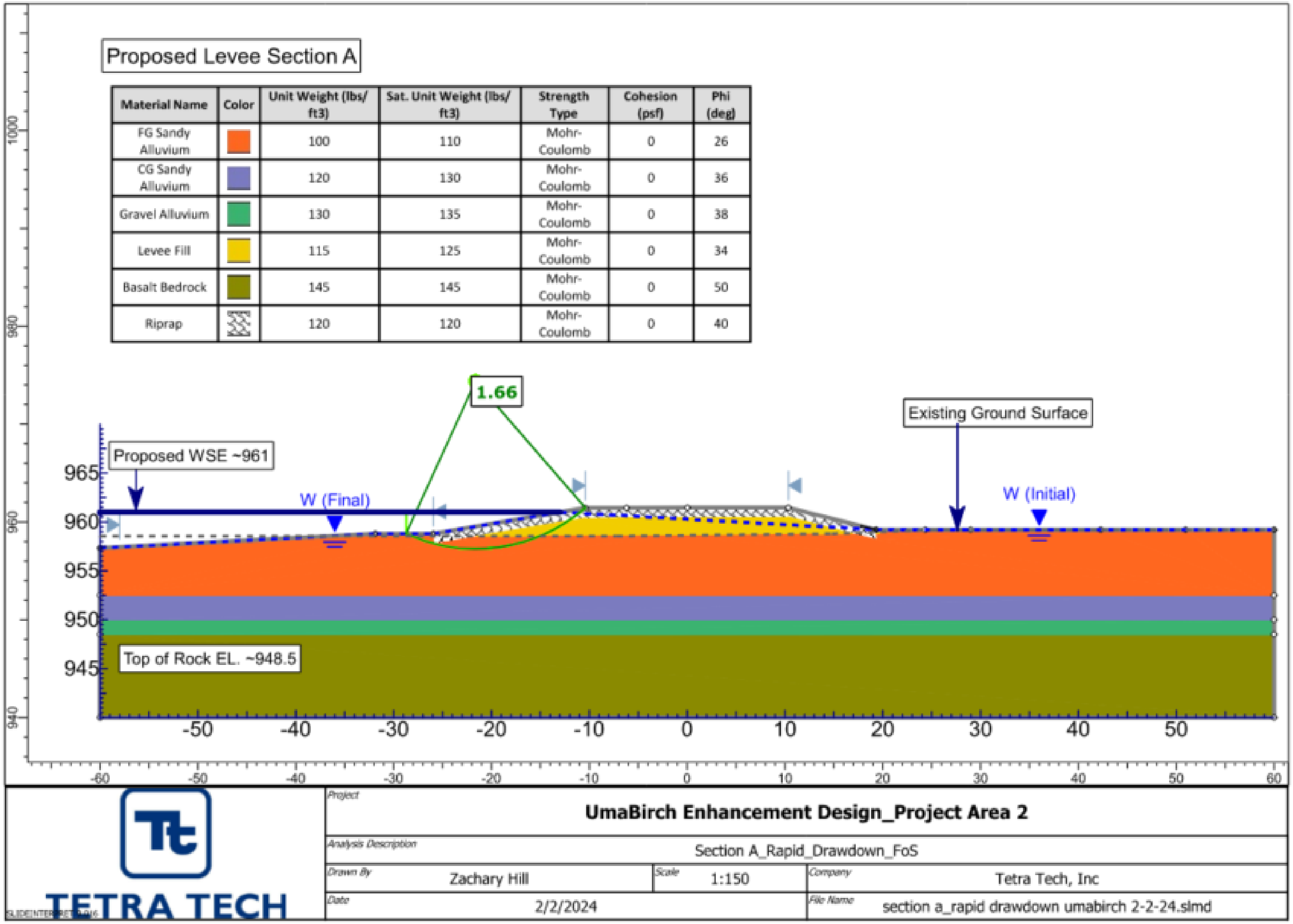
Scale: 1:150

Company: Tetra Tech, Inc

Date: 2/2/2024

File Name: section a_rapid drawdown umabirch 2-2-24.slmd

Figure 5-11. Case 2: Section A Rapid Drawdown Slope Stability Analysis – Landside



Proposed Levee Section A

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project: **UmaBirch Enhancement Design_Project Area 2**

Analysis Description: Section A_Rapid_Drawdown_FoS

Drawn By: Zachary Hill

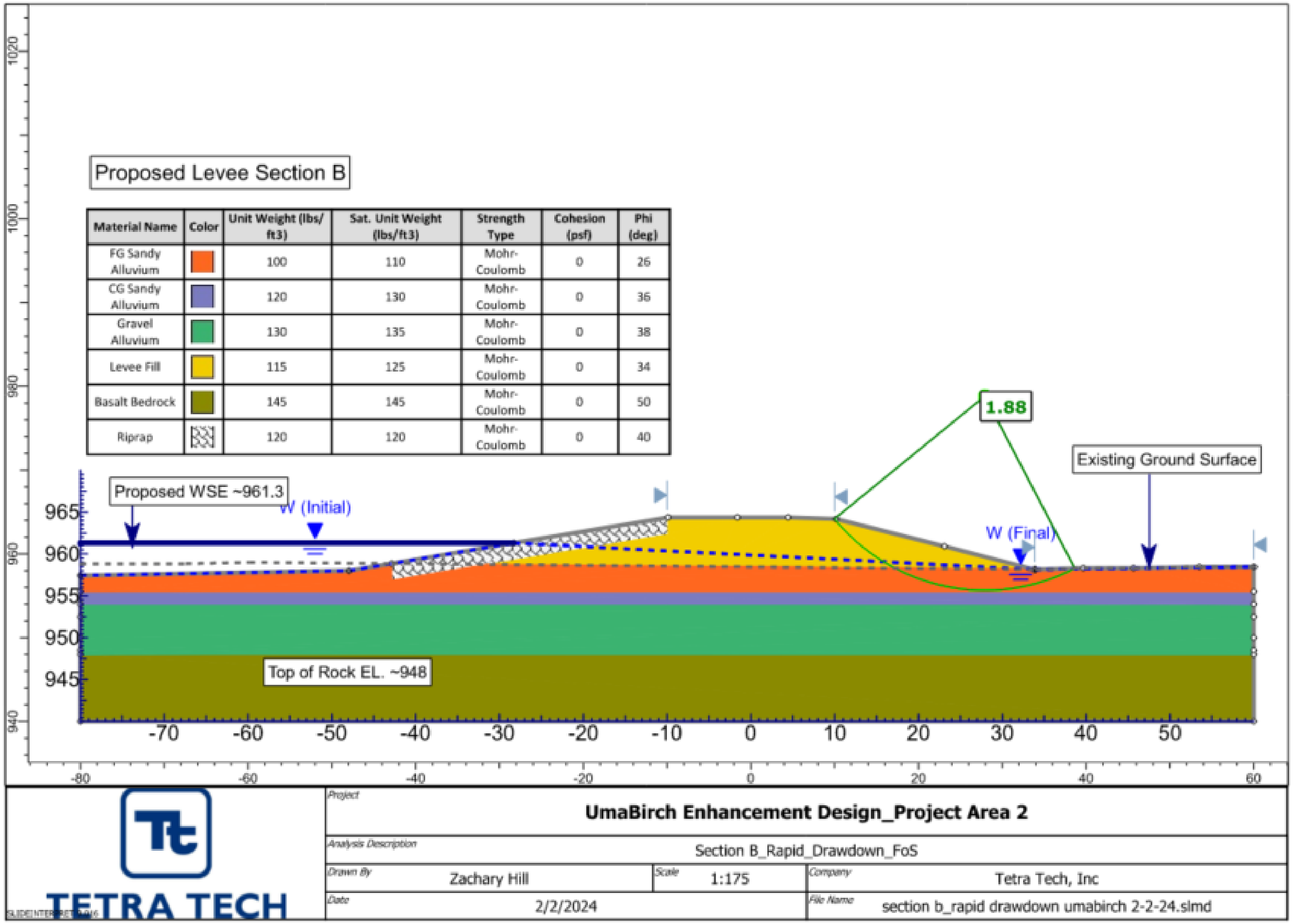
Scale: 1:150

Company: Tetra Tech, Inc

Date: 2/2/2024

File Name: section a_rapid drawdown umabirch 2-2-24.slmd

Figure 5-12. Case 2: Section A Rapid Drawdown Stability Analysis – Riverside



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project: UmaBirch Enhancement Design_Project Area 2

Analysis Description: Section B_Rapid_Drawdown_FoS

Drawn By: Zachary Hill

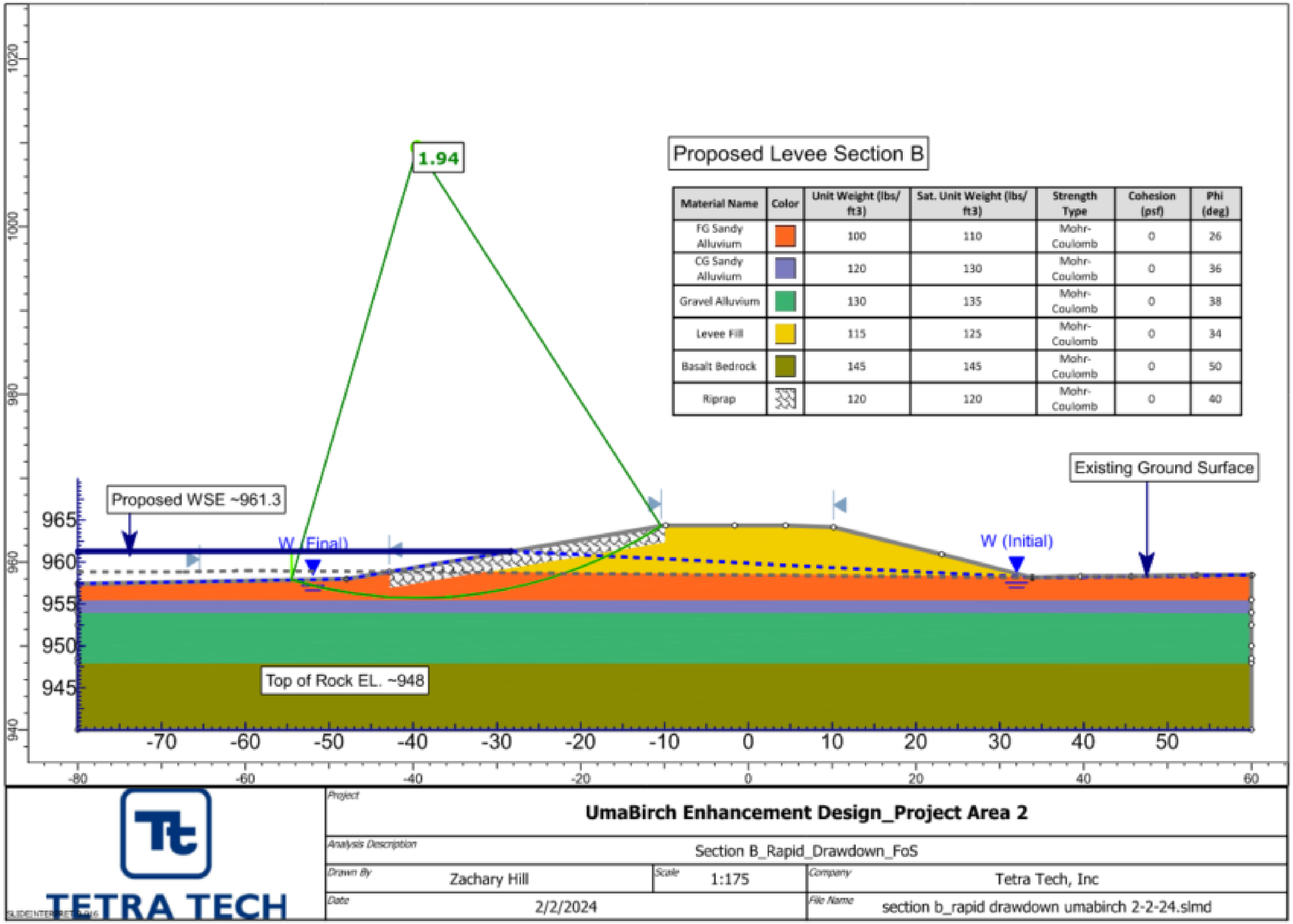
Scale: 1:175

Company: Tetra Tech, Inc

Date: 2/2/2024

File Name: section b_rapid drawdown umabirch 2-2-24.slmd

Figure 5-13. Case 2: Section B Rapid Drawdown Slope Stability Analysis – Landside

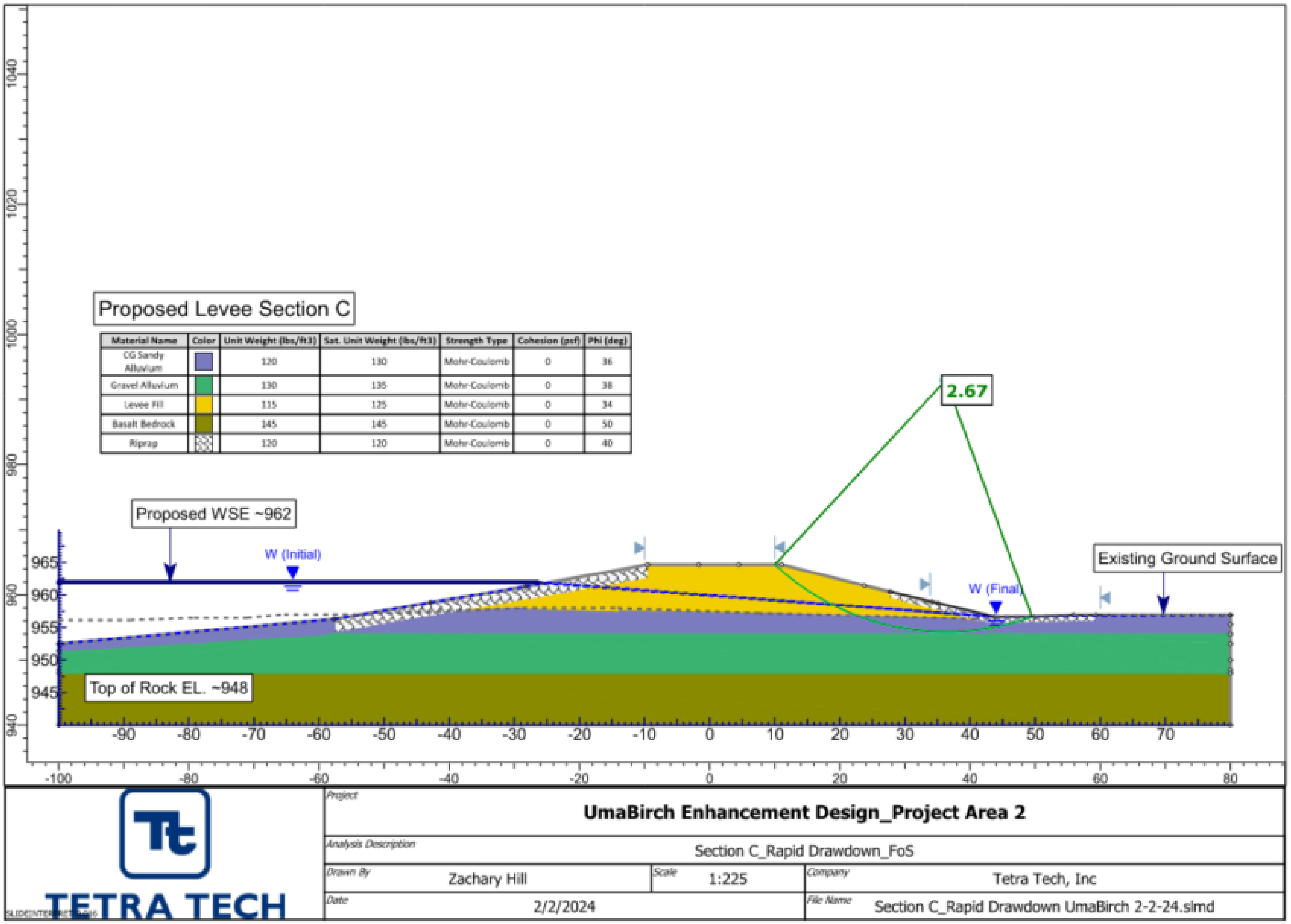


Proposed Levee Section B

Material Name	Color	Unit Weight (lbs/ ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project	UmaBirch Enhancement Design_Project Area 2		
Analysis Description	Section B_Rapid_Drawdown_FoS		
Drawn By	Zachary Hill	Scale	1:175
Company	Tetra Tech, Inc		
Date	2/2/2024	File Name	section b_rapid drawdown umabirch 2-2-24.slmd

Figure 5-14. Case 2: Section B Rapid Drawdown Slope Stability Analysis – Riverside



Proposed Levee Section C

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project **UmaBirch Enhancement Design_Project Area 2**

Analysis Description Section C_Rapid Drawdown_FoS

Drawn By Zachary Hill

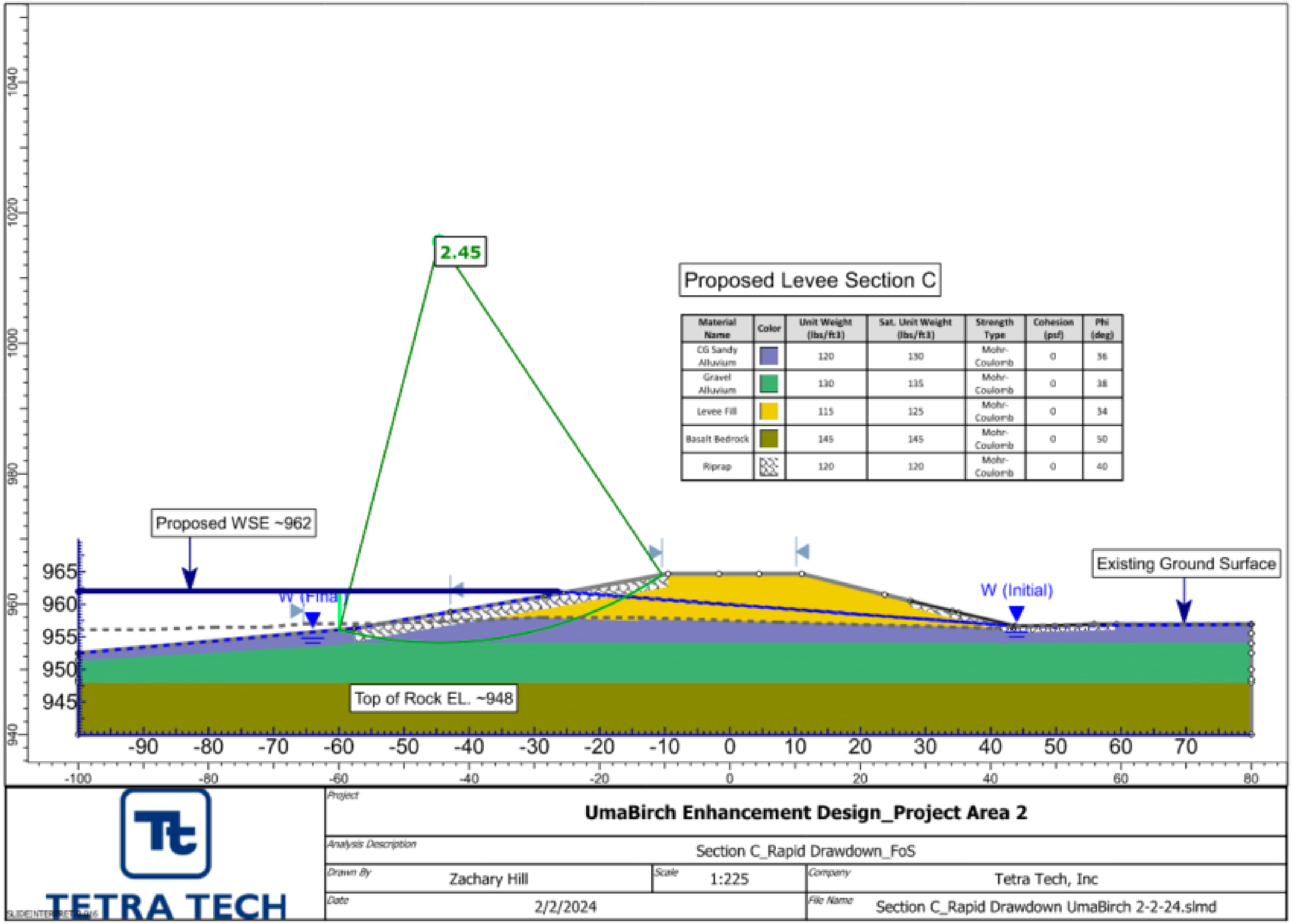
Scale 1:225

Company Tetra Tech, Inc

Date 2/2/2024

File Name Section C_Rapid Drawdown UmaBirch 2-2-24.slmd

Figure 5-15. Case 2: Section C Rapid Drawdown Slope Stability Analysis – Landside



Proposed Levee Section C

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	▨	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project **UmaBirch Enhancement Design_Project Area 2**

Analysis Description Section C_Rapid Drawdown_FoS

Drawn By Zachary Hill

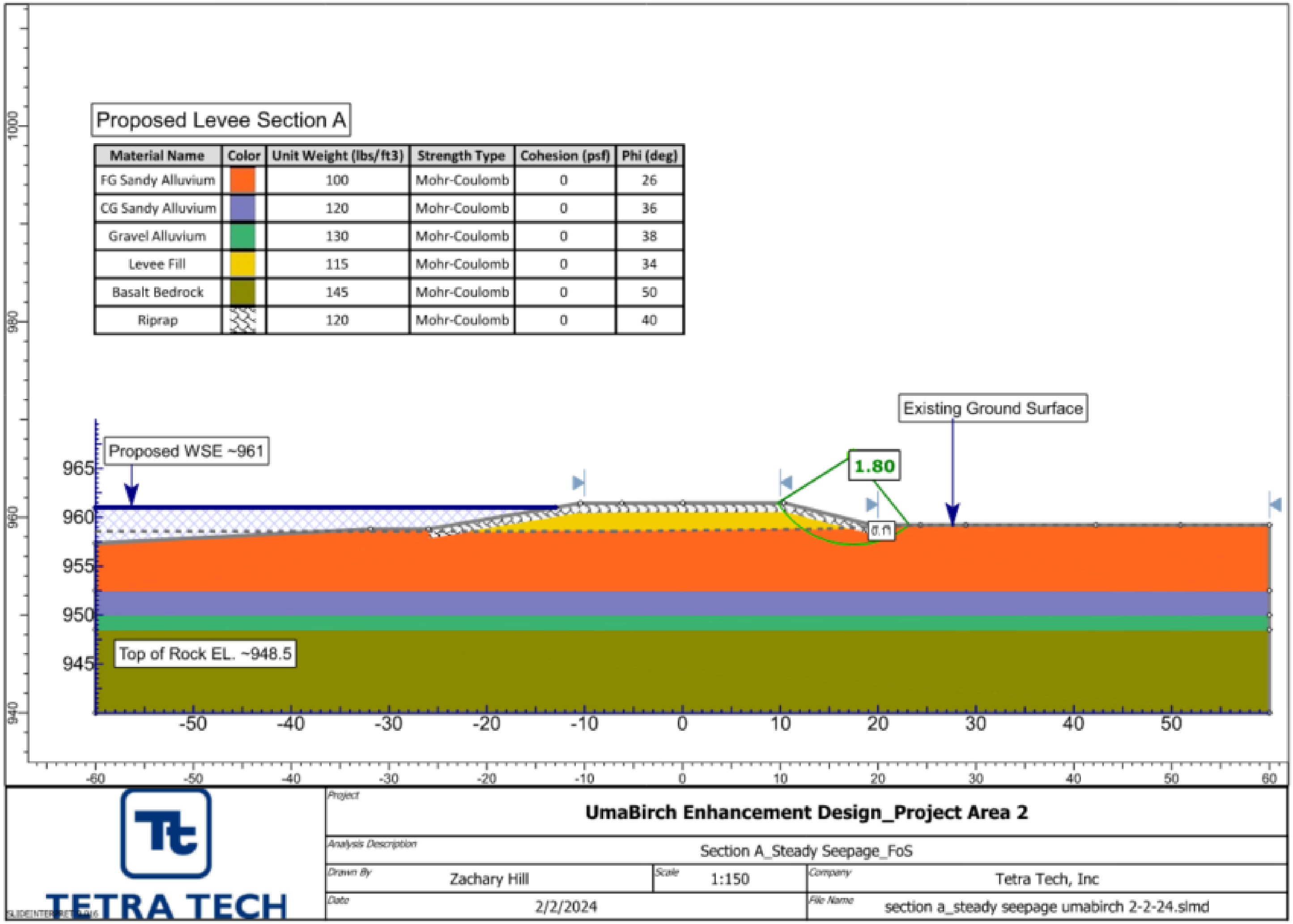
Scale 1:225

Company Tetra Tech, Inc

Date 2/2/2024

File Name Section C_Rapid Drawdown UmaBirch 2-2-24.slmd

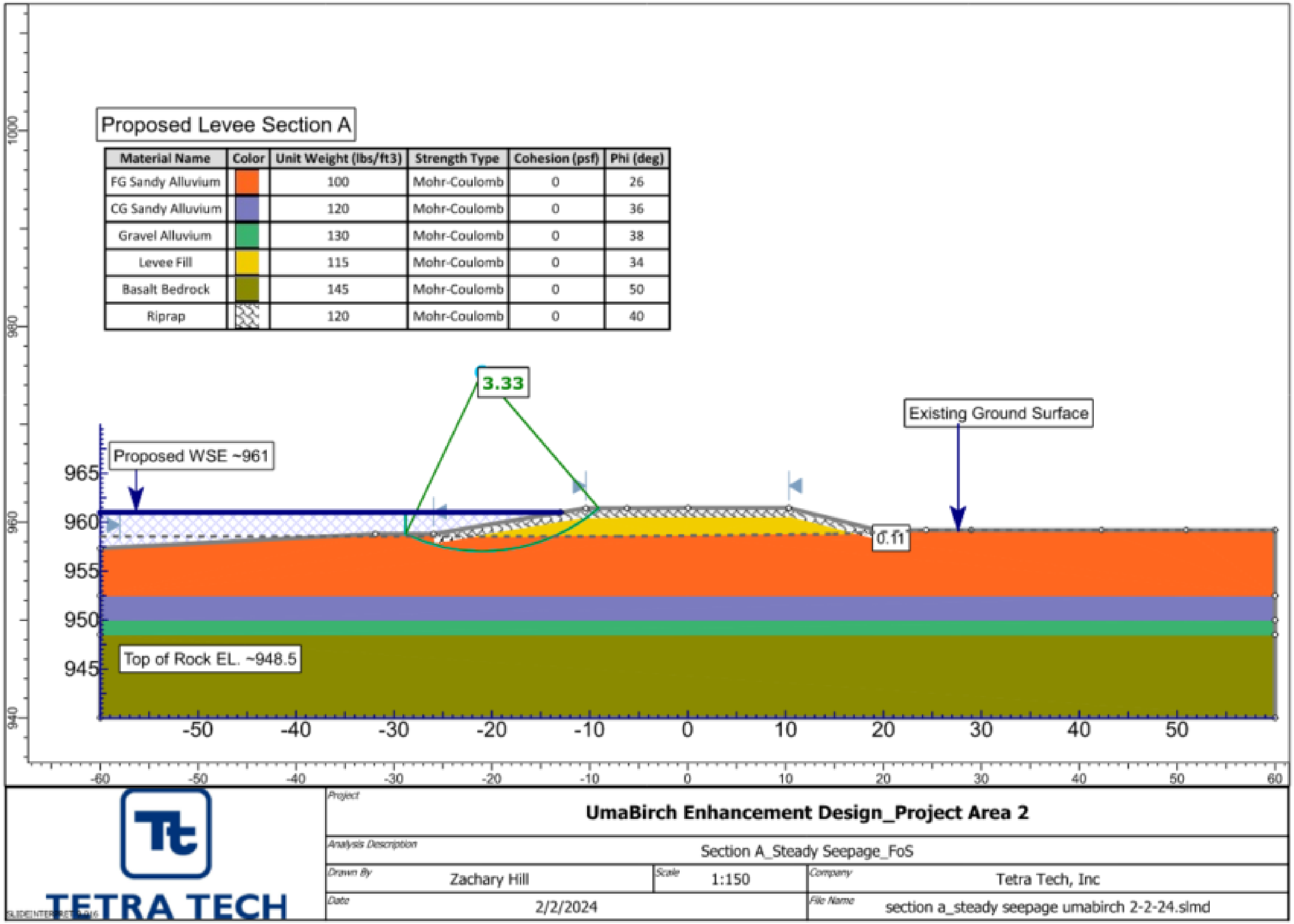
Figure 5-16. Case 2: Section C Rapid Drawdown Slope Stability Analysis – Riverside



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	Mohr-Coulomb	0	38
Levee Fill	🟨	115	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	Mohr-Coulomb	0	50
Riprap	▨	120	Mohr-Coulomb	0	40

Project: UmaBirch Enhancement Design_Project Area 2
Analysis Description: Section A_Steady Seepage_FoS
Drawn By: Zachary Hill
Scale: 1:150
Company: Tetra Tech, Inc
Date: 2/2/2024
File Name: section a_steady seepage umabirch 2-2-24.slmd

Figure 5-17. Case 3: Section A Steady Seepage Slope Stability Analysis – Landside

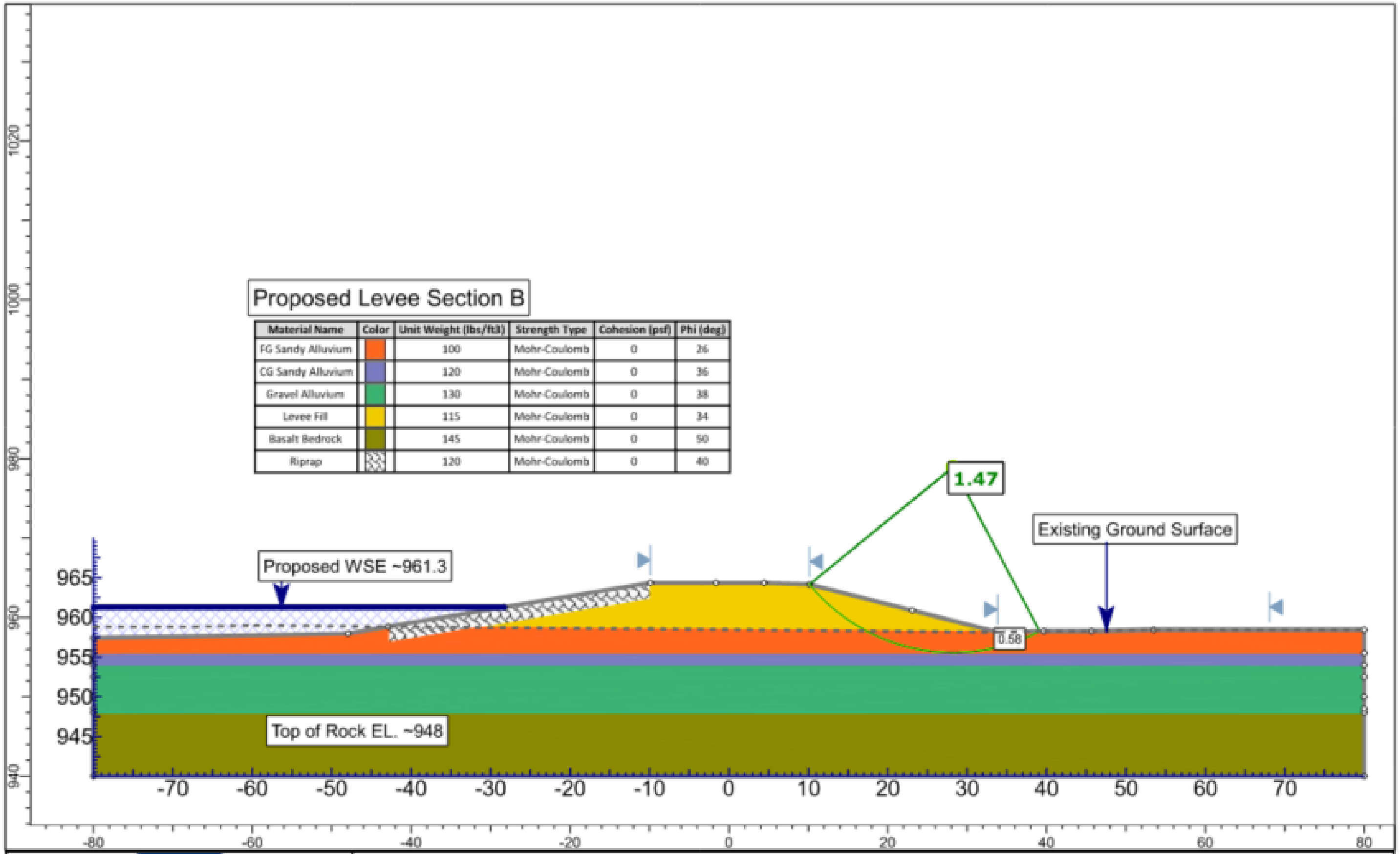


Proposed Levee Section A

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	Mohr-Coulomb	0	38
Levee Fill	🟨	115	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	Mohr-Coulomb	0	50
Riprap	▨	120	Mohr-Coulomb	0	40

Project	UmaBirch Enhancement Design_Project Area 2
Analysis Description	Section A_Steady Seepage_FoS
Drawn By	Zachary Hill
Scale	1:150
Company	Tetra Tech, Inc
Date	2/2/2024
File Name	section a_steady seepage umabirch 2-2-24.slmd

Figure 5-18. Case 3: Section A Steady Seepage Slope Stability Analysis – Riverside



Proposed Levee Section B

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	Mohr-Coulomb	0	38
Levee Fill	🟨	115	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	Mohr-Coulomb	0	50
Riprap	▨	120	Mohr-Coulomb	0	40

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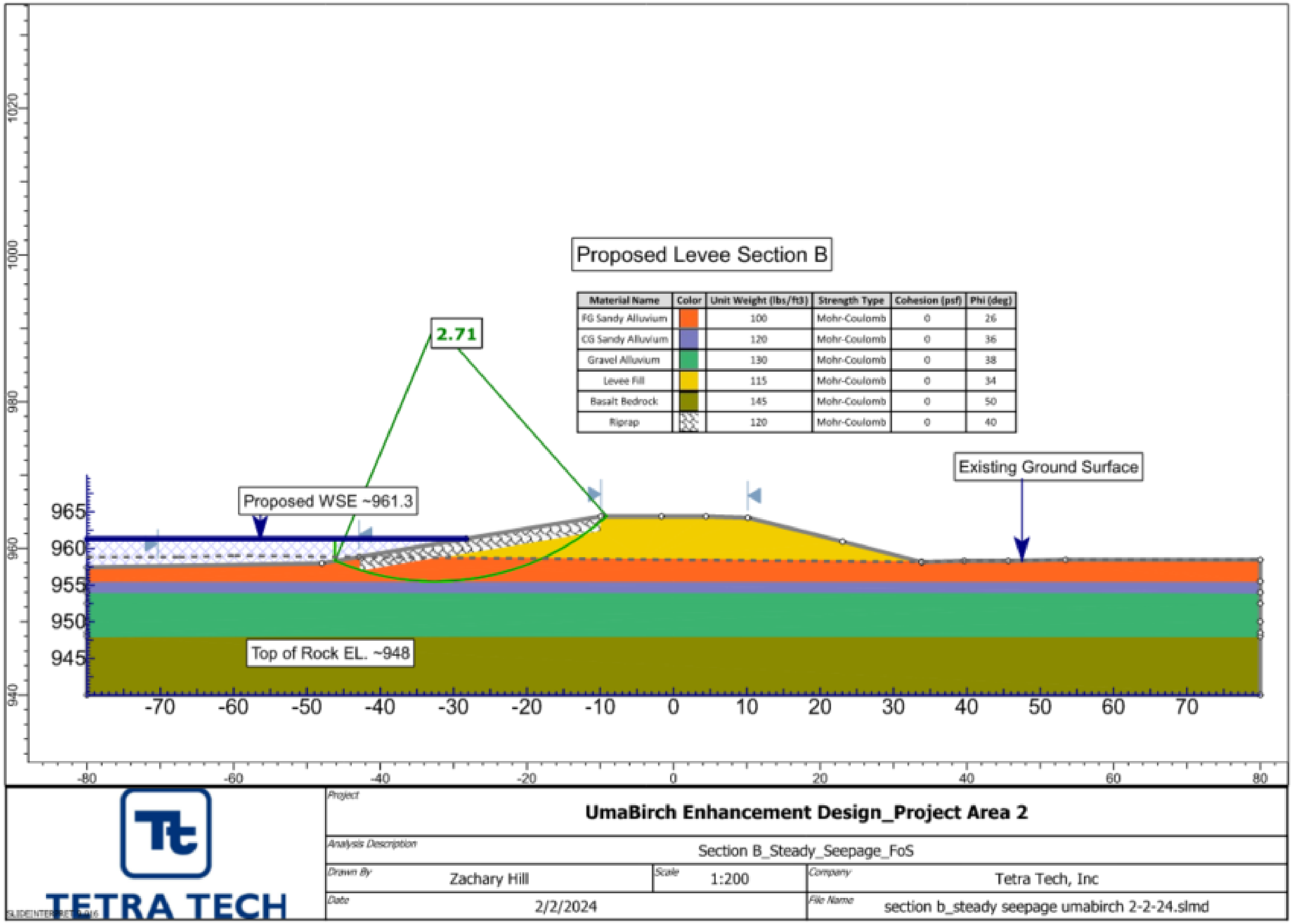
Project	**UmaBirch Enhancement Design_Project Area 2**		
Analysis Description	Section B_Steady_Seepage_FoS		
Drawn By	Zachary Hill	Scale	1:200
Company	Tetra Tech, Inc		
Date	2/2/2024	File Name	section b_steady seepage umabirch 2-2-24.slmd

Figure 5-19. Case 3: Section B Steady Seepage Slope Stability Analysis – Landside



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	Mohr-Coulomb	0	38
Levee Fill	🟨	115	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	Mohr-Coulomb	0	50
Riprap	▨	120	Mohr-Coulomb	0	40

Project: **UmaBirch Enhancement Design_Project Area 2**

Analysis Description: Section B_Steady_Seepage_FoS

Drawn By: Zachary Hill

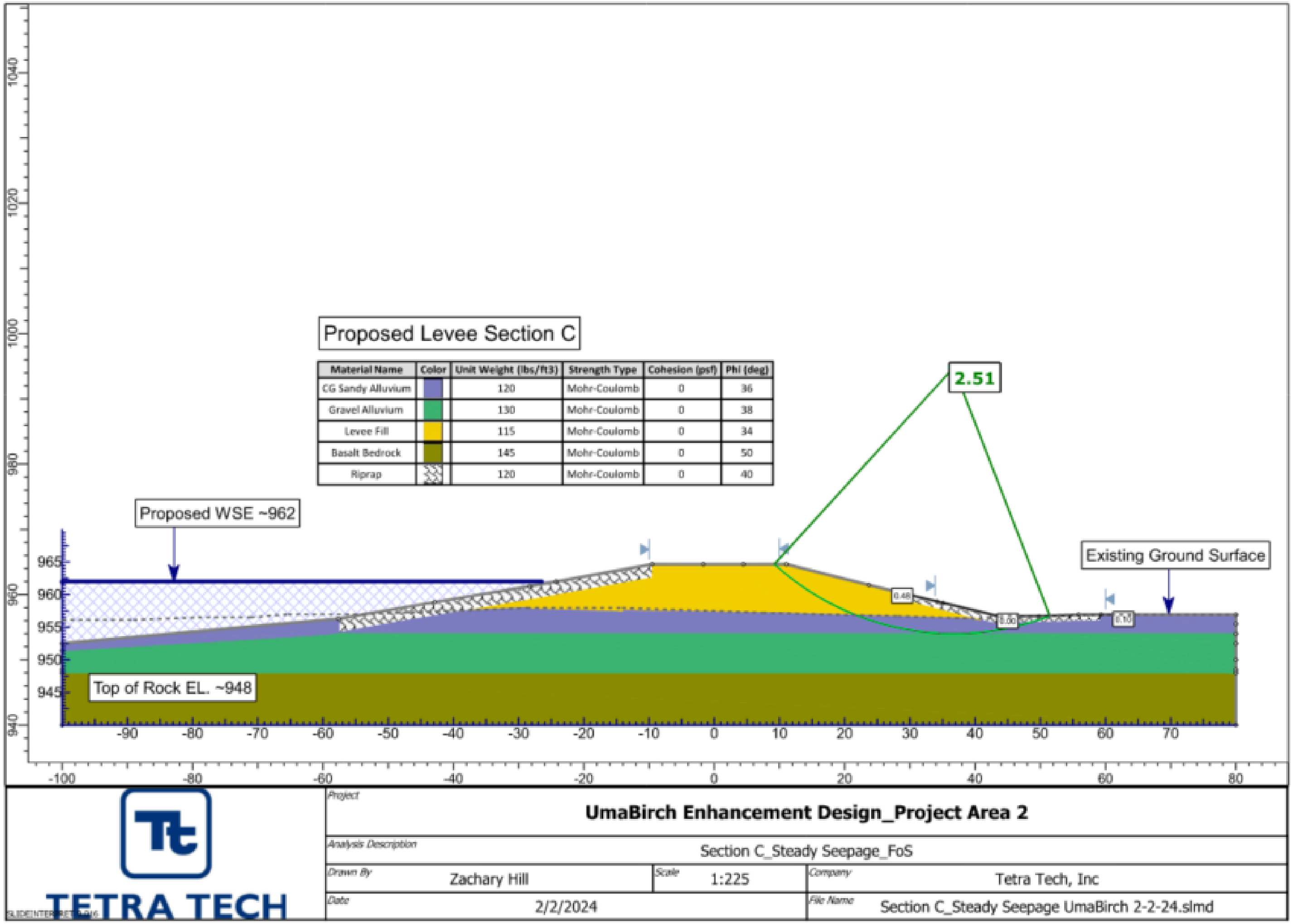
Scale: 1:200

Company: Tetra Tech, Inc

Date: 2/2/2024

File Name: section b_steady seepage umabirch 2-2-24.slmd

Figure 5-20. Case 3: Section B Steady Seepage Slope Stability Analysis – Riverside



Proposed Levee Section C

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
CG Sandy Alluvium	🟪	120	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	Mohr-Coulomb	0	38
Levee Fill	🟨	115	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	Mohr-Coulomb	0	50
Riprap	▨	120	Mohr-Coulomb	0	40

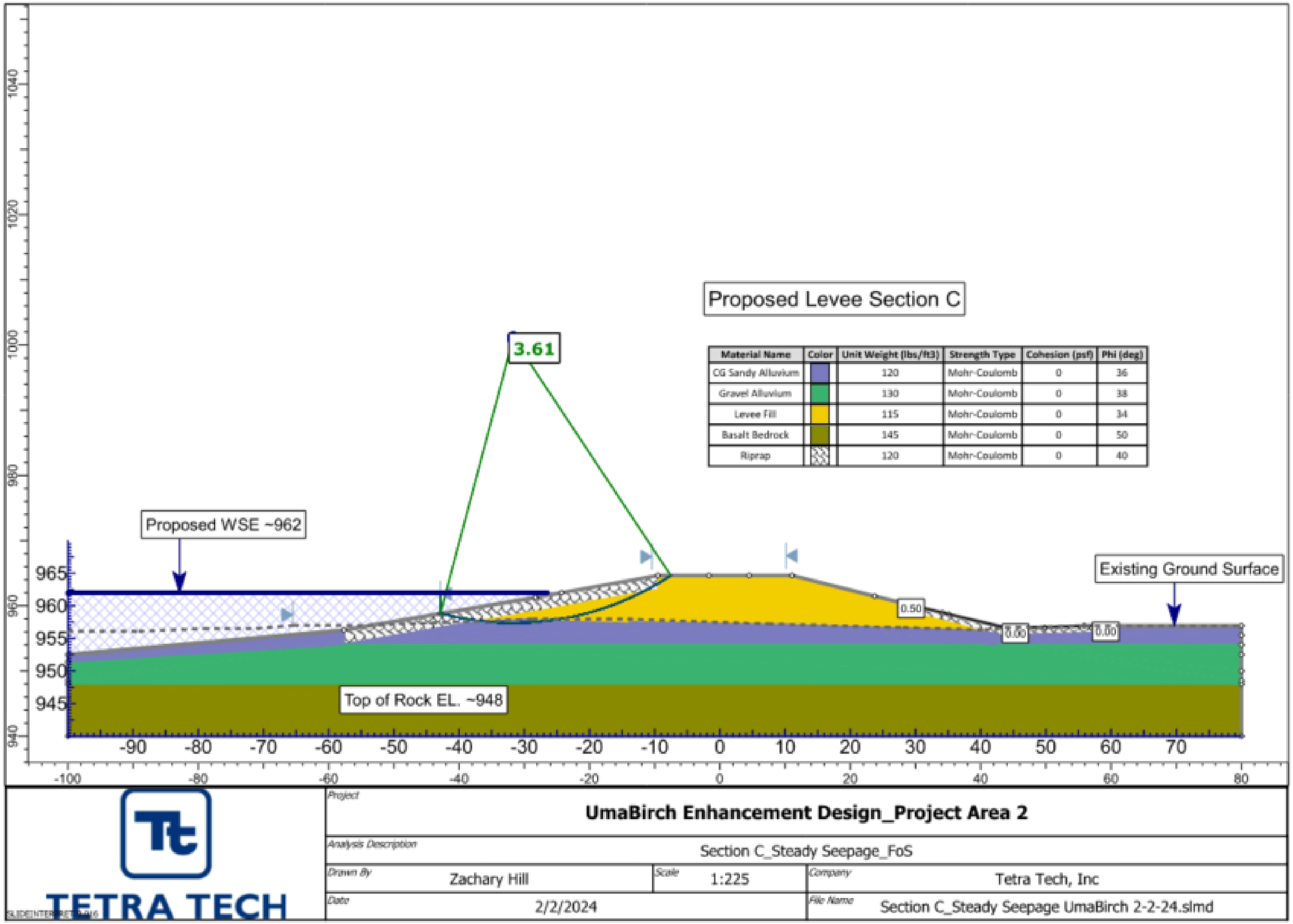
Project **UmaBirch Enhancement Design_Project Area 2**

Analysis Description Section C_Steady Seepage_FoS

Drawn By Zachary Hill *Scale* 1:225 *Company* Tetra Tech, Inc

Date 2/2/2024 *File Name* Section C_Steady Seepage UmaBirch 2-2-24.slmd

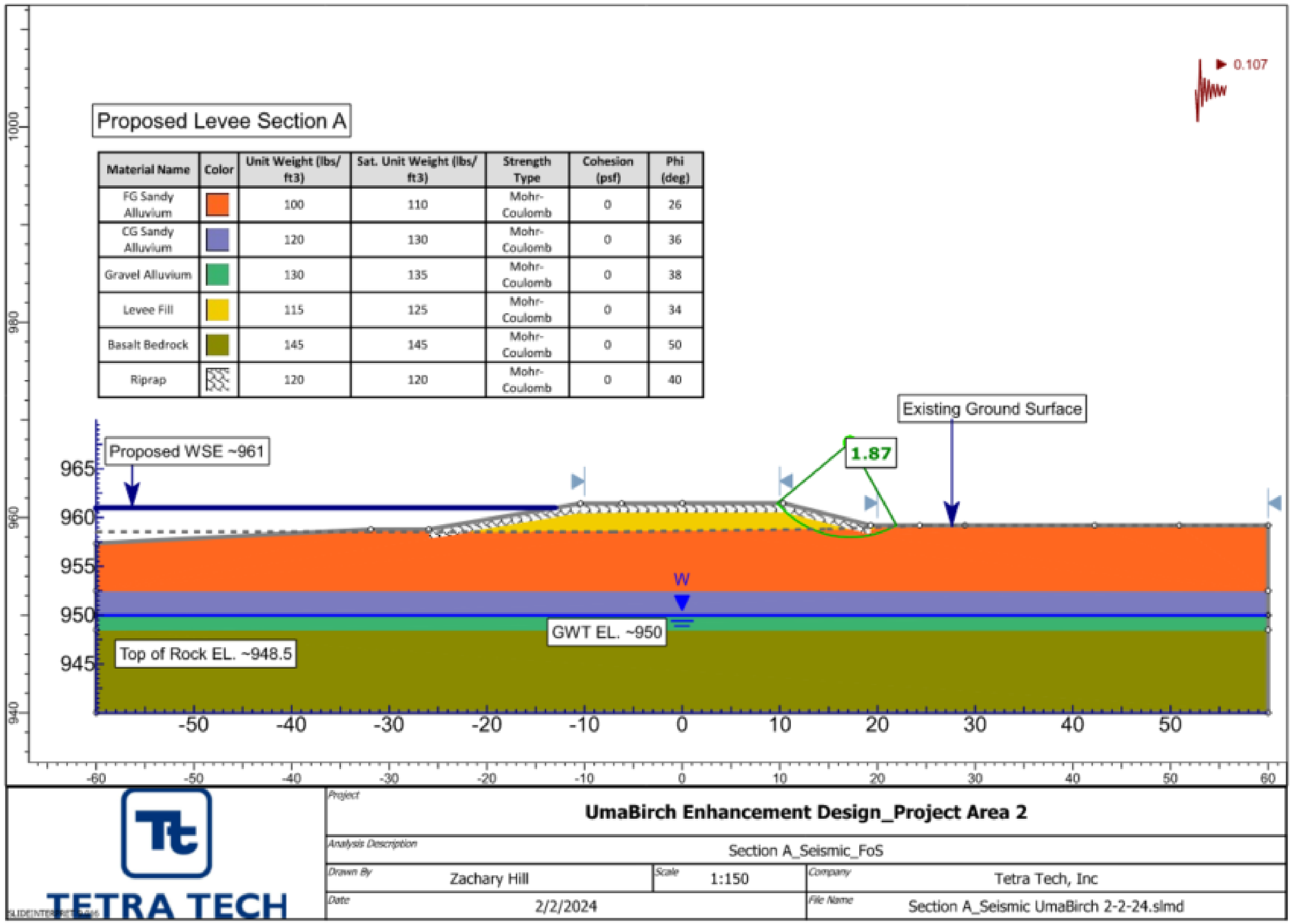
Figure 5-21. Case 3: Section C Steady Seepage Slope Stability Analysis – Landside



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
CG Sandy Alluvium	🟪	120	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	Mohr-Coulomb	0	38
Levee Fill	🟨	115	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	Mohr-Coulomb	0	50
Riprap	▨	120	Mohr-Coulomb	0	40

Project: **UmaBirch Enhancement Design_Project Area 2**
Analysis Description: Section C_Steady Seepage_FoS
Drawn By: Zachary Hill
Scale: 1:225
Company: Tetra Tech, Inc
Date: 2/2/2024
File Name: Section C_Steady Seepage UmaBirch 2-2-24.slmd

Figure 5-22. Case 3: Section C Steady Seepage Slope Stability Analysis – Riverside

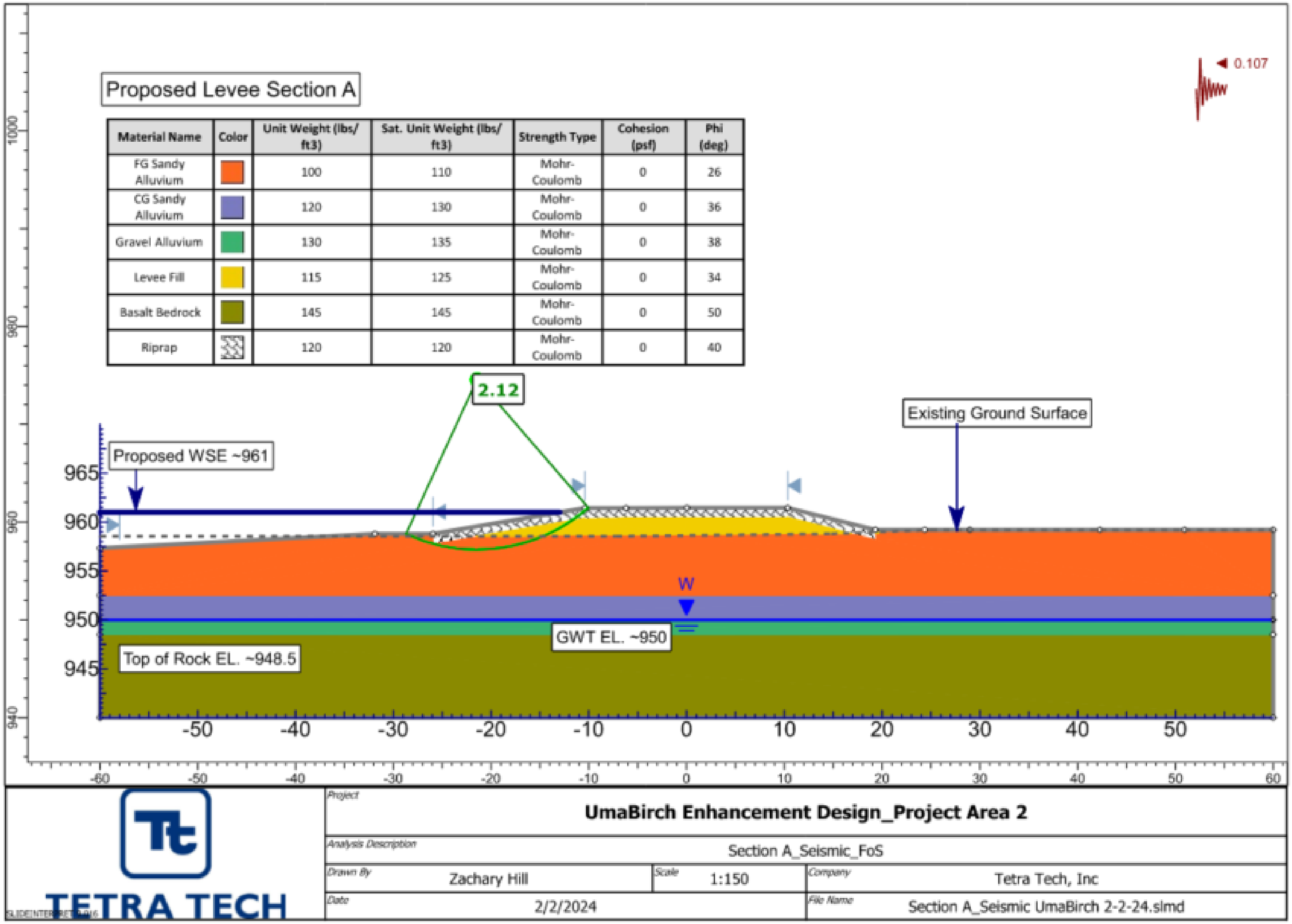


Proposed Levee Section A

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project	**UmaBirch Enhancement Design_Project Area 2**
Analysis Description	Section A_Seismic_FoS
Drawn By	Zachary Hill
Scale	1:150
Company	Tetra Tech, Inc
Date	2/2/2024
File Name	Section A_Seismic UmaBirch 2-2-24.slmd

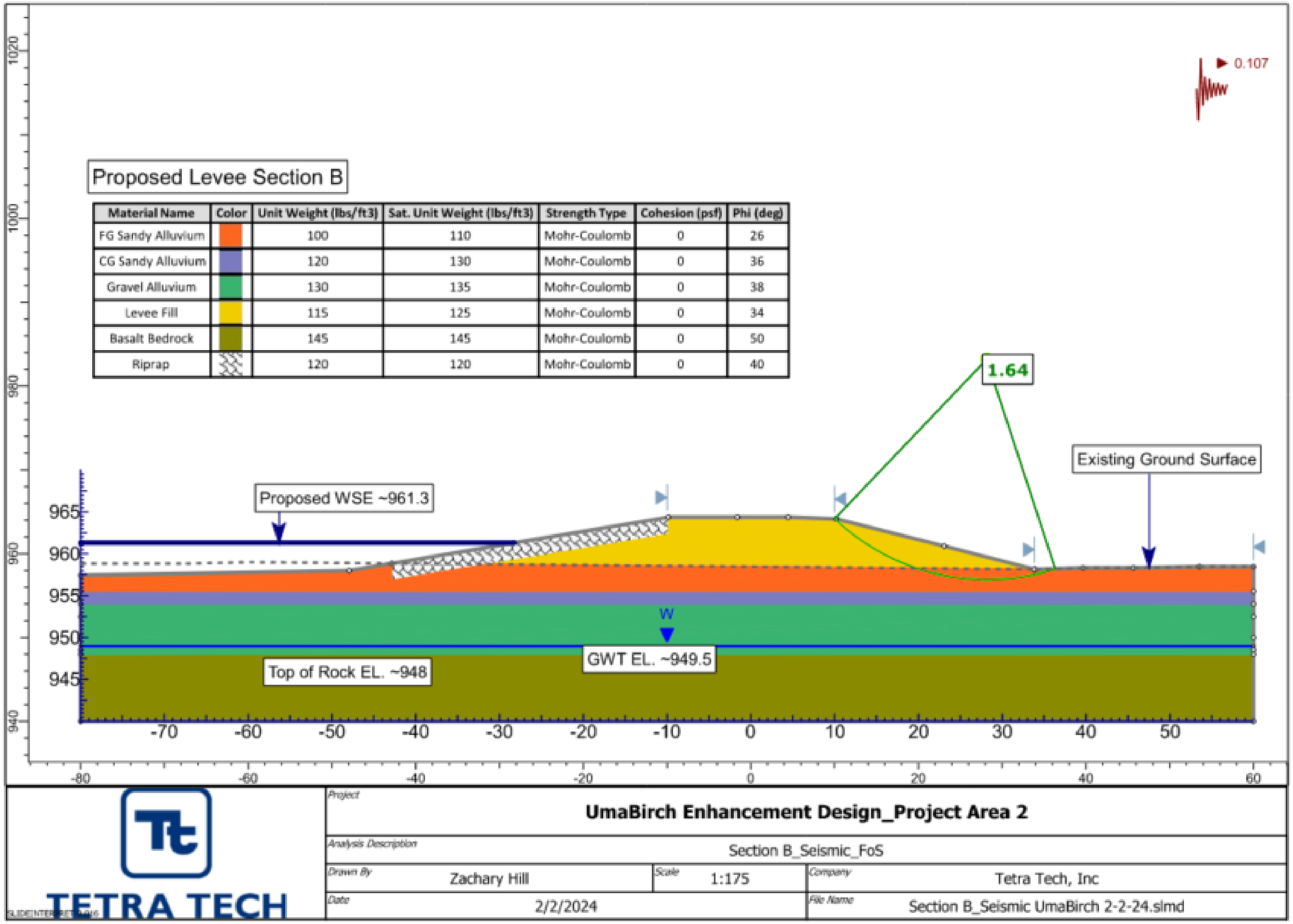
Figure 5-23. Case 4: Section A Seismic Slope Stability Analysis – Landside



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project	**UmaBirch Enhancement Design_Project Area 2**
Analysis Description	Section A_Seismic_FoS
Drawn By	Zachary Hill
Scale	1:150
Company	Tetra Tech, Inc
Date	2/2/2024
File Name	Section A_Seismic UmaBirch 2-2-24.slmd

Figure 5-24. Case 4: Section A Seismic Slope Stability Analysis – Riverside



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project: **UmaBirch Enhancement Design_Project Area 2**

Analysis Description: Section B_Seismic_FoS

Drawn By: Zachary Hill

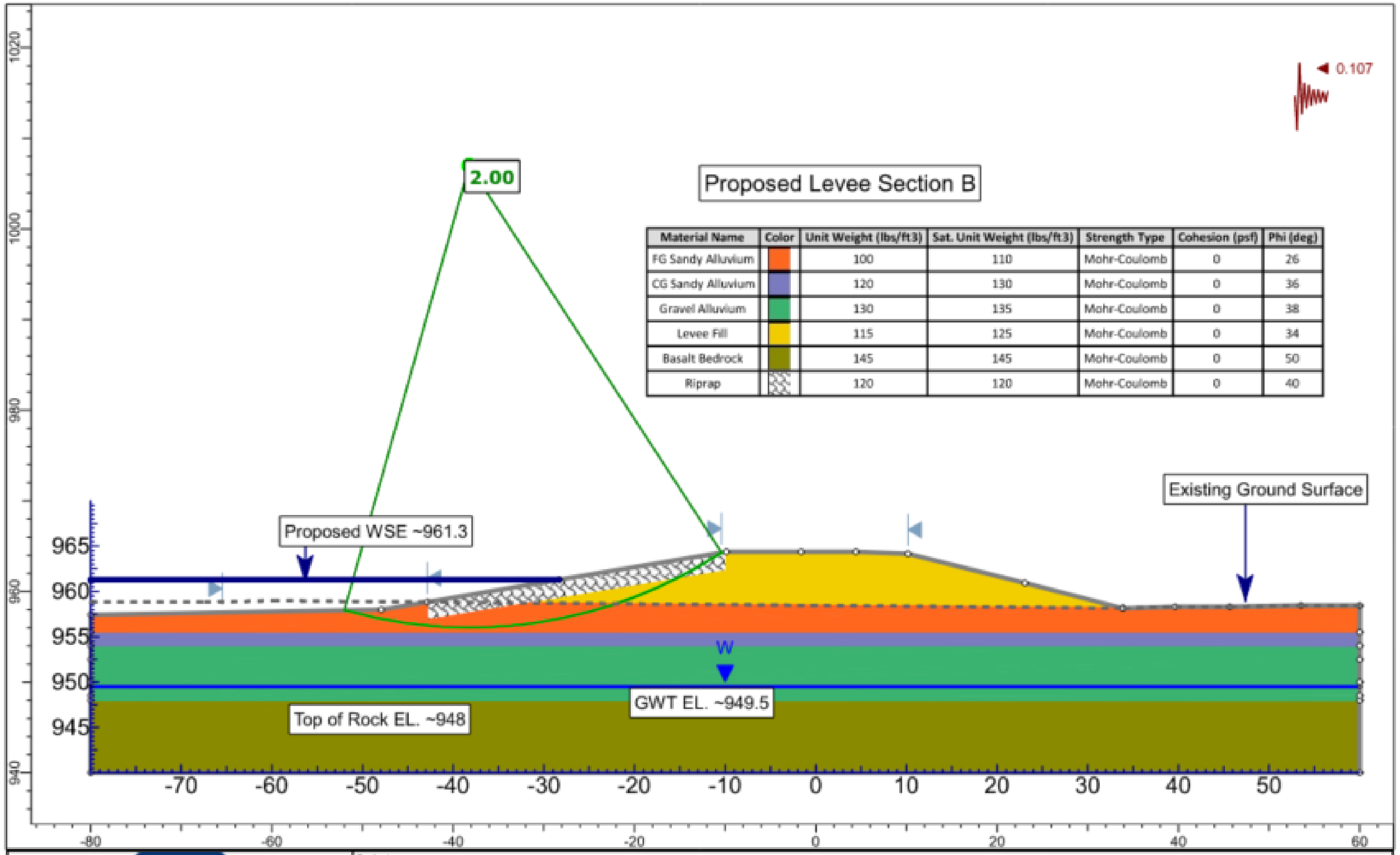
Scale: 1:175

Company: Tetra Tech, Inc

Date: 2/2/2024

File Name: Section B_Seismic UmaBirch 2-2-24.slmd

Figure 5-25. Case 4: Section B Seismic Slope Stability Analysis – Landside



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

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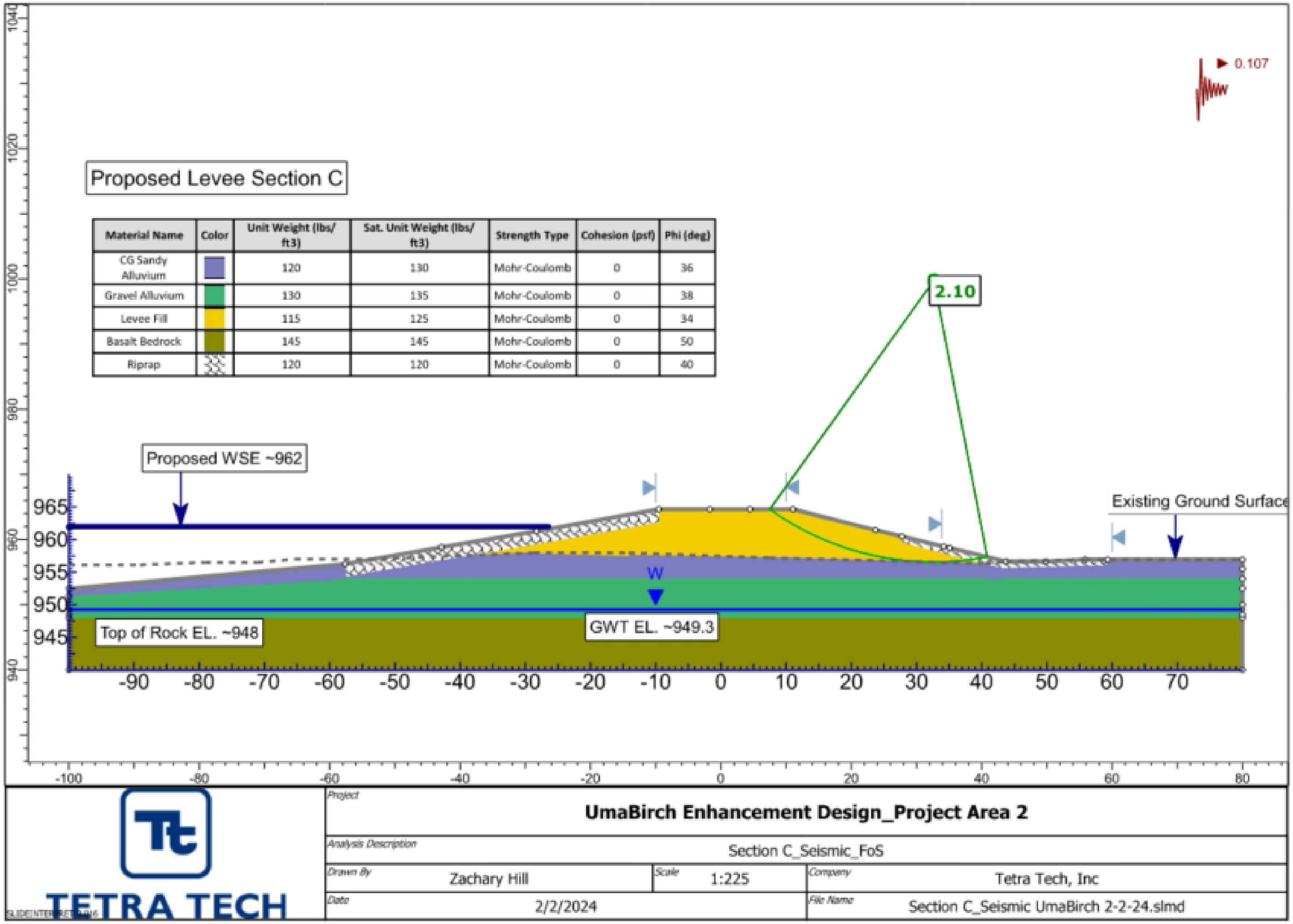
Project
UmaBirch Enhancement Design_Project Area 2

Analysis Description Section B_Seismic_FoS

Drawn By Zachary Hill *Scale* 1:175 *Company* Tetra Tech, Inc

Date 2/2/2024 *File Name* Section B_Seismic UmaBirch 2-2-24.slmd

Figure 5-26. Case 4: Section B Seismic Slope Stability Analysis – Riverside



Material Name	Color	Unit Weight (lbs/ ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

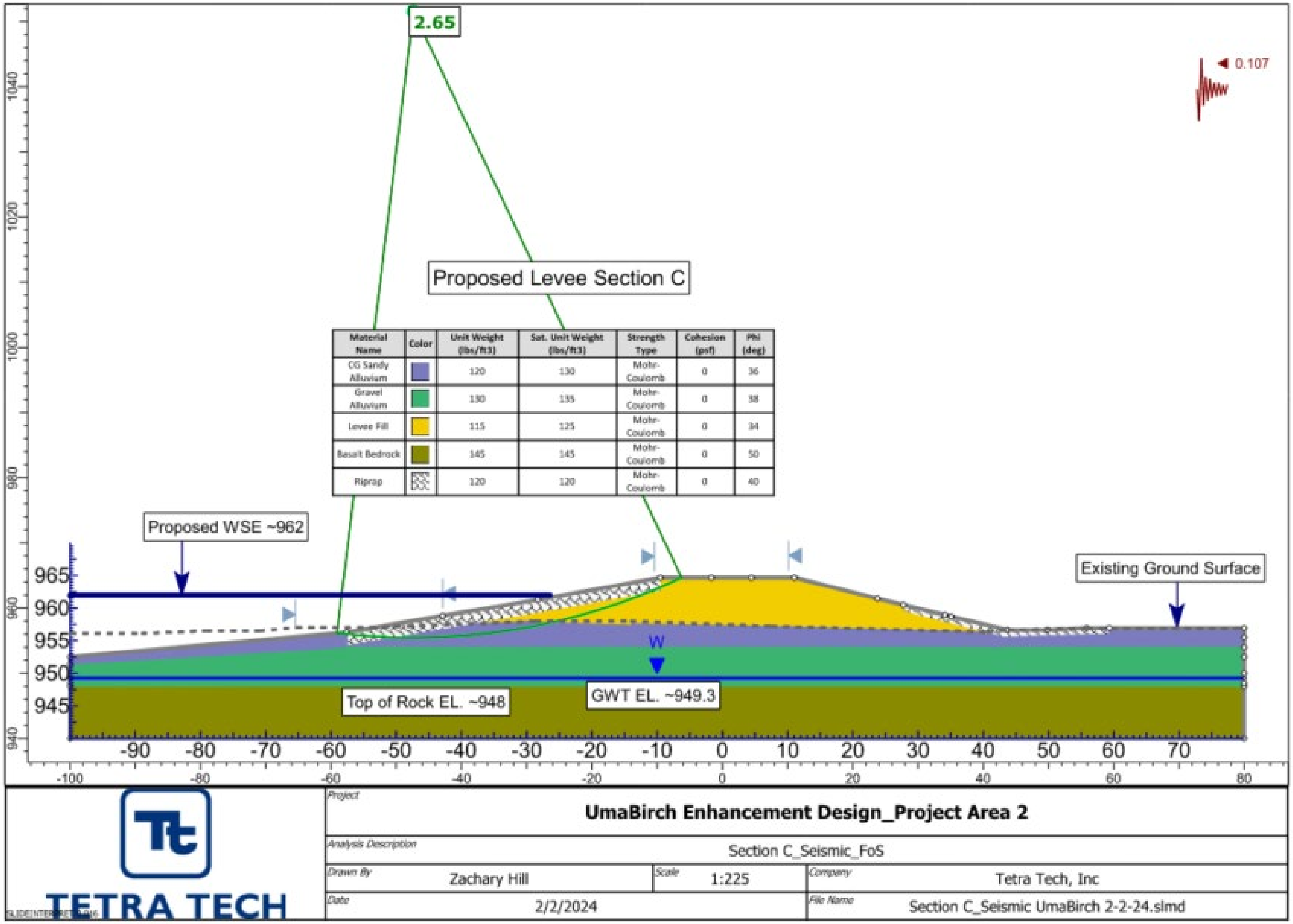
Project: **UmaBirch Enhancement Design_Project Area 2**

Analysis Description: Section C_Seismic_FoS

Drawn By: Zachary Hill
Scale: 1:225
Company: Tetra Tech, Inc

Date: 2/2/2024
File Name: Section C_Seismic UmaBirch 2-2-24.slmd

Figure 5-27. Case 4: Section C Seismic Slope Stability Analysis – Landside



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project: **UmaBirch Enhancement Design_Project Area 2**

Analysis Description: Section C_Seismic_FoS

Drawn By: Zachary Hill

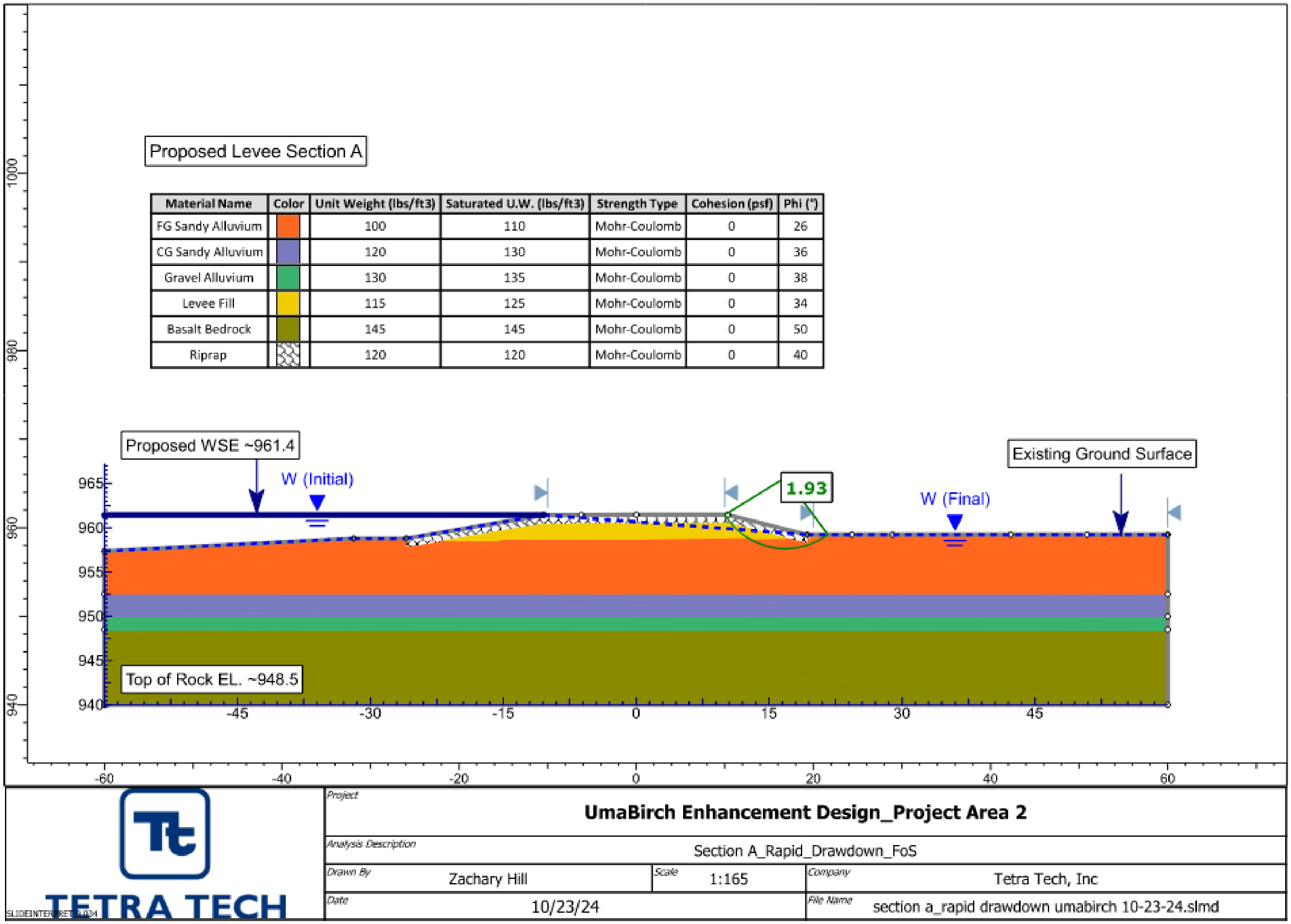
Scale: 1:225

Company: Tetra Tech, Inc

Date: 2/2/2024

File Name: Section C_Seismic UmaBirch 2-2-24.slmd

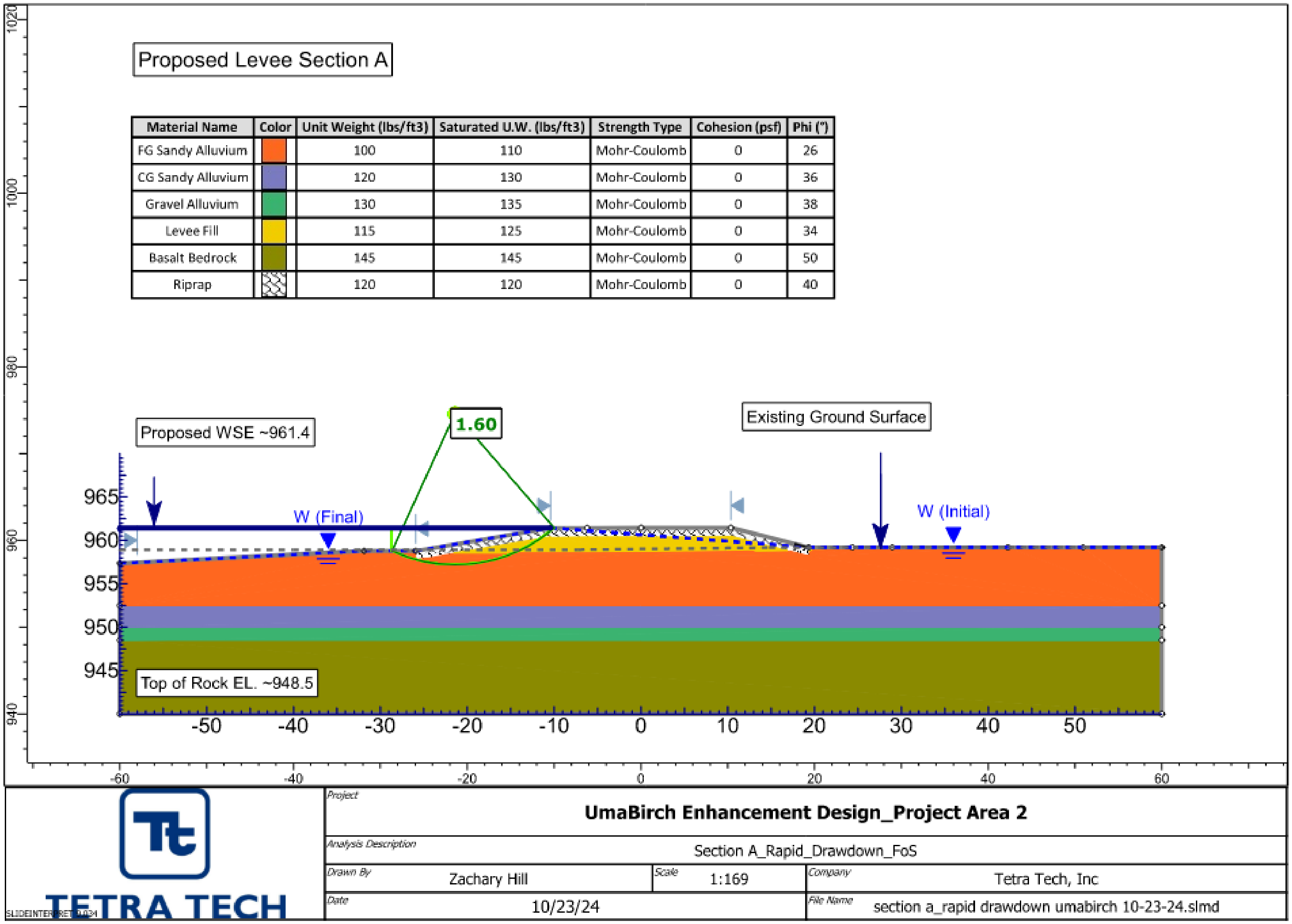
Figure 5-28. Case 4: Section C Seismic Slope Stability Analysis – Riverside



Material Name	Color	Unit Weight (lbs/ft3)	Saturated U.W. (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project	**UmaBirch Enhancement Design_Project Area 2**
Analysis Description	Section A_Rapid_Drawdown_FoS
Drawn By	Zachary Hill
Scale	1:165
Company	Tetra Tech, Inc
Date	10/23/24
File Name	section a_rapid drawdown umabirch 10-23-24.slmd

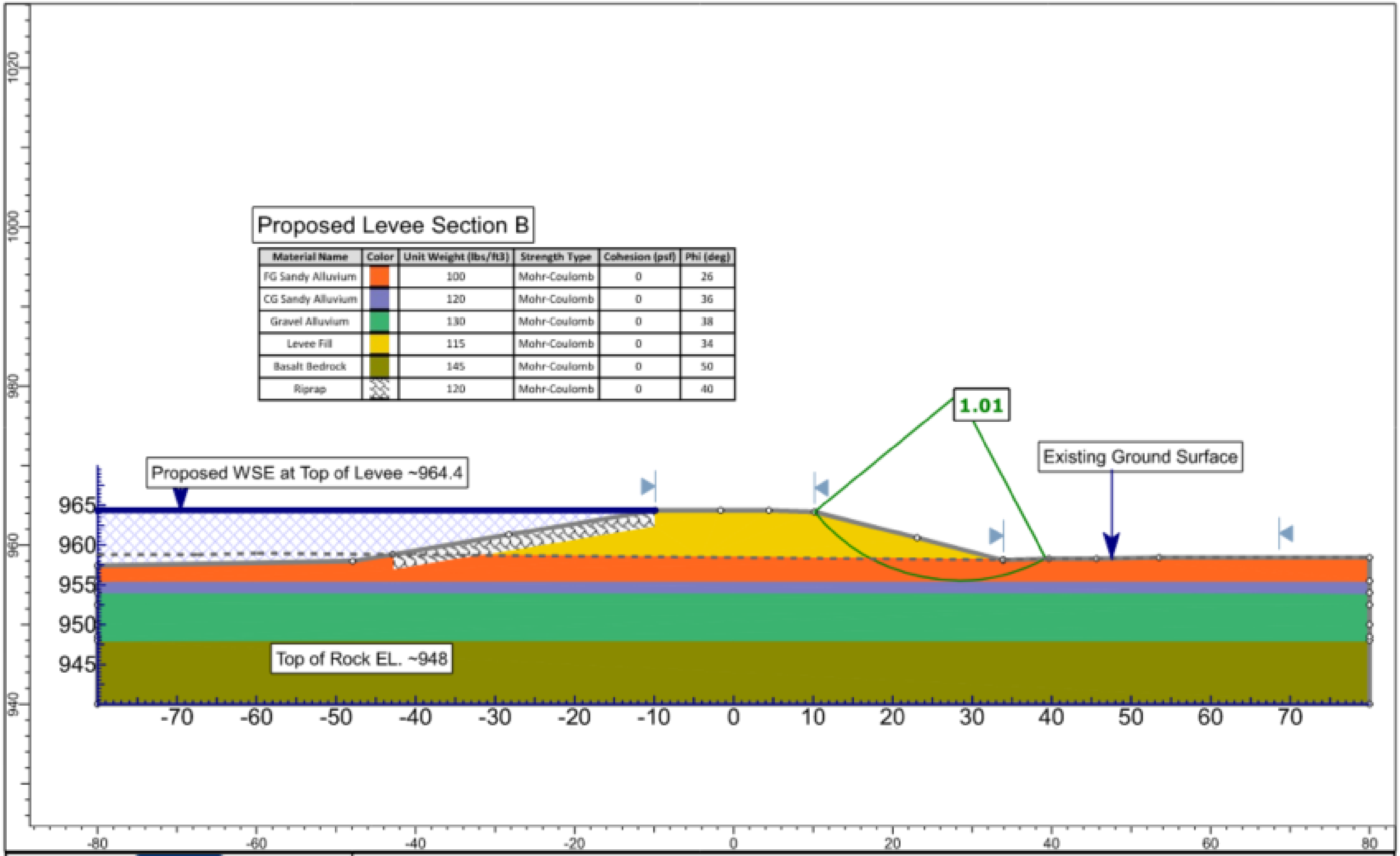
Figure 5-29. Section A Overtopping Rapid Drawdown Stability Analysis – Landside



Material Name	Color	Unit Weight (lbs/ft3)	Saturated U.W. (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
FG Sandy Alluvium	🟧	100	110	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	130	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	135	Mohr-Coulomb	0	38
Levee Fill	🟨	115	125	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	145	Mohr-Coulomb	0	50
Riprap	▨	120	120	Mohr-Coulomb	0	40

Project: UmaBirch Enhancement Design_Project Area 2
Analysis Description: Section A_Rapid_Drawdown_FoS
Drawn By: Zachary Hill
Scale: 1:169
Company: Tetra Tech, Inc
Date: 10/23/24
File Name: section a_rapid drawdown umabirch 10-23-24.slmd

Figure 5-30. Section A Overtopping Rapid Drawdown Stability Analysis – Riverside



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
FG Sandy Alluvium	🟧	100	Mohr-Coulomb	0	26
CG Sandy Alluvium	🟪	120	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	Mohr-Coulomb	0	38
Levee Fill	🟨	115	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	Mohr-Coulomb	0	50
Riprap	▨	120	Mohr-Coulomb	0	40

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Project: **UmaBirch Enhancement Design_Project Area 2**

Analysis Description: Section B_Steady_Seepage_Top_of_Levee_FoS

Drawn By: Zachary Hill

Scale: 1:200

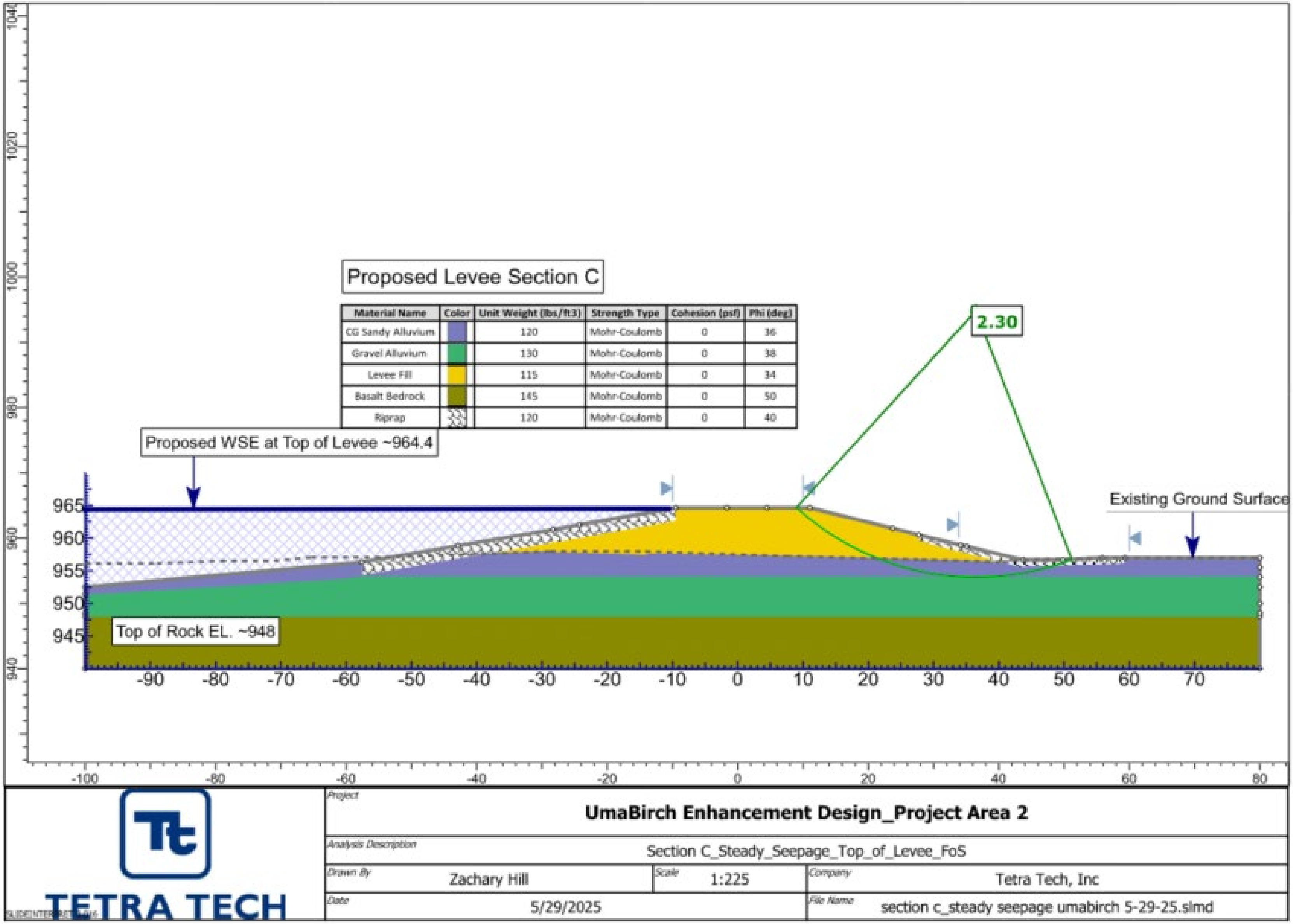
Company: Tetra Tech, Inc

Date: 5/29/2025

File Name: section b_steady seepage umabirch 5-29-25.slmd

SLIDEINTERPRET 9.016

Figure 5-31. Section B Overtopping Steady Seepage Stability Analysis – Landside



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
CG Sandy Alluvium	🟪	120	Mohr-Coulomb	0	36
Gravel Alluvium	🟩	130	Mohr-Coulomb	0	38
Levee Fill	🟨	115	Mohr-Coulomb	0	34
Basalt Bedrock	🟫	145	Mohr-Coulomb	0	50
Riprap	▨	120	Mohr-Coulomb	0	40

Project	UmaBirch Enhancement Design_Project Area 2
Analysis Description	Section C_Steady_Seepage_Top_of_Levee_FoS
Drawn By	Zachary Hill
Scale	1:225
Company	Tetra Tech, Inc
Date	5/29/2025
File Name	section c_steady seepage umabirch 5-29-25.slmd

Figure 5-32. Section C Overtopping Steady Seepage Stability Analysis – Landside

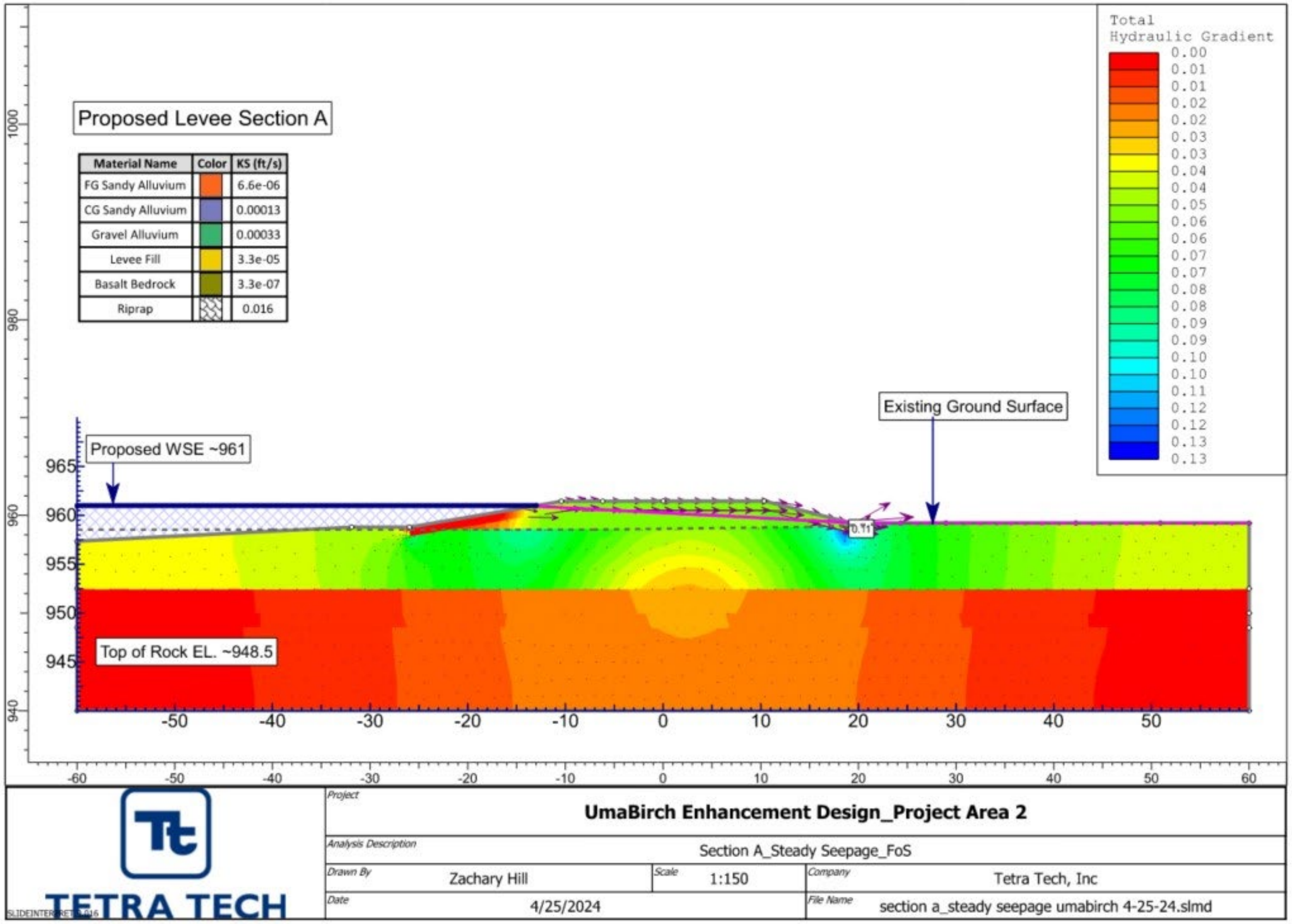
5.3 Seepage Analysis

A seepage analysis was performed using the computer program Slide2 to obtain pore water pressures for steady state conditions. The steady state pore pressures are used for the evaluation of exit hydraulic gradients at the toe of the slope of the levee for long-term conditions. Slide2 provides analyses and results that comply with the USACE guidelines in EM 1110-2-1913. The seepage analysis was performed for the greatest hydraulic gradient through the levee, which is discussed in Section 5.2.3 for Case 3 conditions.

The Slide2 seepage modeling results are presented in Figures 5-33 to 5-35 below for sections A, B, and C, respectively. The maximum vertical exit gradients at Sections A, B, and C are 0.11 foot/foot, 0.59 foot/foot, and 0.50 foot/foot, respectively. While the maximum exit gradient at Section B exceeds the design criterion, a transient flow analysis was conducted to simulate the rapid filling of the levee during the design flood to estimate time for exit gradient exceeding the design criterion. The transient analysis demonstrated that exit gradients exceeding 0.50 foot/foot would not be reached until after 10 days of a WSE at the design flood and long-term steady-state conditions would not be reached until after 30 days of a WSE at the design flood. As the levee is designed for a temporary flood condition and will not hold permanent standing water, it is unlikely that steady-state seepage would result in an exit gradient exceeding the design criterion during the design flood. In addition, the interior drainage overtopping relief section portion of the levee will help dissipate pore pressures during the design flood. Therefore, no special filter material design is required at the toe of the levee.

An additional seepage analysis was performed at Section B when the WSE is at the top of the levee. The vertical exit gradient at this case is 0.82 foot/foot (Figure 5-36). The FS against uplift at the toe of the levee is 1.3 ($FS = \gamma_{sub}/i\ \gamma_w$) where the submerged unit weight of downstream top stratum soil (sandy alluvium) is 67.6 pcf and unit weight of water is 62.4 pcf. This analysis indicates stability against uplift at the toe of the levee with a FS of 1.3 during the levee overtopping conditions.

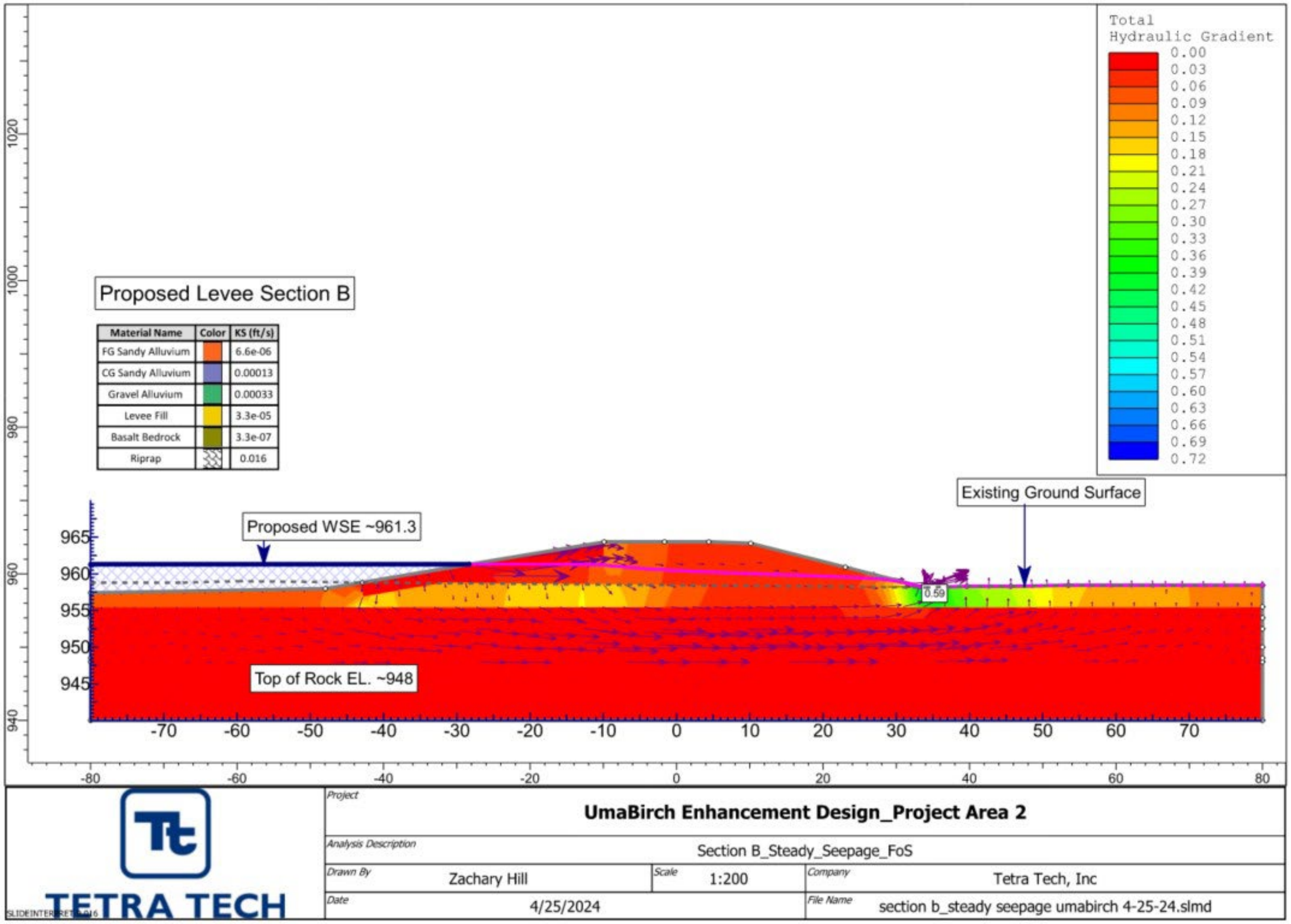
The seepage does not necessarily affect the stability of the levee provided that the seepage does not heave or transport soil (i.e., piping, sandboils). The levee will be inspected routinely to identify any sandboils and seepage problems (See Volume 6). If sandboils or continuously saturated soils are observed on the landward side of the levee under low water conditions, the areas will be repaired to avoid more serious problems under high water conditions.



Material Name	Color	KS (ft/s)
FG Sandy Alluvium	🟧	6.6e-06
CG Sandy Alluvium	🟪	0.00013
Gravel Alluvium	🟩	0.00033
Levee Fill	🟨	3.3e-05
Basalt Bedrock	🟫	3.3e-07
Riprap	▨	0.016

Project: UmaBirch Enhancement Design_Project Area 2
Analysis Description: Section A_Steady Seepage_FoS
Drawn By: Zachary Hill
Scale: 1:150
Company: Tetra Tech, Inc
Date: 4/25/2024
File Name: section a_steady seepage umabirch 4-25-24.slmd

Figure 5-33. Section A Seepage Analysis



Material Name	Color	KS (ft/s)
FG Sandy Alluvium	🟧	6.6e-06
CG Sandy Alluvium	🟪	0.00013
Gravel Alluvium	🟩	0.00033
Levee Fill	🟨	3.3e-05
Basalt Bedrock	🟫	3.3e-07
Riprap	▨	0.016

Project: **UmaBirch Enhancement Design_Project Area 2**

Analysis Description: Section B_Steady_Seepage_FoS

Drawn By: Zachary Hill

Scale: 1:200

Company: Tetra Tech, Inc

Date: 4/25/2024

File Name: section b_steady seepage umabirch 4-25-24.slmd

Figure 5-34. Section B Seepage Analysis

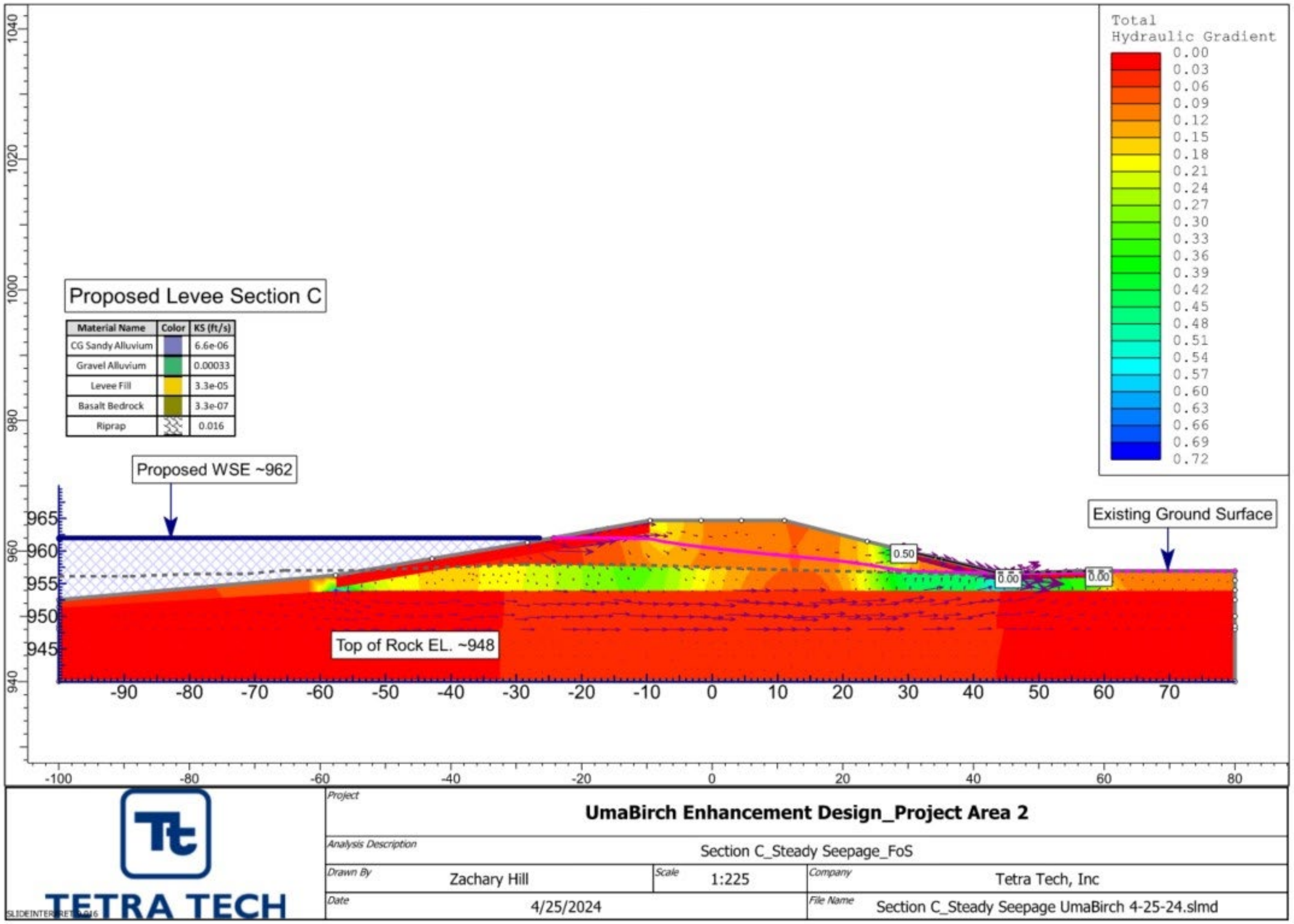
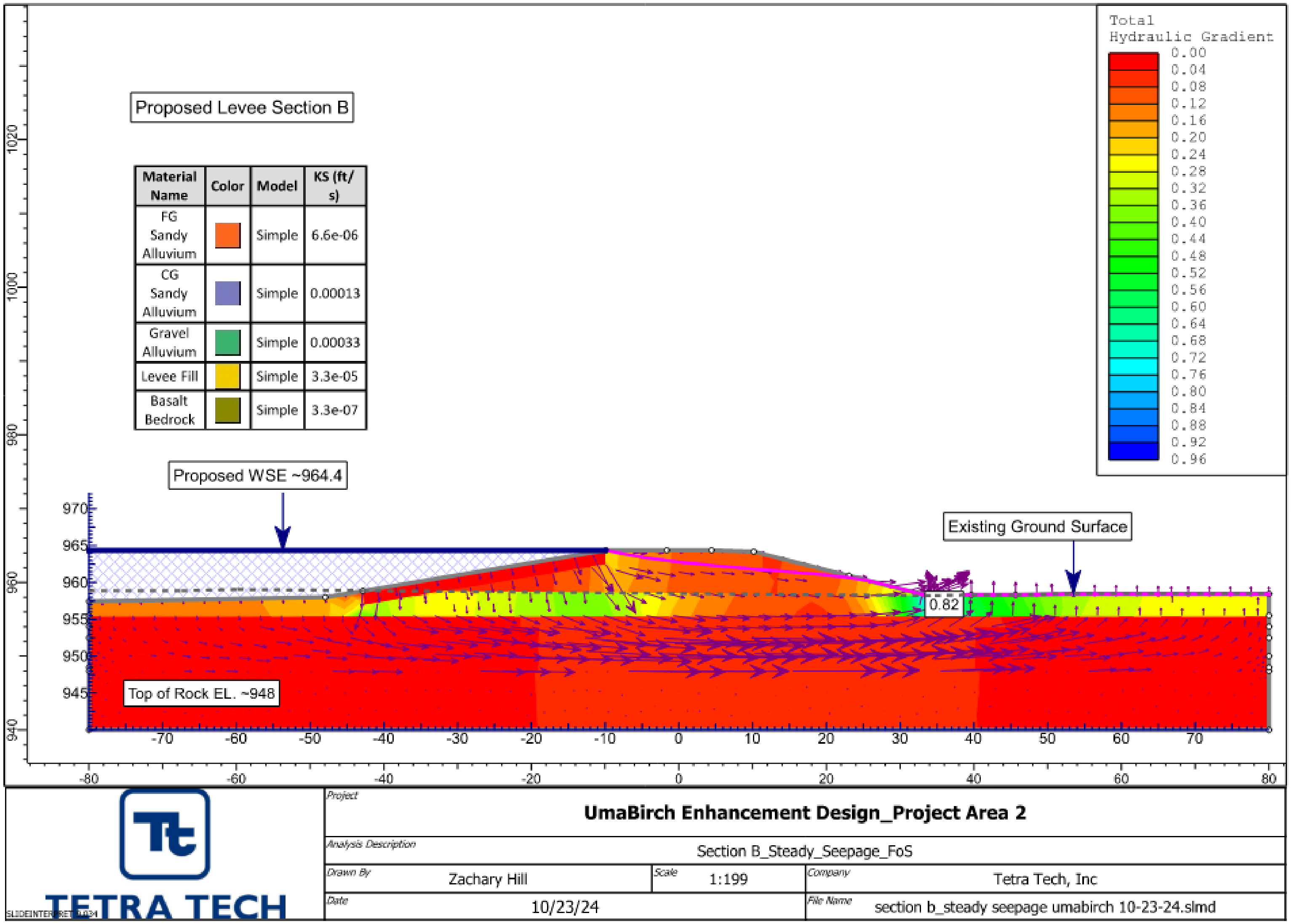


Figure 5-35. Section C Seepage Analysis



Material Name	Color	Model	KS (ft/s)
FG Sandy Alluvium	🟧	Simple	6.6e-06
CG Sandy Alluvium	🟪	Simple	0.00013
Gravel Alluvium	🟩	Simple	0.00033
Levee Fill	🟨	Simple	3.3e-05
Basalt Bedrock	🟫	Simple	3.3e-07

Project
UmaBirch Enhancement Design_Project Area 2

Analysis Description
Section B_Steady_Seepage_FoS

Drawn By
Zachary Hill

Scale
1:199

Company
Tetra Tech, Inc

Date
10/23/24

File Name
section b_steady seepage umabirch 10-23-24.slmd

Figure 5-36. Section B Overtopping Seepage Analysis

6. Conclusion

The geotechnical analyses conducted for the proposed Pendleton 2a Levee Setback indicate that it will meet the requirements of the design criteria for slope stability and seepage. The levee would also remain stable when it is fully loaded with the water surface elevation at the top of the levee representing the overtopping condition.

The geotechnical analyses are based on the soil conditions encountered during the field exploration conducted by Carlson Geotechnical in October 2023. Variations may exist between the soil and groundwater conditions reported at the geotechnical boring locations and those actually underlying the Site. During the construction, if subsurface conditions are different from those described herein or if the structures, flood and loading conditions are modified, such conditions should be reviewed to confirm the stability of the levee.

All flood control works must be properly maintained to provide the protection for which they were designed. Routine maintenance and inspection of the levee is required as outlined in the Operation and Maintenance Manual (Volume 6) to maintain the stability of the proposed Pendleton 2a Levee Setback.

7. References

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8. Attachments

Attachment 1 – Geotechnical Investigation Report

Carlson Geotechnical
A division of Carlson Testing, Inc.
Phone: (541) 330-9155
www.carlsontesting.com

Bend Office **(541) 330-9155**
Eugene Office **(541) 345-0289**
Salem Office **(503) 589-1252**
Tigard Office **(503) 684-3460**

Report of
Geotechnical Investigation
Birch Creek Setback Levee
Birch Creek Road
Umatilla County, Oregon

CGT Project Number B2301679

Prepared for

Senda Ozkan
Tetra Tech
19803 North Creek Parkway
Bothell, WA 98011

November 29, 2023

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CARLSON CGT GEOTECHNICAL

November 29, 2023

Senda Ozkan
Tetra Tech
19803 North Creek Parkway
Bothell, WA 98011

Report of
Geotechnical Investigation
Birch Creek Setback Levee
Birch Creek Road
Umatilla County, Oregon

CGT Project Number B2301679

Dear Senda Ozkan:

Carlson Geotechnical (CGT), a division of Carlson Testing, Inc. (CTI), is pleased to submit this report summarizing the results of our geotechnical investigation for the proposed Birch Creek Setback Levee project. The site is located to the east of Birch Creek Road in Umatilla County, Oregon. We performed our work in general accordance with CGT Proposal BGC.566.R2, dated October 9, 2023. Written authorization for our services was received on October 16, 2023 via Modification 0001 to Purchase Order No. 1199744.

We appreciate the opportunity to work with you on this project. Please contact us at (541) 330-9155 if you have any questions regarding this report.

Respectfully Submitted,
CARLSON GEOTECHNICAL

PARKER B. RICHMOND
E2545
Parker B. Richmond
Expires 06/01/2024

#95830PE
Sam Kane
SEPTEMBER 14, 2021
SAMUEL J. KANE
Renews 06/30/23

Parker Richmond, R.G., C.E.G.
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Sam Kane, P.E.
Project Engineer
skane@carlsontesting.com

Doc ID: G:\GEOTECH\PROJECTS\2023 Projects\001 - Bend Projects\B2301679 - Tetra Tech - Setback Levee Design\008 - Deliverables\Report\B2301679 - Geotechnical Investigation - pbr edits.docx

TABLE OF CONTENTS

ATTACHMENTS

1.0 INTRODUCTION

Carlson Geotechnical (CGT), a division of Carlson Testing, Inc. (CTI), is pleased to submit this report summarizing the results of our geotechnical investigation for the proposed Birch Creek Setback Levee project. The site is located to the east of Birch Creek Road in Umatilla County, Oregon, as shown on the attached Site Location, Figure 1. A draft version of this report was delivered to our client on November 3, 2023. Our client provided comments on the draft report, which was returned to CGT on November 7, 2023 and requested additional laboratory testing be performed on samples retrieved from our drilled borings.

1.1 Project Information

CGT developed an understanding of the proposed project based on our correspondence with our client and review of the following resources, provided and prepared by our client:

- A 95-page "Geotechnical Drilling Program," dated September 1, 2023.
- A 13-page document entitled "Geotechnical Investigation Scope of Work, Birch Creek In-Stream Enhancement and Floodplain Restoration, Setback Levee and Bridge Replacement," dated November 16, 2023.

Based on our review, we understand the project will include the construction of a new setback levee. We understand the levee will be approximately 550 feet long, with a base width of about 100 feet, a crown width of about 20 feet, and a maximum height of 9½ feet relative to the surrounding grade. We understand that design of the levee (including seepage, settlement, and stability analyses) will rest with others.

1.2 Scope of Services

Our scope of work included the following:

- Contact the Oregon Utilities Notification Center to mark the locations of public utilities within a 20-foot radius of our explorations at the site.
- Explore subsurface conditions at the site by advancing four drilled borings at the site to depths of up to about 16 feet below ground surface (bgs). Details of the subsurface investigation are presented in Appendix A.
- Classify the soils encountered in the explorations in general accordance with ASTM D2488 (Visual-Manual Procedure). Rock encountered in the explorations was classified in general accordance with procedures outlined in ASTM D5878.
- Provide a technical narrative describing surface and subsurface deposits, and local geology of the site, based on the results of our explorations and published geologic mapping.
- Provide recommendations for the Seismic Site Class, mapped maximum considered earthquake spectral response accelerations, and site seismic coefficients.
- Provide a qualitative evaluation of seismic hazards at the site, including earthquake-induced liquefaction, landsliding, and surface rupture due to faulting or lateral spread.
- Provide geotechnical recommendations for site preparation and earthwork.
- Provide this written report summarizing the results of our geotechnical investigation and recommendations for the project.

2.0 SITE DESCRIPTION

2.1 Site Geology

The setback levee site is underlain by Holocene age alluvium deposited by the Umatilla River located along the north margin of the site. The alluvium consists of unconsolidated silt, sand and gravel deposited from the channels and flood plains of the river. Based on our review and field exploration, the alluvium deposits are underlain by Grande Ronde basalt flows at depths ranging from approximately 8½ to 11½ feet bgs (below ground surface). The Grande Ronde basalt is part of the Columbia River Basalt Group and consists of a monotonous flow-on-flow sequence of blue to black basalt flows which can weather to produce an orange-brown, blocky basalt structure. We anticipate that the Grande Ronde Basalt extends to depths of up to 300 feet bgs or deeper within the vicinity of the project site.

2.2 Site Surface Conditions

The site was situated within an agricultural field that was bordered to north by the Umatilla River, to the east by Birch Creek Road, to the south by agricultural fields, and to the west by agricultural fields and Birch Creek. The existing "Pendleton 2a levee" was present along the south bank of the Umatilla River, in the northern portion of the job site. This levee was approximately 1300 feet long, with a crown width of about 40 feet, and a maximum height of about 7 feet relative to the existing grade on the north side of the levee. The remainder of the overall site was relatively level, and was surfaced with grasses. Site layout and surface conditions at the time of our field investigation are shown on the attached Site Plan (Figure 2) and Site Photographs (Figure 3).

2.3 Subsurface Conditions

2.3.1 <u>Subsurface Investigation & Laboratory Testing</u>

Our subsurface investigation consisted of four drilled borings (B-1 through B-4) completed on October 16 and 17, 2023. Boring B-4 was advanced through the existing Pendleton 2a levee, and borings B-1 through B-3 were advanced within the footprint of the new setback levee. The approximate exploration locations are shown on the Site Plan, attached as Figure 2. In summary, the borings were advanced to depths ranging from about 10 to 16½ feet bgs. Details regarding the subsurface investigation, logs of the explorations, and results of laboratory testing are presented in Appendix A. Subsurface conditions encountered during our investigation are summarized below.

2.3.2 <u>Subsurface Materials</u>

Logs of the explorations are presented in Appendix A. The following describes each of the subsurface materials encountered at the site.

2.3.2.1 <u>Undocumented Fill Materials</u>

<u>Silty Sand with Gravel Fill (SM FILL)</u>
Undocumented silty sand with gravel fill was encountered at the surface of boring B-4 which was advanced through the existing Pendleton 2a levee, and extended to a depth of 7½ feet bgs. The undocumented silty sand fill was loose to medium dense, brown, dry, subangular to subrounded, and fine- to medium-grained with subangular to subrounded gravel up to 1 inch in diameter. We assume this material represents levee embankment fill emplaced during the construction of the Pendleton 2a levee.

2.3.2.2 Native Soils

Native Silt with Sand (ML), Silt (ML), Silty Sand (SM), Clayey Sand (SC), and Sandy Lean Clay (CL)

Silt with sand was encountered at the surface of boring B-1 and extended to a depth of 2½ feet bgs in that boring. The silt with sand was very stiff, brown, moist, and nonplastic with subangular to subrounded, and contained fine- to medium-grained sand.

Silt was encountered at the surface of boring B-3, and extended to a depth of 7½ feet bgs. The silt was soft to very stiff, brown, moist, and exhibited medium plasticity with subangular to subrounded, fine- to medium-grained sand and subangular to subrounded gravel up to 1 inch in diameter.

Sandy lean clay was encountered at the surface of boring B-2 and extended to a depth of 2½ feet bgs. This soil was very stiff, brown, moist, exhibited low plasticity, and contained subangular to subrounded, fine- to medium-grained sand and subangular to subrounded gravel up to about 1 inch in diameter.

Clayey sand with gravel was encountered underlying the sandy lean clay in boring B-2 and extended to a depth of 4 feet bgs. This material was dense, brown, moist, subangular to subrounded, fine- to medium-grained, and contained low plasticity fines and subangular to subrounded gravel up to 1 inch in diameter.

Silty sand was encountered underlying the silt in boring B-3 and underlying the embankment/levee fill encountered in boring B-4. The native silty sand was medium dense to dense, brown, moist, subangular to subrounded, fine- to medium-grained, and contained nonplastic fines and subangular to subrounded gravel up to 1 inch in diameter.

The silt with sand (ML), the silt (ML), the silty sand (SM), the clayey sand (SC), and the sandy lean clay (CL) will be referred to as “Sandy Alluvium” throughout the remainder of the report.

Native Well-Graded Gravel with Sand (GW-GM), Poorly Graded Gravel with Silt and Sand (GP-GM), Silty Gravel with Sand (GM)

Well-graded gravel with sand was encountered beneath the silt with sand in boring B-1 and extended to a depth of 8½ feet bgs. This material was medium dense to very dense, brown, moist, subangular to subrounded, up to 1½ inches in diameter, and contained subangular to subrounded sand and nonplastic fines.

Poorly graded gravel with silt and sand was encountered underlying the native clayey sand in boring B-2 at a depth of 4 feet bgs and underlying the silty sand in boring B-4 at a depth of 10 feet bgs. This soil was medium dense to very dense, gray to brown, moist, subangular to subrounded, up to 1½-inches in diameter, and contained nonplastic fines, and fine- to medium-grained sand.

Silty gravel with sand was encountered underlying the silty sand in boring B-3 at a depth of 10 feet bgs. This material was very dense, gray to brown, rounded to subangular, up to 1½ inches in diameter, and contained fine- to medium-grained sand and nonplastic fines.

Recognizing their similar characteristics and index properties (e.g. maximum particle size, fines content), the well-graded gravel with sand (GW-GM), the poorly graded gravel with silt and sand (GP-GM), and the silty gravel with sand (GM) will be referred to as "Gravelly Alluvium" throughout the remainder of the report.

2.3.2.3 Bedrock

Grande Ronde Basalt Bedrock (RX)
Basalt bedrock was encountered underlying the materials described above in borings B-1 through B-3 at depths of about 8½ to 11½ feet bgs. The basalt bedrock was typically weak to strong (R2 to R4), dark gray, and slightly weathered. Practical drilling refusal of the hollow stem auger was encountered within this bedrock layer in borings B-1 through B-3.

2.3.3 Groundwater

Within boring B-1 through B-3, groundwater was encountered at depths ranging from about 8½ to 10 feet bgs. Within boring B-4, which was advanced through the existing Pendleton 2a levee, groundwater was encountered at a depth of 15 feet bgs. Depths to groundwater are indicated on the Site Plan, attached as Figure 2.

3.0 SEISMIC CONSIDERATIONS

3.1 Seismic Design

Section 1613.2.2 of the 2022 Oregon Structural Specialty Code (2022 OSSC) requires that the determination of the seismic site class be in accordance with Chapter 20 of the American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures (ASCE 7-16). We have assigned the site as Site Class C ("Very Dense Soil / Soft Rock") based on geologic mapping and subsurface conditions encountered during our investigation.

Earthquake ground motion parameters for the site were obtained in accordance with the 2022 OSSC using the Seismic Hazards by Location calculator on the ATC website[1]. The site Latitude 45.656191° North and Longitude 118.876675° West were input as the site location. The following table shows the recommended seismic design parameters for the site.

Table 1 Seismic Ground Motion Values

Parameter		Value
Mapped Acceleration Parameters	Spectral Acceleration, 0.2 second (S_s)	0.358g
	Spectral Acceleration, 1.0 second (S_1)	0.136g
Coefficients (Site Class C)	Site Coefficient, 0.2 second (F_A)	1.300
	Site Coefficient, 1.0 second (F_V)	1.500
Adjusted MCE Spectral Response Parameters	MCE Spectral Acceleration, 0.2 second (S_{MS})	0.466g
	MCE Spectral Acceleration, 1.0 second (S_{M1})	0.204g
Design Spectral Response Accelerations	Design Spectral Acceleration, 0.2 second (S_{DS})	0.310g
	Design Spectral Acceleration, 1.0 second (S_{D1})	0.136g

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[1] Applied Technology Council (ATC), 2023. USGS seismic design parameters determined using "Seismic Hazards by Location," *accessed November 2023*, from the ATC website https://hazards.atcouncil.org/.

3.2 Seismic Hazards

3.2.1 Liquefaction

In general, liquefaction occurs when deposits of loose/soft, saturated, cohesionless soils, generally sands and silts, are subjected to strong earthquake shaking. If these deposits cannot drain quickly enough, pore water pressures can increase, approaching the value of the overburden pressure. The shear strength of a cohesionless soil is directly proportional to the effective stress, which is equal to the difference between the overburden pressure and the pore water pressure. When the pore water pressure increases to the value of the overburden pressure, the shear strength of the soil approaches zero, and the soil can liquefy. The liquefied soils can undergo rapid consolidation or, if unconfined, can flow as a liquid. Structures supported by the liquefied soils can experience rapid, excessive settlement, shearing, or even catastrophic failure.

For fine-grained soils, susceptibility to liquefaction is evaluated based on penetration resistance and plasticity, among other characteristics. Criteria for identifying non-liquefiable, fine-grained soils are constantly evolving. Current practice to identify non-liquefiable, fine-grained soils is based on moisture content and plasticity characteristics of the soils[2,3,4]. The susceptibility of sands, gravels, and sand-gravel mixtures to liquefaction is typically assessed based on penetration resistance, as measured using SPTs, CPTs, or Becker Hammer Penetration tests (BPTs).

In general, based on the lack of saturated soil conditions at the site, the soils encountered within our explorations are considered non-liquefiable. Where groundwater was encountered in our explorations, it was typically encountered within the Gravelly Alluvium described above. The Gravelly Alluvium encountered at these depths was typically medium dense to better in terms of relative density and therefore considered non-liquefiable. Based on review of geologic mapping, the presence of relatively shallow basalt bedrock, we do not anticipate liquefiable conditions are present at depths below those explored as part of this assignment.

3.2.2 Slope Instability

Due to the relatively level topography at and surrounding the site, the risk of slope instability at the site is considered low. We understand that an assessment of the stability of the planned levee embankments will be completed by others.

3.2.3 Surface Rupture

3.2.3.1 Faulting

Although the site is situated in a region of the country with known active faults and historic seismic activity, no known faults exist on or immediately adjacent to the site. Therefore, the risk of surface rupture at the site due to faulting is considered low.

3.2.3.2 Lateral Spread

Surface rupture due to lateral spread can occur on sites underlain by liquefiable soils that are located on or immediately adjacent to slopes steeper than about 3 degrees (20H:1V), and/or adjacent to a free face, such

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[2] Seed, R.B. et al., 2003. Recent Advances in Soil Liquefaction Engineering: A Unified and Consistent Framework. Earthquake Engineering Research Center Report No. EERC 2003-06.

[3] Bray, Jonathan D., Sancio, Rodolfo B., et al., 2006. Liquefaction Susceptibility of Fine-Grained Soils, Journal of Geotechnical and Geoenvironmental Engineering, Volume 132, Issue 9, September 2006.

[4] Idriss, I.M., Boulanger, R.W., 2008. Soil Liquefaction During Earthquakes, Earthquakes Engineering Research Institute Monograph MNO-12.

as a stream bank or the shore of an open body of water. During lateral spread, the materials overlying the liquefied soils are subject to lateral movement downslope or toward the free face.

Based on the relatively level topography at the site and the non-liquefiable nature of the soils at the site, the risk of damage associated with lateral spread is considered to be negligible. An assessment of the susceptibility of the existing Pendleton 2a levee (located along the south bank of the Umatilla River) to lateral spread is outside of the scope of this assignment.

4.0 CONCLUSIONS

Based on the results of our field explorations and analyses, the site may be developed as described in Section 1.1 of this report, provided the recommendations presented in this report are incorporated into the design and development. Satisfactory subgrade support for the new levee can be obtained from the native, stiff/medium dense to better Sandy Alluvium (ML, SM, SC, CL), the native medium dense to better Gravelly Alluvium, (GW-GM, GP-GM, GM), or the basalt bedrock (RX).

The near surface Sandy Alluvium (ML, SM, SC, CL) is susceptible to disturbance during wet weather. Trafficability of those soils may be difficult, and significant damage to the subgrade could occur, if earthwork is undertaken without proper precautions at times when the exposed soils are more than a few percentage points above optimum moisture content. In the event that construction occurs during wet weather, CGT recommends that measures be implemented to protect the fine-grained subgrade in areas of repeated construction traffic. Geotechnical recommendations for wet weather construction are presented in Section 5.3 of this report.

4.1 Soil Parameters

Soil strength parameters presented in Table 2 below are based on empirical relationships presented in the USACE EM 1110-2-1913[5] (USACE EM) and the results of our laboratory testing, presented in Appendices A and B.

Table 2 Soil Parameters

Soil Type	Total Unit Weight (pcf)	Friction Angle (deg)	Cohesion (psf)	Permeability (cm/s)[2]
Fine-Grained Sandy Alluvium (ML, CL)	100	26	0	2×10^{-4}
Medium Dense to Dense Coarse-Grained Sandy Alluvium (SC, SM)	120	36	0	4×10^{-3}
Medium Dense to Very Dense Gravelly Alluvium (GW-GM, GP-GM, GM)	130 135 bwt[1]	38	0	1×10^{-2}
Levee Embankment Fill (SM FILL)	115	34	0	1×10^{-3}
Basalt Bedrock (RX)	145	50	0	1×10^{-5}

[1] bwt = Below Water Table

[2] Permeability values for fine-grained Sandy Alluvium and Levee Embankment Fill based on Section 3-6 and Appendix B of the USACE EM. Values for coarse-grained Sandy Alluvium and Gravelly Alluvium based on the results of laboratory testing. Values for basalt bedrock based on tabular values and experience with similar materials. The values presented above are unfactored.

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[5] *Design and Construction of Levees EM 1110-2-1913*, USACE, Washington DC, 2000

4.2 Levee Foundation Permeability

The alignment of the new levee (see Figure 2) is underlain by approximately 8½ to 11 feet of medium dense to very dense and soft to very stiff Sandy Alluvium and Gravelly Alluvium, which are underlain by basalt bedrock. As indicated above, we anticipate these soils are more pervious than the underlying basalt bedrock and should be evaluated by the designer. We evaluated the hydraulic conductivity (k) of the site soils based on empirical relationships and engineering judgement. For the granular soils (coarse-grained Sandy Alluvium) we quantitatively estimated the hydraulic conductivity based on grain-size distribution data presented in Appendix B. We utilized empirical relationships developed by Hazen[6] to determine the values presented in Table 2 above for these soils. These empirical relationships are not suitable for estimating permeability of fine-grained soils, which is typically measured through in-situ (field) or laboratory testing on relatively undisturbed samples. The completion of field tests was beyond the scope of this assignment. Therefore, the estimates of permeability values for the fine-grained soils (fine-grained Sandy Alluvium) were based on Section 3-6 and Appendix B of the USACE EM. Recognizing that these values are unfactored, we recommend the designer consult the appropriate reference manual to assign factors of safety for the soils described above.

5.0 RECOMMENDATIONS

The recommendations presented in this report are based on the information provided to us, results of our field investigation and analyses, laboratory data, and professional judgment. CGT has observed only a small portion of the pertinent subsurface conditions. The recommendations are based on the assumptions that the subsurface conditions do not deviate appreciably from those found during the field investigation. CGT should be consulted for further recommendations if the design of the proposed development changes and/or variations or undesirable geotechnical conditions are encountered during site development.

5.1 Site Preparation

5.1.1 Stripping

Existing vegetation and rooted soils should be removed from within, and for a minimum 5-foot margin around, the proposed levee footprint. Based on the results of our field explorations, topsoil stripping depths are anticipated to be less than ¼-foot bgs. These materials may be deeper or shallower at locations away from the completed explorations. The geotechnical engineer's representative should provide recommendations for actual stripping depths based on observations during site stripping. Stripped surface vegetation and rooted soils should be transported off-site for disposal.

5.1.2 Grubbing

Grubbing of trees should include the removal of the root mass and roots greater than ½-inch in diameter. Grubbed materials should be transported off-site for disposal. Root masses from larger trees may extend greater than 3 feet bgs. Where root masses are removed, the resulting excavation should be properly backfilled with structural fill in conformance with Section 5.4.2 of this report.

5.1.3 Existing Utilities & Below-Grade Structures

All existing utilities at the site should be identified prior to excavation. Abandoned utility lines beneath the new levee and associated hardscaping features should be completely removed or grouted full. Soft, loose, or

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[6] Hazen, A., 1911. Discussion of "Dams on Sand Foundations" by A.C. Koenig, Transactions of the American Society of Civil Engineers, 73.

otherwise unsuitable soils encountered in utility trench excavations should be removed and replaced with structural fill in conformance with Section 5.4.2 this report. Buried structures (i.e. footings, foundation walls, retaining walls, slabs-on-grade, tanks, etc.), if encountered during site development, should be completely removed and replaced with structural fill in conformance with Section 5.4.2 of this report.

5.1.4 Subgrade Preparation - Levee Footprint

After site preparation as recommended above, but prior to placement of embankment fill, the geotechnical engineer or their representative should observe the exposed subgrade soils in order to identify areas of excessive yielding through either proof rolling or probing. Proof rolling of subgrade soils is typically conducted during dry weather using a fully-loaded, 10- to 12-cubic-yard, tandem-axle, tire-mounted, dump truck or equivalent weighted water truck. Areas of limited access or that appear too soft or wet to support proof rolling equipment should be evaluated by probing. During wet weather, subgrade preparation should be performed in general accordance with the recommendations presented in Section 5.3 of this report. If areas of soft soil or excessive yielding are identified, the affected material should be over-excavated to firm, unyielding subgrade, and replaced with imported granular structural fill in conformance with Section 5.4.2 of this report.

5.1.5 Freezing Weather Considerations

For construction that occurs during extended periods of sub-freezing temperatures, the following special provisions are recommended:

- Structural fill should not be placed over frozen ground.
- Frozen soil should not be placed as structural fill.
- Fine-grained (silty) soils should not be placed as structural fill during sub-freezing temperatures.

Identification of frozen soils at the site should be in accordance with ASTM D4083-01 “Standard Practice for Description of Frozen Soils” or other approved method. The geotechnical engineer can aid the contractor with supplemental recommendations for earthwork that will take place during extended periods of sub-freezing weather, as required.

5.1.6 Erosion Control

Erosion and sedimentation control measures should be employed in accordance with applicable City, County, and State regulations.

5.2 Temporary Excavations

5.2.1 Overview

Within the Sandy and Gravelly Alluvium, conventional earthmoving equipment in proper working condition should be capable of making necessary excavations for the anticipated site cuts as described earlier in this report. However, where temporary excavations extend into basalt bedrock, we anticipate hydraulic hammering will likely be required to facilitate its removal. All excavations should be in accordance with applicable OSHA and state regulations. It is the contractor's responsibility to select the excavation methods, to monitor site excavations for safety, and to provide any shoring required to protect personnel and adjacent improvements. A “competent person”, as defined by OR-OSHA, should be on-site during construction in accordance with regulations presented by OR-OSHA. CGT’s current role on the project does not include review or oversight of excavation safety.

5.2.2 OSHA Soil Type

For use in the planning and construction of temporary excavations up to 8 feet in depth, an OSHA soil type "C" may be used for the native, Sandy and Gravelly Alluvium. A soil type "C" may similarly be used for fractured or jointed basalt that does not appear stable, otherwise a "Stable Rock" type may be used.

5.2.3 Utility Trenches

Temporary trench cuts should stand near vertical to depths of approximately 4 feet bgs in the native, Sandy and Gravelly Alluvium encountered at the site. If caving of the sidewalls is observed during excavation, the sidewalls should be flattened or shored. Depending on the time of year trench excavations occur, trench dewatering may be required in order to maintain dry working conditions. If groundwater is present at the base of utility excavations, we recommend placing trench stabilization material at the base of the excavations. Trench stabilization material should be in conformance with Section 5.4.3 of this report.

5.2.4 Excavations Near Embankments

Excavations near levee embankments should not extend within a 1 horizontal to 1 vertical (1H:1V) plane projected out and down from the outside, bottom edge of the embankments. In the event excavation needs to extend below the referenced plane, temporary shoring of the excavation may be required. The geotechnical engineer should be consulted to review proposed excavation plans for this design case to provide specific recommendations.

5.3 Wet Weather Considerations

Notwithstanding the generally arid conditions of the Umatilla County area, soil conditions should be evaluated in the field by the geotechnical engineer's representative at the initial stage of site preparation to determine whether the recommendations within this section should be incorporated into construction.

5.3.1 Overview

Due to its fines content, the near-surface Sandy Alluvium (ML, SM, SC) is moisture sensitive and susceptible to disturbance during wet weather. Trafficability of this soil may be difficult, and significant damage to subgrade soils could occur, if earthwork is undertaken without proper precautions at times when the exposed soils are more than a few percentage points above optimum moisture content. Site preparation activities may need to be accomplished using track-mounted equipment, loading removed material onto trucks supported on granular haul roads, or other methods to limit soil disturbance. The geotechnical engineer or their representative should evaluate the subgrade during excavation by probing rather than proof rolling. Soils that have been disturbed during site preparation activities, or soft or loose areas identified during probing, should be over-excavated to firm, unyielding subgrade, and replaced with imported granular structural fill in conformance with Section 5.4.2 of this report.

5.3.2 Geotextile Separation Fabric

We recommend a geotextile separation fabric be placed to serve as a barrier between the prepared subgrade and granular fill/base rock in areas of repeated or heavy construction traffic. The geotextile fabric should meet the requirements presented in the current Oregon Department of Transportation Standard Specification for Construction (ODOT SSC), Section 02320.

5.3.3 Granular Working Surfaces (Haul Roads & Staging Areas)

Haul roads subjected to repeated heavy, tire-mounted, construction traffic (e.g. dump trucks, concrete trucks, etc.) will require a minimum of 18 inches of imported granular material. For light staging areas, 12 inches of imported granular material is typically sufficient. Additional granular material or geo-grid reinforcement may be recommended based on site conditions and/or loading at the time of construction. The imported granular material should be in conformance with Section 5.4.2 and have less than 5 percent material passing the U.S. Standard No. 200 Sieve. The prepared subgrade should be covered with geotextile fabric (Section 5.3.2) prior to placement of the imported granular material. The imported granular material should be placed in a single lift (up to 24 inches deep) and compacted using a smooth-drum, non-vibratory roller until well-keyed.

5.4 Fill Materials

5.4.1 Levee Embankment Fill

The geotechnical engineer should be provided the opportunity to review all materials considered for use as levee embankment fill (prior to placement). Samples of the proposed fill materials should be submitted to the geotechnical engineer a minimum of 5 business days prior their use on site[7]. The geotechnical engineer or their representative should be contacted to evaluate compaction of embankment fill as the material is being placed. Evaluation of compaction may take the form of in-place density tests and/or proof roll tests with suitable equipment. Structural fill should be evaluated at intervals not exceeding every 2 vertical feet as the fill is being placed. The following table presents recommended guidelines for frequency of density testing (where practical) of various fill designations.

Table 3 Recommended Guidelines for Frequency of Density Testing

Fill Designation	Recommended Frequency of Density Tests	
	Maximum Depth Interval	Area-Wide
General Structural Fill (Mass Grading)	Test every 2 vertical feet	At least one density test per 4,000 feet^2 of fill area
Utility Trench Backfill$^\alpha$	Test every 2 vertical feet	At least one density test per 100 feet of trench line
Pavement Base Rock$^\alpha$	Test at surface of section	At least one density test per 4,000 feet^2 of base rock area

$^\alpha$Testing frequency within the public right-of-way should be in conformance with the local jurisdiction requirements.

We recommend that new levee embankment fill consist of well-graded sandy and gravelly materials that closely resemble to soil characteristics of the existing Pendleton 2a levee fill. We recommend that the levee fill material have a maximum particle size of 2 inches with at least 20 percent of the material passing the U.S. Standard No. 200 sieve. As a guideline, grading of this material with particles up to about 2 inches in diameter may follow that presented in the following table.

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[7] Laboratory testing for moisture density relationship (Proctor) is required. Tests for gradation may be required.

Table 4 Guideline Gradation of Levee Embankment Fill

Sieve Size	% Passing
3 inches	100
2 inches	90 – 100
1-inch	70 – 90
½-inch	40 – 60
U.S. Standard No. 4	35 – 50
U.S. Standard No. 200	Min. 20

Re-use of the on-site Sandy and Gravelly Alluvium as embankment fill is feasible, provided these soils are processed in accordance with Table 2 above and are kept free of organic matter and debris. Embankment fill should be placed in lifts with a maximum thickness of about 9 inches at moisture contents within –1 and +3 percent of optimum, and compacted to not less than 95 percent of the material's maximum dry density as determined in accordance with ASTM D1557 (Modified Proctor).

5.4.2 Imported Granular Structural Fill – General Use

Imported granular structural fill should consist of angular pit or quarry run rock, crushed rock, or crushed gravel that is fairly well graded between coarse and fine particle sizes. The granular fill should contain no organic matter, debris, or particles larger than 4 inches, and have less than 10 percent material passing the U.S. Standard No. 200 Sieve. For fine-grading purposes, the maximum particle size should be limited to 1½ inches. The percentage of fines can be increased to 15 percent of the material passing the U.S. Standard No. 200 Sieve if placed during dry weather, and provided the fill material is moisture-conditioned, as necessary, for proper compaction. Imported granular fill material should be placed in lifts with a maximum thickness of about 12 inches, and compacted to not less than 95 percent of the material's maximum dry density, as determined in general accordance with ASTM D1557 (Modified Proctor). Proper moisture conditioning and the use of vibratory equipment will facilitate compaction of these materials.

Granular fill materials with high percentages of particle sizes in excess of 1½ inches are considered non-moisture-density testable materials. As an alternative to conventional density testing, compaction of these materials should be evaluated by proof roll test observation (deflection tests), where accepted by the geotechnical engineer.

5.4.3 Trench Base Stabilization Material

If groundwater is present at the base of utility excavations, trench base stabilization material should be placed. Trench base stabilization material should consist of a minimum of 1 foot of well-graded granular material with a maximum particle size of 4 inches and less than 5 percent material passing the U.S. Standard No. 4 Sieve. The material should be free of organic matter and other deleterious material, placed in one lift, and compacted until well-keyed.

5.4.4 Trench Backfill Material

Trench backfill for the utility pipe base and pipe zone should consist of granular material as recommended by the utility pipe manufacturer. Trench backfill above the pipe zone should consist of well-graded granular material containing no organic matter or debris, have a maximum particle size of ¾ inch, and have less than 8 percent material passing the U.S. Standard No. 200 Sieve. As a guideline, trench backfill should be placed in maximum 12-inch-thick lifts. The earthwork contractor may elect to use alternative lift thicknesses based on their experience with specific equipment and fill material conditions during construction in order to achieve the required compaction. The following table presents recommended relative compaction percentages for utility trench backfill.

Table 5 Utility Trench Backfill Compaction Recommendations

Backfill Zone	Recommended Minimum Relative Compaction	
	Structural Areas[1,2]	**Landscaping Areas**
Pipe Base and Within Pipe Zone	90% ASTM D1557 or pipe manufacturer's recommendation	88% ASTM D1557 or pipe manufacturer's recommendation
Above Pipe Zone	92% ASTM D1557	90% ASTM D1557
Within 3 Feet of Design Subgrade	95% ASTM D1557	90% ASTM D1557

[1] Includes proposed levee, structural fill areas, exterior hardscaping, etc.

5.4.5 Controlled Low-Strength Material (CLSM)

CLSM is a self-compacting, cementitious material that is typically considered when backfilling localized areas. CLSM is sometimes referred to as "controlled density fill" or CDF. Due to its flowable characteristics, CLSM typically can be placed in restricted-access excavations where placing and compacting fill is difficult. If chosen for use at this site, we recommend the CLSM be in conformance with Section 00442 of the most recent, ODOT SSC. The geotechnical engineer's representative should observe placement of the CLSM and obtain samples for compression testing in accordance with ASTM D4832. As a guideline, for each day's placement, two compressive strength specimens from the same CLSM sample should be tested. The results of the two individual compressive strength tests should be averaged to obtain the reported 28-day compressive strength. If CLSM is considered for use on this site, please contact the geotechnical engineer for site-specific and application-specific recommendations.

5.5 Levee Embankment Slopes

Subject to the review of the levee designer, we recommend that finished levee slopes be graded at 2H:1V (horizontal:vertical) on the waterside and landside of the levee, or flatter. Constructed slopes should be overbuilt by a few feet depending on their size and gradient so that they can be properly compacted prior to being cut to final grade. The surface of all slopes should be protected from erosion by seeding, sodding, or other acceptable means.

5.6 Additional Considerations

5.6.1 Drainage

Design of levee drainage systems will rest with others. Subsurface drains should be connected to the nearest storm drain, on-site infiltration system (to be designed by others) or other suitable discharge point. Surface water from paved surfaces and open spaces should be collected and routed to a suitable discharge point. Surface water should not be directed into levee drains (if incorporated).

5.6.2 Expansive Potential

The near surface native soils consist of generally granular soils with low plasticity fines. Based on experience with similar soils in the region and the results of our laboratory testing, these soils are not considered susceptible to appreciable movements from changes in moisture content. Accordingly, no special considerations are required to mitigate expansive potential of the near surface soils at the site.

6.0 RECOMMENDED ADDITIONAL SERVICES

6.1 Design Review

Geotechnical design review is of paramount importance. We recommend the geotechnical design review take place prior to releasing bid packets to contractors.

6.2 Observation of Construction

Satisfactory earthwork performance (i.e. levee construction) depends to a large degree on the quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during subsurface explorations, and recognition of changed conditions often requires experience. We recommend that qualified personnel visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those observed to date and anticipated in this report. We recommend the geotechnical engineer or their representative attend a pre-construction meeting coordinated by the contractor and/or developer. The project geotechnical engineer or their representative should provide observations and/or testing of at least the following earthwork elements during construction:

- Site Stripping and Grubbing
- Subgrade Preparation for Levee Embankments
- Compaction of Levee Embankment Fill and Utility Trench Backfill

It is imperative that the owner and/or contractor request earthwork observations and testing at a frequency sufficient to allow the geotechnical engineer to provide a final letter of compliance for the earthwork activities.

7.0 LIMITATIONS

We have prepared this report for use by the owner/developer and other members of the design and construction team for the proposed development. The opinions and recommendations contained within this report are forwarded to assist in the planning and design process and are not intended to be, nor should they be construed as, a warranty of subsurface conditions.

We have made observations based on our explorations that indicate the soil conditions at only those specific locations and only to the depths penetrated. These observations do not necessarily reflect soil types, strata thickness, or water level variations that may exist between or away from our explorations. If subsurface conditions vary from those encountered in our site explorations, CGT should be alerted to the change in conditions so that we may provide additional geotechnical recommendations, if necessary. Observation by experienced geotechnical personnel should be considered an integral part of the construction process.

The owner/developer is responsible for ensuring that the project designers and contractors implement our recommendations. When the design has been finalized, prior to releasing bid packets to contractors, we recommend that the design drawings and specifications be reviewed by our firm to see that our recommendations have been interpreted and implemented as intended. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification. Design review and construction phase testing and observation services are beyond the scope of our current assignment, but will be provided for an additional fee.

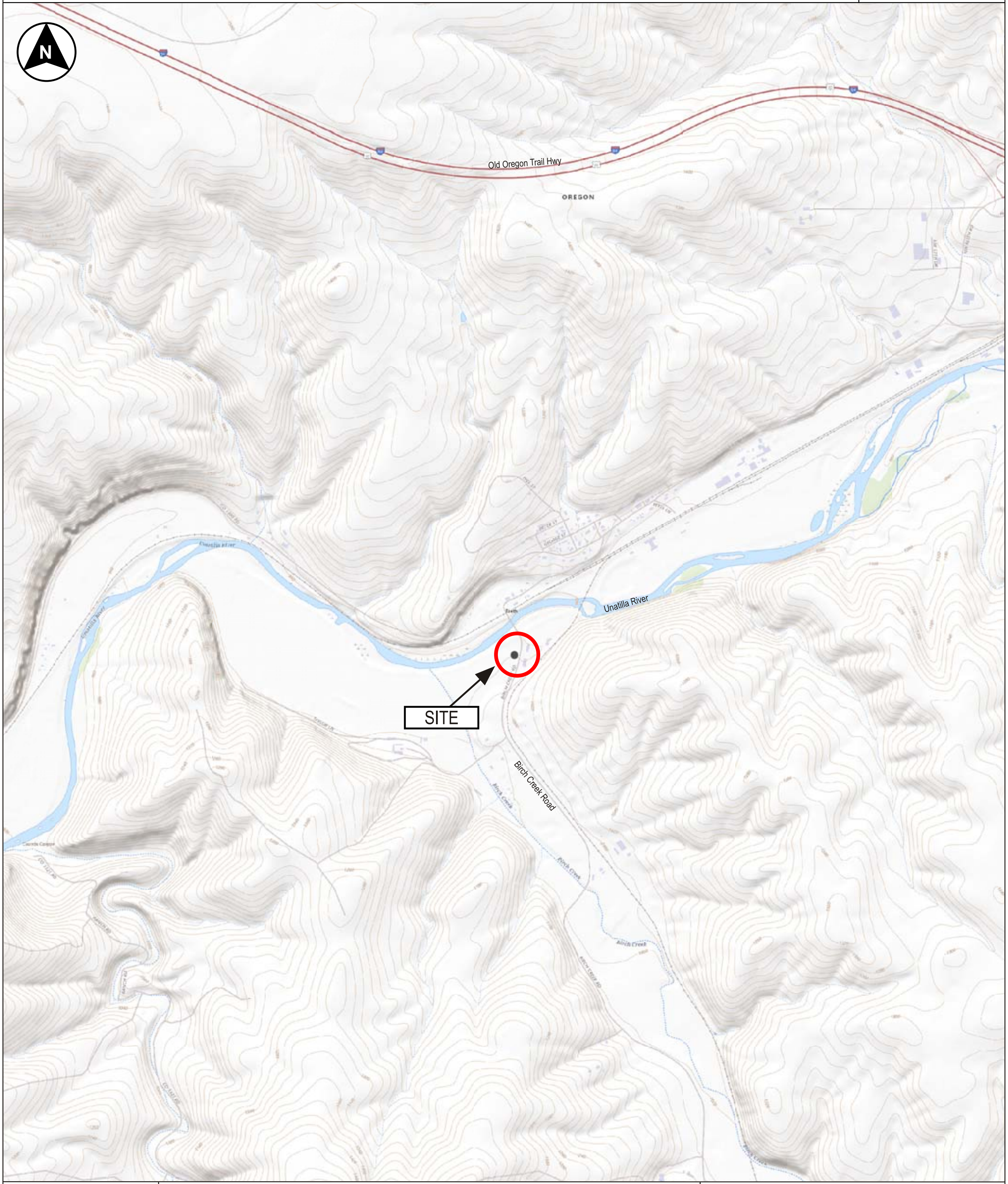
The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Geotechnical engineering and the geologic sciences are characterized by a degree of uncertainty. Professional judgments presented in this report are based on our understanding of the proposed construction, familiarity with similar projects in the area, and on general experience. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared; no warranty, expressed or implied, is made. This report is subject to review and should not be relied upon after a period of three years.

BIRCH CREEK SETBACK LEVEE - UMATILLA COUNTY, OREGON
Project Number B2301679

FIGURE 1

Site Location



CARLSON CGT GEOTECHNICAL 503-601-8250

Drafted by: GS

USGS Topographic base map created with The National Map, 2023, at https://apps.nationalmap.gov/viewer/

Township 02 North, Range 31 East, Section 13/24, Willamette Meridian

Latitude: 45.656191° North
Longitude: 118.876675° West

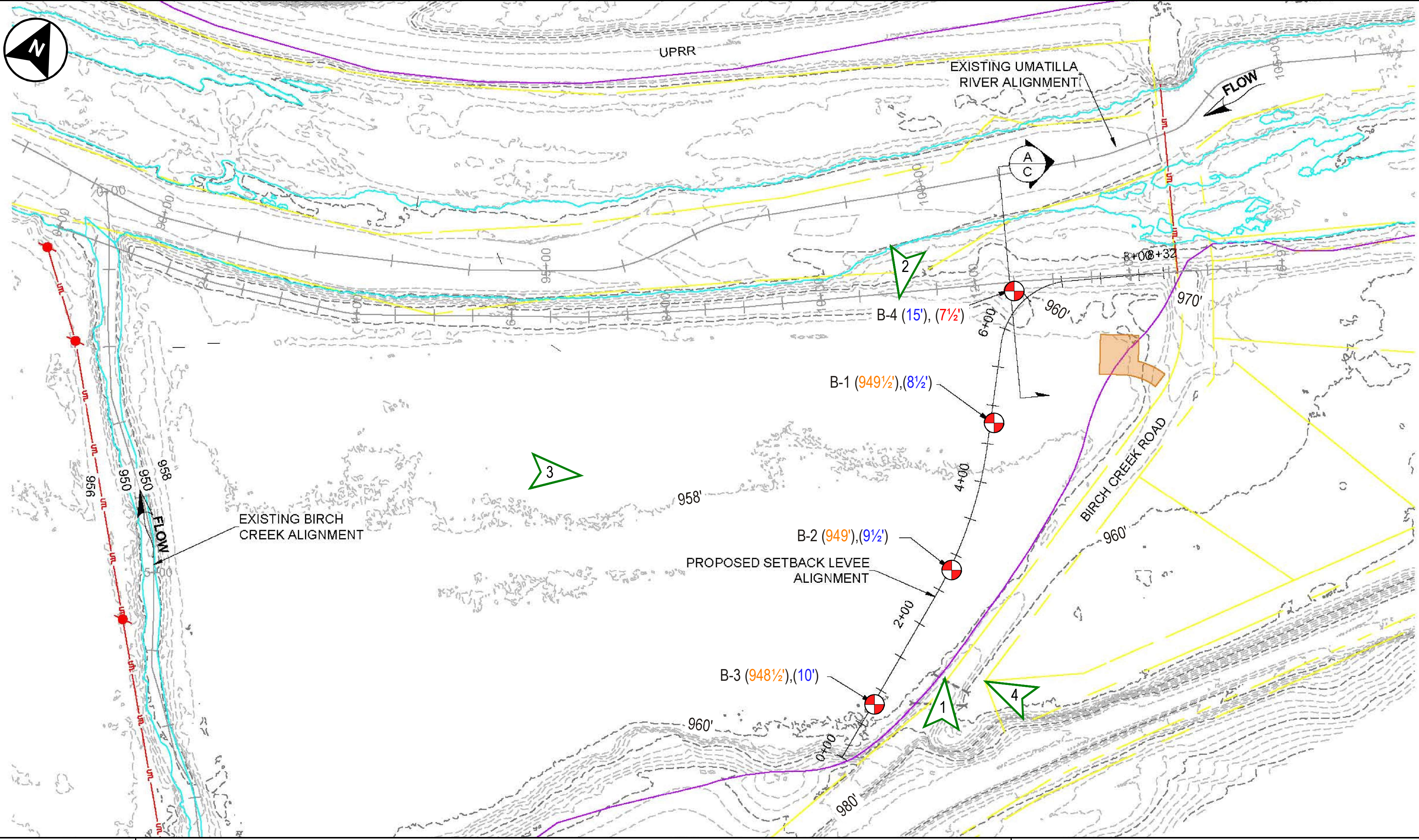
1 Inch = 2,000 feet

0 2000 4000

BIRCH CREEK SETBACK LEVEE - UMATILLA COUNTY, OREGON
Project Number B2301679

FIGURE 2

Site Plan



LEGEND

B-1 (X),(X),(X) ⊕	Drilled boring advanced by CGT. Elevation of basalt bedrock if encountered indicated in (orange). Depth of groundwater if encountered indicated in (blue). Depth of undocumented fill if encountered indicated in (red).
◁ 1	Orientation of site photographs shown on Figure 3.

1 Inch = 250 Feet

0 250 500

NOTES: Drawing based on observations made while on site and "Proposed Boring Layout", produced by Tetra Tech, dated September 1, 2023. All locations are approximate.

CARLSON CGT GEOTECHNICAL 503-601-8250

Drafted by: GS

BIRCH CREEK SETBACK LEVEE - UMATILLA COUNTY, OREGON
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FIGURE 3

Site Photographs

Photograph 1

Photograph 2

Photograph 3

Photograph 4

CARLSON GEOTECHNICAL
503-601-8250
Drafted by: SJK

See Figure 2 for approximate photograph locations and directions. Photographs were taken at the time of our fieldwork.

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Appendix A: Subsurface Investigation and Laboratory Testing

Birch Creek Setback Levee
Birch Creek Road
Umatilla County, Oregon

CGT Project Number B2301679

November 29, 2023

Prepared For:

Senda Ozkan
Tetra Tech
19803 North Creek Parkway
Bothell, WA 98011

Prepared by
Carlson Geotechnical

A.1.0 SUBSURFACE INVESTIGATION

Our field investigation consisted of four drilled borings completed at the site between October 16 and 17, 2023. The exploration locations are shown on the Site Plan, attached to the geotechnical report as Figure 2. The exploration locations shown therein were selected by our client and were provided with the "Geotechnical SOW" document referenced in the main report. Prior to the start of our field work, our client provided the coordinates of each boring, which were located in the field using a smartphone GPS application and are approximate. Surface elevations indicated on the logs were estimated based on the topographic contours shown on the referenced Site Plan (Figure 2) and are approximate. The attached figures detail the exploration methods (Figure A1), soil and rock classification criteria (Figures A2 and A3), and present detailed logs of the explorations (Figures A4 through A7), as discussed below.

A.1.1 Drilled Borings

CGT observed the advancement of four drilled borings (B-1 through B-4) at the site, using a CME 55 track-mounted drill rig provided and operated by our subcontractor, Western States Soil Conservation of Hubbard, Oregon. The borings were advanced using the hollow stem auger drilling technique to depths ranging from approximately 10 to 16½ feet bgs. Upon completion, the augers were pulled slowly from the borehole and a cement-bentonite grout was tremied into base of the hole, in accordance with Section 7.9 of the "Drilling Program Plan," prepared by our client, dated September 1, 2023. The cement-bentonite grout was mixed onsite, and consisted of approximately 13 gallons of water per one 94-pound sack of Type I Portland Cement, with approximately 10 percent (by dry mass) powered cement added to facilitate pumping of the grout.

Borings B-1, B-2, and B-4 were completed on October 16, 2023. Following the completion of these borings, groundwater levels within these borings were measured and the boreholes were grouted in accordance with the procedures described above. CGT returned to the site on October 17, 2023 to complete boring B-3. Upon completion of this boring, groundwater levels were measured in B-3, after which it was observed that the grout within borings B-1, B-2, and B-4 had subsided approximately 24 to 30 inches below the existing site surface at each boring location. Additional cement-bentonite grout was added to B-1, B-2, and B-4 to raise grout levels in the boreholes flush with the surface. CGT revisited the site on October 24, 2023 to observe grout levels within each of the completed borings. During this October 24, 2023 site visit, it was observed that the grout level within B-3 had subsided approximately 24 inches, though the grout levels in borings B-1, B-2 and B-4 had remained flush with the surface after adding additional grout on October 17, 2023. Additional cement-bentonite grout was added to borehole B-3 during this visit to raise grout levels within the borehole flush with the surface.

A.1.2 In-Situ Testing: Standard Penetration Tests (SPTs)

SPTs were conducted within the borings using a split-spoon sampler in general accordance with ASTM D1586. The SPTs were conducted at 2½-foot intervals to the termination depths of the borings. The SPT is described on the attached Exploration Key, Figure A1.

A.1.3 Material Classification & Sampling

Soil samples were obtained at selected intervals in the borings using the referenced split-spoon (SPT) sampler and thin-walled, steel (Shelby) tube samplers, detailed on Figure A1. A qualified member of CGT's geological staff collected the samples and logged the soils in general accordance with the Visual-Manual Procedure (ASTM D2488). Rock was classified in general accordance with procedures outlined in ASTM D5878. An explanation of these classification systems are attached as Figures A2 and A3. The SPT and grab samples were stored in sealable plastic bags and the Shelby tube samples were sealed with caps and tape and transported to our soils laboratory for further examination and testing. Our geological staff visually examined all samples in order to refine the initial field classifications.

A.1.4 Subsurface Conditions

Subsurface conditions are summarized in Section 2.3 of the geotechnical report. Detailed logs of the explorations are presented on the attached exploration logs, Figures A4 through A7.

A.2.0 LABORATORY TESTING

Laboratory testing was performed on samples collected in the field to refine our initial field classifications and determine in-situ parameters. Laboratory testing included the following:

- Fourteen moisture content determinations (ASTM D2216).
- Ten percentage passing the U.S. Standard No. 200 Sieve tests (ASTM D1140).
- Two Atterberg limits (plasticity) test (ASTM D4318).
- One Shelby tube unit weight test (weight-volume measurement).
- Four sieve analyses (ASTM C117/C136)

Results of the laboratory tests are summarized in Table A1 below and are shown on the exploration logs. Graphs of the sieve analyses are presented in Appendix B.

Table A1 Laboratory Soil Index Testing

Boring	Sample	Depth (feet bgs)	Moisture Content Test (ASTM D2216)	Percentage Passing the U.S. #200 Sieve (ASTM D1140)	Atterberg Limits (ASTM D4318)[1]	Unit Weight
B-1	SPT #1	0 - 1½	10%	75%	-	-
	SPT #2	2½ - 4	1%	6%[2]		
B-2	SPT #1	0 - 1½	8%	66%[2]	LL = 32, PL = 22	-
	SPT #2	2½ - 4	7%	48%	-	-
	SPT #4	7½ - 9	7%	-	-	-
	SPT #5	9 - 9⅙	14%	12%	-	-
B-3	SPT #1	0 - 1½	8%	-	-	-
	SPT #2	2½ - 4	16%	-	-	-
	SH #3	4 - 5	45%	88%[2]	LL = 48, PL = 29	Moist: 100 lb/ft^3 Dry: 69 lb/ft^3
	SPT #4	7½ - 9	27%	34%[2]	-	-
	SPT #5	10 - 11	13%	-	-	-
B-4	SPT #1	0 - 1½	6%	12%	-	-
	SPT #3	5 - 6½	5%	14%	-	-
	SPT #7	15 - 16½	9%	12%	-	-

[1] LL = Liquid Limit, PL = Plastic Limit

[2] Refer to Appendix B for the results of sieve analyses on selected samples. Due to limited recovery, a sieve was not completed for boring B-1, SPT #1.

BIRCH CREEK SETBACK LEVEE - BEND, OREGON
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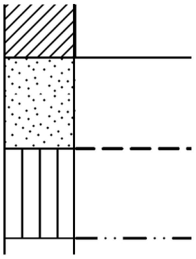
FIGURE A1
Exploration Key

PL —●— LL MC	Atterberg limits (plasticity) test results (ASTM D4318): PL = Plastic Limit, LL = Liquid Limit, and MC= Moisture Content (ASTM D2216)
☐ FINES CONTENT (%)	Percentage passing the U.S. Standard No. 200 Sieve (ASTM D1140)

SAMPLING

GRAB	Grab sample
BULK	Bulk sample
☒ SPT	**Standard Penetration Test** (SPT) consists of driving a 2-inch, outside-diameter, split-spoon sampler into the undisturbed formation with repeated blows of a 140-pound, hammer falling a vertical distance of 30 inches (ASTM D1586). The number of blows (N-value) required to drive the sampler the last 12 inches of an 18-inch sample interval is used to characterize the soil consistency or relative density. The drill rig was equipped with an cat-head or automatic hammer to conduct the SPTs. The observed N-values, hammer efficiency, and N_{60} are noted on the boring logs.
⧗ MC	**Modified California** sampling consists of 3-inch, outside-diameter, split-spoon sampler (ASTM G3550) driven similarly to the SPT sampling method described above. A sampler diameter correction factor of 0.44 is applied to calculate the equivalent SPT N_{60} value per Lacroix and Horn, 1973.
‖ CORE	**Rock Coring** interval
■ SH	**Shelby Tube** is a 3-inch, inner-diameter, thin-walled, steel tube push sampler (ASTM D1587) used to collect relatively undisturbed samples of fine-grained soils.
WDCP	**Wildcat Dynamic Cone Penetrometer** (WDCP) test consists of driving 1.1-inch diameter, steel rods with a 1.4-inch diameter, cone tip into the ground using a 35-pound drop hammer with a 15-inch free-fall height. The number of blows required to drive the steel rods is recorded for each 10 centimeters (3.94 inches) of penetration. The blow count for each interval is then converted to the corresponding SPT N_{60} values.
DCP	**Dynamic Cone Penetrometer** (DCP) test consists of driving a 20-millimeter diameter, hardened steel cone on 16-millimeter diameter steel rods into the ground using a 10-kilogram drop hammer with a 460-millimeter free-fall height. The depth of penetration in millimeters is recorded for each drop of the hammer.
POCKET PEN. (tsf)	**Pocket Penetrometer** test is a hand-held instrument that provides an approximation of the unconfined compressive strength in tons per square foot (tsf) of cohesive, fine-grained soils.

CONTACTS



Observed (measured) contact between soil or rock units.

Inferred (approximate) contact between soil or rock units.

Transitional (gradational) contact between soil or rock units.

ADDITIONAL NOTATIONS

Italics	Notes drilling action or digging effort
{ Braces }	Interpretation of material origin/geologic formation (e.g. { Base Rock } or { Columbia River Basalt })

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All measurements are approximate.

BIRCH CREEK SETBACK LEVEE - UMATILLA COUNTY, OREGON
Project Number B2301679

FIGURE A2
Soil Classification

Classification of Terms and Content

NAME: Group Name and Symbol
Relative Density or Consistency
Color
Moisture Content
Plasticity
Other Constituents
Other: Grain Shape, Approximate Gradation
Organics, Cement, Structure, Odor, etc.
Geologic Name or Formation

Grain Size

		U.S. Standard Sieve
Fines		<#200 (0.075 mm)
Sand	Fine	#200 - #40 (0.425 mm)
	Medium	#40 - #10 (2 mm)
	Coarse	#10 - #4 (4.75 mm)
Gravel	Fine	#4 - 0.75 inch
	Coarse	0.75 inch - 3 inches
Cobbles		3 to 12 inches
Boulders		> 12 inches

Coarse-Grained (Granular) Soils

Relative Density

SPT N_{60}-Value	Density
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
>50	Very Dense

Minor Constituents

Percent by Volume	Descriptor	Example
0 - 5%	"Trace" as part of soil description	"trace silt"
5 - 15%	"With" as part of group name	"**POORLY GRADED SAND WITH SILT**"
15 - 49%	Modifier to group name	"**SILTY SAND**"

Fine-Grained (Cohesive) Soils

SPT N_{60}-Value	Torvane tsf Shear Strength	Pocket Pen tsf Unconfined	Consistency	Manual Penetration Test
<2	<0.13	<0.25	Very Soft	Thumb penetrates more than 1 inch
2 - 4	0.13 - 0.25	0.25 - 0.50	Soft	Thumb penetrates about 1 inch
4 - 8	0.25 - 0.50	0.50 - 1.00	Medium Stiff	Thumb penetrates about ¼ inch
8 - 15	0.50 - 1.00	1.00 - 2.00	Stiff	Thumb penetrates less than ¼ inch
15 - 30	1.00 - 2.00	2.00 - 4.00	Very Stiff	Readily indented by thumbnail
>30	>2.00	>4.00	Hard	Difficult to indent by thumbnail

Minor Constituents

Percent by Volume	Descriptor	Example
0 - 5%	"Trace" as part of soil description	"trace fine-grained sand"
5 - 15%	"Some" as part of soil description	"some fine-grained sand"
15 - 30%	"With" as part of group name	"**SILT WITH SAND**"
30 - 49%	Modifier to group name	"**SANDY SILT**"

Moisture Content

Dry: Absence of moisture, dusty, dry to the touch

Moist: Leaves moisture on hand

Wet: Visible free water, likely from below water table

	Plasticity	Dry Strength	Dilatancy	Toughness
ML	Non to Low	Non to Low	Slow to Rapid	Low, can't roll
CL	Low to Medium	Medium to High	None to Slow	Medium
MH	Medium to High	Low to Medium	None to Slow	Low to Medium
CH	Medium to High	High to Very High	None	High

Structure

Stratified: Alternating layers of material or color >6 mm thick

Laminated: Alternating layers < 6 mm thick

Fissured: Breaks along definite fracture planes

Slickensided: Striated, polished, or glossy fracture planes

Blocky: Cohesive soil that can be broken down into small angular lumps which resist further breakdown

Lenses: Has small pockets of different soils, note thickness

Homogeneous: Same color and appearance throughout

Visual-Manual Classification

Major Divisions			Group Symbols	Typical Names
Coarse Grained Soils: More than 50% retained on No. 200 sieve	Gravels: 50% or more *retained* on the No. 4 sieve	Clean Gravels	GW	Well-graded gravels and gravel/sand mixtures, little or no fines
			GP	Poorly-graded gravels and gravel/sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel/sand/silt mixtures
			GC	Clayey gravels, gravel/sand/clay mixtures
	Sands: More than 50% *passing* the No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly-graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand/silt mixtures
			SC	Clayey sands, sand/clay mixtures
Fine-Grained Soils: 50% or more Passes No. 200 Sieve	Silt and Clays Low Plasticity Fines		ML	Inorganic silts, rock flour, clayey silts
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
			OL	Organic soil of low plasticity
	Silt and Clays High Plasticity Fines		MH	Inorganic silts, clayey silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic soil of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils

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References:

ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
Terzaghi, K., and Peck, R.B., 1948, Soil Mechanics in Engineering Practice, John Wiley & Sons.

BIRCH CREEK SETBACK LEVEE - BEND, OREGON
Project Number B2301679

FIGURE A3

Rock Classification

Scale of Relative Rock Hardness

Term	Field Identification	Hardness Designation	Approximate Unconfined Compressive Strength
Extremely Weak	Can be indented with difficulty by thumbnail. May be moldable or friable with finger pressure.	R0	<150 psi
Very Weak	Crumbles under firm blows with point of geology pick. Can be peeled by pocket knife. Scratched with finger nail.	R1	150-725 psi
Weak	Can be peeled by pocket knife with difficulty. Cannot be scratched with finger nail. Shallow indention made by firm blow of geology pick.	R2	725-3,500 psi
Medium Strong	Can be scratched by knife or pick. specimen can be fractured with a single firm blow of hammer/geology pick.	R3	3,500-7,250 psi
Strong	Can be scratched with knife or pick only with difficulty. Several hard blows required to fracture specimen.	R4	7,250-14,500 psi
Very Strong	Cannot be scratched by knife or sharp pick. Specimen requires many blows of hammer to fracture or chip. Hammer rebounds after impact.	R5	14,500-36,250 psi
Extremely Strong	Can only be chipped with firm blows of hammer.	R6	>36,250 psi

Scale of Relative Rock Weathering

Designation	Field Identification
Fresh	Crystals are bright. Discontinuities may show some minor surface staining. No discoloration in rock fabric.
Slightly Weathered	Rock mass is generally fresh. Discontinuities are stained and may contain clay. Some discoloration in rock fabric. Decomposition extends up to 1 inch into rock.
Moderately Weathered	Rock mass is decomposed 50% or less. Significant portions of rock show discoloration and weathering effects. Crystals are dull and show visible chemical alteration. Discontinuities are stained and may contain secondary mineral deposits.
Highly Weathered	Rock mass is more than 50% decomposed. Rock can be excavated with geologist's pick. All discontinuities exhibit secondary mineralization. Complete discoloration of rock fabric. Surface of core is friable and usually pitted due to washing out of highly altered minerals by drilling water.
Decomposed	Rock mass is completely decomposed. Original rock fabric may be evident. May be reduced to soil with hand pressure.

Spacing Terms

Bedding/Foliation	Spacing	Joints
Very thin	< 2 in.	Very close
Thin	2 in. - 1 ft.	Close
Medium	1 ft. - 3 ft.	Moderately Close
Thick	3 ft. - 10 ft.	Wide
Massive	> 10 ft.	Very Wide

Discontinuity/Joint Condition

Condition	Description
Very Good Condition	Very rough, fresh surfaces, no separation
Good Condition	Slightly rough, slightly weathered surfaces, separation less than 1 mm (0.05 in.)
Fair Condition	Smooth to slightly rough, moderately weathered and altered surfaces, separation greater than 1 mm (0.05 in.)
Poor Condition	Slickensided, highly weathered surfaces, or soft gouge less than 5 mm (0.2 in.) thick, or open discontinuities 1 to 5 mm (0.05 to 0.2 in.)
Very Poor Condition	Highly weathered surfaces with soft gouge greater than 5 mm (0.2 in.) thick, or open discontinuities greater than 5 mm (0.2 in.)

Rock Quality Designation

Rock Quality Designation (RQD) is the percent of a core run with intact lengths greater than 4 inches excluding mechanical breaks caused by drilling.

$$RQD = \frac{\sum \text{length of sound pieces >4 inches}}{\text{total length of core run in inches}}$$

RQD (%)	Designation
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Fracture Frequency

$$FF = \frac{\text{number of natural fractures}}{\text{total length of core recovered}}$$

Degree of Vesicularity

Term	Volume (%)
Trace Vesicles	<5
Some Vesicles	5 - 25
Vesicular	25 - 50
Scoriaceous	> 50

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Explanation of Common Terms Used in Rock Descriptions, adapted from ASTM International D5878, 1987 Oregon Department of Transportation Soil and Rock Classification Manual, 2019 Washington State Department of Transportation Geotechnical Design Manual, and 2017 Federal Highway Administration Geotechnical Engineering Circular No. 5.

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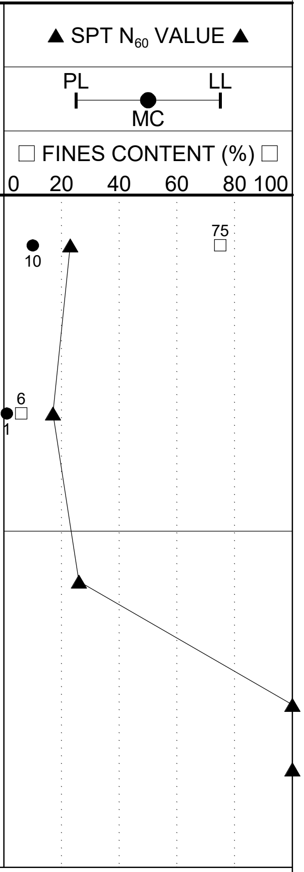
FIGURE A4

Boring B-1

PAGE 1 OF 1

CLIENT Senda Ozkan of Tetra Tech
PROJECT NAME Birch Creek Setback Levee
PROJECT NUMBER B2301679
PROJECT LOCATION Birch Creek Rd. - Umatilla County, OR
DATE STARTED 10/16/23
GROUND ELEVATION 958 ft
ELEVATION DATUM See Figure 2
WEATHER Rain 48°F
SURFACE Sandy Soil
LOGGED BY MSN
REVIEWED BY SJK
DRILLING CONTRACTOR Western State Soil Conservation, Inc.
SEEPAGE ---
EQUIPMENT CME 55 Track
▽ **GROUNDWATER DURING DRILLING** 8.5 ft / El. 949.5 ft
DRILLING METHOD Hollow Stem 4¼-inch ID Auger
GROUNDWATER AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	GROUP SYMBOL	MATERIAL DESCRIPTION	GROUNDWATER	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N_{SPT} VALUE)	N_{60} VALUE ETR_{Hammer} = 75.1%	DRY UNIT WT. (pcf)
		ML	**SILT WITH SAND:** Very stiff, brown, moist, nonplastic fines, subangular to subrounded, fine- to medium-grained sand. {Sandy Alluvium}		0	SPT 1	56	6-9-15 (24)	23	
955		GW-GM	**WELL-GRAVEL GRAVEL WITH SAND:** Medium dense, brown, moist, subangular to subrounded, up to 1½ inches in diameter, subangular to subrounded, fine- to medium-grained sand (15% by volume), trace nonplastic fines. {Gravelly Alluvium}			SPT 2	44	9-8-10 (18)	17	
					5	SPT 3	50	5-13-15 (28)	26	
950			Very dense below 7½ feet bgs.			SPT 4	100	50/2"	100	
			Wet at 8½ feet bgs.	▽		SPT 5	100	50/1"	100	
		RX	**BASALT:** Weak to medium strong (R2-R3), dark gray, slightly weathered. {Grand Ronde Basalt}		10					
945										
940										



- Boring terminated at 10 feet bgs.
- Groundwater encountered at 8½ feet bgs.
- No caving of borehole observed.
- Borehole backfilled per approved Drilling Program Plan. See Appendix A for details.

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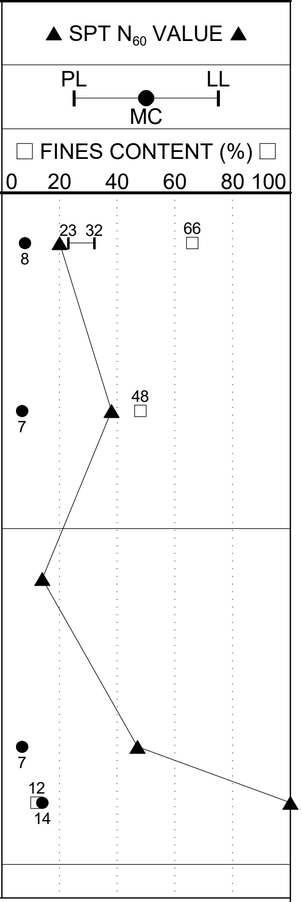
FIGURE A5

Boring B-2

CLIENT Senda Ozkan of Tetra Tech
PROJECT NAME Birch Creek Setback Levee
PROJECT NUMBER B2301679
PROJECT LOCATION Birch Creek Rd. - Umatilla County, OR
DATE STARTED 10/16/23
GROUND ELEVATION 958 ft
ELEVATION DATUM See Figure 2
WEATHER Rain 48°F
SURFACE Sandy Soil
LOGGED BY MSN
REVIEWED BY SJK
DRILLING CONTRACTOR Western State Soil Conservation, Inc.
SEEPAGE ---
EQUIPMENT CME 55 Track
▽ **GROUNDWATER DURING DRILLING** 9.5 ft / El. 948.5 ft
DRILLING METHOD Hollow Stem 4¼-inch ID Auger
▼ **GROUNDWATER AFTER DRILLING** 9.0 ft / El. 949.0 ft

ELEVATION (ft)	GRAPHIC LOG	GROUP SYMBOL	MATERIAL DESCRIPTION	GROUNDWATER	DEPTH (ft) 0	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N_{SPT} VALUE)	N_{60} VALUE ETR_{Hammer} = 75.1%	DRY UNIT WT. (pcf)
		CL	**SANDY LEAN CLAY:** Very stiff, brown, moist, low plasticity, subangular to subrounded, fine- to medium-grained sand, subangular to subrounded gravel (9% per sieve result) up to 1 inch in diameter. {Sandy Alluvium}			SPT 1	67	5-10-11 (21)	20	
955		SC	**CLAYEY SAND WITH GRAVEL:** Dense, brown, moist, subangular to subrounded, fine- to medium-grained, low plasticity fines, subangular to subrounded gravel (10% by volume) up to 1 inch in diameter. {Sandy Alluvium}			SPT 2	67	7-20-21 (41)	38	
		GP-GM	**POORLY GRADED GRAVEL WITH SILT AND SAND:** Medium dense, brown, moist, subangular to subrounded, up to 1½ inches in diameter, subangular to subrounded, fine- to medium-grained sand (15% by volume), nonplastic fines. {Gravelly Alluvium}		5	SPT 3	44	5-9-6 (15)	14	
950			Very dense below 7½ feet bgs.			SPT 4	72	14-15-35 (50)	47	
				▼ ▽		SPT 5	100	50/2"	100	
			Groundwater encountered at 9½ feet bgs.		10					
		RX	**BASALT:** Medium strong to strong (R3-R4), dark gray, slightly weathered. {Grand Ronde Basalt}							
945										
940										



- Boring terminated at 10½ feet bgs.
- Groundwater first encountered at 9½ feet bgs, static groundwater observed at 9 feet bgs after completion of drilling.
- No caving of borehole observed.
- Borehole backfilled per approved Drilling Program Plan. See Appendix A for details.

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FIGURE A6

Boring B-3

PAGE 1 OF 1

CLIENT Senda Ozkan of Tetra Tech
PROJECT NAME Birch Creek Setback Levee
PROJECT NUMBER B2301679
PROJECT LOCATION Birch Creek Rd. - Umatilla County, OR
DATE STARTED 10/17/23
GROUND ELEVATION 960 ft
ELEVATION DATUM See Figure 2
WEATHER Rain 48°F
SURFACE Sandy Soil
LOGGED BY MSN
REVIEWED BY SJK
DRILLING CONTRACTOR Western State Soil Conservation, Inc.
SEEPAGE ---
EQUIPMENT CME 55 Track
▽ **GROUNDWATER DURING DRILLING** 10.0 ft / El. 950.0 ft
DRILLING METHOD Hollow Stem 4¼-inch ID Auger
GROUNDWATER AFTER DRILLING ---

ELEVATION (ft)	GROUP SYMBOL	MATERIAL DESCRIPTION	GROUNDWATER	DEPTH (ft)
				0
	ML	**SILT:** Very stiff, brown, moist, medium plasticity, subangular to subrounded, fine- to medium-grained sand (12% per sieve result) and subangular to subrounded gravel (10% by volume) up to 1 inch in diameter. {Sandy Alluvium} Soft below 2½ feet bgs.		
955				5
	SM	**SILTY SAND WITH GRAVEL:** Dense, gray to brown, moist, rounded to subangular, fine- to medium-grained, nonplastic fines, subangular to subrounded gravel (15% by volume) up to 1 inch in diameter. {Sandy Alluvium} Wet below 10 feet bgs.		
950			▽	10
	GM	**SILTY GRAVEL WITH SAND:** Very dense, gray to brown, moist, rounded to subangular, up to 1½ inches in diameter, subangular to subrounded, fine- to medium-grained sand (15% by volume), nonplastic fines. {Gravelly Alluvium}		
	RX	**BASALT:** Medium strong to strong (R3-R4), dark gray, slightly weathered. {Grand Ronde Basalt}		
945				
940				

- •Boring terminated at 11½ feet bgs.
- •Groundwater first encountered at 10 feet bgs.
- •No caving of borehole observed.
- •Borehole backfilled per approved Drilling Program Plan. See Appendix A for details.

SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N_{SPT} VALUE)	N_{60} VALUE ETR_{Hammer} = 75.1%	DRY UNIT WT. (pcf)
SPT 1	39	6-8-8 (16)	15	
SPT 2	22	1-1-3 (4)	4	
SH 3	81			69
SPT 4	78	3-15-24 (39)	37	
SPT 5	100	16-50/5"	100	
SPT 6	100	50/5"	100	

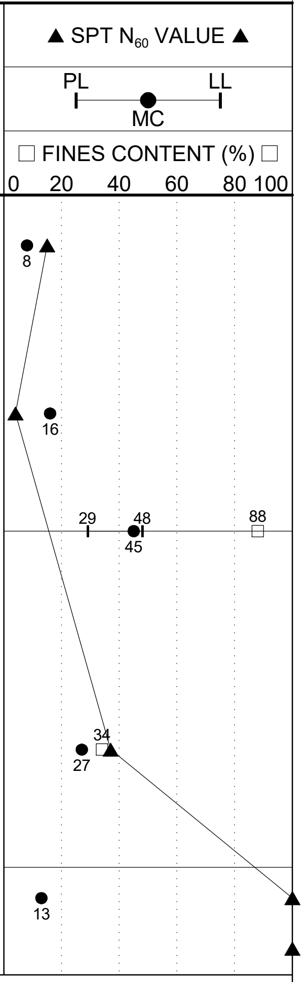

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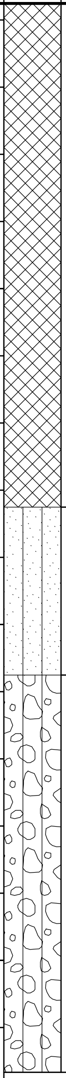
FIGURE A7

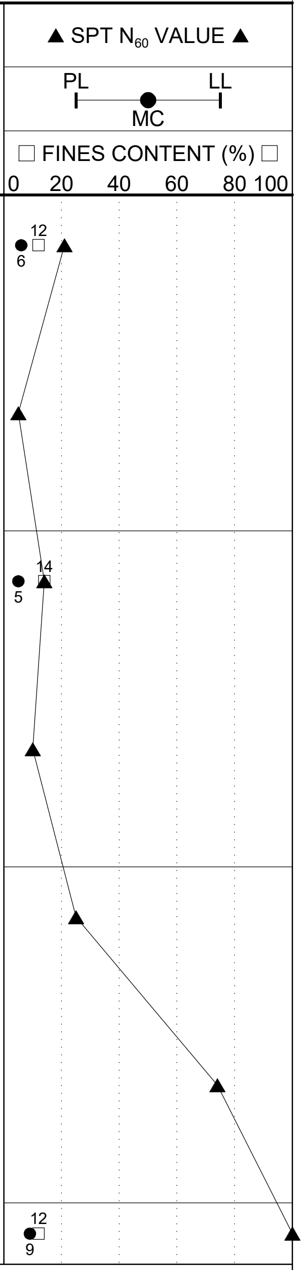
Boring B-4

PAGE 1 OF 1

CLIENT Senda Ozkan of Tetra Tech
PROJECT NAME Birch Creek Setback Levee
PROJECT NUMBER B2301679
PROJECT LOCATION Birch Creek Rd. - Umatilla County, OR
DATE STARTED 10/16/23
GROUND ELEVATION 964.25 ft
ELEVATION DATUM See Figure 2
WEATHER Rain 48°F
SURFACE Fill
LOGGED BY MSN
REVIEWED BY SJK
DRILLING CONTRACTOR Western State Soil Conservation, Inc.
SEEPAGE ---
EQUIPMENT CME 55 Track
▽ **GROUNDWATER DURING DRILLING** 15.0 ft / El. 949.3 ft
DRILLING METHOD Hollow Stem 4¼-inch ID Auger
GROUNDWATER AFTER DRILLING ---

ELEVATION (ft)	GROUP SYMBOL	MATERIAL DESCRIPTION	GROUNDWATER	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N_{SPT} VALUE)	N_{60} VALUE ETR_{Hammer} = 75.1%	DRY UNIT WT. (pcf)
	SM FILL	**SILTY SAND WITH GRAVEL FILL:** Medium dense, brown, dry, subangular to subrounded, fine- to medium-grained, nonplastic fines, subangular to subrounded gravel, up to 1 inch in diameter. {Levee Embankment Fill}		0	SPT 1	33	8-12-10 (22)	21	
960		Loose below 2½ feet bgs.			SPT 2	17	4-3-2 (5)	5	
		Medium dense below 5 feet bgs.		5	SPT 3	28	5-7-8 (15)	14	
955	SM	**SILTY SAND:** Medium dense, brown, moist, subangular to subrounded, fine- to medium-grained, nonplastic fines. {Sandy Alluvium}			SPT 4	33	3-3-8 (11)	10	
	GP-GM	**POORLY GRADED GRAVEL WITH SILT AND SAND:** Medium dense, gray to brown, moist, subrounded to subangular, up to ¾-inch in diameter, nonplastic fines, fine- to medium-grained sand (30% by volume). {Gravelly Alluvium}		10	SPT 5	22	17-15-10 (25)	25	
950		Very dense, subangular to subrounded gravel, up to 1½ inches in diameter below 12½ feet bgs.			SPT 6	56	13-24-50 (74)	74	
		Groundwater encountered at 15 feet bgs.	▽	15	SPT 7	100	30-50/5"	100	
945									





- Boring terminated at 16 feet bgs.
- Groundwater encountered at 15 feet bgs.
- No caving of borehole observed.
- Borehole backfilled per approved Drilling Program Plan. See Appendix A for details.

CGT BOREHOLE B2301679 BORING LOGS.GPJ 11/29/23 DRAFTED BY: GS

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Eugene Office	**(541) 345-0289**
Salem Office	**(503) 589-1252**
Tigard Office	**(503) 684-3460**

Appendix B: Sieve Analysis Results

Birch Creek Setback Levee
Birch Creek Road
Umatilla County, Oregon

CGT Project Number B2301679

November 29, 2023

Prepared For:

Senda Ozkan
Tetra Tech
19803 North Creek Parkway
Bothell, WA 98011

Prepared by
Carlson Geotechnical

FIGURE B1

CTI Job #: B2301679

SIEVE ANALYSIS

PROJECT: BIRCH CREEK SETBACK LEVEE **AIP #:** **LAB LOG #:** B9398

CLIENT: TETRA TECH **SAMPLE METHOD:** SPTs/SH **BILL CODE:**

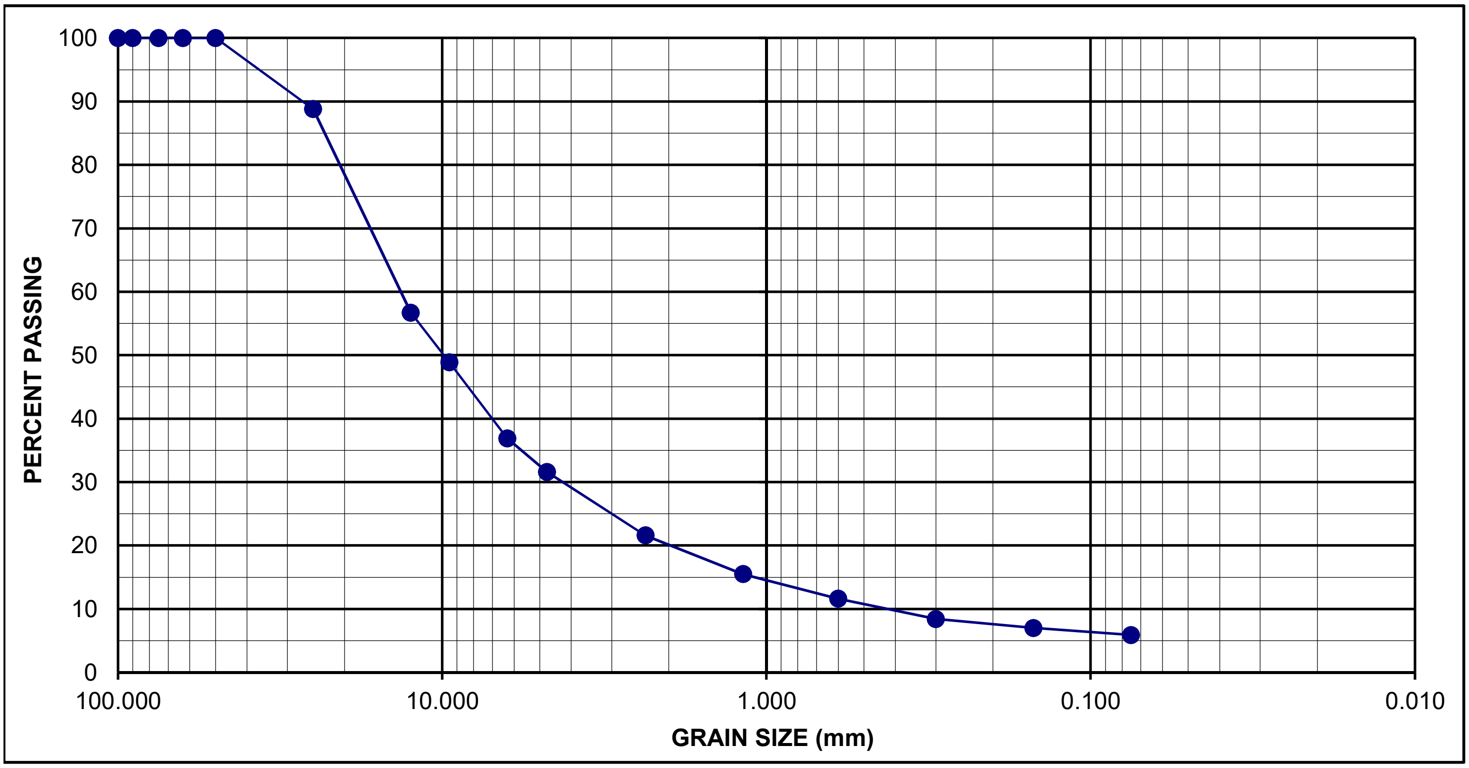
SUPPLIER/SOURCE: EARTH(B-1 SPT2) **SAMPLED BY:** MSN **DATE:** 11/13/23

MATERIAL TYPE: NATIVE **SAMPLED FROM:** DRILLED BORINGS

DATE RECEIVED: 11/8/23 **DATE STARTED:** 11/13/23 **DATE FINISHED:** 11/17/23 **TESTED BY:** GS

METHOD OF TESTING

ASTM C117 ☑ **ASTM C136** ☑ **AASHTO T11** ☐ **AASHTO T27** ☐



Sieve Size	Percent Passing	Specifications
4"	100	
3-1/2"	100	
3"	100	
2-1/2"	100	
2"	100	
1"	88.8	
1/2"	56.7	
3/8"	48.9	
1/4"	36.9	
#4	31.6	
#8	21.6	
#16	15.5	
#30	11.6	
#50	8.4	
#100	7	
#200	5.9	

D_{max}
25.0
D_{85}
24.0
D_{60}
15.0
D_{50}
10.0
D_{30}
4.3
D_{10}
0.450
C_u
33.3
C_c
2.7

FIGURE B2

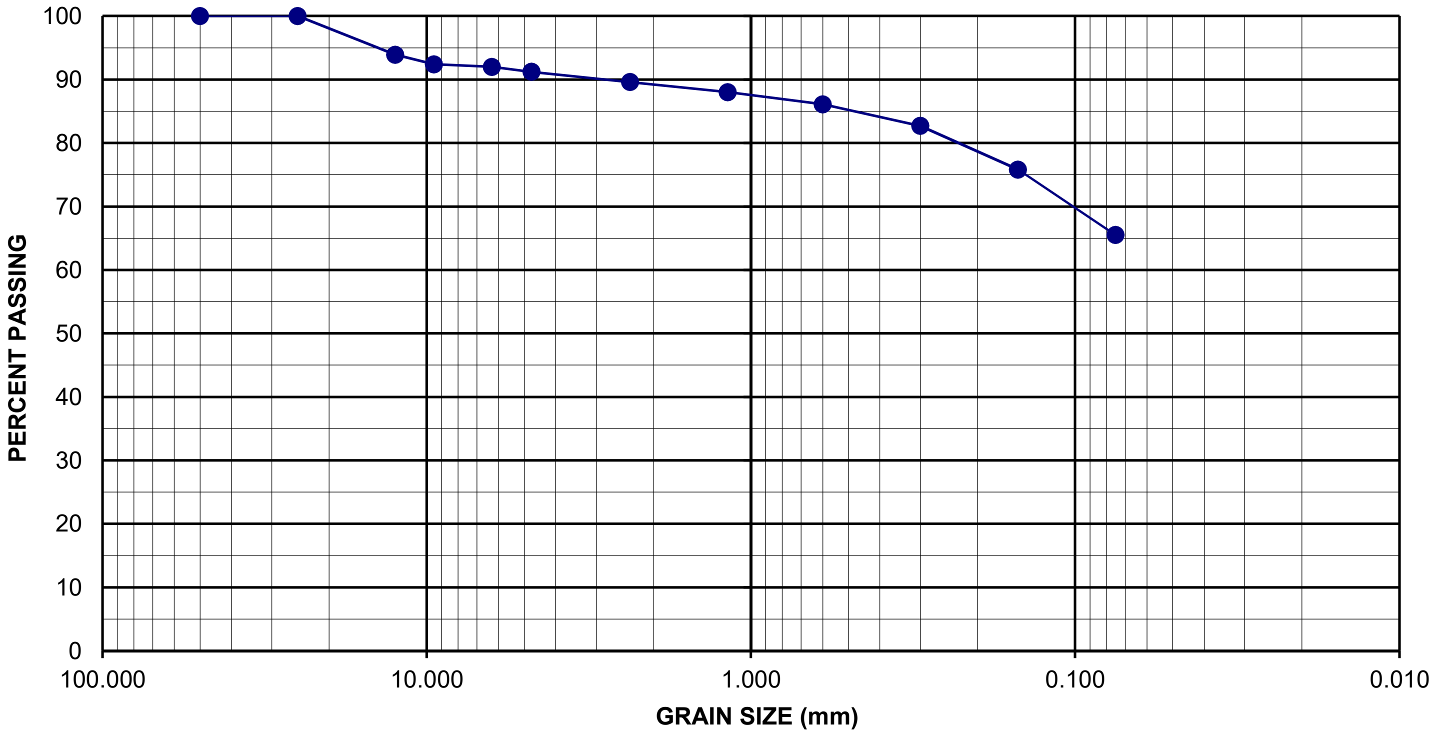
CTI Job #: B2301679

SIEVE ANALYSIS

PROJECT: BIRCH CREEK SETBACK LEVEE **AIP #:** **LAB LOG #:** B9398
CLIENT: TETRA TECH **SAMPLE METHOD:** SPTs/SH **BILL CODE:**
SUPPLIER/SOURCE: EARTH **SAMPLED BY:** MSN **DATE:** 11/13/23
MATERIAL TYPE: NATIVE (B-2 SPT-1) **SAMPLED FROM:** DRILLED BORINGS
DATE RECEIVED: 11/8/23 **DATE STARTED:** 11/13/23 **DATE FINISHED:** 11/17/23 **TESTED BY:** GS

METHOD OF TESTING

ASTM C117 ☐ **ASTM C136** ☐ **AASHTO T11** ☐ **AASHTO T27** ☐



Sieve Size	Percent Passing	Specifications
2"	100	
1"	100	
1/2"	93.9	
3/8"	92.4	
1/4"	92	
#4	91.2	
#8	89.6	
#16	88	
#30	86.1	
#50	82.7	
#100	75.8	
#200	65.5	

D_{max}
12.5
D_{85}
0.5
D_{60}
0.1
D_{50}
0.1
D_{30}
0.1
D_{10}
0.075
C_u
1.0
C_c
1.0

FIGURE B3

CTI Job #: B2301679

SIEVE ANALYSIS

PROJECT: BIRCH CREEK SETBACK LEVEE **AIP #:** **LAB LOG #:** B9398

CLIENT: TETRA TECH **SAMPLE METHOD:** SPTs/SH **BILL CODE:**

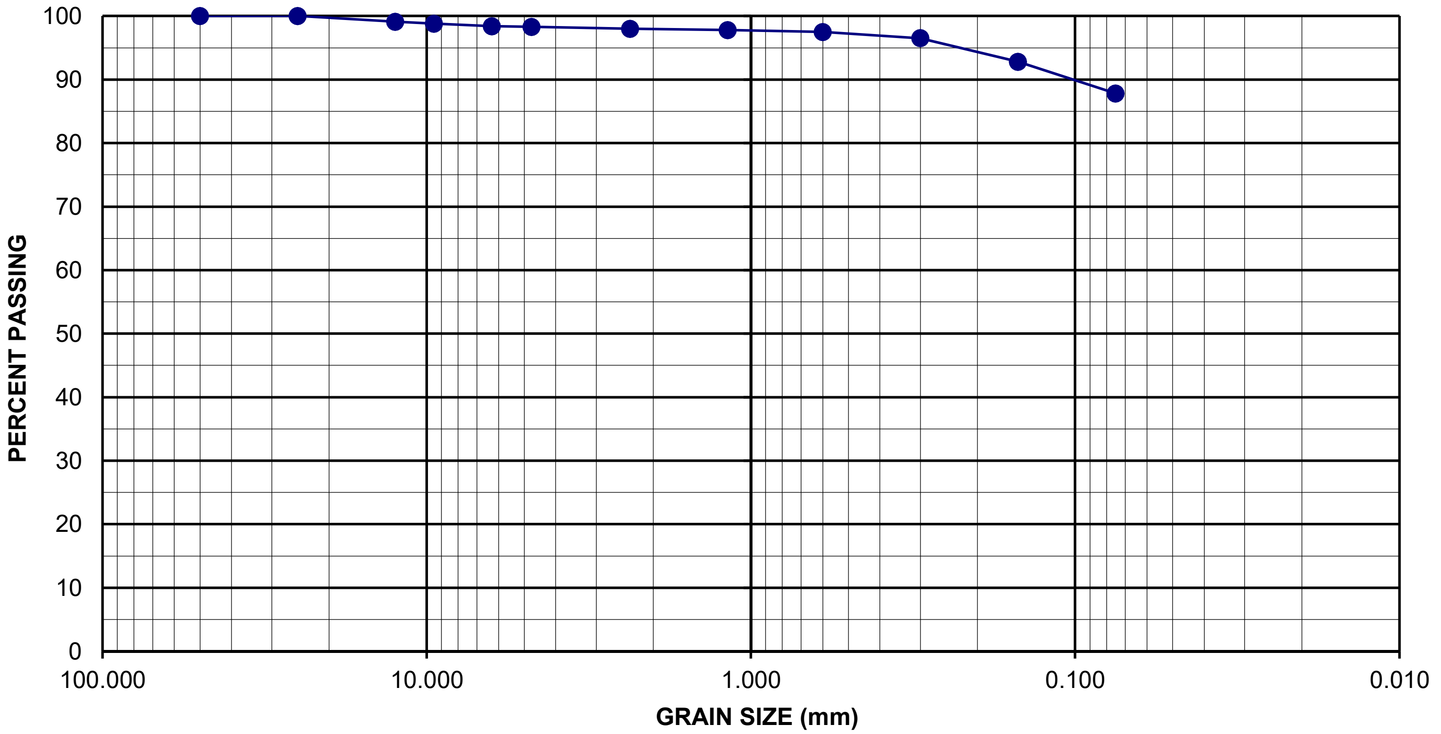
SUPPLIER/SOURCE: EARTH **SAMPLED BY:** MSN **DATE:** 11/13/23

MATERIAL TYPE: NATIVE(B-3 SH3) **SAMPLED FROM:** DRILLED BORINGS

DATE RECEIVED: 11/8/23 **DATE STARTED:** 11/13/23 **DATE FINISHED:** 11/17/23 **TESTED BY:** GS

METHOD OF TESTING

ASTM C117 ☐ **ASTM C136** ☐ **AASHTO T11** ☐ **AASHTO T27** ☐



Sieve Size	Percent Passing	Specifications
2"	100	
1"	100	
1/2"	99.1	
3/8"	98.8	
1/4"	98.4	
#4	98.3	
#8	98	
#16	97.8	
#30	97.5	
#50	96.5	
#100	92.8	
#200	87.8	

D_{max}
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D_{85}
0.1
D_{60}
0.1
D_{50}
0.1
D_{30}
0.1
D_{10}
0.075
C_u
1.0
C_c
1.0

FIGURE B4 CTI Job #: B2301679

SIEVE ANALYSIS

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MATERIAL TYPE: NATIVE (B-3 SPT4) **SAMPLED FROM:** DRILLED BORINGS

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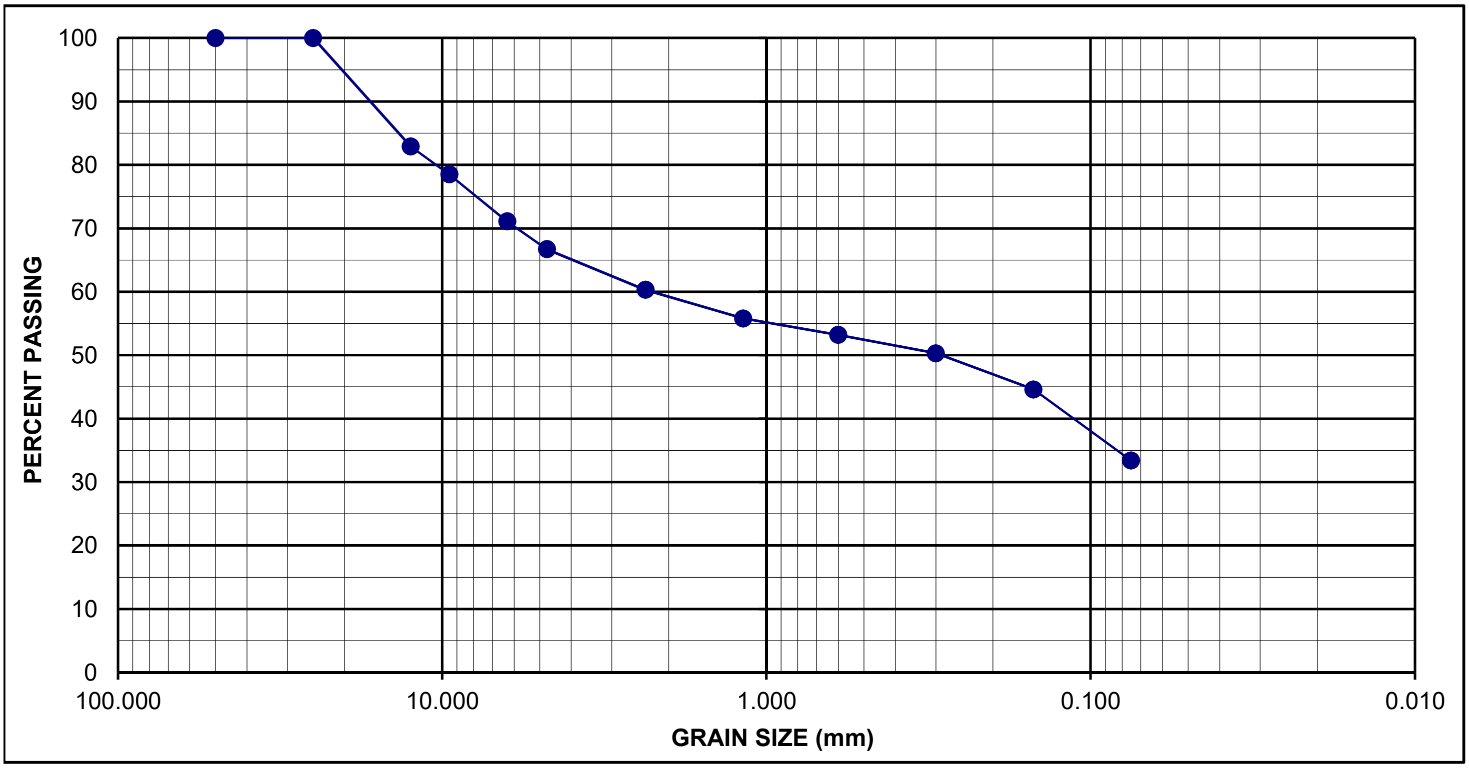
METHOD OF TESTING

ASTM C117 ☐ **ASTM C136** ☐ **AASHTO T11** ☐ **AASHTO T27** ☐



Sieve Size	Percent Passing	Specifications
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1"	100	
1/2"	82.9	
3/8"	78.5	
1/4"	71.1	
#4	66.7	
#8	60.3	
#16	55.8	
#30	53.2	
#50	50.3	
#100	44.6	
#200	33.4	

D_{max}
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D_{85}
15.0
D_{60}
2.4
D_{50}
0.3
D_{30}
0.1
D_{10}
0.075
C_u
31.5
C_c
0.1

VOLUME 6

UMATILLA COUNTY

Pendleton 2a Levee Setback

OPERATIONS AND MAINTENANCE MANUAL

Prepared By:

TETRA TECH
19803 North Creek Parkway
Bothell, WA 98011

July 2025

Contents

Figures

Tables

1. General

It should be noted that Section 4.1.4 of The International Levee Handbook (CIRIA, 2013) states that a levee's O&M procedures should be defined during the design phase; however, the first version of the manual should not be issued until after completion of construction. Note that this draft O&M manual is narrated as if the levee has already been completed but will remain draft until completion of the proposed levee.

The project for the Pendleton 2a Levee Setback included modification to a section of the existing U.S. Army Corps of Engineers (USACE) levee located along the south of the Umatilla River, known as the Pendleton 2a Levee. The previous Pendleton 2a Levee (System ID: 500500041) (USACE 2022) is identified in the USACE National Levee Database as part of the Pendleton Zone 2 Flood Damage Reduction Project, which was a federally authorized and constructed, and non-federally operated and maintained levee system (USACE 2022). The Pendleton 2a Levee Setback project removed a section of the existing levee and constructed a setback levee. The setback portion of this levee is the focus area of this Operation and Maintenance Manual.

This Operation and Maintenance Manual was prepared in general accordance with the following:

- USACE Publication ER 1110-2-401 – Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors;
- USACE Publication EP 1110-2-18 – Guidelines for Landscape Planting and Vegetation Management at Levees;
- 33 CFR Part 208 Section 208.10, Title 33 - Navigation and Navigable Waters, Chapter II - Corps of Engineers, Department of the Army, Department of Defense – Maintenance and Operation of Levees; and
- USACE Levee Owner's Manual, March 2006.

2. Authorization

Construction of the Pendleton 2a Levee Setback was authorized by USACE on ___________(*to be completed upon authorization*). Construction of the levee commenced on ___________(*to be completed upon construction completion*). Construction of the levee was complete and approved by USACE on ___________(*to be completed upon construction completion*).

3. Location

The Pendleton 2a Levee Setback is located near the Umatilla River and Birch Creek confluence in Umatilla County. It is upstream of the confluence, and on the south (river left) side of the Umatilla River (Tetra Tech 2022). See Figure 1-1 below for a regional vicinity map, and Figure 1-2 below for a local vicinity map of the levee location.

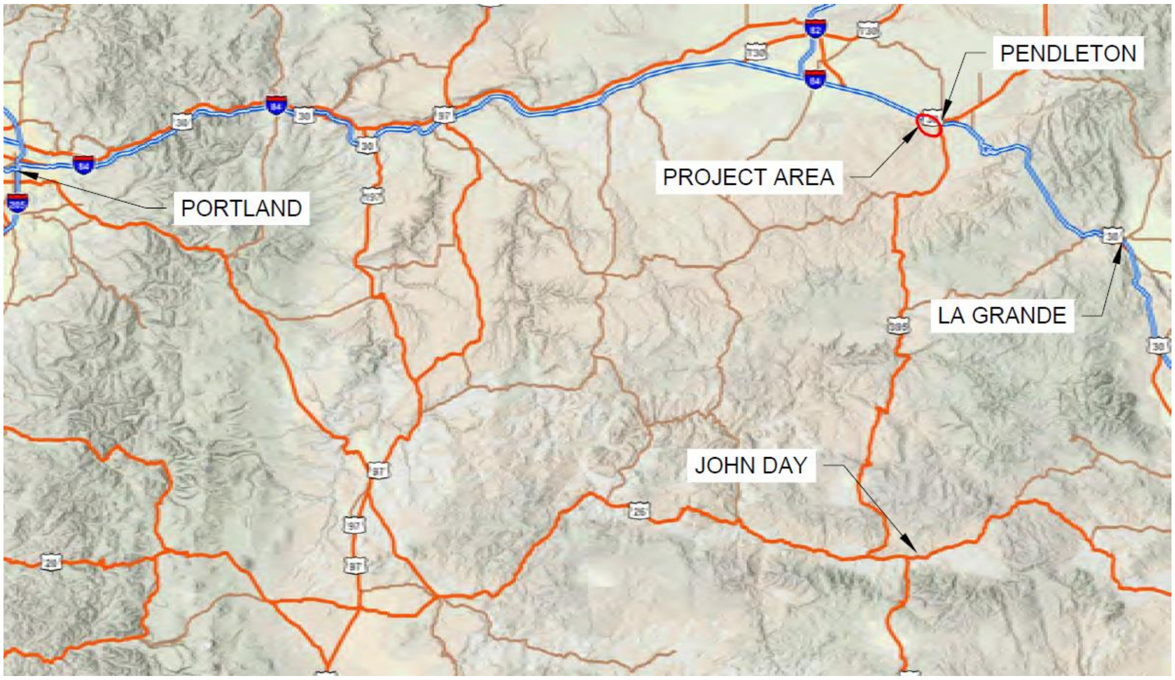

Figure 1-1. Regional Vicinity Map

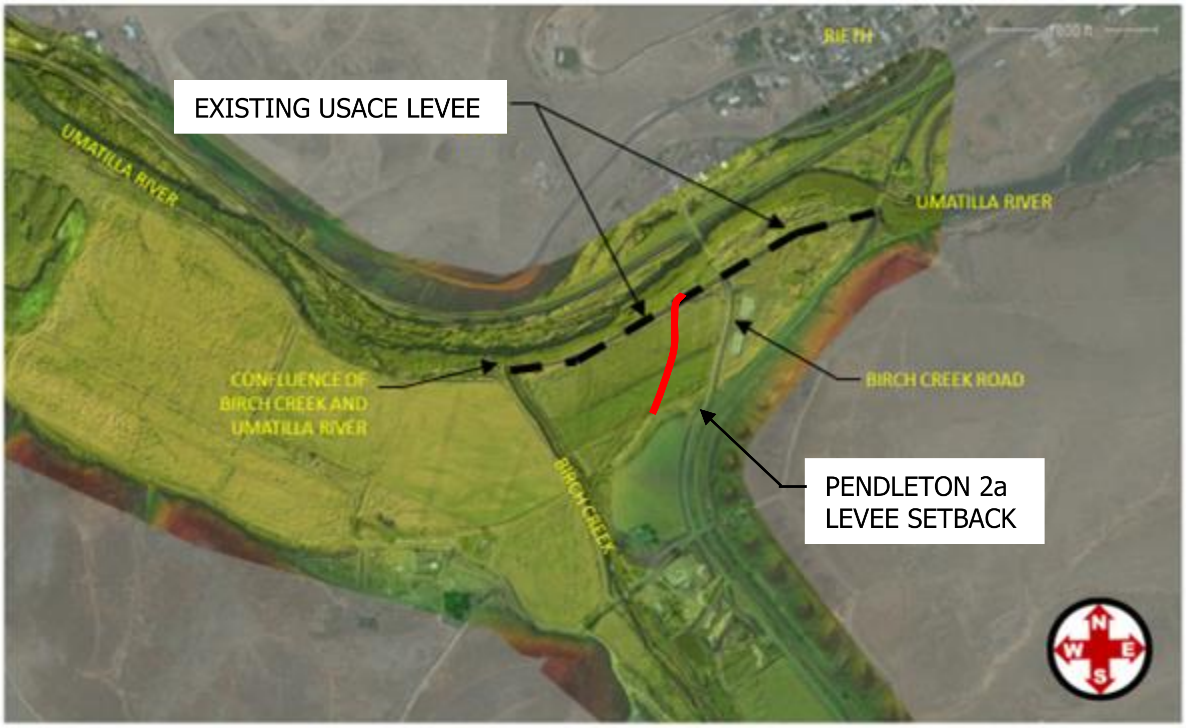

Figure 1-2. Local Vicinity Map

4. Other Pertinent Information

The Pendleton 2a Levee was constructed as part of the Project Area 2 Umatilla River and Birch Creek Confluence Instream Enhancement and Floodplain Restoration project. The goals of this project were to improve instream habitat for ESA-listed and non-listed fish, reestablish natural channel morphology and instream processes, and protect existing infrastructure on the Umatilla River from RM 48.7 to RM 49.7 and Birch Creek from RM 0.0 to RM 0.3.

In order to restore floodplain connectivity and natural river processes, a portion of the Pendleton 2a Levee was setback upland from the previous levee alignment. The new portion of Pendleton 2a Levee Setback consisted of the following:

- Levee embankment structural fill;
- Scour protection and riprap revetment;
- Interior Drainage overflow relief protection riprap;
- Two (2) 36-inch diameter culverts with anti-seepage filter material, doubled hinged flap gate and inlet/outlet protection riprap; and
- Erosion control seeding/vegetation.

5. Construction History

This section will be completed upon construction of the proposed Pendleton 2a Levee Setback.

6. Project Performance

This section will be completed upon construction of the proposed Pendleton 2a Levee Setback.

7. Project Cooperation Agreement

The Project Cooperation Agreement for the Pendleton 2a Levee Setback is an agreement between the USACE (Government) and Umatilla County (Public Sponsor) defining responsible parties, requirements, and party responsibilities for the levee and levee appurtenances. See Appendix B for the Project Cooperation Agreement.

8. Maintenance and Inspection

All flood control works (FCWs) must be properly maintained to provide the protection for which they were designed. Public sponsors are solely responsible for ensuring that the FCW is properly maintained. Even if sub-agreements with local landowners or other entities are in place for routine maintenance, the public sponsor is ultimately responsible for the operations and maintenance of the FCW. If landowners or other assigned entities fail to perform needed maintenance or correct deficiencies on their property, it’s the duty of the public sponsor to ensure maintenance and repairs are completed. Proper maintenance of the FCW must be taken seriously, and local plans and budgets need to be structured such that the maintenance of each project feature is carried out on a regular and continual basis. In addition to providing for usual operations and maintenance expenses, this budget needs to account for the replacement of more expensive project components such as culverts and flap gates as they age and come to the end of their design life.

This section identifies the activities that are necessary to maintain the Pendleton 2a Levee Setback FCWs. The following sub-sections provide maintenance recommendations, requirements, and examples of the types of deficiencies that will require maintenance or repair action.

8.1 EROSION

8.1.1 Types of Erosion

There are several types of erosion that effect FCWs. For example, the slopes of any embankment can become eroded from rain runoff, or by embankment overtopping. Depending on the extent of the erosion, the level of protection provided by the FCW can be significantly reduced. In cases of embankment overtopping during a flood, there may be a total failure of the FCW.

A second type of erosion often seen on embankments is wave wash. Under high water conditions, wave action can form long terraces along the length of the embankment slopes. If additional material or bank protection is not provided, the embankment will continue to cave as the waves work their way farther into the slope.

A third type of embankment erosion is caused by the flow of water within a river or channel. These flows can erode a channel bank or levee, or undermine other flood control structures and cause them to cave into the water. Bank caving or stream bank erosion can be a very serious threat to the stability of an FCW. It’s critical that the riverward bank be inspected for bank caving or erosion. If the river or stream bank erosion or caving is observed to be moving in the direction of a levee or floodwall, immediate action should be taken to stabilize the banks.

8.1.2 Repair or Areas Damaged by Erosion

All erosion gullies need to be repaired to prevent further erosion and damage during high water. The ground should be scarified and backfilled with the same type of material that the levee was constructed. The backfill material should generally be placed in six (6) inch layers and compacted mechanically or by hand, in order to restore the original shape of the levee. Additionally, since erosion is typically a reoccurring problem, something additional measures should be considered to improve drainage and prevent further erosion in the area. Consideration should be given to installing drainage channels or appropriately sized riprap revetment. And areas of the levee that remain exposed should be reseeded and mulched. Please refer to section 8.6, below, for details on the placement of riprap.

8.2 PROJECT AREA 2 HABITAT FEATURES

Habitat features associated with the Project Area 2 restoration efforts include habitat boulders and complex structures made of large woody material. No habitat features are a part of the proposed Levee 2A Setback design per USACE design standard. Proposed habitat features near the Levee 2A Setback are located on the opposite bank of the Levee 2A Setback and are designed to be stable up to the 100-year flood and material dislodging from the structures is unlikely. However, if material does become dislodged, it is likely that the material will be carried downstream and away from the Levee 2A Setback as the velocities in the main channel coupled with the distance of the channel width are sufficient to make it unlikely to be deposited on the Levee 2A Setback location.

8.3 ENCROACHMENTS

Excavations, structures, or other obstructions present within the FCW easement area are generally prohibited. Fencing that prohibits access along the crown of the levee is prohibited. Table 8-1 below lists examples of common encroachments and whether they should be permitted. All Future encroachments will be required to go through the Section 408 permitting process.

Table 8-1. Common Levee Encroachment Types and Acceptability

Acceptable Encroachment Example
Landowner tilling and farming land up to 10-15 ft of toe of levee slope.
Minimally Acceptable Encroachment Example
Landowner tilling and farming land up to toe of levee slope.
Unacceptable Encroachment Examples
Landowner tilling and farming the soils on levee slope.
Utility poles installed in levee embankment.
Piping for lawn irrigation drilled through levee without approval.
Fallen woody debris on levee – this requires removal.
Material stockpiled against levee.
Gardens and compost bins located on levee crest and slopes.
Patio and retaining wall constructed on levee without approval.

8.4 SLOPE STABILITY

Some earthen materials tend to become saturated with water very easily. When this happens, they lose stability and can't support their own weight. If a stream or river embankment is composed of these materials, the embankment has potential to slump off and move down the slope, causing a bulge at the base of the slope. When riverbanks break down like this, they have slope stability problems and need to be repaired.

Levees, like riverbanks, are subject to the same soil saturation effects during a flood or period of heavy rainfall. Levees are generally less susceptible to slope stability problems because of the materials they are made of and because of their shallow slopes. However, slope failures have occurred during prolonged periods of high water or heavy rainfall. While slope failures will generally occur on the riverward slope of a levee, be aware that slope failures on landward slopes are also possible. A levee should be carefully inspected for slope stability problems after high water or rainfall events.

A related slope failure/stability problem involves trees growing on or near the channel or levee slopes. It’s very important to prevent tree growth near levee or channel embankments, because when the roots of these trees decay, they leave voids in the soil, which allow water to quickly saturate the slope and potentially cause a slope failure. Trees can also be uprooted and deflect flood flows into the embankment, accelerating the erosion of a levee.

The classic signs of slope stability problems are listed below, and you should watch for these signs during routine inspections:

- Wide deep cracks that parallel the riverbank or levee crest. These cracks may also extend down the slope of the levee;
- Vertical movement of the material along the crack. Remember that this movement may be very obvious, or very subtle if the stability problem is just starting to develop; and
- If the slope has slumped or is starting to slump, examine the area along the toe of the embankment. In many cases there will be a noticeable bulge in the slope or riverbank.

Please also refer to Section 8.8 Cracking, for further discussion on levee cracking.

Deep seated sliding often requires the removal and replacement of that section of the levee or river slope, and the stabilization of the area with soil or rock fill. If you identify signs of a developing slope stability problem, contact your local USACE district office for an investigation and to get technical assistance regarding the best repair approach.

8.5 REMOVAL OF DEBRIS

Any accumulations of drift, grass clippings, and other objectionable materials deposited on the riverward side of any FCW or along the crown and side slopes of a levee must be removed and disposed of at suitable locations outside of the floodway. When debris collects in a flowing channel, an unforeseen log jam can deflect the water towards the channel bank and cause excessive erosion on the levee.

Lawn clippings and yard waste should be removed from the levee. Piles of clippings or yard waste will kill the grass cover that protects the levee. During a high water and rainfall, the debris can get washed away, exposing the levee material to erosion.

8.6 ANIMAL CONTROL

Close attention must be given to the presence of burrowing animals since they may not be readily detected without a thorough inspection. Burrows created by gophers, muskrats, opossums, badgers, and other animals can lead to rapid levee failures during floods. For this reason, an active animal abatement program needs to be implemented to remove these animals. If necessary, Oregon Department of Fish and Wildlife (ODFW) should be contacted to determine which rodent control procedures are allowable and recommended. Inspections to detect the presence of burrowing animal activity are generally most effective immediately after the levee has been mowed. Animal burrows that are identified should be thoroughly excavated and inspected, backfilled with compacted soil that is similar to material of the levee, and reseeded. This will avoid the possibility of water piping through unfilled portions of the burrows during a flood.

Beaver colonizing is a desired result of stream restoration projects and beaver action may be observed the restored PA2 floodplain. However, beaver potential could pose a concern by building dams, blocking culverts, and by burrowing into the stream bank to create a den. When beaver activity is noted in the floodplain, the levee and culvert should be monitored for potential adverse impacts to the levee. If damage occurs due to beaver action the beavers should be relocated, and the dam and blockages removed with coordination with ODFW. Failure to correct the problem may result in increased levee erosion and slope stability problems in the area of the beaver den during periods of high water.

8.7 RIPRAP REVETMENTS AND BANKS

Riprap can be a very effective method for protecting a riverbank or flood control feature from erosion. However, if the riprap protection is not placed correctly, it can cause eddy currents to erode unprotected areas of the bank upstream or downstream of the project.

Any areas of stone riprap that have settled, moved, or been damaged by erosion should be filled in with hard, durable rock of suitable size including filter blanket between the soil and the rock. These sublayers allow the water to pass from the soil, yet prevent the fine soil from washing out from under the stone riprap.

When selecting stone for riprap, durable rock that's insoluble in water and meets the project specifications in Section 31 37 00 for riprap rock should be utilized. Per Section 31 37 00, riprap material used shall be in accordance with Oregon Department of Transportation (ODOT) Standard Specifications Section 00390 (English Units), and the Class 50 and Class 200 riprap as labeled in the Drawings. Stratified or easily crumbled rocks such as shale, or rocks such as claystones that are likely to decompose in water are not good for riprap. Stone for riprap should be block shaped with a specific gravity of at least 2.5. Smooth rounded stone or flat, thin, elongated and slab stones are not recommended. As a general rule, no more than 25% of the stones distributed throughout the gradation should have a length more than 2.5 times longer than the other dimensions, and none of the stones should be 3 times longer than their width or thickness.

Grouted riprap should be avoided unless it is absolutely necessary. The surface of grouted riprap can look perfectly fine until the bond between the grout and the rock fails. Grouted riprap can fail suddenly if it is undermined, and this can lead to unexpected and catastrophic failure of the slope. Other objections to using grout include the cost of installation, the lasting environmental impact, and the undesirable aesthetics of having a cement-lined stream bank as opposed to a plain rock bank.

8.8 VEGETATION

8.8.1 Grass or Sod Vegetative Cover

Grass or sod vegetative cover is one of the most effective and economical means of protecting flood control levees and drainage swales against erosion caused by rain runoff, channel flows, and wave wash. Maintaining sufficient vegetative cover requires periodic fertilizing, watering, and mowing of the grasses as needed. In addition, every effort must be made to prevent unauthorized encroachments, grazing, vehicle traffic, the misuse of chemicals, or burning during inappropriate seasons which could lead to degradation of vegetative cover. Failure to properly maintain vegetative cover can result in unnecessary erosion.

8.8.2 Mowing

Periodic mowing is essential to maintaining a good ground cover. Levees should be mowed regularly in order to control weeds and to prevent the growth of brush and saplings. Long grasses and native prairie grasses are one of the many challenges facing the project inspector. Long grasses (greater than 12 inches in length) can make a visual inspection nearly impossible and can hide serious concerns such as rodent activity, levee slides, and cracking; all of which can lead to the failure of the levee. For these reasons, the grass should be mowed to a minimum height of 3 inches. The last mowing of the season should be accomplished under conditions that will allow the grass to grow to approximately 8 to 10 inches by the winter season. It's important to ensure that the entire levee profile has been mowed, including zones extending 15 feet beyond the toes of the embankment, which should be free of all woody growth and should be clear of other obstructions so that a truck could drive beside the levee if needed.

8.8.3 Control of Trees, Brush, and Weeds

If the public sponsor mows the levee at regular intervals, the growth of saplings, trees, and brush will not become a problem. However, if the levee is not mowed regularly, the resulting growth will make it difficult to properly maintain and inspect the project. Trees and brush can also affect the stability of the levee and interfere with emergency operations during highwater conditions. All trees and brush must be cleared and disposed of away from the flood control project. The disposal of material on the riverward side of the levee or areas where flood waters can carry the material downstream is prohibited. In riprap protected areas, ditches, or in other areas of the project where power mowing is impractical, unwanted vegetation should be controlled with an approved herbicide spray or should be cut by hand. Any trees that reach 2 inches in diameter or greater, and are located on the levee, riprapped areas, drainage channels, or within 15 feet of the toe of the levee must be cut down, the root ball removed, the voids filled with impervious material, and the fill material firmly compacted and reseeded.

8.9 CRACKING

It's important to closely monitor and evaluate all visible areas of cracking on a levee or riverbank, to ensure they don't develop slope stability problems as discussed in section 8.3. Cracks in a levee develop when the levee material is saturated with water and when it is overly dry. Clay, like most impervious materials, will shrink as it dries and re-expand when wet. Clay levee surfaces tend to shrink and expand slightly, and some cracks in the surface of the clay levee are to be expected. Shrinkage cracks are generally narrow and shallow, not extending more than more than a few inches into the levee, but during long periods of drought they may extend as much as two feet into the levee. These cracks can run longitudinally or transverse to the levee, or may appear as blocks. If the cracking becomes excessive, it needs to be corrected even if the levee appears to be stable.

8.10 RUTS AND DEPRESSIONS

Ruts and other depressions often develop along levees or access roads as a result of pedestrian or vehicular traffic, settlement, or because of an inadequate crown slope. Sometimes the levee material over a culvert can settle, leaving a trench across the crown of a levee. Ruts and depressions are a problem because they allow water to pond on the levee crest or access road. If left uncorrected, the ponded water will seep into the levee’s interior or into roadway embankment, saturating the foundation material, and making the levee more susceptible to failure during a flood. The levee should be inspected for ruts, potholes, and areas of standing water after it rains. To correct these problems, the area should be excavated and inspected, backfilled with compacted soil that is similar to material of the levee, and reseeded.

8.11 SEEPAGE / SANDBOILS

Sandboils and seepage problems are not generally identified during routine inspections because these problems typically only appear under high water conditions. However, if sandboils or continuously saturated soils (not caused by ponded water or poor drainage) are observed on the landward side of the levee under low water conditions, regardless of their size, they will likely become serious problems under high water conditions.

8.12 INTERNAL DRAINAGE SYSTEMS

During non-flood conditions, rainwater is permitted to drain naturally through culverts in the levee and into the Umatilla River. However, during high water, the flap gate on the drainage culverts are closed, and rainfall and flood seepage becomes trapped within the protected area of the levee. If there is insufficient ponding area within the levee, the water will need to be pumped over the levee or floodwall and into the river. Even if a levee operates exactly as intended to keep the river back, a community can still be flooded from within if the interior drainage system is not functioning properly.

Features of the Pendleton 2a Levee Setback interior drainage system include a ponding area, drainage swales or ditches, inlet and outlet protection, flap gate valves, culverts, and anti-seepage filter material.

The public sponsor is responsible for ensuring that all ditches, drainage structures, and other components of the project are kept in an acceptable operating condition. All drainage structures should be inspected and maintained at least once a year prior to flood season and again after periods of high water.

8.12.1 Drainage Ditches and Swales

Drainage ditches should be maintained to ensure that the capacity of the ditch is not decreased by heavy vegetation growth or sedimentation. As part of a good maintenance program, the drainage ditches should be cleared at scheduled intervals and restored to the original channel design grade and cross section. Material removed from drainage ditches should be removed from the area, and not left near the banks. During an inspection, drainage ditches should be rated on flow capacity, sedimentation, vegetative growth, and cross section. Regularly scheduled maintenance will ensure the flood control project performs in a satisfactory manner during high water.

8.12.2 Culverts, Headwalls, and Wingwall.

All culvert pipes and pre-cast concrete inlet/outlet headwalls and wingwall must be clear of debris and must be structurally sound free of cracks, spalling, or excessive settlement. Inspections of drainage structures that require physical entry will require compliance with confined space entry regulations. If any pipe has been separated from other pipe segment or the pre-cast concrete inlet/outlet units, the drainage features shall be repaired as soon as possible. If significant settlement is detected in the culvert pipe or inlet/outlet units and joints have separated, it should be excavated, the foundation regraded, the feature replaced, the fill material placed and compacted in lifts around the pipe or inlet/outlet to a density equal to or greater to that of the surrounding undisturbed material, and the area reseeded.

8.12.3 Flap Gates

The flap gate need to be inspected at least once a year just before the flood season and in accordance with the manufacturer’s recommendations. If gates aren’t seated properly, water will flow back through the culverts during high water. During the inspection, all flap gates should be manually operated, and any debris or obstructions removed. All valve seats should be checked and the frames readjusted if the gate is not seating properly. Cracked or damaged valves need to be replaced. The inlet and outlet channels need to be kept free of debris, trees, brush and other vegetation, and sediment. If any pipe has separated from the inlet/ outlet, this needs to be repaired as soon as possible. When high water is predicted, all flap gates should again be inspected, and any debris or obstructions should be removed immediately.

9. Emergency Operation

A detailed emergency action plan (EAP) has been provided as an appendix to this document (See Appendix D Emergency Action Plan). The purpose of the EAP is to reduce the risk of human harm and to minimize property damage in the event of an actual or potential emergency associated with the Pendleton 2A Levee Setback Project. This document provides a general overview of the emergency operation protocol, contact information in the event of an emergency, and other flood response processes necessary for emergency operations.

10. References

33 CFR (Code of Federal Regulations) Part 208 Section 208.10, Accessed December 2022. Title 33 - Navigation and Navigable Waters, Chapter II - Corps of Engineers, Department of the Army, Department of Defense – Maintenance and Operation of Levees

CIRIA (Construction Industry Research and Information Association). 2013. International Levee Handbook, Section 4.1.4.

Tetra Tech (Tetra Tech, Inc.). 2022. UmaBirch Instream Design and Construction Oversight - Project Area 2 Umatilla River and Birch Creek Confluence Instream Enhancement and Floodplain Restoration Basis of Design Report 60 Percent Design. Prepared for the Confederated Tribes of the Umatilla Indian Reservation. Bothell, WA.

USACE (U.S. Army Corps of Engineers). 1994. September. Publication ER 1110-2-401. Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors.

USACE. March 2006. Levee Owner’s Manual for Non-Federal Flood Control Works.

USACE. May 2019. Publication EP 1110-2-18. Guidelines for Landscape Planting and Vegetation Management at Levees.

USACE. 2022. National Levee Database. Available online at: https://levees.sec.usace.army.mil/#/levees/search/&viewType=map&resultsType=systems&advanced=true&hideList=false&eventSystem=false

APPENDIX A

AS-BUILT INFORMATION

This appendix will be completed upon construction of the proposed Pendleton 2a Levee Setback.

APPENDIX B

PROJECT COOPERATION AGREEMENT

This appendix will be completed upon construction of the proposed Pendleton 2a Levee Setback.

APPENDIX C

LEVEE INSPECTION GUIDE

APPENDIX C: FCW INSPECTION GUIDE

U.S. Army Corps of Engineers
Inspection Guide for Flood Control Works

Name of Project: ____________________

Date Inspected: ____________________

Public Sponsor: ____________________

Sponsor Phone/ Email: ____________________

Corps of Engineers Inspector: ____________________

Public Sponsor Representative: ____________________

Type of Inspection (Check One):
- ☐ **Initial**
- ☐ **Continuing**

Overall Project Rating (Check One):
- ☐ **Acceptable**
- ☐ **Minimally Acceptable (Maintenance is required)**
- ☐ **Unacceptable**

INSPECTOR'S OBSERVATIONS:

Contents of this Inspection Report:
- ☐ Basic Eligibility (IEI specific)
- ☐ FCW Engineering (IEI specific)
- ☒ General Items for All Flood Control Works
- ☐ Levees
- ☐ Concrete Floodwalls
- ☐ Interior Drainage System
- ☐ Pump Stations
- ☐ Earthen Flood Control Channels
- ☐ Concrete Lined Channels
- ☒ Instructions

Note: A plan view drawing of the Flood Control Works, with stationing, should be attached to this report to reference locations of items rated less than acceptable. Photos should be taken of general project condition and any noted deficiencies.

Basic Eligibility

Page 1 of 1

For use only during Initial Eligibility Inspections of Non-Federally Constructed Flood Control Works

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Public Sponsor (A or U only)		▨	▨	▨	**A** The Public Sponsor is a legally constituted public body with full authority and capability to perform the terms of its agreement as the non-Federal partner of the Corps for a project, able to pay damages, if necessary, in the event of its failure to perform. The public sponsor may be a State, County, City, Town, Federally recognized Indian Tribe or tribal organization, Alaska Native Corporation, or any political subpart of a State or group of states that has the legal and financial authority and capability to provide the necessary cash contributions and the lands, easements, rights-of-way, relocations, and borrow and dredged or excavated materials disposal areas (LERRD's) necessary for the project, and who could legally hold and save the Federal government free from damages that could potentially arise during post-flood rehabilitations or other work on the FCW.	
	▨	▨		▨	**U** The project does not have a public sponsor as defined above.	
2. Flood Protection (A or U only)		▨	▨	▨	**A** The principal function of the project is to protect people or property from floods.	
	▨	▨		▨	**U** The project was built or is primarily used for channel alignment, recreation, fish and wildlife, land reclamation, drainage, to protect against land erosion or tidal inflows, or for some other non-flood related purpose.	
3. Project Completion (A or U only)		▨	▨	▨	**A** Project construction has been completed.	
	▨	▨		▨	**U** The project is still under construction.	
4. Construction Compliance (A or U only)		▨	▨	▨	**A** Appropriate local, State, tribal, and/or Federal permits (right-of-way, easements, regulatory permits, etc.), or waivers thereof, have been obtained for FCW construction and subsequent modifications. The project was constructed in accordance with all applicable Federal, state and local codes, ordinances, and applicable laws.	
	▨	▨		▨	**U** The appropriate permits (or waivers thereof) have not been obtained for the project, or the project was not constructed in accordance with applicable codes, ordinances, and laws.	

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FCW Engineering

For use only during Initial Eligibility Inspections of Non-Federally Constructed Flood Control Works

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Minimum Elevation (A or U only) (See instructions)	☐				**A** • **Urban Levees and Floodwalls**- Minimum elevation corresponding to a flood level with 10% probability of occurring in a given year (10-year flood). • **Agricultural Levees and Floodwalls**- Minimum elevation corresponding to a flood level with 20% probability of occurring in a given year (5-year flood). • **Flood Control Channels**- Minimum capacity is for a flood with a 10% probability of occurring in a given year (10-year flood). Improved channels must additionally provide drainage for at least 1.5 square miles of land and have a capacity of at least 800 cfs. (NOTE: Interior drainage channels within the protected area of a levee system are not flood control channels.)	
			☐		**U** The FCW does not meet requirements for minimum elevation, capacity, or drainage area.	
2. Physical Location and Cross Section (A or U only)	☐				**A** The physical location, cross section, and other design elements of the FCW are sufficient to provide reliable flood protection. The FCW is (or is an element of) a closed system, tied into high ground.	
			☐		**U** The FCW was not constructed in an appropriate location, does not have an appropriate cross section; is not properly tied into high ground, or has other shortcomings with design elements necessary for providing reliable flood protection.	
3. Embankment Fill	☐				**A** Embankment material is suitable to prevent slides and seepage problems.	
			☐		**U** Embankment material is unsuitable and is likely to contribute to the development of slides or seepage problems.	
4. Embankment Material Uniformity/ Compactness	☐				**A** Fill material is uniform and adequately compacted throughout the entire FCW.	
		☐			**M** Fill material is uniform and adequately compacted in 75% or more of the FCW.	
			☐		**U** Fill material is not uniform, or there is no compaction and evidence indicates a need for compaction.	
5. Foundations	☐				**A** Foundation material will not cause piping, sand boils, seepage, or settlements that will reduce the level of protection.	
		☐			**M** Foundation material may show signs of excessive seepage, minor sand boils, and localized settlement.	
			☐		**U** Foundation materials are unsuitable and likely to cause excessive uncontrolled seepage, sand boils, and / or piping.	
				☐	**N/A** The foundation problems described above do not apply to this type of FCW.	
6. Primary Levee	☐				**A** In the case of a levee project, the levee is a primary levee or is a secondary levee which is designed to protect human life or was designed as a major component of the primary levee system, necessary to assure the flood control protection of the total system.	
			☐		**U** The levee is a secondary levee, and was not designed to protect human life or as a major component of the primary levee system.	
				☐	**N/A** The FCW is not a levee system.	

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FCW Engineering - Continued on Next Page

FCW Engineering (continued)

For use only during Initial Eligibility Inspections of Non-Federally Constructed Flood Control Works

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
7. Interior Drainage System (including culverts, gates, pump stations)	☐				**A** Given the level of protection provided by the FCW, interior drainage structures are appropriately sized, situated, and constructed to move anticipated runoff and seepage out of the protected area. Pump stations will not become inundated during regular operation and their power system is adequately designed and reliable.	
			☐		**U** Interior drainage structures are undersized, poorly constructed, poorly situated, or unreliably designed.	
				☐	**N/A** The issue of interior drainage does not apply to this type of FCW.	
8. Structures	☐				**A** Structures are capable of performing their designed functions and show no signs of failure.	
		☐			**M** Structures are performing their design functions but show signs of overtopping and bypassing flows.	
			☐		**U** Structures are not performing their designed functions or show signs of potential structural failure.	
9. Erosion Control	☐				**A** Erosion protection is capable of handling the designed flow velocity for the level of protection for the entire FCW. The FCW is protected against bank caving and slides in all necessary areas, and has adequate drainage to protect FCW slopes from runoff erosion.	
		☐			**M** Erosion protection is capable of handling the designed flow velocity for the level of protection for 75% or more of the FCW.	
			☐		**U** Erosion protection measures protect less that 75% of the FCW. Erosion protection is not present and there is evidence indicating a need for erosion protection.	

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General Items for All Flood Control Works

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For use during Initial and Continuing Eligibility Inspections of all Flood Control Works

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Project Operations and Maintenance Manual (A or U only)	☐	▨	▨	▨	**A** Levee Owner's Manual, ICW O&M Manuals, and/or manufacturer's operating instructions are present.	
	▨	▨	☐	▨	**U** These manuals are lost or missing.	
2. Emergency Supplies and Equipment	☐	▨	▨	▨	**A** The sponsor maintains a stockpile of sandbags, shovels, and other flood fight supplies which will adequately supply all needs for the initial days of a flood fight.	
	▨	☐	▨	▨	**M** The sponsor does not maintain an adequate supply of flood fighting materials as part of their preparedness activities.	
3. Flood Preparedness and Training (A or M only)	☐	▨	▨	▨	**A** Sponsor has a solid understanding of how to operate, maintain, and staff the FCW during a flood, and has written plans that include information such as low spots or sand boils. The sponsor also has plans that cover short term situations. (For instance, if a culvert through the levee is being replaced, then the sponsor knows how to respond to a flood while the levee integrity is lacking due to the construction.)	
	▨	☐	▨	▨	**M** The sponsor maintains a good working knowledge of flood response activities, but there are insufficient plans to address project specific features or short term situations, or the knowledge of flood response activities is maintained by a very small number of individuals within the community. Additional planning or training is required to ensure the success of the FCW during a flood event.	

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Levees

For use during all Initial and Continuing Eligibility Inspections of levees

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Sod Cover	☐				**A** There is good coverage of sod cover over the levee.	
		☐			**M** Approximately 25% of the sod cover is missing or damaged over a significant portion or over significant portions of the levee embankment. This may be the result of over-grazing or feeding on the levee, unauthorized vehicular traffic, chemical or insect problems, or burning during inappropriate seasons.	
			☐		**U** Over 50% of the sod cover is missing or damaged over a significant portion or over significant portions of the levee embankment. This may be the result of over-grazing or feeding on the levee, unauthorized vehicular traffic, chemical or insect problems, or burning during inappropriate seasons.	
2. Unwanted Vegetation Growth	☐				**A** The levee has a good grass cover with little or no unwanted vegetation (trees, bushes, or undesirable weeds) and has been recently mowed. Except in those cases where a vegetation variance has been granted by the Corps, a 5 meter (15') zone, free from all woody vegetation, is maintained adjacent to the landward/ riverside toe of the FCW for maintenance and flood-fighting activities. Additionally, a 1 meter (3') root free zone is maintained to protect the external limits of the levee cross section. Reference EM 1110-2-301 and/or local Corps policy.	
		☐			**M** Minimal number of trees (5 cm (2") diameter or smaller) and/or brush present on the levee or within the 5 meter (15') zone, that will not threaten the integrity of the project but which need to be removed.	
			☐		**U** Tree, weed, and brush cover exists in the FCW requiring removal to reestablish or ascertain FCW integrity. (NOTE: If significant growth on levees exists, prohibiting the inspection of animal burrows or other inspection items, then the levee inspection should be ended until this item is corrected.)	
3. Depressions/ Rutting	☐				**A** There are no ruts, pot holes, or other depressions on the levee, except for minor depressions caused by levee settlement. The levee crown, embankments, and access road crowns are well established and drain properly without any ponded water.	
		☐			**M** Some minor depressions in the levee crown, embankment, or access roads that will not pond water and do not threaten the integrity of the levee.	
			☐		**U** There are depressions greater than 15 cm (6 inches) deep that will pond water, endangering the integrity of the levee.	
4. Erosion/ Bank Caving	☐				**A** No active erosion or bank caving observed on the landward or on the riverward side of the levee.	
		☐			**M** There are areas where active erosion is occurring or has occurred on or near the levee embankment, but levee integrity is not threatened.	
			☐		**U** Erosion or caving is occurring or has occurred that threatens the stability and integrity of the levee. The erosion or caving has progressed into the levee section or into the extended footprint of the levee foundation and has compromised the levee foundation stability.	

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Levees - Continued on Next Page

Levees (continued)

For use during all Initial and Continuing Eligibility Inspections of levees

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
5. Slope Stability	☐	▨	▨	▨	**A** No slides present.	
	▨	☐	▨	▨	**M** Minor superficial sliding that with deferred repairs will not pose an immediate threat to FCW integrity.	
	▨	▨	☐	▨	**U** Evidence of deep seated sliding that threatens FCW integrity. Repairs are required to reestablish FCW integrity.	
6. Cracking	☐	▨	▨	▨	**A** No cracking observed on the levee greater than 15 cm (6 inches) deep.	
	▨	☐	▨	▨	**M** Longitudinal and/or transverse cracking greater than 15 cm (6 inches) deep. No evidence of vertical movement along the crack.	
	▨	▨	☐	▨	**U** Longitudinal and/or transverse cracking present and exhibits signs of vertical movement.	
7. Animal Control	☐	▨	▨	▨	**A** Continuous animal burrow control program in place that includes the elimination of active burrowing and the filling in of existing burrows.	
	▨	☐	▨	▨	**M** The existing animal burrow control program needs to be improved. Several animal burrows present which may lead to seepage or slope stability problems, and they require immediate attention.	
	▨	▨	☐	▨	**U** Animal burrow control program is not effective or is nonexistent. Significant maintenance is required to fill existing burrows, and the levee will not provide reliable flood protection until this maintenance is complete.	
8. Encroachments	☐	▨	▨	▨	**A** No trash, debris, excavations, structures, or other obstructions present within the project easement area. Encroachments which do not diminish proper functioning of the project have been previously approved by the Corps.	
	▨	☐	▨	▨	**M** Trash, debris, excavations, structures, or other obstructions present, or inappropriate activities that will not inhibit project operations and maintenance or emergency operations. Encroachments have not been approved by the Corps.	
	▨	▨	☐	▨	**U** Trash, debris, excavation, structures, or other obstructions present, or inappropriate activities that will inhibit project operations and maintenance or emergency operations.	
9. Riprap Revetments & Banks	☐	▨	▨	▨	**A** Existing riprap protection is properly maintained and is undamaged. Riprap clearly visible.	
	▨	☐	▨	▨	**M** No riprap displacement or scouring activity that could undercut banks, erode embankments, or restrict desired flow. Unwanted vegetation must be cleared and sprayed with an appropriate herbicide.	
	▨	▨	☐	▨	**U** Dense brush, trees, or grasses hide the rock protection, or meandering and/or scour activity is undercutting banks, eroding embankments, or impairing channel flows by causing turbulence or shoaling.	
	▨	▨	▨	☐	**N/A** There is no riprap protecting the levee.	

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Levees - Continued on Next Page

Levees (continued)

For use during all Initial and Continuing Eligibility Inspections of levees

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
10. Closure Structures (Stop Log, Earthen Closures, or Gates) (A or U only)		▨	▨	▨	**A** Closure structure in good repair. Placing equipment, stoplogs, and other materials are readily available at all times. Components of closure clearly marked and installation instructions / procedures readily available.	
	▨	▨		▨	**U** Closure structure in poor condition. Parts missing or corroded. Placing equipment may not be available within normal warning time.	
	▨	▨	▨		**N/A** There are no closure structures along the levee.	
11. Underseepage Relief Wells/ Toe Drainage Systems		▨	▨	▨	**A** Toe drainage systems and pressure relief wells necessary for maintaining FCW stability during flood events functioned properly during the last flood event and no sediment is observed in horizontal system (if applicable). Nothing is observed which would indicate that the system won't function properly during the next flood.	
	▨		▨	▨	**M** Toe drainage systems or pressure relief wells are damaged and may become clogged if they are not repaired.	
	▨	▨		▨	**U** Toe drainage systems or pressure relief wells necessary for maintaining FCW stability during flood events have fallen into disrepair or have become clogged.	
	▨	▨	▨		**N/A** There are no relief wells/ toe drainage systems along the levee.	

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Additional issues noted during the inspection:

Concrete Floodwalls

For use during all Initial and Continuing Eligibility Inspections of concrete floodwalls

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Concrete Surfaces		▨	▨	▨	**A** Negligible spalling, scaling or cracking. If the concrete surface is weathered, rough to the touch, or holds moisture, it is still satisfactory but should be seal coated to prevent freeze/ thaw damage.	
	▨		▨	▨	**M** Spalling, scaling, and open cracking present, but the immediate integrity or performance of the structure is not threatened. Reinforcing steel may be exposed. Repairs/ sealing is necessary to prevent additional damage during periods of thawing and freezing.	
	▨	▨		▨	**U** Surface deterioration or deep, controlled cracks present that result in an unreliable structure.	
2. Tilting, Sliding or Settlement of Concrete and Sheet Pile Structures		▨	▨	▨	**A** There are no significant areas of tilting, sliding, or settlement that would endanger the integrity of the project.	
	▨		▨	▨	**M** There are areas of tilting, sliding, or settlement (either active or inactive) that need to be repaired. The integrity of the structure is not in danger.	
	▨	▨		▨	**U** There are areas of tilting, sliding, or settlement (either active or inactive) that threaten the structure's integrity and performance.	
3. Foundation of Concrete and Sheet Pile Structures		▨	▨	▨	**A** No scouring / erosion, or undermining near the structure.	
	▨		▨	▨	**M** Scouring / erosion near the footing of the structure but not close enough to affect structure stability during the next flood.	
	▨	▨		▨	**U** Scouring or undermining at the foundation that has affected structural integrity.	
4. Monolith Joints		▨	▨	▨	**A** The monolith joint material is in good condition.	
	▨		▨	▨	**M** The monolith joint material is deteriorating and needs to be repaired or replaced to prevent spalling and cracking during freeze/ thaw cycles.	
	▨	▨		▨	**U** The monolith joint material is severely deteriorated and the concrete has spalled and cracked, damaging the waterstop to the point where it will not provide the intended level of protection during a flood.	
	▨	▨	▨		**N/A** There are no monolith joints in the floodwall.	
5. Erosion/ Bank Caving		▨	▨	▨	**A** No active erosion or bank caving on the riverward side of the floodwall which might endanger its stability.	
	▨		▨	▨	**M** There are areas where the ground is eroding towards the base of the floodwall and efforts need to be taken to slow and repair this erosion, but the erosion has not yet progressed to the point that the floodwall will loose stability during a flood event.	
	▨	▨		▨	**U** Erosion or bank caving is occurring or has occurred riverward of the levee which threatens the stability of the floodwall.	

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Concrete Floodwalls- Continued on the next page

Concrete Floodwalls (continued)

For use during all Initial and Continuing Eligibility Inspections of concrete floodwalls

RATED ITEM	A	M	U	N/A		EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
6. Unwanted Vegetation Growth		▨	▨	▨	**A**	A grass-only zone is maintained on both sides the floodwall. All trees, brush, and unwanted vegetation have been removed from this zone for maintenance, flood-fighting activities, and to protect the floodwall. The grass-only zone extends from the concrete wall to a point 2.5 meters (8') beyond the underground toe and heel of the floodwall. Reference EM 1110-2-30 and/or local Corps policy.	
	▨		▨	▨	**M**	There are some areas where unwanted vegetation is growing near the floodwall. This vegetation must be removed, but does not currently threaten the integrity of the project.	
	▨	▨		▨	**U**	There is a significant amount of tree, weed, or brush growth near the floodwall, which may limit access during flood fight operations or the roots of which may offer accelerated seepage paths under the structure.	
7. Encroachments		▨	▨	▨	**A**	No trash, debris, excavations, structures, or other obstructions present within the project easement area. Encroachments which do not diminish proper functioning of the project have been previously approved by the Corps.	
	▨		▨	▨	**M**	Trash, debris, excavations, structures, or other obstructions present, or inappropriate activities that will not inhibit project operations and maintenance or emergency operations. Encroachments have not been approved by the Corps.	
	▨	▨		▨	**U**	Trash, debris, excavation, structures, or other obstructions present, or inappropriate activities that will inhibit project operations and maintenance or emergency operations.	
8. Closure Structures (Stop Log Closures and Gates) (A or U only)		▨	▨	▨	**A**	Closure structure in good repair. Placing equipment, stoplogs, and other materials are readily available at all times. Components of closure clearly marked and installation instructions / procedures readily available.	
	▨	▨		▨	**U**	Closure structure in poor condition. Parts missing or corroded. Placing equipment may not be available within normal warning time.	
	▨	▨	▨		**N/A**	There are no closure structures along the floodwall.	
9. Underseepage Relief Wells/ Toe Drainage Systems		▨	▨	▨	**A**	Toe drainage systems and pressure relief wells necessary for maintaining FCW stability during flood events functioned properly during the last flood event and no sediment is observed in horizontal system (if applicable). Nothing is observed which would indicate that the system won't function properly during the next flood.	
	▨		▨	▨	**M**	Toe drainage systems or pressure relief wells are damaged and may become clogged if they are not repaired.	
	▨	▨		▨	**U**	Toe drainage systems or pressure relief wells necessary for maintaining FCW stability during flood events have fallen into disrepair or have become clogged.	
	▨	▨	▨		**N/A**	There are no relief wells/ toe drainage systems along the floodwall.	

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Additional issues noted during the inspection:

Interior Drainage System

For use during all Initial and Continuing Eligibility Inspections of systems carrying interior drainage through the FCW

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Vegetation and Obstructions	☐	▨	▨	▨	**A** Minimal, scattered obstructions or vegetation. The flow is not impeded.	
	▨	☐	▨	▨	**M** Log jams, snags, vegetation growth (such as cat tails, bull rushes, bushes, or saplings), or other obstructions block approximately 25% of the FCW.	
	▨	▨	☐	▨	**U** Log jams, snags, vegetation growth (such as cat tails, bull rushes, bushes, or saplings), or other obstructions block approximately 50% of the FCW.	
2. Encroachments	☐	▨	▨	▨	**A** No trash, debris, excavations, structures, or other obstructions present within the project easement area. Encroachments which do not diminish proper functioning of the project have been previously approved by the Corps.	
	▨	☐	▨	▨	**M** Trash, debris, excavations, structures, or other obstructions present, or inappropriate activities that will not inhibit project operations and maintenance or emergency operations. Encroachments have not been approved by the Corps.	
	▨	▨	☐	▨	**U** Trash, debris, excavation, structures, or other obstructions present, or inappropriate activities that will inhibit project operations and maintenance or emergency operations.	
3. Riprap Revetments of Inlet/ Discharge Areas	☐	▨	▨	▨	**A** Existing riprap protection is properly maintained and is undamaged. Riprap clearly visible.	
	▨	☐	▨	▨	**M** No riprap displacement or scouring activity that could undercut banks, erode embankments, or restrict desired flow. Unwanted vegetation must be cleared and sprayed with an appropriate herbicide.	
	▨	▨	☐	▨	**U** Dense brush, trees, or grasses hide the rock protection, or meandering and/or scour activity is undercutting banks, eroding embankments, or impairing channel flows by causing turbulence or shoaling.	
	▨	▨	▨	☐	**N/A** There is no riprap protecting the interior drainage system, or the riprap is discussed in another section.	
4. Erosion of Inlet/ Discharge Areas	☐	▨	▨	▨	**A** No active erosion or bank caving observed on the landward or on the riverward side of the levee.	
	▨	☐	▨	▨	**M** There are areas where active erosion is occurring or has occurred on or near the levee embankment, but levee integrity is not threatened.	
	▨	▨	☐	▨	**U** Erosion or caving is occurring or has occurred that threatens the stability and integrity of the levee. The erosion or caving has progressed into the levee section or into the extended footprint of the levee foundation and has compromised the levee foundation stability.	
	▨	▨	▨	☐	**N/A** There are no inlet/discharge areas.	

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Interior Drainage - Continued on Next Page

Interior Drainage System (continued)

For use during all Initial and Continuing Eligibility Inspections of systems carrying interior drainage through the FCW

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
5. Blockage of Culverts (Inlets, Sump, and Discharge Areas)	☐	▨	▨	▨	**A** There is little or no debris, sediment, or vegetation blocking the culverts, inlets, sump, or discharge areas. The channel capacity for designed flow is not affected.	
	▨	☐	▨	▨	**M** Debris, sediment, or vegetation blocks less than 10 percent of the culvert opening, but must be removed.	
	▨	▨	☐	▨	**U** Accumulated debris, sediment, or vegetation blocks more than 10 percent of the culvert opening, impairing the culvert's capacity and hydraulic effectiveness.	
	▨	▨	▨	☐	**N/A** There are no culverts.	
6. Culverts	☐	▨	▨	▨	**A** There are no breaks, holes, cracks in the culvert that would result in significant water leakage. Corrugated metal pipes, if present, are in good condition or have been relined with appropriate material, which is still in good condition.	
	▨	☐	▨	▨	**M** There are breaks, holes, cracks in the culvert that would result in water leakage and need to be repaired, but do not threaten the integrity of the project. Corrugated metal pipes, if present, are showing deterioration but the entire length of pipe is still structurally sound and is not in danger of collapsing.	
	▨	▨	☐	▨	**U** Culvert has deterioration and/or has significant leakage such that it threatens the integrity of the FCW. Corrugated metal pipes are in danger of collapsing or have already begun to collapse.	
	▨	▨	▨	☐	**N/A** There are no culverts.	
8. Trash Racks (non-mechanical)	☐	▨	▨	▨	**A** Trash racks are fastened in place and properly maintained.	
	▨	☐	▨	▨	**M** Trash racks are in place but are unfastened or have bent bars that allow debris to enter into the pipe or pump station. Repair or replacement is required.	
	▨	▨	☐	▨	**U** Trash rack is missing or damaged to the extent that it is no longer functional and must be replaced.	
	▨	▨	▨	☐	**N/A** There are no trash racks.	
9. Flap Gates/Flap Valves/ Pinch Valves RODI	☐	▨	▨	▨	**A** Flap gates open and close easily with minimal leakage. Gates show no corrosion damage and have been maintained.	
	▨	☐	▨	▨	**M** Gate will not fully open or close because of obstructions that can be easily removed, or has corrosion damage that requires maintenance.	
	▨	▨	☐	▨	**U** Gate is missing, has been damaged, or has deteriorated and needs repair.	
	▨	▨	▨	☐	**N/A** There are no flap gates.	

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Interior Drainage - Continued on Next Page

Interior Drainage System (continued)

For use during all Initial and Continuing Eligibility Inspections of systems carrying interior drainage through the FCW

RATED ITEM	A	M	U	N/A	EVALUATION		LOCATIONS/ REMARKS / RECOMMENDATIONS
10. Sluice / Slide Gates RODI	☐	▨	▨	▨	**A**	Gates open and close freely with minor leakage. Sill is free of sediment and other obstructions. Gates and lifters have been maintained.	
	▨	☐	▨	▨	**M**	Gates have been damaged or have deteriorated, and open and close with resistance or binding. Leakage quantity is controllable and is not a threat to project performance. Maintenance is required.	
	▨	▨	☐	▨	**U**	Gates do not open or close. Gate, stem, lifter and/or guides may be damaged or corroded.	
	▨	▨	▨	☐	**N/A**	There are no sluice/ slide gates.	
11. Electric Gate Operators for Sluice / Slide Gates RODI	☐	▨	▨	▨	**A**	All electric gate operators are in good working condition and are adequately powered, and are capable of opening and closing the gate properly. Preventative maintenance is being performed and the system is tested periodically.	
	▨	☐	▨	▨	**M**	All electric gate operators are operational with minor deficiencies, but should perform through the next period of usage.	
	▨	▨	☐	▨	**U**	The electric gate operators are not operational, or the power source is not considered reliable to sustain operations during flood conditions.	
	▨	▨	▨	☐	**N/A**	There are no electric gate operators.	
12. Manual Operators (Backups) for Sluice / Slide Gates RODI	☐	▨	▨	▨	**A**	All manual gate operators are in good working condition and are capable of opening and closing the gate properly. Preventative maintenance is being performed and the system is tested periodically.	
	▨	☐	▨	▨	**M**	Manual gate operators are operational with minor deficiencies, but should perform through the next period of usage.	
	▨	▨	☐	▨	**U**	Manual gate operators are not operational.	
	▨	▨	▨	☐	**N/A**	If there are sluice or slide gates, there needs to be means of operating them manually. If there are no sluice/slide gates, this item is N/A.	
13. Concrete Surfaces (Such as gate wells, outfalls, intakes, or culverts)	☐	▨	▨	▨	**A**	Negligible spalling, scaling or cracking. If the concrete surface is weathered, rough to the touch, or holds moisture, it is still satisfactory but should be seal coated to prevent freeze/ thaw damage.	
	▨	☐	▨	▨	**M**	Spalling, scaling, and open cracking present, but the immediate integrity or performance of the structure is not threatened. Reinforcing steel may be exposed. Repairs/ sealing is necessary to prevent additional damage during periods of thawing and freezing.	
	▨	▨	☐	▨	**U**	Surface deterioration or deep, controlled cracks present that result in an unreliable structure.	
	▨	▨	▨	☐	**N/A**	There are no concrete surfaces.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Interior Drainage - Continued on Next Page

Interior Drainage System (continued)

For use during all Initial and Continuing Eligibility Inspections of systems carrying interior drainage through the FCW

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
14. Tilting, Sliding or Settlement of Concrete and Sheet Pile Structures (Such as gate wells, outfalls, intakes, or culverts)	☐	▨	▨	▨	**A** There are no significant areas of tilting, sliding, or settlement that would endanger the integrity of the project.	
	▨	☐	▨	▨	**M** There are areas of tilting, sliding, or settlement (either active or inactive) that need to be repaired. The integrity of the structure is not in danger.	
	▨	▨	☐	▨	**U** There are areas of tilting, sliding, or settlement (either active or inactive) that threaten the structure's integrity and performance.	
	▨	▨	▨	☐	**N/A** There are no concrete structures.	
15. Foundation of Concrete Structures (Such as gate wells, outfalls, or culverts)	☐	▨	▨	▨	**A** No scouring / erosion, or undermining near the structure.	
	▨	☐	▨	▨	**M** Scouring / erosion near the footing of the structure but not close enough to affect structure stability during the next flood.	
	▨	▨	☐	▨	**U** Scouring or undermining at the foundation that has affected structural integrity.	
	▨	▨	▨	☐	**N/A** There are no concrete structures.	
16. Safety Fencing RODI	☐	▨	▨	▨	**A** Safety/ security fencing is in good condition and provides protection against falling or unauthorized access. Gates open and close freely, locks are in place, and there is little corrosion on metal parts.	
	▨	☐	▨	▨	**M** Safety/ security fencing or gates are damaged or corroded but appear to be maintainable. Locks may be missing or damaged.	
	▨	▨	☐	▨	**U** Safety/ security fencing and gates are damaged or corroded to the point that replacement is required, or potentially dangerous project features are not secured.	
	▨	▨	▨	☐	**N/A** There are no features of the internal drainage system that require safety fencing.	
17. Other Metallic Items	☐	▨	▨	▨	**A** All metal parts are protected from corrosion damage, and show no rust, damage, or deterioration that would cause a safety concern.	
	▨	☐	▨	▨	**M** Corrosion seen on metallic parts appear to be maintainable.	
	▨	▨	☐	▨	**U** Metallic parts are severely corroded and require replacement to prevent failure, equipment damage, or safety issues.	
	▨	▨	▨	☐	**N/A** There are no other significant metallic items associated with the interior drainage system.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Additional issues noted during the inspection:

Pump Stations

For use during all Initial and Continuing Eligibility Inspections of pump stations

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Pump Stations Operating Log (A or U only)		▨	▨	▨	**A** Operation and maintenance log is present at the pump station and is being used and updated, and personnel have been trained in pump station operations. Names and last training date shown in the log book.	
	▨	▨		▨	**U** No operating log present, or refresher training for personnel has not been conducted.	
2. Pump Station Operations and Maintenance Manual (A or U only)		▨	▨	▨	**A** Operation and Maintenance Manual and/or posted operating instructions are present and adequately cover all pertinent pump station features.	
	▨	▨		▨	**U** Operation and Maintenance Manual missing or sponsor is unsure of location.	
3. Plant Building		▨	▨	▨	**A** The building is in good structural condition, with no major cracks in concrete or brick. The roof is not leaking, exhaust fans are operational, there are no exposed electrical components, and the working environment is safe.	
	▨		▨	▨	**M** There is significant cracking in the building structure, or the building is damaged in other ways such that it needs repair but does not threaten pumping operations.	
	▨	▨		▨	**U** The structural integrity or stability of the building is threatened, or there is other damage to the building such a that pumping operations can not be performed as intended.	
4. Communications (A or U only)		▨	▨	▨	**A** A telephone, cellular phone, two-way radio, or similar device is available to pump station operator and maintenance personnel.	
	▨	▨		▨	**U** A telephone, cellular phone, two-way radio, or similar device is <u>not</u> available to pump station operator and maintenance personnel.	
5. Safety (A or U only)		▨	▨	▨	**A** Exhaust fans, vents/louvers are working properly. Fuel storage / distribution meets state / local requirements. Fire extinguishers of sufficient quality, quantity, and type are on hand and are properly charged. Safety hardware (hand rails, grates for wet-wells, etc) is installed. Required safety items used (hearing, eyes, etc).	
	▨	▨		▨	**U** Safety issues exist that could cause injury or loss of life.	
6. Safety Fencing RODI		▨	▨	▨	**A** Safety/ security fencing is in good condition and provides protection against falling or unauthorized access. Gates open and close freely, locks are in place, and there is little corrosion on metal parts.	
	▨		▨	▨	**M** Safety/ security fencing or gates are damaged or corroded but appear to be maintainable. Locks may be missing or damaged.	
	▨	▨		▨	**U** Safety/ security fencing and gates are damaged or corroded to the point that replacement is required, or potentially dangerous project features are not secured.	
	▨	▨	▨		**N/A** There are no features in or around the pump stations that require safety fencing.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Pump Stations - Continued on Next Page

Pump Stations (continued)

For use during all Initial and Continuing Eligibility Inspections of pump stations

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
7. Cranes RODI	☐				**A** Crane operational, and have been inspected and load tested in accordance with OSHA requirements.	
		☐			**M** Crane has not been inspected or operationally tested with the past year, or there are visible signs of corrosion, oil leakage, etc, requiring maintenance.	
			☐		**U** Crane not operational, or tagged out of service.	
				☐	**N/A** There are no cranes.	
8. Pumps	☐				**A** All pumps are properly maintained and lubricated. Systems are periodically tested, and there is no evidence of cavitation, vibrations, or unusual sounds.	
		☐			**M** Minor deficiencies exist which need to be closely monitored or repaired, such as the presence of minor vibrations or the corrosion of the pump shaft housing. However, the pumps are operational and are expected to perform through the next period of usage.	
			☐		**U** One or more of the pumps are not operational, or the pump capacity has degraded to the point where project performance is in question.	
9. Power (A or U only)	☐				**A** The power source is adequate, safe, and reliable. Backup generators are on hand or there is a reliable backup power plan in place. Backup units are properly sized, operational, periodically exercised, and properly maintained.	
			☐		**U** Power source not considered safe or reliable to sustain operations during flood conditions.	
10. Insulation Megger Testing	☐				**A** Results of megger tests show that the insulation meets manufacturer's or industry standards. Tested within the last 2 years.	
		☐			**M** Results of megger test show that insulation resistance is lower than manufacturer's or industry standard, but can be corrected with proper application of heat, or megger testing not conducted with the last 2 years.	
			☐		**U** Megger tests not conducted within past three years or indicate that insulation resistance is low enough that the equipment will not be able to meet design standards of operation; or evidence of arching or shorting is detected visually.	
11. Motors, Engines, Fans and Gear Reducers	☐				**A** All items are operational. Preventative maintenance and lubrication is being performed and the system is periodically subjected to performance testing. Instrumentation, alarms, and auto shutdowns are operational.	
		☐			**M** Systems have minor deficiencies, but are operational and will function adequately through the next flood.	
			☐		**U** One or more of the primary motors or systems is not operational.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Pump Stations - Continued on Next Page

Pump Stations (continued)

For use during all Initial and Continuing Eligibility Inspections of pump stations

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
12. Pump Control Systems	☐				**A** Operational and maintained free of damage, corrosion, or other debris.	
		☐			**M** Operational with minor discrepancies. Will function adequately during the next flood event.	
			☐		**U** Pump controls not operational. May not function adequately during the next flood event.	
13. Sumps / Wet well	☐				**A** Clear of excessive debris, sediment, or other obstructions. Procedures are in place to remove debris accumulation during operation.	
		☐			**M** Debris, sediment, or other obstructions are present and must be removed, but the sump/ wet well will function as intended during the next flood. Procedures are in place to remove debris accumulation during operation.	
			☐		**U** Large debris or excessive silt present which will hinder or damage pumps during operation, or no procedures have been established to remove debris accumulation during operation.	
14. Trash Rakes (Mechanical Operations) RODI	☐				**A** Drive chain, bearing, gear reducers, and other components are in good operating condition and are being properly maintained.	
		☐			**M** The trash rake is in need of maintenance, but is still operational.	
			☐		**U** Trash rake not operational or deficiencies will inhibit operations during the next flood event.	
				☐	**N/A** There are no mechanical trash rakes.	
15. Trash Racks (non-mechanical)	☐				**A** Trash racks are fastened in place and properly maintained.	
		☐			**M** Trash racks are in place but are unfastened or have bent bars that allow debris to enter into the pipe or pump station. Repair or replacement is required.	
			☐		**U** Trash rack is missing or damaged to the extent that it is no longer functional and must be replaced.	
				☐	**N/A** There are no non-mechanical trash rakes.	
16. Sluice / Slide Gates RODI	☐				**A** Gates open and close freely with minor leakage. Sill is free of sediment and other obstructions. Gates and lifters have been maintained.	
		☐			**M** Gates have been damaged or have deteriorated, and open and close with resistance or binding. Leakage quantity is controllable and is not a threat to project performance. Maintenance is required.	
			☐		**U** Gates do not open or close. Gate, stem, lifter and/or guides may be damaged or corroded.	
				☐	**N/A** There are no sluice/slide gates.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Pump Stations - Continued on Next Page

Pump Stations (continued)

For use during all Initial and Continuing Eligibility Inspections of pump stations

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
17. Electric Gate Operators for Sluice / Slide Gates (Intake/ Discharge) RODI	☐	▨	▨	▨	**A** All electric gate operators are in good working condition and are adequately powered, and are capable of opening and closing the gate properly. Preventative maintenance is being performed and the system is tested periodically.	
	▨	☐	▨	▨	**M** All electric gate operators are operational with minor deficiencies, but should perform through the next period of usage.	
	▨	▨	☐	▨	**U** The electric gate operators are not operational, or the power source is not considered reliable to sustain operations during flood conditions.	
	▨	▨	▨	☐	**N/A** There are no electric gate operators.	
18. Manual Operators (Backups) for Sluice / Slide Gates RODI	☐	▨	▨	▨	**A** All manual gate operators are in good working condition and are capable of opening and closing the gate properly. Preventative maintenance is being performed and the system is tested periodically.	
	▨	☐	▨	▨	**M** Manual gate operators are operational with minor deficiencies, but should perform through the next period of usage.	
	▨	▨	☐	▨	**U** Manual gate operators are not operational.	
	▨	▨	▨	☐	**N/A** If there are sluice or slide gates, there needs to be means of operating them manually. If there are no sluice/slide gates, this item is N/A.	
19. Other Metallic Items (Equipment, Ladders, Platform Anchors, etc)	☐	▨	▨	▨	**A** All metal parts are protected from corrosion damage, and show no rust, damage, or deterioration that would cause a safety concern.	
	▨	☐	▨	▨	**M** Corrosion seen on metallic parts appear to be maintainable.	
	▨	▨	☐	▨	**U** Metallic parts are severely corroded and require replacement to prevent failure, equipment damage, or safety issues.	
	▨	▨	▨	☐	**N/A** There are no other significant metallic items associated with the pump stations.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Additional issues noted during the inspection:

Earthen (Excavated) Flood Control Channels

For use during all Initial and Continuing Eligibility Inspections of excavated flood control channels

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Vegetation and Obstructions	☐				**A** There are minimal obstructions or vegetation blocking the FCW.	
		☐			**M** The channel is obstructed by minor log jams, snags, or vegetation. Less than 20% of the channel is obstructed.	
			☐		**U** Obstructions or vegetation growth have obstructed over 20% of the river or channel.	
2. Shoaling	☐				**A** No shoaling present.	
		☐			**M** Non-aquatic grasses present on shoal. No trees or brush is present on shoal, and channel flow is not impeded.	
			☐		**U** Shoaling is well established, stabilized by trees, brush, or other vegetation. Shoals are diverting flow to channel bank causing bank erosion and undercutting.	
3. Encroachments	☐				**A** No trash, debris, excavations, structures, or other obstructions present within the project easement area. Encroachments which do not diminish proper functioning of the project have been previously approved by the Corps.	
		☐			**M** Trash, debris, excavations, structures, or other obstructions present, or inappropriate activities that will not inhibit project operations and maintenance or emergency operations. Encroachments have not been approved by the Corps.	
			☐		**U** Trash, debris, excavation, structures, or other obstructions present, or inappropriate activities that will inhibit project operations and maintenance or emergency operations.	
4. Riprap Revetments & Banks	☐				**A** Existing riprap protection is properly maintained and is undamaged. Riprap clearly visible.	
		☐			**M** No riprap displacement or scouring activity that could undercut banks, erode embankments, or restrict desired flow. Unwanted vegetation must be cleared and sprayed with an appropriate herbicide.	
			☐		**U** Dense brush, trees, or grasses hide the rock protection, or meandering and/or scour activity is undercutting banks, eroding embankments, or impairing channel flows by causing turbulence or shoaling.	
				☐	**N/A** There is no riprap protecting the channel.	
5. Erosion	☐				**A** No head cutting or horizontal deviation observed.	
		☐			**M** Head cutting and horizontal deviation evident, but is less than 30 cm (1 foot) from the designed grade or cross section.	
			☐		**U** Apparent head cutting and horizontal deviation of more than 30 cm (1 foot) from the designed grade or cross section. Corrective actions required to stop or slow erosion.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Earthen Flood Control Channels - Continued on Next Page

Earthen (Excavated) Flood Control Channels (continued)

For use during all Initial and Continuing Eligibility Inspections of excavated flood control channels

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
6. Concrete Surfaces	☐				**A** Negligible spalling, scaling or cracking. If the concrete surface is weathered, rough to the touch, or holds moisture, it is still satisfactory but should be seal coated to prevent freeze/ thaw damage.	
		☐			**M** Spalling, scaling, and open cracking present, but the immediate integrity or performance of the structure is not threatened. Reinforcing steel may be exposed. Repairs/ sealing is necessary to prevent additional damage during periods of thawing and freezing.	
			☐		**U** Surface deterioration or deep, controlled cracks present that result in an unreliable structure.	
				☐	**N/A** There are no concrete structures associated with the flood control channel.	
7. Tilting, Sliding or Settlement of Concrete Structures	☐				**A** There are no significant areas of tilting, sliding, or settlement that would endanger the integrity of the project.	
		☐			**M** There are areas of tilting, sliding, or settlement (either active or inactive) that need to be repaired. The integrity of the structure is not in danger.	
			☐		**U** There are areas of tilting, sliding, or settlement (either active or inactive) that threaten the structure's integrity and performance.	
				☐	**N/A** There are no concrete structures associated with the flood control channel.	
8. Foundation of Concrete Structures	☐				**A** No scouring / erosion, or undermining near the structure.	
		☐			**M** Scouring / erosion near the footing of the structure but not close enough to affect structure stability during the next flood.	
			☐		**U** Scouring or undermining at the foundation that has affected structural integrity.	
				☐	**N/A** There are no concrete structures associated with the flood control channel.	
9. Flap Gates/Flap Valves/ Pinch Valves RODI	☐				**A** Flap gates open and close easily with minimal leakage. Gates show no corrosion damage and have been maintained.	
		☐			**M** Gate will not fully open or close because of obstructions that can be easily removed, or has corrosion damage that requires maintenance.	
			☐		**U** Gate is missing, has been damaged, or has deteriorated and needs repair.	
				☐	**N/A** There are no flap gates.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Additional issues noted during the inspection:

Concrete Lined Flood Control Channels

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For use during all Initial and Continuing Eligibility Inspections of concrete lined flood control channels

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
1. Vegetation and Obstructions	☐	▨	▨	▨	**A** No obstructions, vegetation, debris, or sediment accumulation within the channel. Channel joints and weep holes are also free of grass and weeds.	
	▨	☐	▨	▨	**M** Sediment and debris present, but not to the degree that it supports vegetation. Obstructions/ debris have not impaired the channel flow capacity. Sediment and debris removal recommended.	
	▨	▨	☐	▨	**U** Sediment shoals are well established and support vegetation, or there are obstructions or accumulated debris that have impaired the channel flow capacity. Sediment and debris removal required to re-establish flow capacity.	
2. Shoaling	☐	▨	▨	▨	**A** No shoaling present.	
	▨	☐	▨	▨	**M** Non-aquatic grasses present on shoal. No trees or brush is present on shoal, and channel flow is not impeded.	
	▨	▨	☐	▨	**U** Shoaling is well established, stabilized by saplings, brush, or other vegetation. Shoals are diverting flow to channel walls. Channel flow capacity is reduced and maintenance is required.	
3. Concrete Surfaces	☐	▨	▨	▨	**A** Negligible spalling, scaling or cracking. If the concrete surface is weathered, rough to the touch, or holds moisture, it is still satisfactory but should be seal coated to prevent freeze/ thaw damage.	
	▨	☐	▨	▨	**M** Spalling, scaling, and open cracking present, but the immediate integrity or performance of the structure is not threatened. Reinforcing steel may be exposed. Repairs/ sealing is necessary to prevent additional damage during periods of thawing and freezing.	
	▨	▨	☐	▨	**U** Surface deterioration or deep, controlled cracks present that result in an unreliable structure.	
4. Tilting, Sliding or Settlement of Concrete Structures	☐	▨	▨	▨	**A** There are no significant areas of tilting, sliding, or settlement that would endanger the integrity of the project.	
	▨	☐	▨	▨	**M** There are areas of tilting, sliding, or settlement (either active or inactive) that need to be repaired. The integrity of the structure is not in danger.	
	▨	▨	☐	▨	**U** There are areas of tilting, sliding, or settlement (either active or inactive) that threaten the structure's integrity and performance.	
5. Foundation of Concrete Structures	☐	▨	▨	▨	**A** No scouring / erosion, or undermining near the structure.	
	▨	☐	▨	▨	**M** Scouring / erosion near the footing of the structure but not close enough to affect structure stability during the next flood.	
	▨	▨	☐	▨	**U** Scouring or undermining at the foundation that has affected structural integrity.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Concrete Lined Channels - Continued on Next Page

Concrete Lined Flood Control Channels

For use during all Initial and Continuing Eligibility Inspections of concrete lined flood control channels

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS/ REMARKS / RECOMMENDATIONS
6. Monolith Joints	☐				**A** The monolith joint material is in good condition.	
		☐			**M** The monolith joint material is deteriorating and needs to be repaired or replaced to prevent spalling and cracking during freeze/ thaw cycles.	
			☐		**U** The monolith joint material is severely deteriorated and the concrete has spalled and cracked, damaging the waterstop to the point where it will not provide the intended level of protection during a flood.	
				☐	**N/A** There are no monolith joints.	
7. Flap Gates/Flap Valves/ Pinch Valves RODI	☐				**A** Flap gates open and close easily with minimal leakage. Gates show no corrosion damage and have been maintained.	
		☐			**M** Gate will not fully open or close because of obstructions that can be easily removed, or has corrosion damage that requires maintenance.	
			☐		**U** Gate is missing, has been damaged, or has deteriorated and needs repair.	
				☐	**N/A** There are no flap gates.	

Key: **A** = Acceptable. **M** = Minimally Acceptable; Maintenance is required. **U** = Unacceptable. **N/A** = Not Applicable. **RODI** = Requires Operation During Inspection

Additional issues noted during the inspection:

Instructions for the Inspection Guide

GENERAL INSTRUCTIONS.

1. The sections of this report labeled "Basic Eligibility" and "FCW Engineering" only need to be completed during Initial Eligibility Inspections.
2. Determination of Minimum Elevation for Levees and Floodwalls (#1 under FCW Engineering):
Depending on available data and local Corps policy, the minimum elevation required may be calculated using traditional methods, with the addition of 1 foot of freeboard in agricultural areas and 2 feet of freeboard in urban areas, or using annual exceedance probability, which numerically accounts for the natural variation and uncertainty when estimating discharge-probability and stage-discharge functions so that additional requirements for elevation are based on the level of risk in the data.
3. All other sections of this guide that correspond to project features in the Flood Control Work must be fully completed during every Continuing and Initial Eligibility Inspection.
4. RODI stands for "Requires Operation During Inspection". Items marked "RODI" will be rated based on the way they work during the inspection.
5. Additional areas for inspection will be incorporated by the inspector into this guide if the layout or physical characteristics of the project warrant this. Appropriate entries will be made in the REMARKS block.

RATINGS OF INDIVIDUAL ITEMS:

The following terms and definitions are used when determining the rating for each item and/or component in the flood control work.

A - Acceptable: The rated item is in satisfactory condition, with no deficiencies, and will function as designed and intended during the next flood event.
M - Minimally Acceptable: This rated item has minor deficiencies that need to be corrected. The minor deficiencies will not seriously impair the functioning of the item during the next flood event. The overall reliability of the project will be lowered because of the minor deficiency.
U - Unacceptable: The deficiencies are serious enough that the rated item will not adequately function during the next flood event, compromising the project's ability to provide reliable flood protection.

DETERMINATION OF OVERALL PROJECT CONDITION CODE:

The lowest single rating given for a rated item will determine the overall condition of the project:

1. If all items are rated as Acceptable, the overall project condition will be rated as Acceptable.
2. If one or more items are rated as Minimally Acceptable, the overall project condition will be rated Minimally Acceptable.
3. If one or more item is rated as Unacceptable, the overall project condition will be rated as Unacceptable.

PROJECT CONDITION AND ELIGIBILITY FOR PL84-99 ASSISTANCE:

1. Projects rated as Acceptable are considered **"Active"** and eligible for PL84-99 post flood or storm damage rehabilitation assistance from the U.S. Army Corps of Engineers.
2. Projects rated Minimally Acceptable are considered **"Active"** and eligible for PL84-99 rehabilitation assistance during the time that it takes to make needed corrections. This timeframe will be agreed upon between the project sponsor and Corps inspector at the time of the inspection (or shortly thereafter). If the project sponsor does not present the Corps with proof of completion of the repairs/maintenance by the end of this timeframe, then the project will be **"Inactive"** and will be ineligible for PL84-99 rehabilitation assistance.
3. Projects rated as Unacceptable are immediately put in an **"Inactive"** status and are not eligible for PL84-99 post flood or storm damage rehabilitation assistance from the Corps of Engineers. The project will remain in an inactive status until the project sponsor presents the Corps with proof that all of the required repairs/maintenance has been completed. (This includes any repairs/ maintenance required for project features rated minimally Acceptable, as well as those rated Unacceptable.)

APPENDIX D

EMERGENCY ACTION PLAN

UMATILLA COUNTY

Pendleton 2a Levee Setback

Emergency Action Plan

Prepared By:

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19803 North Creek Parkway
Bothell, WA 98011

February 2024

Contents

Figures

1. Emergency Action Plan Overview

The Pendleton 2a Levee is a U.S. Army Corps of Engineers (USACE) levee located along the Umatilla River near the town of Reith, Oregon. The Pendleton 2a Levee (System ID: 500500041) (USACE 2023) identified in the USACE National Levee Database was part of the Pendleton Zone 2 Flood Damage Reduction Project, which was a federally authorized and constructed, and non-federally operated and maintained levee system (USACE 2023). In 2024, the Pendleton 2a Levee was modified by setting a portion of the levee closer to Birch Creek Road to facilitate restoration of the Umatilla River and its disconnected floodplain. This setback project was identified by the USACE as request #FY19-NO46 and is referred to as the Pendleton 2a Levee Setback project. The Pendleton 2a Levee Setback is the focus area of this Emergency Action Plan (see Figures 1 and 2).

1.1 PURPOSE

The purpose of this plan is to reduce the risk of harm to human life and injury and to minimize property damage in the event of an actual or potential emergency associated with the Pendleton 2A Levee Setback. This document provides a general overview of the protocol and contact information in the event of an emergency. It is recommended that entities listed in 2.3.3 and the landowner within the protected area familiarize themselves with this plan and its protocols. Umatilla County is responsible for implementation, training, and maintenance of all response plans.

1.2 LEVEE LOCATION AND ACCESS

The Pendleton 2a Levee Setback is located near the Umatilla River and Birch Creek confluence in Umatilla County. It is upstream of the confluence, and on the south (river left) side of the Umatilla River. See Figure 1 below for a local vicinity map of the levee location. Access to the levee is located off Birch Creek Road.

Features wtihin the leveed area include Birch Creek Road, one private residence, several out-buildings, and a farm field. Topography is flat or gently sloping, with a hillslope to the southeast. Levee failure would generally include shallow inundation and property damage, with limited potential for loss of life, as indicated by inundation maps and local terrain and topography surrounding the levees. Flooding could result in damage to crops, one single family home, and several outbuildings. Slow rise flooding would be the most common scenario in inundated areas, giving time for notification and evacuation.

Figure 1. Location Map.

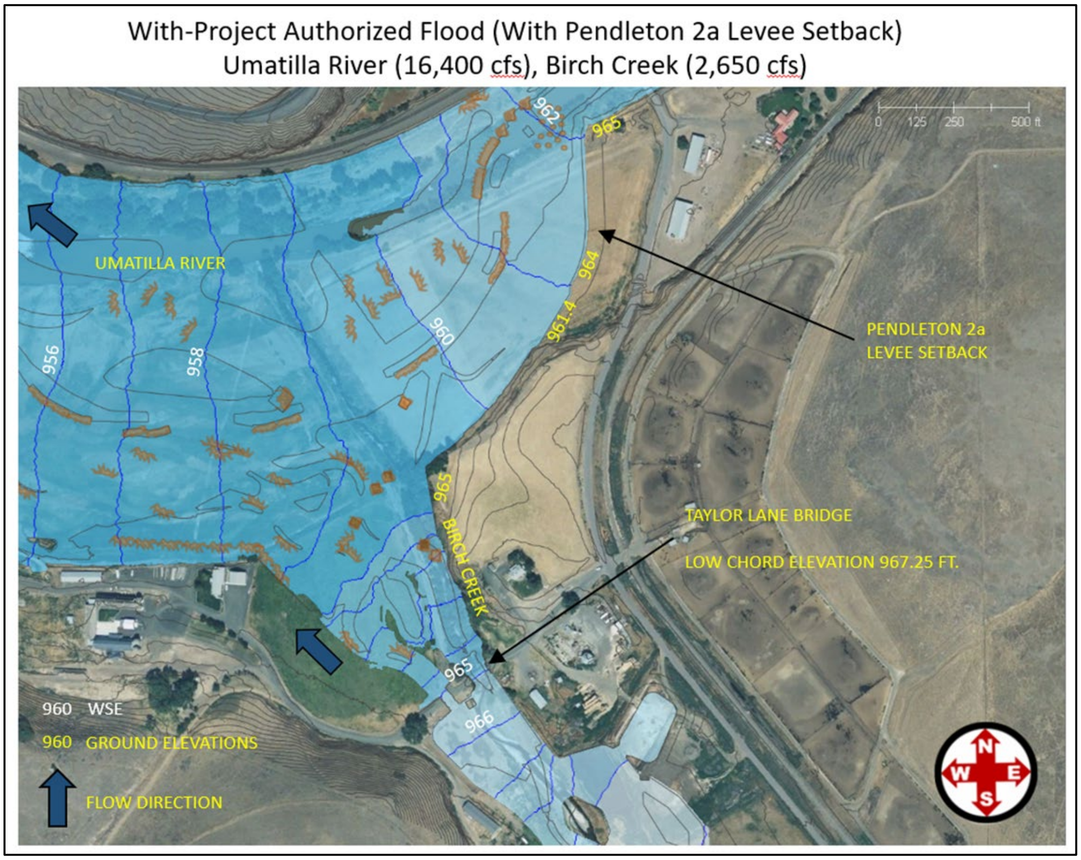
1.3 DESCRIPTION OF LEVEE

The Pendleton 2a Levee Setback is an approximately 650 feet long earthen levee that consists of the following:

- Levee embankment structural fill;
- Scour protection and riprap revetment;
- Interior Drainage overflow relief protection riprap;
- Two (2) 36-inch diameter culverts with anti-seepage filter material, doubled hinged flap gate and inlet/outlet protection riprap; and
- Erosion control seeding/vegetation.

1.4 INUNDATION MAPS

Figure 2 shows inundation of the Pendleton 2a Levee Setback during the authorized flood, based on hydraulic modeling. The authorized flood is the event to which the Pendleton 2a Levee Setback is designed to function. Response to flood events that exceed the authorized flood are described in Section 2.



With-Project Authorized Flood (With Pendleton 2a Levee Setback)
Umatilla River (16,400 cfs), Birch Creek (2,650 cfs)

Figure 2. Inundation Map Under Authorized Flood Conditions. This figure shows inundation on Birch Creek and downstream from the levee as a result of proposed habitat restoration.

2. Flood Response Process

2.1 MONITOR

2.1.1 Flood Source Monitoring

The National Weather Service (NWS) provides current river levels, forecasting, threshold levels, and exceedance probability for the Umatilla River at Pendleton, Oregon (NWS 2020).

(https://water.weather.gov/ahps2/hydrograph.php?wfo=pdt&gage=pdto3)

2.1.2 Levee System Monitoring

All flood control works (FCWs) must be properly maintained to provide the protection for which they were designed. Public sponsors are solely responsible for ensuring that the FCW is properly monitored and maintained. Even if sub-agreements with local landowners or other entities are in place for routine maintenance, the public sponsor is ultimately responsible for the operations and maintenance of the FCW. More information on levee monitoring and maintenance is included in the *Operations and Maintenance Manual* (Tetra Tech, 2024).

2.2 DETERMINE INCIDENT LEVEL

Incident level will be determined based on the National Weather Service thresholds for the Umatilla River flood stages. Each incident will be categorized into one of the following levels:

- Emergency Level 1: Unusual event or slowly developing situation
    - This classification indicates a situation is developing; however, the levee is not in danger of failing. Downstream residents need to be notified if flooding threatens life or property.
- Emergency Level 2: Potential failure
    - This classification indicates that a situation is developing that could cause the levee to fail. A reasonable amount of time is available for analysis before deciding on evacuation of residents. Emergency responders in affected areas shall be alerted that an unsafe situation is developing.
- Emergency Level 3: Imminent failure
    - This classification indicates levee failure is imminent or flooding threatens life and property. When it is determined that there is no longer time available

to implement corrective measures to prevent failure, an order for evacuation of residents in potential inundation areas shall be issued.

2.3 COMMUNICATE

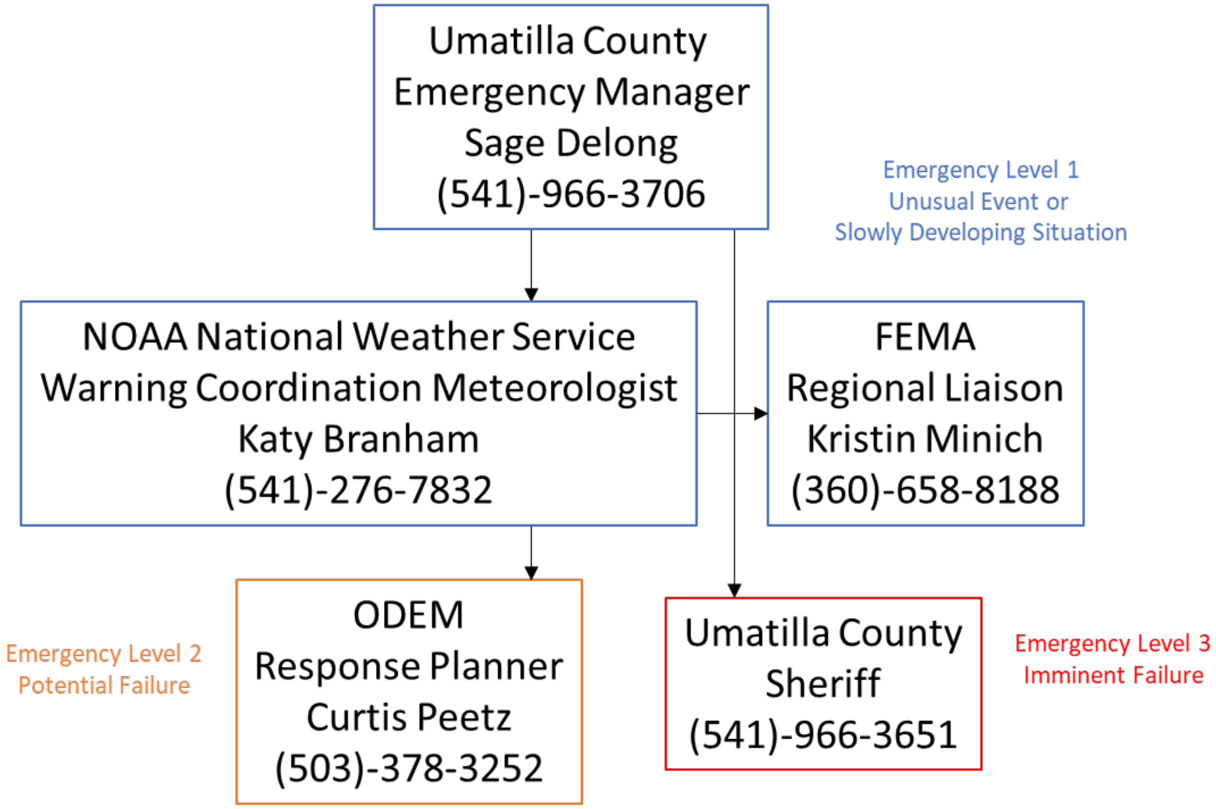
2.3.1 Communication Roles and Responsibilities

- Umatilla County Emergency Management (UCEM): UCEM coordinates with National Oceanic and Atmospheric Administration (NOAA) NWS when notices may be required to inform response agencies and the general public of potential flooding events.
    - Contact: Sage Delong, Emergency Manager
      sage.delong@umatillacounty.gov, (541)-966-3706
- National Weather Service (NOAA NWS): NOAA NWS is able to issue notices to response agencies and to the public via television, radio, internet and Weather Radios (formerly Tone Alert Radios) when the potential for flooding is likely (Umatilla County 2014).
    - Contact: Katy Branham, Warning Coordination Meteorologist
      katy.branham@noaa.gov
- Federal Emergency Management Agency (FEMA): FEMA's National Flood Insurance Program works with the state and counties to support during a flooding event. The FEMA app allows people to receive real-time weather and emergency alerts (FEMA 2024).
    - Contact: Kristin Minich, Region 10 Regional Liaison
      kristin.minich@associates.fema.dhs.gov, (360)-658-8188
- Oregon Department of Emergency Management (ODEM): ODEM coordinates with individual counties and provides statewide support. The state of Oregon and ODEM response is outlined in the State of Oregon Comprehensive Emergency Management Plan (CEMP) (State of Oregon 2010).
    - Contact: Curtis Peetz, Response Planner
      curtis.peetz@oem.oregon.gov, 503-378-3252

2.3.2 Communication During Flood Events

Umatilla County is responsible for coordination of communication and implementation of the Umatilla County Emergency Operations Plan (Umatilla County 2021).

2.3.3 Notification Chart and Communication Lists



2.4 IMPLEMENT EMERGENCY RESPONSE ACTIVITIES

2.4.1 Flood Fighting Activities

Umatilla County Emergency Management (UCEM) response and coordination is outlined in the Umatilla County Emergency Operations Plan and usually involves disseminating materials addressing shelter locations, sandbag locations, and response contact information. Should a flood event become severe, UCEM can activate the Emergency Operations Center (EOC) and Joint Information Center (JIC) to coordinate flood fights, emergency response, evacuation and the dissemination of important public safety information (Umatilla County NHMP, 2014). The following contractors are in the vicinity and may be utilized to aid in flood fighting activities.

- Rod Anderson Construction, Inc.
    - Address: 4531 NW ‘A’ Avenue, Pendleton, OR 97801.
    - Phone: (541) 276-4104
- Columbia River Restoration
    - 30485 Oldfield St, Hermiston, OR 97838
    - (541) 701-4031
- Silver Creek Contracting
    - 505 Willamette St #102, Umatilla, OR 97882
    - (541) 626-2060

2.4.2 Evacuation Process

The Umatilla County Emergency Management Agency is responsible for issuing evacuation notices for the leveed area. The Umatilla County Emergency Management Agency depends on timely and accurate information about the levee in order to make effective evacuation decisions.

Jurisdictions within the leveed area maintain effective relationships and communications with the local emergency management agency. While they do not have a flood warning system, leveed area inhabitants are generally aware of their flood risk and of the importance of monitoring emergency notifications and evacuation notifications, increasing the likelihood of an effective evacuation if a breach were to occur.

Immediately upon the Umatilla County Emergency Management Agency issuing an evacuation notice, the county will inform the impacted public. Umatilla County police, fire, and emergency responders will assist with evacuation notifications and with executing the evacuation in accordance with the Umatilla County Emergency Operations Plan. The evacuation route is shown in Figure 3. The resident within the protected area sill evacuate to Birch Creek Road from the main driveway, and head north or south on Birch Creek Road. In the event that water is overtopping Birch Creek Road, the north evacuation route over the Umatilla River bridge is recommended.

Figure 3. Evacuation route map.

3. Roles and Responsibilities

3.1 LEVEE OWNER

The Pendleton 2a Levee Setback project removed a section of the existing levee and constructed a setback levee. As the project modified an existing, federally authorized and constructed USACE levee, the USACE is considered the setback levee owner. However, the levee will continue to be non-federally operated and maintained by Umatilla County.

3.2 COUNTY EMERGENCY MANAGEMENT AGENCIES

Umatilla County Emergency Management (UCEM) is responsible for coordinating communication with response agencies and the general public of potential flooding events, and for future revisions to this document. UCEM response is outlined in the Umatilla County Emergency Operations Plan (Umatilla County 2021) and the Umatilla County Natural Hazard Mitigation Plan (Umatilla County 2014).

3.3 STATE EMERGENCY MANAGEMENT AGENCIES

Oregon Department of Emergency Management (ODEM) can coordinate with and support Umatilla County. The State of Oregon Comprehensive Management Plan outlines the state Emergency Operations Plan with information on floods, including dam and levee failure (State of Oregon 2010).

3.4 LOCAL LAW ENFORCEMENT

The Umatilla County Sheriff office provides emergency services and would be contacted in the event of a Level 3 – Imminent Failure event. The Umatilla County Communications Division and 911 Regional Dispatch Center is the first point of contact for most citizens who live in Umatilla County when they call for police, fire, ambulance or other kinds of assistance (Umatilla County 2024).

4. References and Resources

FEMA 2024. Emergency Alerts. Federal Emergency Management Agency. Available online at: https://www.ready.gov/alerts

NWS 2020. Advanced Hydrologic Prediction Service. Umatilla River at Pendleton. National Weather Service. Available online at: https://water.weather.gov/ahps2/hydrograph.php?wfo=pdt&gage=pdto3

State of Oregon 2010. Incident Annex 3 – Flood (including Dam/Levee Failure). Comprehensive Emergency Management Plan. Oregon Emergency Management. Available online at: https://www.oregon.gov/oem/emresources/Plans_Assessments/Pages/CEMP.aspx

Tetra Tech. 2024. Pendleton 2a Levee Setback Operations and Maintenance Manual. Prepared for Umatilla County. February 2024.

Umatilla County 2014. Natural Hazard Mitigation Plan. Umatilla County Department of Land Use Planning. Available online at: https://www.umatillacounty.net/fileadmin/user_upload/Planning/NHMP/2012-2013_NHMP_Update_FINAL_FEMA_ADOPTED_4-17-14.pdf

Umatilla County 2021. Emergency Operations Plan. Umatilla County Emergency Management. Available online at: https://www.umatillacounty.net/fileadmin/user_upload/Sheriff/Emergency_Management/2022_Umatilla_County_Emergency_Operations_Plan.pdf

Umatilla County 2024. Communications - 911 Regional Dispatch Center. Available online at: https://www.co.umatilla.or.us/sheriff/departments/sheriff/communications

USACE 2023. National Levee Database. United States Army Corps of Engineers. Available online at: https://levees.sec.usace.army.mil/#/levees/system/5005000041/summary

VOLUME 7

TETRA TECH

TECHNICAL MEMORANDUM

To:	United States Army Corps of Engineers
Cc:	Confederated Tribes of the Umatilla Indian Reservation
From:	Jeremy Andrews, PE, and Chris James, CWM, CERP (Tetra Tech, Inc.)
Date:	December 16, 2024
Subject:	Volume 7 - Pendleton 2a Levee Setback Risk Analysis

1. Introduction

This technical memorandum is being provided by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Tetra Tech, Inc. (Tetra Tech) to the U.S. Army Corps of Engineers (USACE). It is intended to be a continuance of the USACE Section 408 process and review of UmaBirch In-Stream Design and Construction Oversight Project (the Project). The Project has been identified by the USACE as request #FY19-NO46 and is linked to the nationwide permit NWP-2019-489. The Project is associated with the USACE Pendleton 2a Levee which is listed in the USACE National Levee Database as System ID# 500500041 (USACE, 2022). The purpose of the Project is to restore floodplain connectivity and natural riverine processes, while maintaining the function of the Pendleton 2a Levee. The USACE Section 408 review is requested because the Project proposes to setback a portion of the Pendleton 2a Levee downstream of Birch Creek Road located near Rieth, Oregon, in order to achieve the purpose of the Project.

This technical memorandum provides a review of existing data, proposed Project design data, risk assessment methods, and findings of the risk analysis associated with the proposed Project. The review and analysis are in support of the United USACE Section 408 review of the Project (see Volumes 1 – 6 for specific Project details). The Project is located on the Umatilla River from river mile (RM) 48.7 to RM 49.7 and Birch Creek from RM 0.0 to RM 0.3. The Project is part of a larger series of project’s being proposed by the CTUIR and Bonneville Power Administration (BPA) located downstream on the Umatilla River and upstream on Birch Creek. To provide a phased construction approach based on funding, hydrology and geomorphology, and anticipated environmental permitting requirements, all project actions being proposed by the CTUIR and BPA, have been separated into four distinct project areas. Of these project areas, the USACE Pendleton 2a Levee is located within Project Area 2 (PA 2). Throughout various reports (e.g., Volumes 1 - 6) and other documents (e.g., environmental compliance and permitting applications), the Project and its location are commonly referred to as PA 2.

This technical memorandum is Volume 7 of 7. Combined, the volumes assist in documenting historic conditions, existing data, and analyses necessary to demonstrate that the proposed Project will not adversely impact the

Pendleton 2a Levee system. Specific to Volume 7 and based on the review and analyses completed as part of the other volumes provided with this Section 408 #FY19-NO46 submittal, the risk assessment provided in this technical memorandum concludes that the proposed Project will not adversely impact the existing Pendleton 2a Levee system, and the risks mitigated by this Project were determined to be acceptable.

2. Purpose

The purpose of this technical memorandum is to perform a risk analysis associated with the proposed Project. In December 2021, representatives of the USACE, BPA, CTUIR, and Tetra Tech met to discuss the Pendleton 2a Levee and the scope of work for the Project and Section 408 review process. As a part of that meeting, and to support the Section 408 process, the USACE requested that the CTUIR and Tetra Tech reconstruct the historical Pendleton 2a Levee (see Volume 1) and utilize that information to evaluate the without- and with-Project conditions. This technical memorandum provides the concluding risk analysis necessary to determine if the proposed Project has any adverse impacts on the existing Pendleton 2a Levee system.

2.1 Background

The Project proposes modifications to a section of the existing Pendleton 2a Levee located along the south bank of the Umatilla River. The Pendleton 2a Levee (segment ID: 5004430001) is identified in the USACE National Levee Database as part of the Pendleton Zone 2 Flood Damage Reduction (FDR) Project, which is a federally authorized and constructed, and non-federally operated and maintained levee system (USACE, 2022). Volume 1 – Pendleton 2a Levee Setback Existing Data Review and Levee Reconstruction Analysis; Volume 2 – Hydrologic and Hydraulic Analyses; Volume 3 – Interior Drainage Analysis; Volume 4 – Pendleton 2a Levee Setback Design and Analysis; Volume 6 – Pendleton 2a Levee Setback Operation and Maintenance Manual; and Volumes 1- 6 provides detailed information regarding the historic (i.e., 1959 levee) and current conditions; without- and with-Project condition hydraulic analyses; without-and with-Project interior drainage analyses; stability analysis of the Pendleton 2a Levee proposed setback; operation and maintenance of the proposed levee setback; and proposed levee setback and floodplain reconstruction designs, respectively, associated with the Pendleton 2a Levee system. Utilizing these sources, the USACE guidance and supporting material (see Section 2.2 below), along with the data review described in Section 3 below, a risk assessment was completed to determine if the proposed Project has any adverse impacts on the existing Pendleton 2a Levee system (see Section 4 below).

2.2 USACE Materials

The guidance and supporting USACE materials utilized in this analysis include:

- USACE EM 1105-2-101: Risk Assessment for Flood Risk Management
- USACE EM 1110-2-1913: Design and Construction of Levees
- USACE ER 1110-2-1619: Risk-Based Analysis for Flood damage Reduction Studies

Throughout this technical memorandum, the risk assessment references the following volumes:

- Volume 1 – Pendleton 2a Levee Setback Existing Data Review and Levee Reconstruction Analysis
- Volume 2 – Pendleton 2a Levee Setback Hydrologic and Hydraulic Analyses
- Volume 3 – Pendleton 2a Levee Setback Interior Drainage Analysis
- Volume 4 – Pendleton 2a Levee Setback Design and Analysis
- Volume 6 – Pendleton 2a Levee Setback Operation and Maintenance Manual

3. Data Review

This section discusses the review of available data for the without-Project (Existing Data) conditions and with-Project (Proposed Project Design Data) conditions necessary for the risk assessments.

3.1 Existing Data

The Volume 1 – Pendleton 2a Levee Setback Existing Data Review and Levee Reconstruction Analysis provides a detailed evaluation of available data and a reconstruction analysis of the existing Pendleton 2a Levee. See below for a summary of Volume 1 and see the full technical memorandum and associated attachments for further details on the data review and reconstruction analysis.

3.1.1 Existing Data Review

Volume 1 reviewed Federal Emergency Management Agency (FEMA) data and determined the designation of the Umatilla River in the immediate vicinity of the Pendleton 2a Levee to be Zone A. In addition, data from the USACE National Levee Database was extracted, evaluated, and presented as Attachment 3 to Volume 1. Moreover, historic construction drawings dated 1959 were provided by the USACE, evaluated in detail and presented as Attachment 4 to Volume 1.

3.1.2 Levee Reconstruction Analysis

The intent of the reconstruction analysis was to evaluate the current condition of the Pendleton 2a Levee and determine if it currently provides the original authorized protection. The analysis reviewed the historic construction drawings and evaluated it against the light detection and ranging (LiDAR) data collected in 2019 (QSI, 2019). Based on this evaluation, it was determined that the 2019 LiDAR data (QSI, 2019) combined with the topobathymetric data collected in 2021 (Volume 1), was an accurate terrain model of the original (i.e., historic 1959 levee and revetment based on construction plan, profiles, and detail sheets provided by the USACE to Tetra Tech) design and maintains the original authorized protection. Based on the results of the levee reconstruction analysis, the 2019 LiDAR data (QSI, 2019) with the topobathymetric data collected in 2021 (Volume 1), was used as the without-Project condition in support of quantitative and qualitative analyses for the Project.

3.2 Project Design Data

The subsections below provide a summary of sources on the Project design and analyses. These sources were used with-Project condition information in support of quantitative and qualitative analyses for the Project. See each volume provided with this Section 408 Request #FY19-NO46 submittal for the comprehensive details of each analysis.

3.2.1 Volume 2 – Pendleton 2a Levee Setback Hydrologic and Hydraulic Analyses

Volume 2 includes analyses that were completed as part of the 90 percent Design phase for the Project to document available hydrologic information, which was utilized in the hydraulic evaluation of the without-Project condition and the with-Project condition. These analyses included detailed evaluation of stream gage data, historic storm flows, inundation extents, and hydraulic loading for the with- and without-Project conditions.

3.2.2 90-Percent Construction Drawings

The Project construction drawings are included in Volume 2 as Attachment 1 and detail the Project features at the most recent design stage. These features include grading and construction elevations of the levee setback, interior drainage culverts among other Project features. The drawings provide comprehensive design details for the with- and without-Project conditions in support of the quantitative and qualitative analyses for the Project.

3.2.3 Volume 3 – Pendleton 2a Levee Setback Interior Drainage Analysis

Volume 3 documents the supporting engineering methods and calculations of the interior drainage analyses performed to confirm that the adjacent property to the east of the Project is not impacted by the Pendleton 2a Levee proposed setback design and maintains existing drainage characteristics. As the Umatilla River experiences flooding conditions, the design includes gravity drains through the Pendleton 2a Levee proposed setback equipped with flap gates to prevent floodwaters from entering the with-Project interior drainage area west. The with-Project interior drainage area west includes enough storage to pond all inflow resulting from stormwater runoff including seepage rates occurring in both interior drainage areas east and west without overtopping Birch Creek Road or increasing the water surface within the with-Project interior drainage east.

3..2.4 Volume 4 – Pendleton 2a Levee Setback Design and Analysis

Volume 4 includes a geotechnical desktop study, slope stability analyses, and seepage analyses on the Pendleton 2a Levee proposed setback in support of the Project. The analyses conducted for the proposed levee setback indicate that it will meet the requirements of the design criteria for slope stability and seepage.

4. Risk Assessment

Regarding this assessment, risk was defined as exposure to a chance of injury or loss (USACE, 1996). Both quantitative and qualitative analyses were performed for this assessment.

4.1 Risk Assessment Methods

Below is a discussion of potential failure modes for the Pendleton 2a Levee proposed setback, along with risk mitigation components of the Project design. The nature of some failure modes allowed for quantitative analysis and determination of a factor of safety (FOS). Other failure modes were evaluated qualitatively.

4.1.1 Overtopping

Failure Mode

The overtopping failure mode could result in flow into the interior drainage areas resulting in failure to protect the interior drainage facilities and could also result in a breach of levee causing loss of property or life.

Mitigation

In order to mitigate this failure mode, the design provides adequate freeboard of the Pendleton 2a Levee Setback to prevent overtopping from occurring. As designed, the Pendleton 2a Levee proposed setback does not overtop during the 100-year recurrence interval. See Volume 2 for additional details.

4.1.2 Slope Stability

Failure Mode

For slope stability, failure of the levee slope was considered to be any deformation of slope geometry under specific loading conditions. Slope failure of the levee could result flooding of the interior area and loss of property or life.

Mitigation

Stability analyses were performed for two representative levee cross sections under both static and rapid drawdown conditions. The USACE (USACE, 2000) recommends a minimum of 10 to 12 feet to provide access for normal maintenance operations and flood-fighting operations. The proposed top width of the Pendleton 2a Levee proposed setback is 20 feet to facilitate construction equipment and vehicle access.

A slope of two horizontal to one vertical (i.e., 2H:1V slope) is generally accepted as the steepest stable slope that can be constructed and can accommodate stability of any riprap layers. A 3H:1V slope is the steepest slope that can be conveniently traversed with conventional mowing equipment and walked on during inspections. The proposed side slope of the Pendleton 2a Levee proposed setback is in the range of 4H:1V to 6H:1V to ensure stability and allow maintenance and vehicle access.

Overall, the proposed levee setback cross section is much more robust than what typical minimum levee design criteria prescribe. As a result, the slope stability calculations for this setback levee result in FOS consistently over 2.0. See Volume 4 for detailed discussion of the slope stability calculations performed.

4.1.3 Seepage

Failure Mode

A failure mode was evaluated to determine if there was risk associated with potential seepage risk through the proposed setback levee creating pore water pressure and displacement of material on the landside toe of setback levee slope. Seepage that causes hydraulic uplift and displacement of material on an embankment could result in slope failure. Slope failure of the proposed setback levee could result flooding of the interior area and loss of property or life.

Mitigation

Similar to the slope stability mitigation, the proposed setback levee width and side slopes are considered conservative for levee design. The proposed setback levee material used during construction will also be pre-qualified via lab testing to confirm it meets or exceeds assumed permeability characteristics required to mitigate seepage risk. An additional seepage mitigation precaution consists of the anti-seepage collars proposed to be installed around the interior drainage system culverts. See Volume 4 for detailed discussion regarding the seepage calculations.

4.1.4 Interior Drainage System Blockage

Failure Mode

The interior drainage system consists of two (2) 36-inch diameter culverts with flap gates. A failure mode evaluated for these components was complete blockage of the culverts or the flap gates preventing outflow of the interior drainage area.

Mitigation

As proposed, the interior drainage area has sufficient storage to contain the volume during a 100-year storm event, including seepage into the interior drainage areas. If the culverts/gates were inoperable, minimal flooding within the interior drainage area would occur. Additionally, there is redundancy provided in the design with two (2) outfall culverts. If one culvert / flap gate were to become blocked, the other could remain operable. See Volume 3 for additional details regarding the interior drainage analysis.

4.1.5 Interior Drainage System Flap Gates Stuck Open

Failure Mode

For the interior drainage system (culverts and flap gates), a failure mode was considered consisting of the flap gates sticking in the open position allowing water to backflow through the levee during a flood event. This could result flooding of the interior area and loss of property or life.

Mitigation

As mitigation for this failure mode risk, it will be recommended that the public sponsor keep a spare valve on hand in the event one of the valves needs replacement in an emergency situation. In addition, the operation and maintenance manual will prescribe routine maintenance and inspections to be performed to ensure these valves remain operable and are replaced if needed.

4.1.6 Erosion

Failure Mode

As an earthen embankment, the levee will be susceptible to erosion and displacement of surficial material. Erosion is a failure mode risk due to rainfall events creating sheetflow on the proposed setback levee, as well as due to flood high water events causing hydraulic loading of the river side of the proposed setback levee. If unmitigated, erosion could exacerbate to the extent of levee failure and could result in flooding of the interior area and loss of property or life.

Mitigation

This failure mode is mitigated by maintaining riprap revetment in areas identified as susceptible to erosion due to river side flow depths/velocities, riprap at culvert inlets/outlets, and vegetation on all other levee surfaces. The levee maintenance and operation manual also prescribes routine maintenance and inspections to be performed to ensure riprapped areas remain in-tact, and other levee surfaces maintain sufficient vegetative cover.

4.2 Risk Assessment Results

The risk assessments of the above failure modes are summarized in Table 4-1 below.

Table 4-1 Summary of Failure Mode Risk Assessment Results

Failure Mode	Factor of Safety	Qualitative Risk Mitigation Category
Overtopping	N/A	Acceptable
Slope Stability	Over 2.0	Acceptable
Seepage	N/A	Acceptable
Interior Drainage System Blockage	N/A	Acceptable
Interior Drainage System flap gate Stuck Open	N/A	Acceptable
Erosion	N/A	Acceptable

5. Conclusion

Both existing (i.e., current) data and Project design data were reviewed as part of this risk assessment. Critical failure modes were identified and detailed based on the Project design and specific design components. The nature of some failure modes allowed for quantitative analysis and determination of a FOS, while other failure modes were evaluated qualitatively. Based on the risk assessment presented in this technical memorandum, the Project will not adversely impact the existing Pendleton 2a Levee system, and the risks mitigated by this Project were determined to be acceptable.

6. References

Quantum Spatial, Inc. (QSI). 2019. Aerial Light Detection and Ranging (LiDAR) Survey. Performed for Confederated Tribes of the Umatilla Indian Reservation UmaBirch In-Stream Design and Construction Oversight Project.

U.S. Army Corps of Engineers (USACE). 1996. Risk-Based Analysis for Flood Damage Reduction Studies. EM 1110-2-1619. Washington, DC.

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