Ventura County
Public Works Agency – Watershed Protection

Live Oak Acres Levee Project

Ventura County, California

Intermediate Design
Basis of Design and Alternatives Report

September 2020

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Prepared for:

Ventura County Public Works Agency
Watershed Protection

Prepared by:

Tetra Tech

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<u>Attachment I - (Documents Related to Alternatives Analysis)</u>

- **A.** Alternative Plans
- **B.** Cost Estimates
- **C.** Summary of Hydraulics
- **D.** Summary of Scour Calculations
- **E.** Landside Improvement Exhibits

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1.0 INTRODUCTION

1.1 System Background

The Live Oak Acres Levee, referred to as the Ventura River Levee and Floodwall (VR-3 Levee System), is located at Live Oak Acres in the community of Oak View. The Live Oak Acres Levee system is located along the west side of the Ventura River. The levee system consists of embankment levees, floodwalls, high ground, and side drainage penetrations. The levee system is intended to protect existing residential, commercial, and potentially developable property in low-lying areas within the base flood floodplain of the Ventura River Watershed. The levee system begins at the Santa Ana Boulevard (Blvd.) Bridge in Ventura County, continues upstream to the confluence with the Live Oak Creek Diversion, and ends along the Live Oak Creek Diversion at Burnham Road. The length of the levee is approximately 1.3 miles. Its earthen berm is protected by riprap that is grouted along certain portions. An access road that is approximately 10 to 17.5 feet wide runs along the top.

As part of the *Matilija Dam Ecosystem Restoration Project, Hydrology, Hydraulics, and Sediment Studies for the Meiners Oaks and Live Oak Levees* (USBR 2006), the United States Bureau of Reclamation (USBR) evaluated the effects of sediment deposition and water surface elevations in a dam removal condition. The USBR used their G-Star sediment transport program to analyze the river from the dam to the ocean. The Live Oak Acres Levee is approximately 6 miles downstream of the dam, and the USBR predicted a potential 100-year water surface elevation increase of up to ±2 feet.

In 2009, during previous work conducted by Tetra Tech as part of the Federal Emergency Management Agency (FEMA) Levee Certification program, it was determined that the Live Oak Levee system does not currently meet 44 CFR 65.10 requirements. As part of the FEMA Levee Certification work, a field investigation was performed that identified deficiencies in the Live Oak Acres Levee system which require rehabilitation.

In 2010, the Ventura County Public Works Agency – Watershed Protection (previously known as Ventura County Watershed Protection District [VCWPD]) contracted with Tetra Tech to evaluate the studies and reports prepared by the USBR, and the subsequent plans, technical specifications, and reports prepared by the U.S. Army Corps of Engineers, South Pacific Division, Los Angeles District (USACE SPL) [USACE SPL 2008] for the improvement of the Live Oak Acres Levee within the Ventura River Watershed. The improvements to the levee were part of the proposed Matilija Dam Ecosystem Restoration project to mitigate potential flooding impacts resulting from the dam removal. The evaluation consisted of site reconnaissance and a review of studies, reports, plans, and technical specifications prepared by the USBR and the USACE SPL for the improvements to the Live Oak Acres Levee in the Ventura River Watershed. The *Matilija Dam Ecosystem Restoration, Live Oak and Meiners Oaks Levees, Evaluation Report* (Tetra Tech 2010) was prepared that documented Tetra Tech's evaluation of engineering analyses and the proposed improvements to the Meiners

Oaks and Live Oak Acres Levee systems to ensure that they satisfy the requirements of Title 44 of the Code of Federal Regulations, Section 65.10 (44 CFR, 65.10) so that levee certifications can be submitted to FEMA.

1.2 Current Study

Using available information, this study is meant to summarize the selection and development of the levee alternative that was determined to be most appropriate for the Live Oak Acres Levee System. This report describes the progression of the study in two parts: 1) Conceptual-Level Alternatives Comparison and 2) Intermediate Design.

The Conceptual-Level Alternatives Comparison was used to compare multiple alternatives and evaluate what levee improvement should be applied to this system. The Intermediate Design evaluates the selected alternative in more detail. More information discussing these two phases of the study are provided in the sections below.

1.2.1 Conceptual Alternatives Comparison

Section 3 of this report documents the alternatives that have been investigated for the Live Oak Acres Levee Project. This alternatives analysis compares two (2) alternatives for the Live Oak Acres Levee System. Several screening-level concepts have been discussed in previous meetings and were documented in a memorandum, *Proposed Screening-Level Concepts Comparison* (Tetra Tech 2019). That memorandum evaluated and recommended concreted riprap (as referenced as grouted stone) slope protection to be the alternative to move forward with in the next phase. After review by VCPWA and subsequent discussion, it was determined that the following alternatives would be evaluated: 1.5H:1V Concreted Riprap and 2H:1V Concreted Riprap. Section 3 of this report summarizes the basis of design and the description and comparison of each of the alternatives. The comparison for the alternatives includes comparing costs and impact area.

1.2.2 Selected Alternative and Alternative Design

Section 4 of this report documents the development of the selected alternative. The VCPWA has contracted Tetra Tech to develop the selected alternative in accordance with the Intermediate Design requirements as defined by the California Department of Fish and Wildlife (CDFW). This alternative was selected by VCPWA after reviewing the information and evaluation included in Section 3 of this report.

2.0 TECHNICAL STUDIES

Section 2 explains the technical analyses that were used to develop the project design criteria and assumptions.

The hydrology and hydraulics used for this project are based on the results of the *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum* (AECOM/Stillwater Sciences 2019a). The following sections summarize the methods used in the 2019 Study.

2.1 Hydrology

As part of the *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum* (AECOM/Stillwater Sciences 2019a), AECOM / Stillwater Sciences reviewed hydrologic information from the two studies for the Ventura River:

- USBR 2006. *Hydrology, Hydraulics, and Sediment Studies for the Matilija Dam Ecosystem Restoration Project, Ventura CA – Draft Report*. Prepared for the USACE SPL, by the U.S. Bureau of Reclamation. November. Revised September 23, 2008.
- FEMA 2015. *Flood Insurance Study, Ventura County, California and Incorporated Areas*. Federal Emergency Management Agency. January 7.

Based on the review of the two studies above, AECOM / Stillwater Sciences Study indicated that the USBR Study was more appropriate for use in their study. The adopted values are shown in Table 2.1. For design purposes, VCPWA also requires the evaluation of a “design flow” considered to be 10 percent greater than the base level flow (100-year).

Table 2.1: Adopted Discharge Frequency Values at Live Oak Acres Levee

2-Year (cfs)	5-Year (cfs)	10-Year (cfs)	20-Year (cfs)	50-Year (cfs)	100-Year (cfs)	Design Flow (cfs)
3,380	7,910	16,000	19,800	24,800	28,300	31,130

cfs = cubic feet per second

A full summary of the hydrologic data can be found in Section 2.3 (Scour Computations) of the *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum* (AECOM/Stillwater Sciences 2019a).

2.2 Hydraulics and Sediment Transport

The hydraulic parameters used for this levee design is based on the hydraulic model associated with the *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum* (AECOM/Stillwater Sciences 2019a). This study considers the hydraulics with potential sediment aggradation (under Future Dam Removal Conditions) occurring throughout the system. The model includes the runs for the 100-year flow, and the “Design Flow”, which is the 100-year flow bulked by 10%. The Design Flow run was used to extract the water surface elevations (WSELs) from each of the cross-sections in the hydraulic model. These WSELs were then used to develop a top-of-levee design height. It should be noted, that the AECOM/Stillwater Study indicated multiple cross-sections where the 50-year event (with aggradation of sediment) resulted in a higher water surface than Design Flow water surface. In these instances, the higher of the two water surfaces was used for design.

A full summary of the sediment transport and hydraulics can be found in *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum* (AECOM/Stillwater Sciences 2019a). It should also be noted that the hydraulic model in that study did not model the proposed widening improvements to the Santa Ana Blvd. Bridge. Therefore, the water surfaces and proposed top-of-levee will need to be re-evaluated in a future phase of this project. It is recommended that a 2-D hydraulic analysis be performed to better understand the flooding that may occur as flows exit the Santa Ana Blvd. Bridge crossing. It should be noted be noted that the thickness of the bank protection may change once the hydraulics are finalized during a subsequent phase of design.

2.3 Scour Computations

The hydraulic parameters used for this design are based on the hydraulic model associated with the *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum* (AECOM/Stillwater Sciences 2019a). This hydraulic study was based on the findings from the preceding sediment transport study, *Matilija Dam Removal 65% Design Subtask 2.2: Detailed Sediment Transport Modeling from Matilija Dam to Downstream to Ventura River Delta* (AECOM/Stillwater Sciences 2019b). These studies, in conjunction, evaluate the hydraulics with potential sediment aggradation and degradation occurring throughout the system.

Tetra Tech performed a local scour analysis, which considers potential: low-flow, anti-dune, contraction, and bend scour in the vicinity of the levee. Based on the river geometry, bed materials and general hydraulics that are expected within this river system, it was determined that bend scour and contraction scour would be the only appropriate local scour components. In this area, the Ventura River is a coarse-grain system dominated by gravel and cobbles. For this reason, it is not subject to transient bed elevation changes associated with the presence of dunes nor low-flow channels that are not represented in topographic surveys, both of which are characteristic of sand dominated systems. In addition, pier scour at the Santa Ana Blvd. Bridge was evaluated, but was not added to the total scour since the embankment protection is outside the zone of influence for pier scour. Contraction scour results from a dramatic channel width reduction imposed by man-made structures or similar non-erodible features and is generally isolated to the point of contraction. Within the area of the levee upstream of the Santa Ana Blvd. Bridge, the future abutment/bridge widening will cause no imposed contractions that create a focused point of scour that contributes to bed elevations changes. Through this evaluation, the Maynord Equation (1996) was selected for determining estimated bend scour. The scour analysis is based on the hydraulic properties output from AECOM's hydraulic model. In addition, Stillwater Sciences sediment transport study identifies potential single event bed degradation and long-term bed degradation in each of the hydraulic reaches in their study, which indicates that the most severe bed degradation in this project reach occurs with the dam in-place (vs. dam removal).

Total estimated scour is the sum of the local scour components and either the single-event scour component or the long-term scour component, whichever is larger. The local scour analysis was performed for the 100-year hydraulic output and the Design Flow hydraulic output. In this instance, the Design Flow hydraulic output resulted in a larger magnitude of scour, and therefore, was applied to calculate total estimated scour depth. The single-event and long-term scour components were extracted from the figures at the end of the Stillwater Sciences sediment study and the larger of the two components were applied to the total estimated scour depth. The total estimated scour depth was then applied to the channel thalweg (at each of the hydraulic cross-sections) to determine a minimum toe-down protection elevation. It should be noted that Tetra Tech's preliminary findings estimate scour potential up to 2.3 feet deeper than the currently proposed bank protection at the Santa Ana Blvd. Bridge as presented in the *Matilija Dam Ecosystem Restoration, Santa Ana Blvd Bridge Replacement, Channel Improvements* (VCWPD 2016a). However, the estimated scour is based on the AECOM/Stillwater Sciences hydraulic study, which does not include the proposed widening improvements to the Santa Ana Blvd. Bridge. A refined hydraulic study in this area will be needed to more accurately estimate the scour potential at the bridge.

Tables summarizing the hydraulic output and scour components are provided in Table 4.1 and Table 4.2. The summary of hydraulics and design parameters presented in Table 4.3 reveal how the scour was applied and toe-down protection elevations were established. A complete table of the hydraulic output and scour components is provided in Attachment I-D. The complete hydraulics and design parameters show how the scour was applied and toe-down protection elevations were established, and is presented in Attachment I-C.

2.4 Interior Drainage

There has been no interior drainage analysis performed for this phase of the project. However, based on the field investigation and review of the as-built plans, there are three existing storm-drain penetrations through the Live Oak Acres Levee: a 48" reinforced concrete pipe (RCP) storm drain at Station 2+92, a 24" corrugated steel pipe (CSP) at Station 16+50, and a CSP at Station 33+50. The 48" storm drain has a flap gate (Station 2+92), however, the two 24" storm drains do not (USACE SPL 2008). It was assumed these side-drainage structures would still be necessary, and have been incorporated into the design and construction cost estimates in this analysis. An interior drainage analysis will be performed during a later phase of this project.

2.5 Geotechnical Evaluation

A Geotechnical Engineering Memorandum (Tetra Tech 2020) was developed in order to summarize the existing geotechnical data for the Live Oak Acres Levee Project, as well as to provide preliminary geotechnical recommendations in support of conceptual design of new levee design alternatives. Based on the results of previous field explorations, it was determined that from a geotechnical standpoint, the construction of the Live Oak Acres Levee is feasible with placement of concreted riprap protection and flood wall extensions. However, as the project advances to a final design stage, it is expected that a detailed geotechnical investigation be performed.

The geotechnical memorandum concluded the following:

- The 2H:1V concreted riprap protection is anticipated to meet the required Factor of Safety for slope stability.
- The 1.5H:1V concreted riprap protection would likely require a thickened toe (e.g., 8-foot horizontal thickness for approximately the lower 12 feet of the slope) and full grout/concrete penetration. The final dimensions of the protection would be based on site-specific evaluation of foundation conditions and stability analyses of the proposed geometry.
- Several active earthquake faults exist in close proximity to the levee and/or potentially project across the levee alignment. Given this setting, surface fault rupture across the levee system in the vicinity of the Villanova, Devil's Gulch, and La Vista faults is considered to be possible. Surface rupture along these faults as a result of a significant seismic event could cause damage to the levee system. However, given the low probability of fault rupture coinciding with design flood water level, it is deemed appropriate to address such conditions as a part of the levee operation and maintenance.
- The presence of large boulders within the soil matrix at the site may increase the excavation difficulty.
- Previous geotechnical investigation in the proximity of the levee indicate that groundwater is found within the alluvial soils and likely perches on the underlying bedrock. Groundwater levels within either Live Oak Creek or the Ventura River could fluctuate significantly due to changes in flow conditions in these channels. Depending on hydrological conditions within these channels during construction, surface diversion of channel and dewatering and control of groundwater seepage could be significant issues.

3.0 CONCEPT-LEVEL ALTERNATIVE DEVELOPMENT

Section 3 details the development of the concept-level alternatives and the comparison and evaluation of the alternatives. Of the two sets of Attachments included as part of this report, Attachment I includes all of the references related to the Concept-Level Alternatives Analysis.

3.1 Concept-Level Basis of Design

The proposed improvements (and supporting technical analyses) as part of this study are based on parameters that would satisfy the requirements of Title 44 of the Code of Federal Regulations, Section 65.10 (44 CFR, 65.10), so that levee certifications can be submitted to FEMA.

The design of the concept-level alternatives was limited to a single plan view and a minimum of six cross-sections.

3.1.1 Alignment

The alignment for this levee system is based on the alignments from previous improvements along this levee system. A similar alignment was provided in the *Matilija Dam Ecosystem Restoration, Meiners Oaks and Live Oak Acres Levees, Design Plans* (USACE SPL 2008). The proposed improvements, as presented in this report, currently extend along the Live Oak Creek Diversion and tie into Burnham Road (at the upstream limit). For this study, it is assumed that this entire reach will be protected similar to the reach along Ventura River. However, this portion of the levee will need to be further evaluated to understand the extent of (1) the erosion protection and (2) the vegetation management that will be required in this area, if any.

The plan views included in Attachment I-A show the alignment in relation to the available right-of-way data.

3.1.2 Top-of-Levee Elevation

The top-of-levee elevations are based on the design flow water surfaces described in Section 2.2 (Hydraulics and Sediment Transport).

FEMA deterministic freeboard requirements were applied to the Design Flow water surface elevations (which accounted for aggradation of sediment) to develop a design top-of-levee profile. FEMA deterministic freeboard requires that the top-of-levee height provide at least three feet of freeboard throughout the levee system and an additional half foot at the upstream tie-in (3.5 feet total), and an additional foot within 100 feet of the Santa Ana Blvd. Bridge (4 feet total). A table summarizing the hydraulics and the design top-of-levee elevations for this system is provided in Table 4.1.

Results show that the existing levee is deficient of freeboard requirements throughout most of the levee system, except at floodwall-improved reaches. The existing reinforced-concrete floodwall improvements meet the freeboard requirements, and based on a preliminary evaluation, are assumed to meet the appropriate factors of safety to withstand hydraulic loading. For this reason, it is proposed that floodwalls will be extended upstream and downstream of the existing floodwall improvements where there is limited right-of-way. The final required floodwall design will be further evaluated in future phases of this project.

3.1.3 Toe-Down Protection Elevation

The hydraulic parameters used for the project design are based on the hydraulic model associated with the *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum* (AECOM/Stillwater Sciences 2019a). This hydraulic study was based on the findings from the preceding sediment transport study, *Matilija Dam Removal 65% Design Subtask 2.2: Detailed Sediment Transport Modeling from Matilija Dam to Downstream to Ventura River Delta* (AECOM/Stillwater Sciences 2019b). These studies, in conjunction, evaluate the hydraulics with potential sediment aggradation and degradation occurring throughout the system.

The total estimated scour depth, as described in Section 2.3 (Scour Computations), was applied to the channel thalweg (at each of the hydraulic cross-sections) to determine a minimum toe-down protection elevation. A table summarizing the design levee toe elevation, hydraulic output, and scour components are provided in Table 4.2. The summary of hydraulics and design parameters presented in Table 4.3, shows how the scour was applied and toe-down protection elevations were established.

3.2 Concept Alternatives Descriptions

This alternatives analysis compares two (2) alternatives for the Live Oak Acres Levee System: 1.5H:1V Concreted Riprap and 2H:1V Concreted Riprap. Table 3.1 summarizes the impacts, cost, benefits, and constraints/challenges associated with each of the alternatives considered as part of this analysis. The following sections describe each of the alternatives with further detail.

A plan view and multiple cross-sections for each alternative are included in Attachment I-A of this memorandum. The cross-section geometry is based on the initial hydraulics and sediment transport results from the *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum* (AECOM/Stillwater Sciences 2019a). It should be noted that Tetra Tech did not review or revise this model for accuracy/errors. It should also be noted that the hydraulic model in that study did not model the proposed improvements to the Santa Ana Blvd. Bridge.

Quantities for cost and impacts were calculated using the six cross-sections for each alternative, the levee alignment lengths, and corridors generated in AutoCAD. The cost estimates and estimated impact area for each alternative are summarized in Table 3.1. The preliminary cost estimates are included in Attachment I-B.

Table 3.2 is a summary of the potential landside improvements that can assist in maintaining the levee from potential root systems and/or rodent burrowing (without using herbicide or rodenticide). Since there are properties along the landside for much of this levee it is assumed that the extent of the landside improvements would be limited to Station 18+50 to Station 44+00, where there are no constructed facilities adjacent to the levee (however, right-of-way would likely need to be acquired). Landside Improvement A would allow for adjacent vegetation scrub to be planted, and B and C would not. Attachment I-E contains examples of these landside improvement details. Costs for each of these landside improvements are included as options (not included in the totals) in the cost estimates presented in Attachment I-B.

Table 3.1: Summary of Alternatives Impacts and Cost

Alternative / Alignment	Description	Est. Impact Area[1] (Acres)	Est. Cost[2]	Benefits	Challenges/Constraints
1	1.5H:1V Concreted Riprap	11.90	$14,641,934	Prevents burrowing through protection.	Would likely need full grout/concrete penetration and thick toe to meet stability requirements. Doesn't meet standard USACE levee geometry requirements.
2	2H:1V Concreted Riprap	13.23	$10,938,361	Prevents burrowing through protection.	Larger impact area.

[1]The estimated impact area includes both the permanent and temporary impact areas. Permanent – footprint of structural features. Temporary – footprint of excavation. The impact area does not include a buffer for temporary construction easement areas; this will be factored in at a later time. In addition, this estimate impact area do not include additional impacts from the Landside Improvements listed in Table 3.2.

[2] The estimated costs are based on the cost estimates provided in Attachment I-B. It should be noted, the mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimate shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

Table 3.2: Summary of Potential Landside Improvements (Station 18+50 to Station 44+00)

Improvement	Potential Landside Improvements	Compatible with Following Alternatives	Approx. Additional Cost	Approx. Additional Impact Area (acres)	Application/Benefit
A	Concreted Riprap on Landside Slope (asphalt on crown)	1, 2	$815,575	2.3	This 2-foot-thick concreted riprap layer would extend 5 feet below existing grade at a 2H:1V slope. This landside improvement would allow for grasses, native scrub, and vegetation with a mature trunk diameter of less 2 inches and shallow root structures to be planted adjacent to the landside slope. Trees or larger shrubs would need to be planted at least 15 feet away from the landside toe of the levee. This would also protect against burrowing of rodents/animals and eliminate the need for rodenticide.
B	Wire Mesh	1, 2	$132,250	1.6	This wire mesh would be embedded 6 inches into the face of the landside slope and extend 5 feet below grade at a slope of 2H:1V. This landside improvement would assist in protecting the slope against burrowing rodents/animals, but it would not eliminate the need for rodent control on the landside. Since this improvement would not provide an adequate root barrier, all vegetation (except grass) would need to be planted at least 15 feet away from the landside levee toe. Any vegetation that grows on or near the landside slope would need to be actively maintained/removed.
C	Raptor Perches / Owl Boxes	1, 2	$22,500	0.0	These raptor perches would be placed at 500-foot spacing near the landside toe of the levee. This landside improvement would assist in protecting the slope against burrowing rodents/animals, but it would not eliminate the need for rodent control on the landside. This alternative would not provide any root barrier, which means that all vegetation (except grass) would need to be planted at least 15 feet away from the landside levee toe or 8 feet away from the floodwall footing. Any vegetation that grows on or near the landside slope would need to be actively maintained/removed.

3.2.1 Alternative 1: 1.5H:1V Concreted Riprap Protection

The design of Alternative 1 (Figure 3.1) consists of a 30-inch-thick concreted riprap blanket that would be placed on a 1.5H:1V slope. The concreted riprap slope would extend from the levee prism hinge point down to the potential scour depth. A weephole system would be required with this alternative. Based on VCPWA standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits and retain existing crown width where right-of-way does not permit. Asphalt concrete would extend laterally from the top of the concreted riprap to provide an access road. Any of the landside improvements (from Table 3.2) could be applied to this alternative to assist in maintaining the landside of the levee. Floodwalls would need to be added at two locations: (1) just upstream of the Santa Ana Blvd. Bridge and (2) Station 12+40 (upstream of the current floodwalls) to Station 19+15. The floodwall is up to 5.5' above adjacent ground at the Santa Ana Blvd. Bridge, and up to 3.5 feet above adjacent ground from Station 12+40 to Station 19+15.

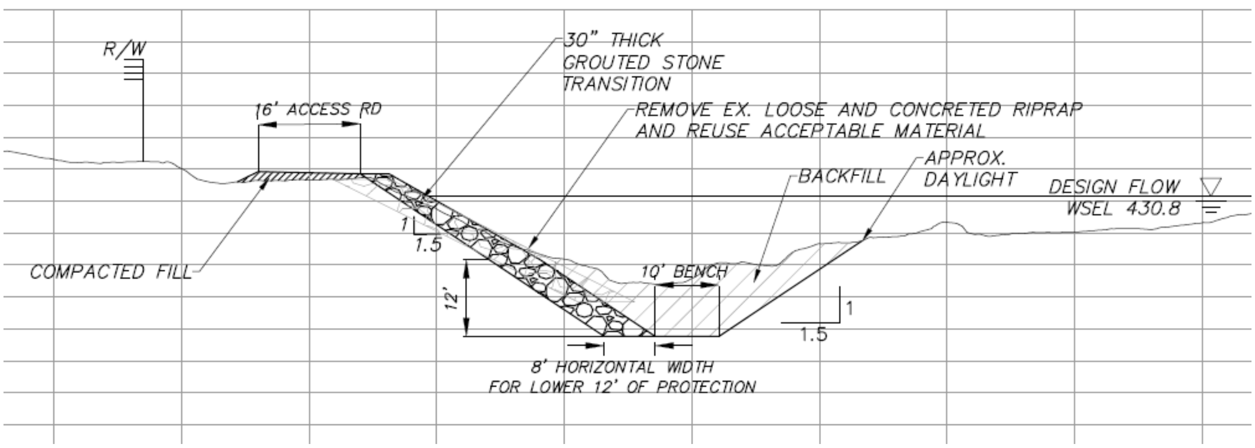

Figure 3.1: Alternative 1 – Typical Section

This concreted riprap slope at 1.5H:1V would likely provide sufficient stability from a geotechnical standpoint but would likely require a thickened toe and full grout/concrete penetration. This concreted riprap slope would provide a solid slope protection that would prevent burrowing through from rodents. This would reduce/eliminate the need for herbicides and pesticides (for small vegetation and rodents) along the riverside portion of the levee.

Some of the foreseeable concerns associated with this alternative include the following:

- In order to meet the required factors of safety for slope stability, the concreted riprap at 1.5H:1V would likely need to have an 8-foot horizontal thickness for the lowest 12 feet of the slope (which transitions to a 30-inch thick layer at the top). In addition, full grout/concrete penetration would be required. These elements significantly increase costs for this alternative and may create difficulties during construction.
- Concreted riprap is generally a brittle material that may crack under differential stress

conditions.

General Maintenance Requirements: Inspect facility routinely, especially after large storm events. Repair stress cracking on concreted riprap surface. If Landside Improvement A is applied to this alternative, minor vegetation could be planted adjacent to the landside slope and the need for rodenticide would be eliminated. If Landside Improvement A is not applied to this alternative, all vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary. Landside Improvements B and C would reduce, but not eliminate the need for maintenance on the landside slope.

3.2.2 Alternative 2: 2H:1V Concreted Riprap Protection

The design of Alternative 2 (Figure 2) consists of a 30-inch-thick concreted riprap blanket that would be placed on a 2H:1V slope. This alternative was added to evaluate if there could be increased cost-savings by flattening the slope and removing the need for a thickened toe. The concreted riprap slope would extend from the levee prism hinge point down to the potential scour depth. A weephole system would be required with this alternative. Based on VCPWA standards/requirements, a 16-foot-wide access road would be placed on the levee crown where right-of-way permits and retain existing crown width where right-of-way does not permit. Asphalt concrete would extend laterally from the top of the riprap to provide an access road. Any of the landside improvements (from Table 3.2) could be applied to this alternative to assist in maintaining the landside of the levee. Floodwalls would need to be added at two locations: (1) just upstream of the Santa Ana Blvd. Bridge and (2) Station 12+40 (upstream of the current floodwalls) to Station 19+15. The floodwall is up to 5.5' above adjacent ground at the Santa Ana Blvd. Bridge, and up to 3.5 feet above adjacent ground from Station 12+40 to Station 19+15.

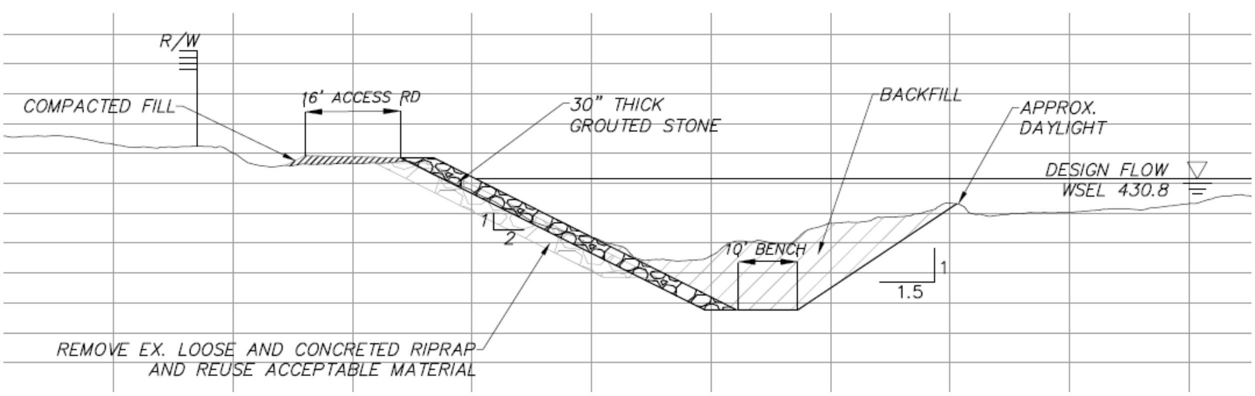

Figure 3.2: Alternative 2 – Typical Section

This concreted riprap slope at 2H:1V would likely provide sufficient stability from a geotechnical standpoint. This concreted riprap slope would provide a solid slope protection that would prevent burrowing through from rodents. This would reduce/eliminate the need for herbicides and pesticides (for small vegetation and rodents) along the riverside portion of the levee.

Some of the foreseeable concerns associated with this alternative include the following:

- Relatively larger impact area compared to the other alternative.
- Concreted riprap is generally a brittle material that may crack under differential stress conditions.

General Maintenance Requirements: Inspect facility routinely, especially after large storm events. Repair stress cracking on concreted riprap surface. If Landside Improvement A is applied to this alternative, minor vegetation could be planted adjacent to the landside slope and the need for rodenticide would be eliminated. If Landside Improvement A is not applied to this alternative, all vegetation regardless of size or root structure (except grasses) must be planted 15 feet from the landside toe, and active maintenance to remove rodents/animals and repair burrows would be necessary. Landside Improvements B and C would reduce, but not eliminate the need for maintenance on the landside slope.

3.3 Comparison and Evaluation

3.3.1 Evaluation Scoring

In an effort to compare each of the alternatives, below is a table that lists the “Evaluation Score” for each of the alternatives (Table 3.3). The “Evaluation Score” is based on the following components for each alternative: impact area, cost, technical feasibility of the design, and maintenance requirements. Table 3.3 summarizes and explains the ratings for each of the alternatives.

Table 3.3: Evaluation Score Table

Alternative	Alternative	Impact Area Rating[1] (Ranked 1-2)	Cost Rating[2] (Ranked 1-2)	Technical Feasibility Rating[3] (Ranked 1-2)	Evaluation Score[4] Averaged Score
1	1.5H:1V Grouted Stone	2	1	1	1.3
2	2H:1V Grouted Stone	1	2	2	1.7

Notes:

[1] Impact Area Rating is based on a ranking of the alternative's impact area from 1 to 2; 2 being the smaller impact area.

[2] Cost Rating is based on a ranking of the alternative's construction cost from 1 to 2; 2 being the less expensive.

[3] Technical Feasibility Rating is based on a ranking of the alternative's technical feasibility from 1 to 2; 2 being the alternative with the least amount of potential construction complications.

[4] Evaluation Score is an average of the other ratings assigned to the alternative. The higher the score, the better.

3.3.2 Impact Areas Sum

The impact areas presented in previous portions of this report only include the acreage for the riverside improvement and levee prism. These impacts do not include the impacts of potential landside improvements and additional temporary construction easement buffer. Below is table that approximates the potential total impact area including these elements.

Table 3.4: Summary of Alternatives Impacts and Cost

Alternative	Impact Area (acres)	Landside Improvement (acres)		Additional TCE (acres)	Total (acres)
1	11.90	A	2.3	2.07	16.27
2	13.23	A	2.3	2.07	17.6
TCE = Temporary Construction Easement. This is calculated assuming an additional 8-foot buffer on each side of the earthwork limits along the entire length of the levee.					

4.0 SELECTED ALTERNATIVE AND INTERMEDIATE DESIGN DEVELOPMENT

Based on the information provided in Section 3 of this report, the VCPWA determined that Alternative 2 (2H:1V Concreted Riprap) with no landside improvement will be the selected alternative moving forward. Furthermore, Alternative 2 will now be referred to as the selected alternative in the remainder of this report.

Section 4 details the development of the selected alternative and the associated Intermediate Design. Of the two sets of Attachments included as part of this report, Attachment II includes all of the references related to the Intermediate Design of the Selected Alternative.

4.1 Selected Alternative Basis of Design

The proposed improvements (and supporting technical analyses) as part of this study are based on parameters that would satisfy the requirements of Title 44 of the Code of Federal Regulations, Section 65.10 (44 CFR, 65.10). These requirements are necessary for levee certification from FEMA.

The plans for the selected alternative were prepared to include the following: title sheet, aerial photograph plan, plans and profiles (1”=100’ horizontal and 1”=10’ vertical), typical sections and details, and cross-sections (at no less frequent than 500’ on center and at changes in toe-down depth).

4.1.1 **Alignment**

The alignment used in the Intermediate Design is similar to the alignment used in the conceptual-level design. As described in Section 3.1.1 (Alignment) of this report, the alignment for this levee system is based on the alignments from previous improvements along this levee system. A similar alignment was provided in the *Matilija Dam Ecosystem Restoration, Meiners Oaks and Live Oak Acres Levees, Design Plans* (USACE SPL 2008). The proposed improvements, as presented in this report, currently extend along the Live Oak Creek Diversion and tie into Burnham Road (at the upstream limit). For this study, it is assumed that this entire reach will be protected similar to the reach along Ventura River. However, this portion of the levee (from Burnham Road to Ventura River) will need to be further evaluated to understand the extent of: (1) the erosion protection required, (2) the vegetation management that will be required in this area, if any, and (3) the potential for straightening of the alignment in this reach. This will be further evaluated in a subsequent phase of design.

The alignment for the Intermediate Design is described above. In addition, there have been minor revisions to the alignment which include the following:

1) The VCPWA has performed several technical studies for the Santa Ana Bridge and has contracted with Quincy Engineering to prepare the design for the replacement of the Santa Ana Bridge. These improvement features include: a change of the bridge opening, abutment protection, pier modifications, relocation of centerline, etc. Tetra Tech has

slightly modified the alignment in the vicinity of the bridge to accommodate and tie into the bridge improvements.

2) A meeting with VCPWA, Tetra Tech, and AECOM took place to discuss the potential of flooding downstream of the Santa Ana Blvd. Bridge. During this meeting all participating parties discussed potentially extending the alignment downstream to prevent flooding in the adjacent area. In a subsequent discussion with Tetra Tech and VCPWA, it was determined that there is currently not enough information to support extending the levee further downstream. At this time, the understanding is that further hydraulic analysis will be required to accurately evaluate the levee extents in the reach. The determination was to extend the levee to just downstream of Santa Blvd. Bridge during this phase of work. The current Santa Ana Bridge Improvements (VCWPD 2020) include bank protection from upstream of the bridge to downstream of the bridge. The Intermediate Design is currently intended to tie into these improvements upstream of the proposed bridge.

4.1.2 **Top-of-Levee Elevation**

The top-of-levee elevations are based on the design flow water surfaces described in Section 2.2 (Hydraulics and Sediment Transport). As described in Section 3.1.2 (Top-of-Levee Elevation), FEMA deterministic freeboard requirements were applied to the Design Flow water surface elevations to develop a design top-of-levee profile. Table 4.1 summarizes the design top-of-levee elevations, as well as the hydraulic output and scour components.

The preliminary design of the top-of-levee elevation profile developed for the conceptual-level alternatives is discussed in Section 3.1.2. This preliminary top-of-levee profile was used to develop the Intermediate Design top-of-levee profile, but also includes the following revisions to the profile:

1) The design top-of-levee elevations (Table 4.1) were adjusted to avoid unnecessary grade breaks in the profile and to replace abrupt changes in elevation with smoother transitions. These design elevations are also provided in the profiles of the Intermediate Design drawings (Attachment II-F).

2) In locations where the height of the existing ground was higher than the required levee, the top of levee was designed at or near the existing levee elevation. By matching the existing ground with the top of levee, at these locations, the amount of excavation and backfill material is minimized. In addition, this would prevent lowering the existing levels of flood protection.

Table 4.1: Hydraulic Output and Scour Components(TOL)

Approximate Levee Station	HEC-RAS XS RM	Existing Computed Water-Surface Elevation (feet)		Future Dam Removal Condition Computed Water-Surface Elevation (feet)		Existing Top-of-Levee Elevation (feet)	FEMA Required Freeboard	Min. Design Levee TOL Elev.	Design Levee TOL Elev.
		100-Year	Design Flow	100-Year	Design Flow				
N/A	10.23	468.64	468.87	470.29	470.52		3.50	474.02	475.00
46+89	10.13	461.99	462.24	463.06	463.31	465.27	3.50	466.81	467.00
41+83	10.04	455.64	455.93	456.46	456.75	458.04	3.00	459.75	460.00
36+69	9.94	448.60	448.86	449.17	449.43	450.51	3.00	452.43	453.00
33+72	9.85	442.06	442.35	442.56	442.85	446.65	3.00	445.85	446.00
28+59	9.75	435.55	435.78	435.55	435.78	439.98	3.00	438.78	439.00
23+53	9.66	428.88	429.21	429.93	430.26	432.89	3.00	433.26	434.00
18+50	9.56	424.82	425.40	426.08	426.66	426.86	3.00	429.66	430.00
13+41	9.47	419.78	420.14	419.84	420.20	420.24	3.00	423.20	424.00
8+40	9.38	413.99	414.51	414.32	414.84	419.01	3.00	417.84	419.01
3+69	9.29	410.48	411.53	411.46	412.51	417.51	3.00	415.51	417.51
0+77	9.25	409.41	410.60	410.51	411.70	410.50	4.00	415.70	416.00
0+65*	Santa Ana Blvd Bridge								

*Approximate Station at Santa Ana Blvd Bridge (existing location).

4.1.3 Toe-Down Protection Elevation

The total estimated scour depth, as described in Section 2.3 (Scour Computations), was applied to the channel thalweg (at each of the hydraulic cross-sections) to determine a minimum toe-down protection elevation. Table 4.2 summarizes the hydraulic output and scour components. The summary of hydraulics and design parameters presented in Table 4.3 , shows how the scour was applied and toe-down protection elevations were established. The design levee toe elevations (Table 4.2) were adjusted to avoid unnecessary grade breaks in the profile and to replace abrupt changes in elevation with smoother transitions. These design elevations are also provided in the profiles of the Intermediate Design drawings (Attachment II-F).

Table 4.2: Hydraulic Output and Scour Components (Toe)

Approximate Levee Station	HEC-RAS XS RM	Channel Thalweg (feet)	Total Scour Depth	Min Design Levee Toe Elev.	Design Levee Toe Elev.
N/A	10.23	460.79	6.60	454.19	452.00
46+89	10.13	452.81	6.60	446.21	444.00
41+83	10.04	446.22	7.40	438.82	437.00
36+69	9.94	436.92	7.40	429.52	428.00
33+72	9.85	430.78	7.40	423.38	422.00
28+59	9.75	424.51	7.40	417.11	416.00
23+53	9.66	417.24	7.40	409.84	408.00
18+50	9.56	412.61	7.40	405.21	404.00
13+41	9.47	405.59	6.50	399.09	397.00
8+40	9.38	404.50	6.50	398.00	396.00
3+69	9.29	395.34	6.50	388.84	387.00
0+77	9.25	393.17	6.50	386.67	383.00
0+65*	Santa Ana Blvd Bridge		8.50	384.67	383.00

*Approximate Station at Santa Ana Blvd Bridge (existing).

Table 4.3: Summary of Scour Calculations

Reach	River Station	Bend Scour Depth (ft)	Long Term Scour	Single Event Scour	Total
Ventura River	10.23	4.1	2.50	0.50	6.6
	10.13	4.1	2.50	0.50	6.6
	10.04	4.9	2.50	0.50	7.4
	9.94	4.9	2.50	0.50	7.4
	9.85	4.9	2.50	0.50	7.4
	9.75	4.9	2.50	0.50	7.4
	9.66	4.9	2.50	0.50	7.4
	9.56	4.9	2.50	0.50	7.4
	9.47	4.0	2.50	0.50	6.5
	9.38	4.0	2.50	0.50	6.5
	9.29	4.0	2.50	0.50	6.5
	9.25	4.0	2.50	0.50	6.5

*Table is for the design flow, which is of larger magnitude than the 100-yr storm event. Complete tables for both the 100-yr storm event and the design flow can be found in Attachment I-D.

4.2 Selected Alternative Description

4.2.1 **2H:1V Concreted Riprap**

The design of the selected alternative used in the Intermediate Design consists of a 30-inch-thick concreted riprap blanket be placed on a 2H:1V slope. See Section 3.2.2 (Alternative 2: 2H:1V Concreted Riprap Protection) of this report to see a description of the conceptual-level design. The concreted riprap slope will extend from the levee prism hinge point down to the potential scour depth. A few general items related to the design are below:

- The excavation cut (towards the river) for the toe-down construction is shown at a 1.5H:1V slope.
- There is a 10-foot construction bench at the toe of the slope protection.
- A weephole system will be constructed along the entire length of the levee. Weepholes will be constructed on the riverside slope, with two weephole outlet pipes at no less frequent than 100’ on center.
- Based on VCPWA standards/requirements, a 16-foot-wide access road will be placed on the levee crown where right-of-way permits and retain existing crown width where right-of-way does not permit.
- Crushed miscellaneous base will be placed on the crown.
- Floodwalls will be added at two locations: (1) Station 1+25 (just upstream of the Santa Ana Blvd. Bridge) to Station 1+75 and (2) Station 12+40 (upstream of the current floodwalls) to Station 19+15.

- Flap gates will be replaced where they exist and added where they do not.

The following tables, text, and cross-sections summarize the proposed design by reach.

Table 4.4: Summary of Improvements

Station		Description
Start	End	
0+50	1+25	• Current Santa Ana Bridge improvements • Protect concreted riprap in place
1+25	1+75	• Proposed Floodwall (tie into Santa Ana Bridge wingwall) • Replace bank protection with Concreted Riprap Slope Protection
1+75	4+80	• Existing Floodwall • Replace bank protection with Concreted Riprap Slope Protection
4+80	5+80	• Existing Floodwall Transition (F/W on each side of access road) • Replace bank with Concreted Riprap Slope Protection
5+80	12+40	• Existing Floodwall • Replace bank with Concreted Riprap Slope Protection
12+40	19+15	• Proposed Floodwall • Replace bank with Concreted Riprap Slope Protection
19+15	56+50	• No Floodwall • Replace bank with Concreted Riprap Slope Protection

From Station 0+50 to 1+25, the existing alignment crosses through proposed Santa Ana Blvd Bridge. The currently design improvements include concreted riprap slope protection at the abutment. These design improvements are to be protected in place and tie into the improvements upstream.

From Station 1+25 to 1+75, a proposed reinforced concrete floodwall will span from the wingwall at Santa Ana Bridge to the existing floodwall at Station 1+75. The floodwall is proposed to be 5.5 feet in height above grade to meet levee height requirements. The proposed 30-inch-thick concreted riprap blanket will replace the existing riprap slope. There will be no access road in this reach since it is adjacent to Riverside Rd. See Figure 4.1 below for the typical section.

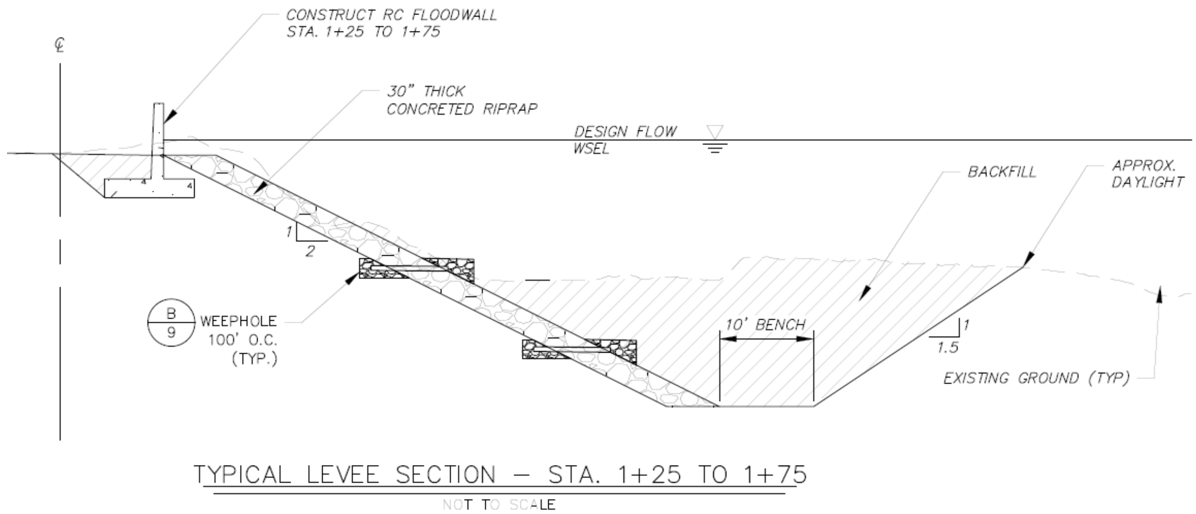

Figure 4.1: Typical Section – Station 1+25 to 1+75

From Station 1+75 to 4+80, an existing reinforced concrete floodwall to the east of the access road is currently in place. The floodwall is to be protected in place. The proposed 30-inch-thick concreted riprap blanket will replace the existing riprap slope. There will be no access road in this reach since it is adjacent to Riverside Rd from Station 1+75 to 3+10. An existing asphalt concrete access road spans from Station 3+10 to 4+80 in this reach and will be protected in place. See Figure 4.2 below for the typical section.

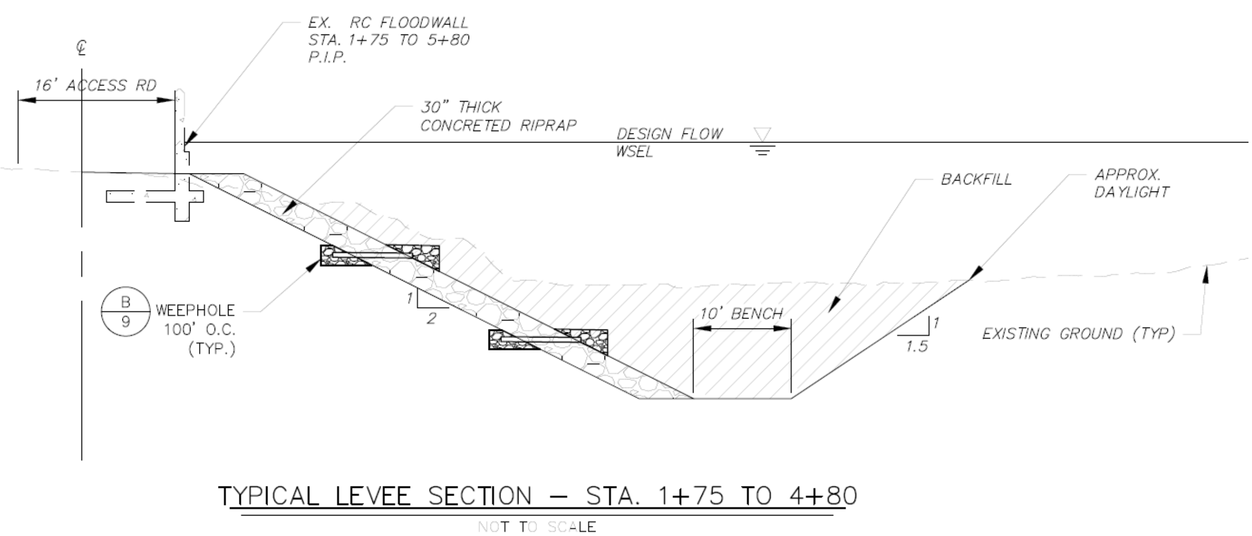

Figure 4.2: Typical Section – Station 1+75 to 4+80

From Station 4+80 to 5+80, an existing reinforced concrete floodwall transition along both the east and west of the access road is currently in place. The floodwall is to be protected in place. The proposed 30-inch-thick concreted riprap blanket will replace the existing riprap slope. An existing asphalt concrete access road spans from Station 4+80 to 5+80 in this reach and will be protected in place. See Figure 4.3 below for the typical section.

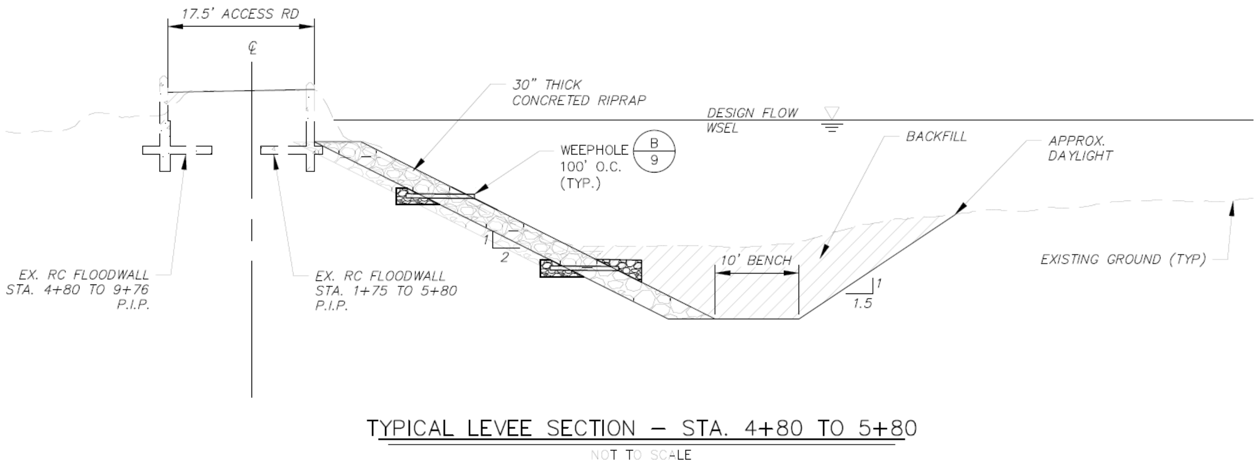

Figure 4.3: Typical Section – Station 4+80 to 5+80

From Station 5+80 to 12+40, an existing reinforced concrete floodwall to the west of the access road is currently in place. The floodwall is to be protected in place. The proposed 30-inch-thick concreted riprap blanket will replace the existing riprap slope. An existing asphalt concrete access road spans from Station 5+80 to 6+03 in this reach and will be protected in place. An existing CMB access road spans from Station 6+03 to 12+40 in this reach and will be protected in place. See Figure 4.4 below for the typical section.

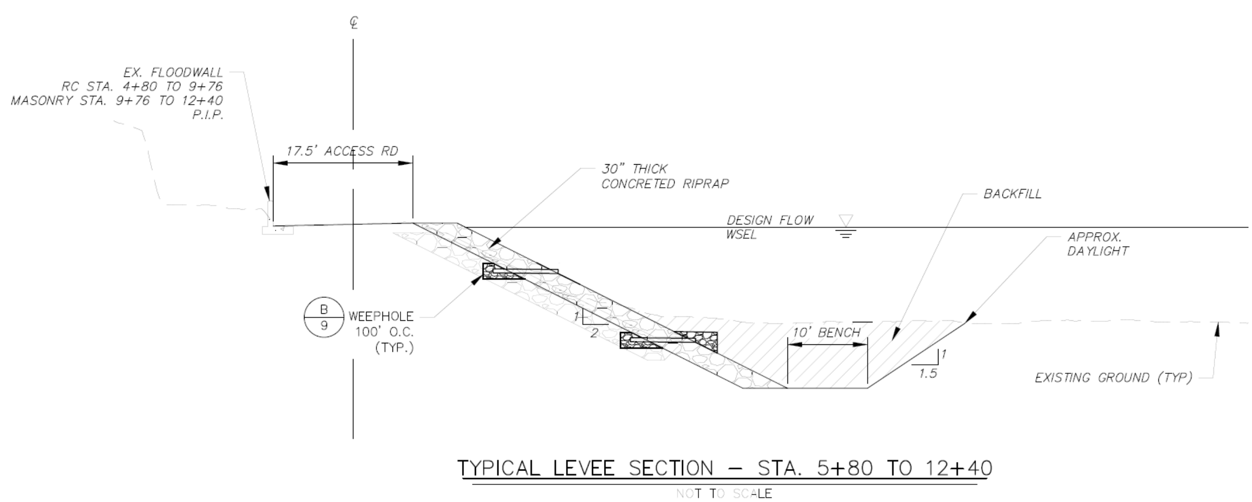

Figure 4.4: Typical Section – Station 5+80 to 12+40

From Station 12+40 to 19+15, an existing reinforced concrete floodwall to the west of the access road is currently in place. The floodwall is to be protected in place. The proposed 30-inch-thick concreted riprap blanket will replace the existing riprap slope. An existing CMB access road spans from Station 12+40 to 18+15 in this reach and will be protected in place. From Station 18+15 to 19+15, the top of levee crown is proposed to transition to match the top-of-floodwall height. See Figure 4.5 below for the typical section.

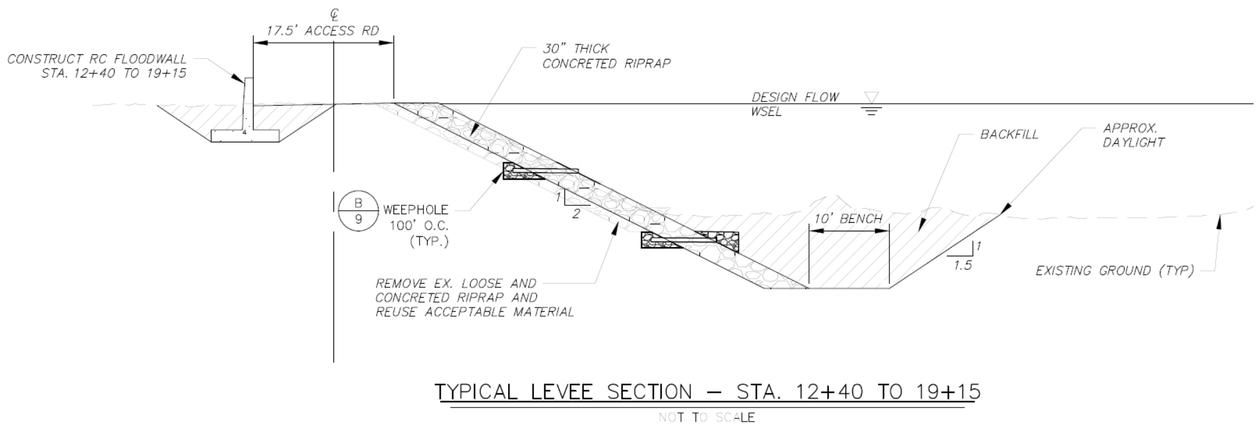

Figure 4.5: Typical Section – Station 12+40 to 19+15

From Station 19+15 to Station 56+50, the levee is proposed to be increased in height (no floodwall). The proposed 30-inch-thick concreted riprap blanket will replace the existing riprap slope. An existing CMB access road spans from Station 12+40 to 18+15 in this reach and will be replaced with the improvements to the levee. See Figure 4.6 below for the typical section.

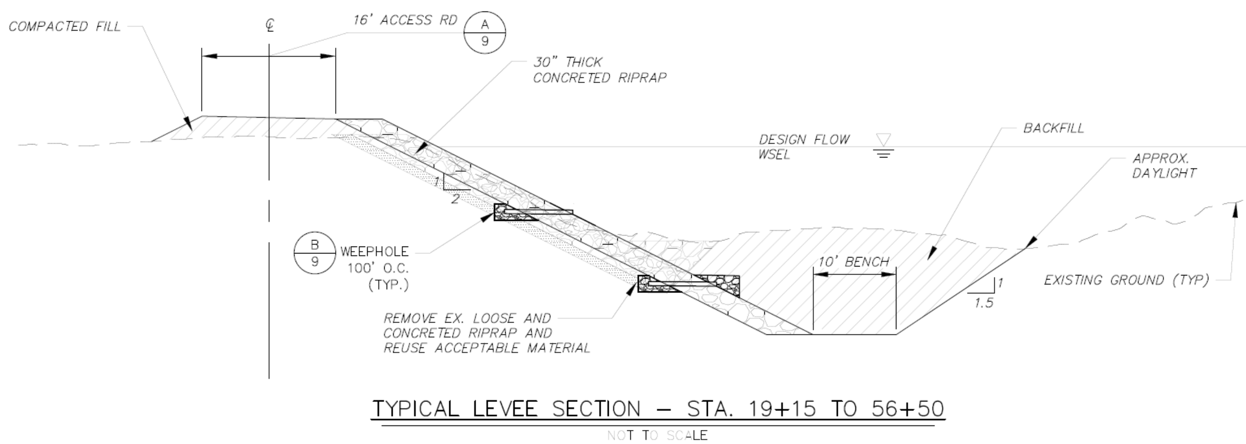

Figure 4.6: Typical Section – Station 19+15 to 56+50

4.2.2 Side-Drainage Structures

A 48" RCP side-drainage structure exists along this levee system at Station 2+92 (USACE SPL 2008). The 48" RCP will be protected in place and extended to the meet the grade of the new slope protection. The existing outlet structure will be replaced, and a flap gate will be added to the end of the pipe. It is assumed the existing flap gate on this pipe will need to be replaced.

Based on a review of as-built drawings, two 24" CSPs penetrate the levee at Station 16+50 (1-24" CSP) and Station 33+50 (1-24" CSP). It is assumed that theses penetrations are necessary, and will be replaced with 24" RCP with outlet structures and flap gates.

4.2.3 Access Road

The access road material will vary from crushed miscellaneous base (CMB) to asphalt concrete. In places where the levee crown access road is being modified, the crown will be constructed with a 6-inch CMB layer (Figure 4.10). In places where the levee crown access road is not being modified, the existing CMB or asphalt concrete will remain in place. The crown will be constructed at a two percent grade, towards the riverside of the levee for the entire length. See Table 4.2 for summary of access road description.

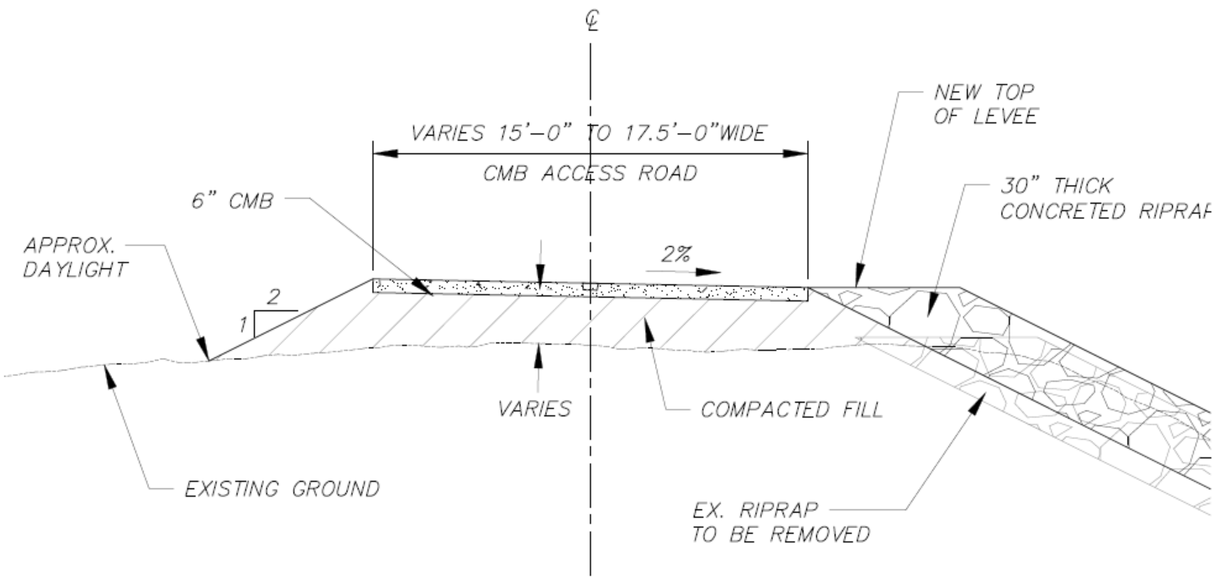

Figure 4.7: Access Road Detail

Table 4.5: Summary of Access Road

Station		Description
Start	**End**	
1+25	3+10	Riverside Rd. (existing)
3+10	6+03	6-inch Asphalt Concrete (existing) Protect in place
6+03	18+15	Crushed Miscellaneous Base (existing) Protect in place
18+15	56+50	Crushed Miscellaneous Base (existing) Replace with Crushed Miscellaneous Base (proposed)

4.2.4 Access Ramps

Two access ramps will be constructed along the levee system, at Station 8+00 and Station 41+00. The access ramps are 16' wide, composed of 8" RC, and designed for a 10% maximum slope from the top of the levee to the existing ground.

4.2.5 Maintenance Requirements

The General Maintenance Requirements of the selected alternative used in the Intermediate Design include: routine facility inspections, especially after large storm events; repair stress cracking on concreted riprap surface. Vegetation would need to be monitored and removed throughout the entire levee.

4.3 Environmental Considerations

4.3.1 Impact Areas

The impact areas presented in previous portions of this report only include the acreage for the riverside improvement and levee prism. These impacts do not include the impacts of potential landside improvements and additional temporary construction easement buffer. Table 4.4 shows the potential total impact area, including these elements.

Table 4.6: Summary of Impact Areas

Selected Alternative	Permanent Impact Area (acres)	Temporary Impact Area (acres)	Additional TCE (acres)	Total Temporary Impact Area (acres)
2H:1V Concreted Riprap Protection	9.3	4.0	5.5	18.8
TCE = Temporary Construction Easement. This is calculated assuming an additional 40-foot buffer from the excavation limit on the riverside and a 3-foot buffer on the landside. In the vicinity of the bridge, this temporary work are was reduced to a 30-foot buffer on the riverside to prevent additional impacts in a "Natural Recruitment" area. These buffers were provided by VCPWA.				

4.3.2 Potential Stockpiling Locations and Staging Areas

Several potential stockpiling locations and staging areas have been identified in Figure 4.8. The locations identified are based off field investigations, discussions amongst the Casitas Municipal Water District, VCPWA and Tetra Tech, and those previously designated in the *Matilija Dam Ecosystem Restoration, Meiners Oaks and Live Oak Acres Levees, Design Plans* (USACE SPL 2008). However, these locations will not be confirmed until after the Intermediate Design.

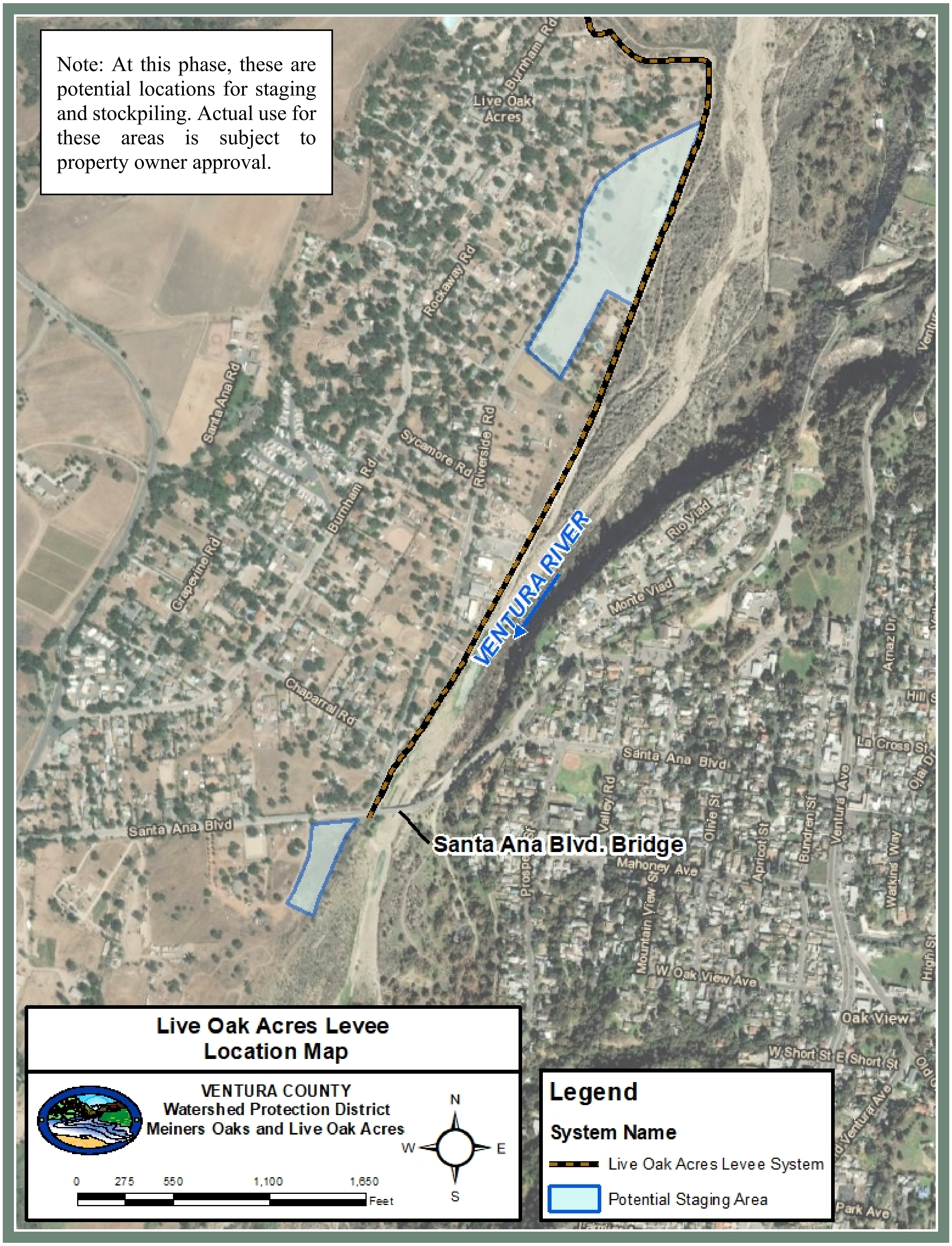

Figure 4.8: Potential Stockpiling Locations and Staging Areas

4.3.3 Stormwater Capture/Treatment

Potential stormwater capture/treatment methods are currently being discussed. One possible capture may include a gravel trench along the landside or riverside toe. It was determined by VCPWA that the stormwater capture/treatment options will be further defined in a subsequent phase of design.

4.3.4 CEQA Support

As part of the current scope of work, Tetra Tech was contracted to provide impact areas (see Section 4.3.1) and average daily labor and equipment that enter and exit the construction site and the duration of time the equipment will operate. See below:

<u>Average Daily Labor:</u>

- Estimated 25 laborers (including OH staff) per day on average

<u>Average Daily Equipment (that enter and exits the construction site):</u>

- Estimated 30 haul trucks would enter and exit the site per day on average.
    - It should be noted that most other equipment will enter the site on the first day and remain on site until construction is completed.

<u>Duration of time the equipment will operate:</u>

- Equipment will operate onsite for 8 hours per day
- Estimated 154 working days (approximately 7.5 months assuming 5-day work weeks)

The information above was calculated by breaking out the durations of each of component of the items included in the cost estimate. See Attachment II-K for the Calculations of Durations and Vehicle Trips.

4.4 Cost

4.4.1 Cost and Quantity Calculations

An engineer's estimate for construction cost has been prepared on the basis of the Intermediate Design (Attachment II-G).

This cost estimate is based on the quantities calculated from the cross-sections shown in the attached Intermediate Design plans. The quantity calculations assume typical conditions between the cross-sections. The quantities were completed using AutoCAD programming to allow for accurate estimating of lengths, areas and volumes. Further calculation assumptions and quantity summaries were then calculated using Excel. Detailed information on the quantity calculations is provided in Attachment II-H.

The unit prices reflected in the cost estimate are assumed to account for all necessary construction activities to complete each item as discussed in this report. The unit prices in the cost estimate have been developed with detailed breakdowns of construction activities to the sub-feature level. The unit prices used for these sub-feature items have been taken from various sources. These sources include RS Means, previous contractor bids, and recent vendor quotes. All sourced unit prices have been escalated and adjusted to reflect current prices at the project location.

As the project advances to a final design stage, further information will become available and further technical analyses will be performed (H&H, geotechnical investigation, etc.). This information and results may alter the quantities, unit costs, and general assumptions used during this phase of design. Additionally, any fees or permits required for construction or maintenance activities and real estate requirements are not included.

4.4.2 Key Cost Estimate Assumptions

The unit prices and quantities used in the cost estimate for the Intermediate Design are based on several key assumptions. The following are the assumptions for the primary construction items:

- **Availability.** All required import materials (stone, asphalt, concrete, etc.) are readily available from a nearby distributor at market value.
- **Backfill.** All material for use as backfill would come from the excavated materials. No borrow fill is assumed to be delivered to the project site for backfill (only for compacted fill of the prism).
- **Excavation.** All excavated material would be stockpiled on-site and made available for reuse as backfill.
- **Export.** It is assumed that there would be no export or disposal necessary. Excess material is assumed to be reused or stockpiled by the County.
- Concreted Rock Riprap Reuse. It assumed currently assumed that 50% of the existing riprap material that is removed can be used for the concreted rock riprap.
- **Riprap Removal.** The removed material would be stockpiled on-site and reused in the toe backfill. It is assumed none of this material would need to be exported.
- **Side-Drainage Structures.** The unit cost assumes that the existing pipe is in good condition and would only need to be extended.
- **Total Construction Costs.** The mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the

cost estimate shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.

4.4.3 Total Project Cost Estimate

A summary of the total cost for the Intermediate Design is provided in Table 4.7.

Table 4.7: Total Project Cost

	Contract Items	Unit	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$1,005,000.00	$1,005,000
2	Clearing and Grubbing	ACR	16	$4,500.00	$72,000
3	Diversion and Control of Water	LS	1	$1,500,000.00	$1,500,000
4	Levee Slope Protection (Concreted Riprap)	LF	5,525	$1,478.05	$8,166,250
5	Access Ramps	EA	2	$122,904.00	$245,808
6	Storm Drains	EA	3	$22,500.00	$67,500
				Total Project Cost	**$11,056,558**

See Attachment II-G for a detailed breakout of the quantities and cost estimate sub items.

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5.0 REFERENCES

AECOM/ Stillwater Sciences. 2019a. *Matilija Dam Removal 65% Design Subtask 2.3: Hydraulic Studies to Determine 100-yr Water Surface Elevations Technical Memorandum.* August 26.

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VCWPD. 2016b. *Matilija Dam Ecosystem Restoration, Santa Ana Blvd Bridge Replacement, Road Improvements*. February.

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ATTACHMENT I

Supporting Documents Related to the Alternatives Analysis

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ATTACHMENT A

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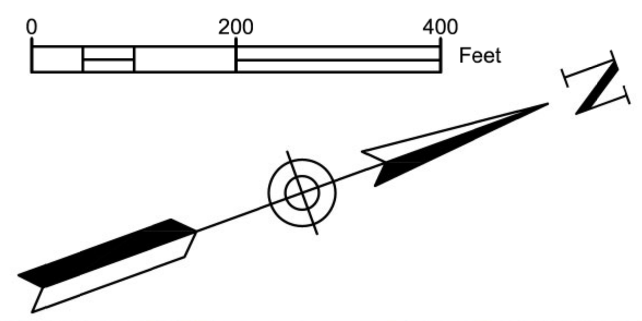
LIVE OAK ACRES LEVEE
ALTERNATIVE 1
GROUTED STONE (1.5H:1V) ALTERNATIVE



NOTES:

(1) CONSTRUCT LEVEE BANK PROTECTION PER PLAN HEREON. TYPICAL SECTIONS ON SHEET 2.

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– DESIGNED	PROJECT MANAGER DATE	COUNTY OF VENTURA PUBLIC WORKS AGENCY WATERSHED PROTECTION DISTRICT	SPEC. NO. –
– DRAWN	DEPUTY DIRECTOR DATE		PROJ. NO. –
– CHECKED	DISTRICT DIRECTOR DATE		

MEINERS OAKS AND LIVE OAK ACRES PROJECT
LIVE OAK ACRES LEVEE

PLAN AND CROSS-SECTIONS
PLAN VIEW (ALT 1)

SHEET 1 OF 2

DRAWING NO. Y-?-?

LIVE OAK ACRES LEVEE
ALTERNATIVE 1
GROUTED STONE (1.5H:1V) ALTERNATIVE

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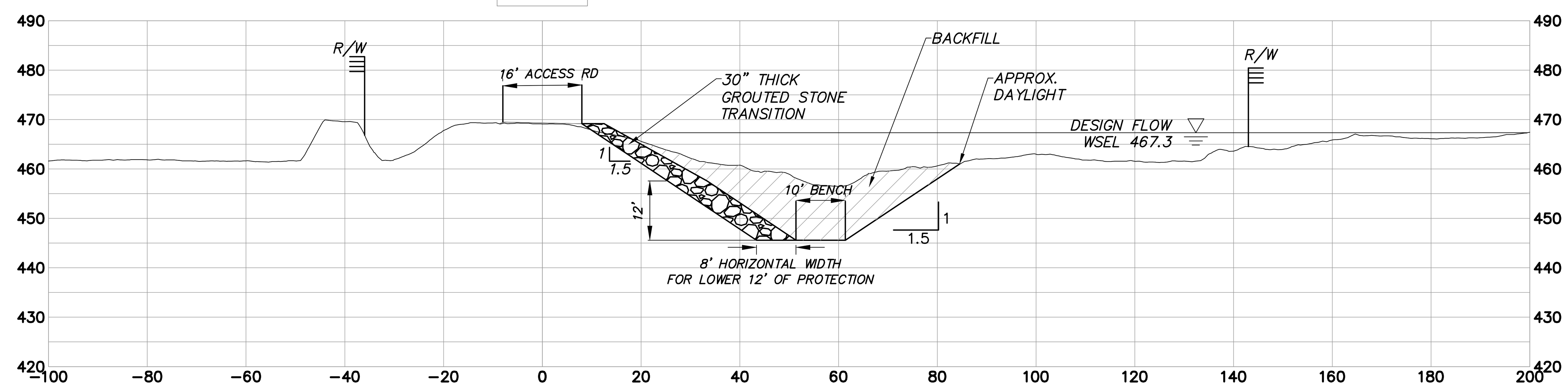

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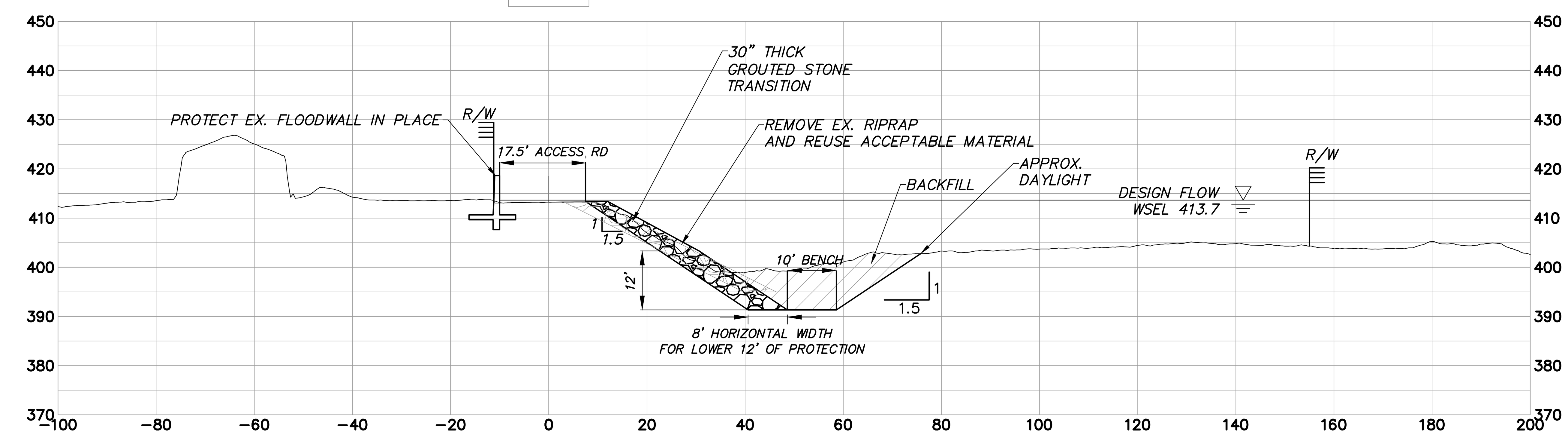

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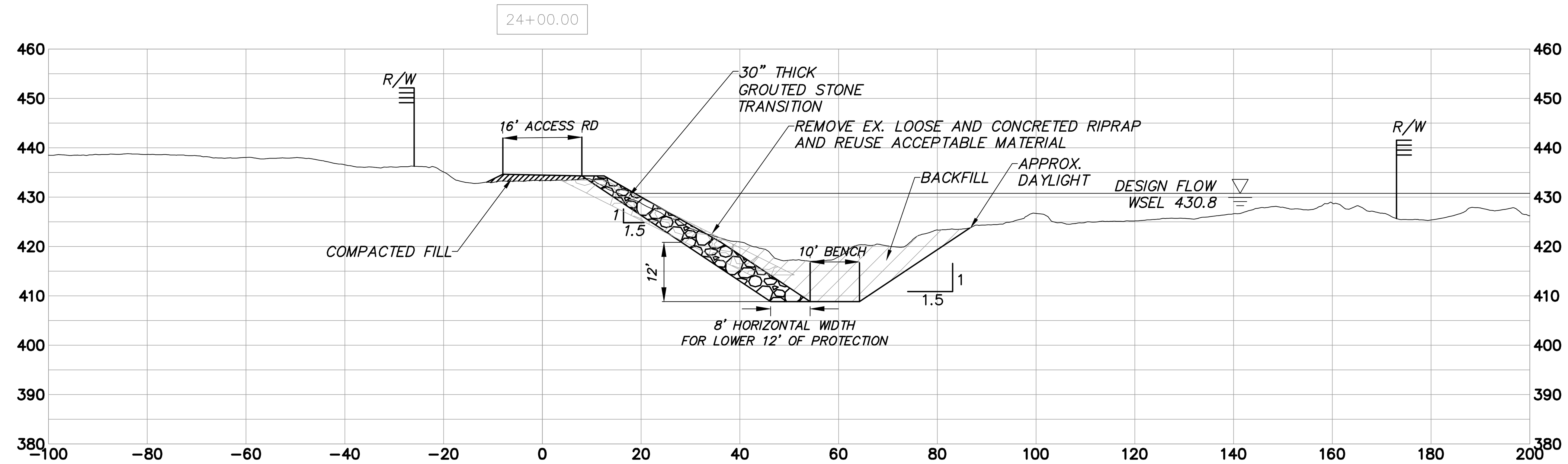

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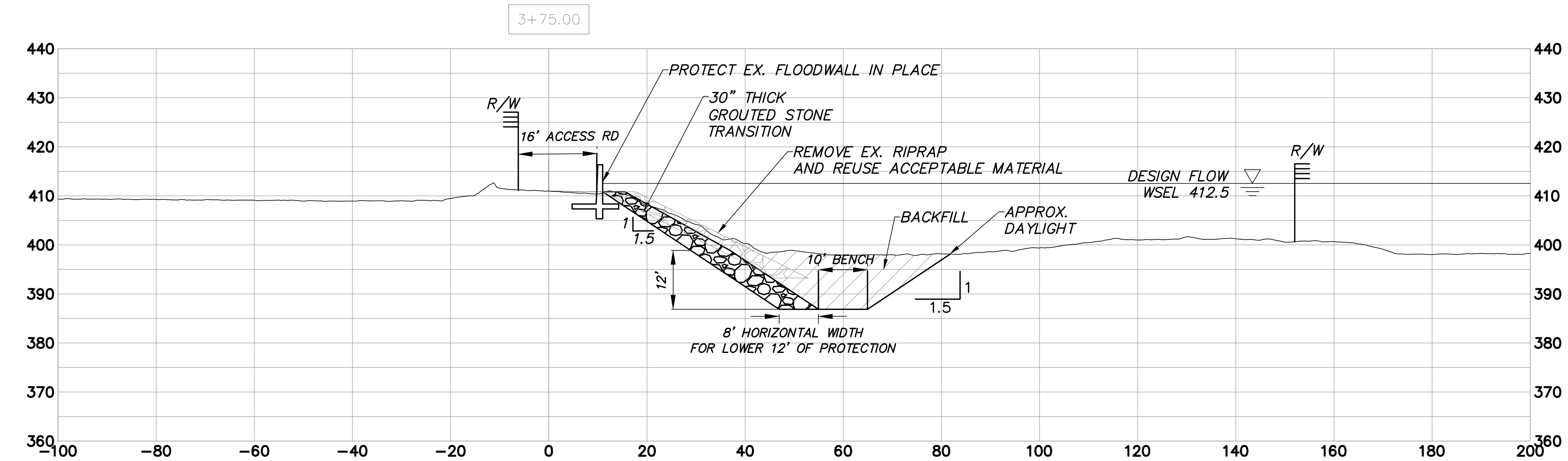

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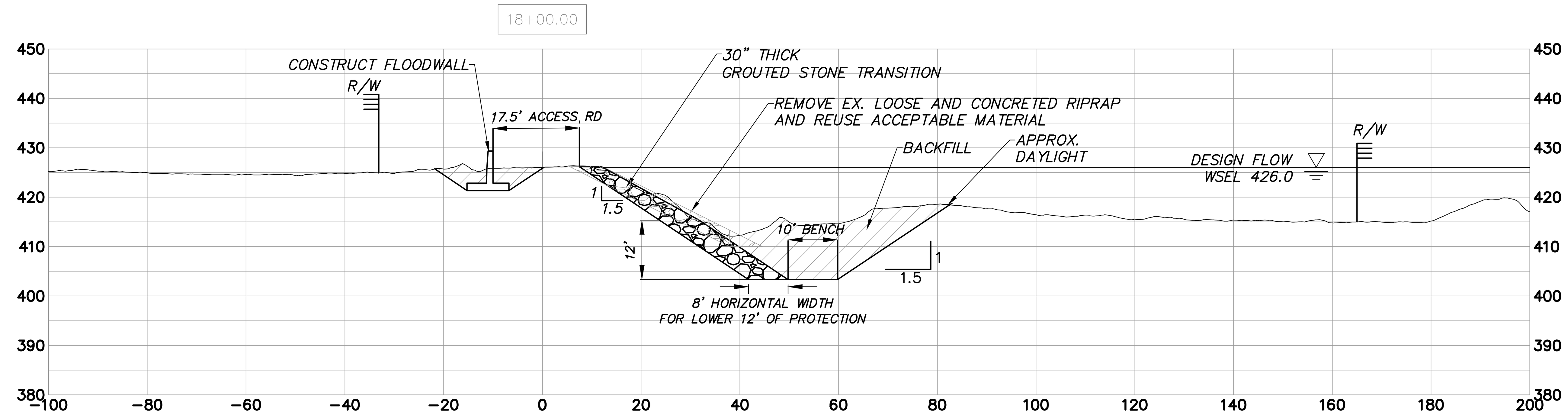

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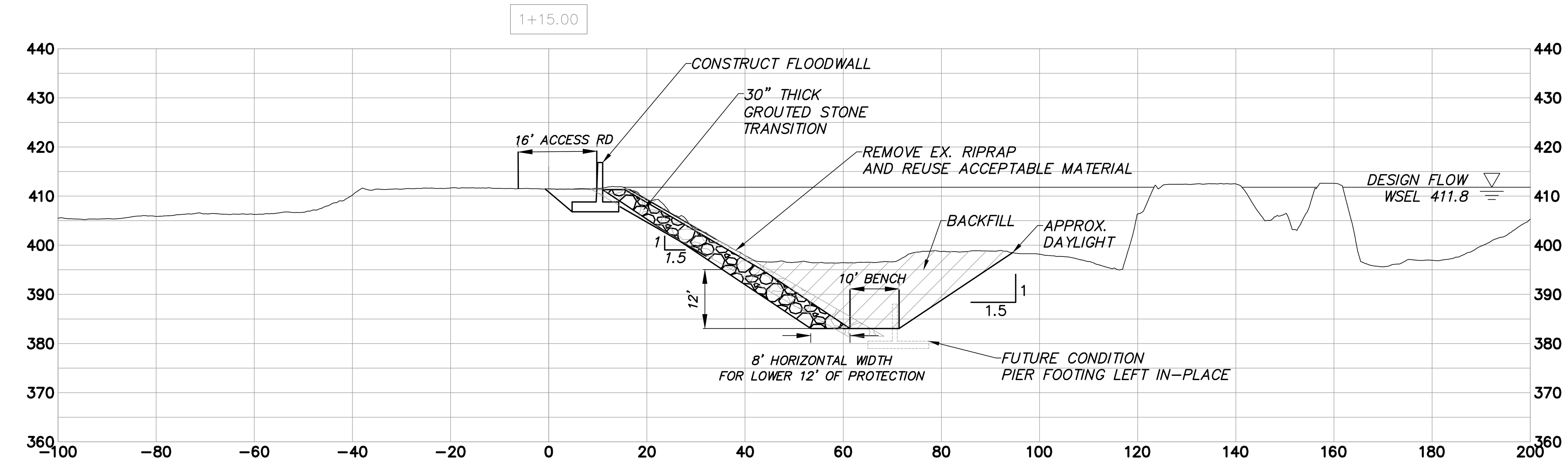

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DEPUTY DIRECTOR DATE
DISTRICT DIRECTOR DATE

COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION DISTRICT

SPEC. NO. –
PROJ. NO. –

MEINERS OAKS AND LIVE OAK ACRES PROJECT
LIVE OAK ACRES LEVEE

PLAN AND CROSS–SECTIONS
CROSS–SECTIONS (ALT 1)

SHEET 2 OF 2
DRAWING NO. Y–?–?

LIVE OAK ACRES LEVEE
ALTERNATIVE 2
GROUTED STONE (2H:1V) ALTERNATIVE

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COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION DISTRICT

SPEC. NO. –
PROJ. NO. –

MEINERS OAKS AND LIVE OAK ACRES PROJECT
LIVE OAK ACRES LEVEE

PLAN AND CROSS-SECTIONS
PLAN VIEW (ALT 2)

SHEET 1 OF 2
DRAWING NO. Y-?-?

LIVE OAK ACRES LEVEE
ALTERNATIVE 2
GROUTED STONE (2H:1V) ALTERNATIVE

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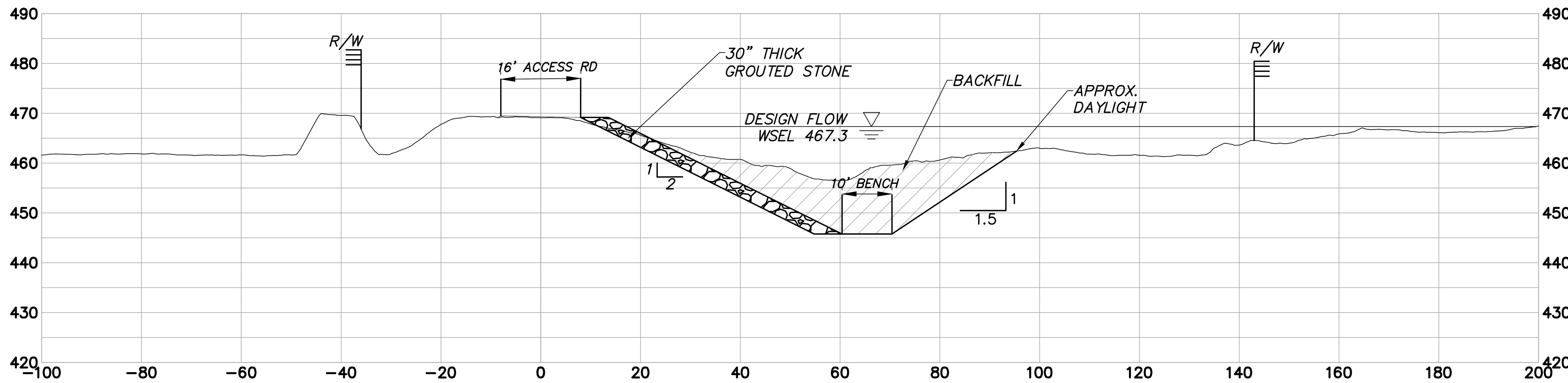

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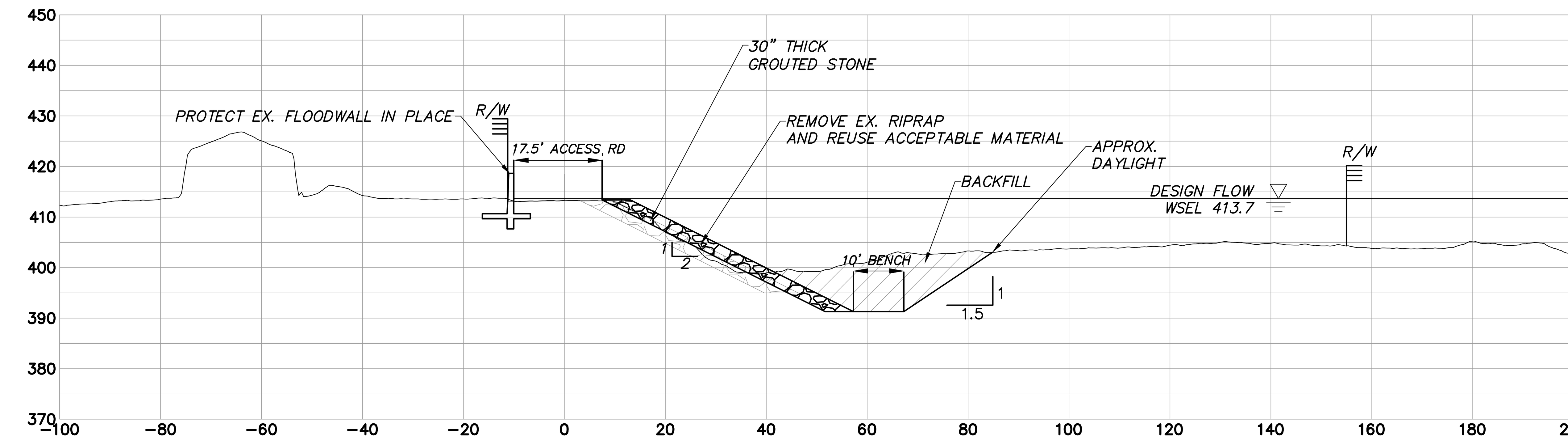

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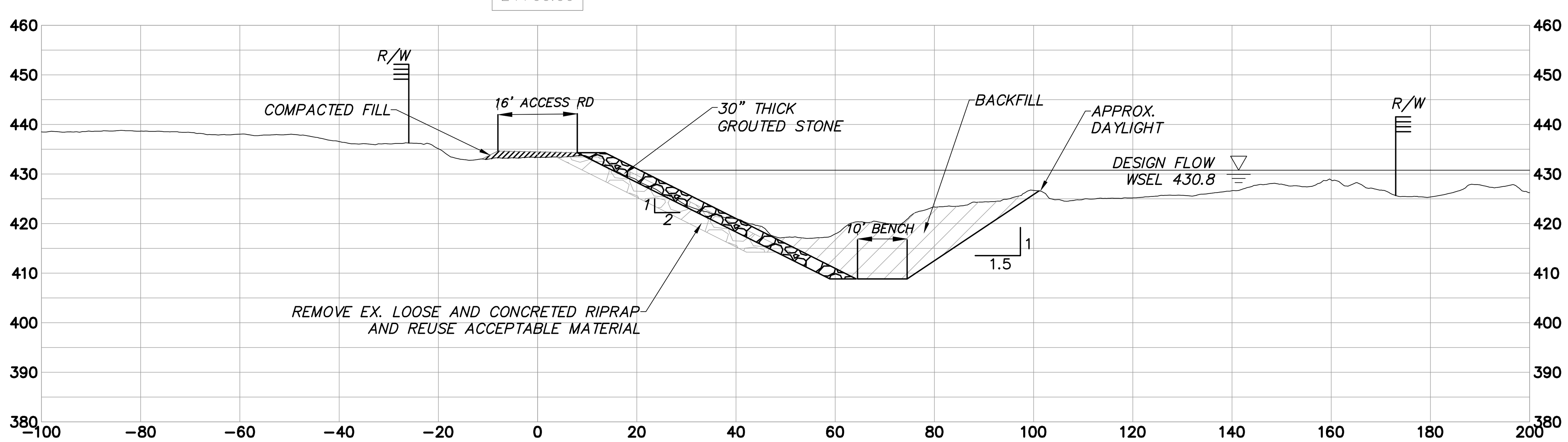

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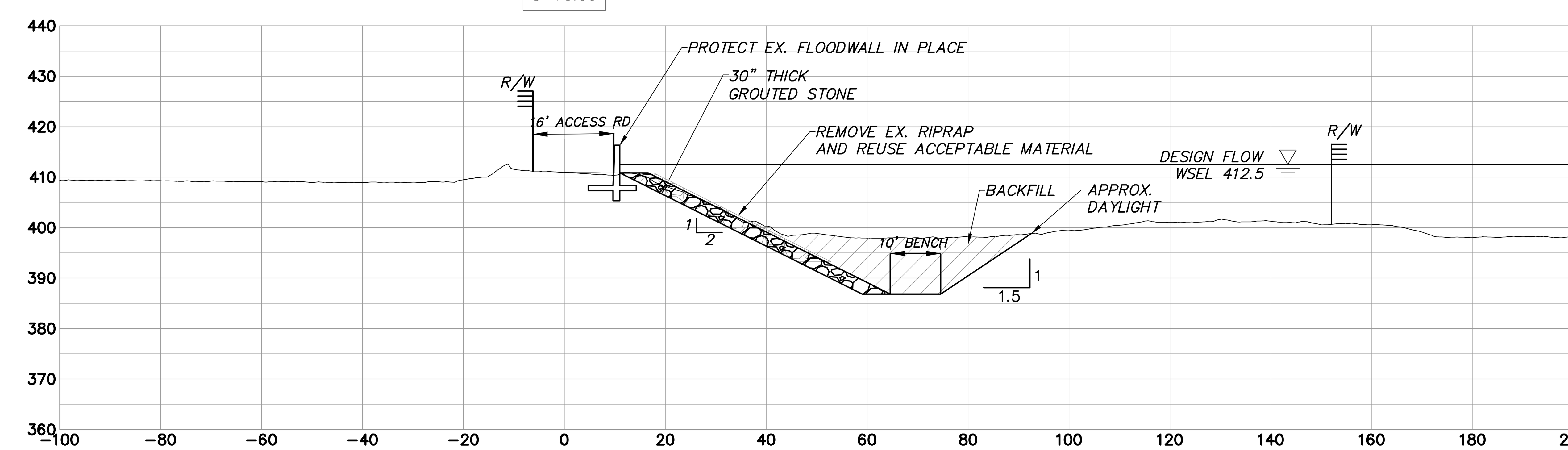

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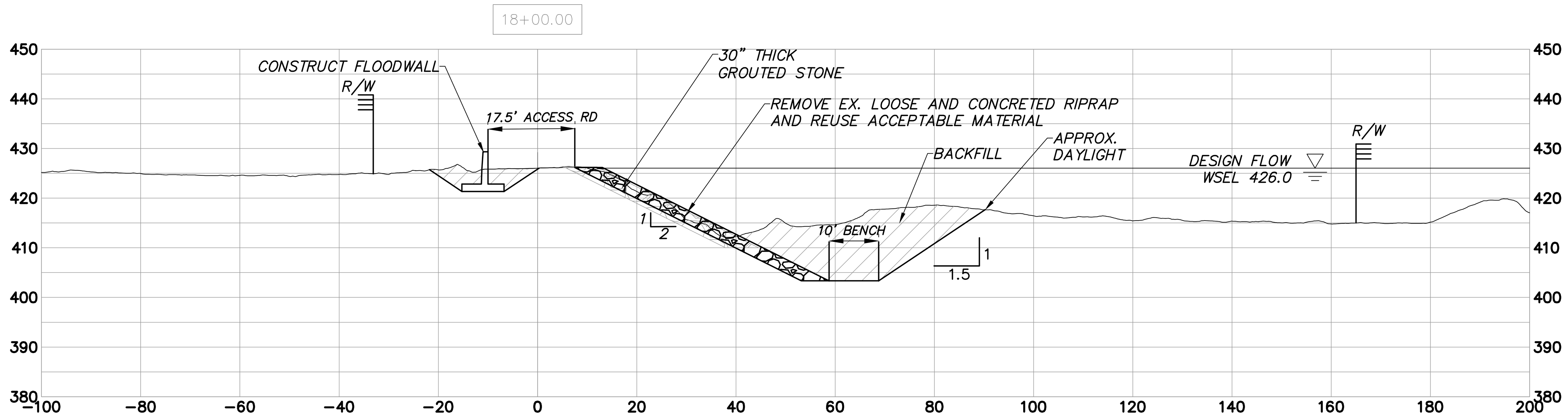

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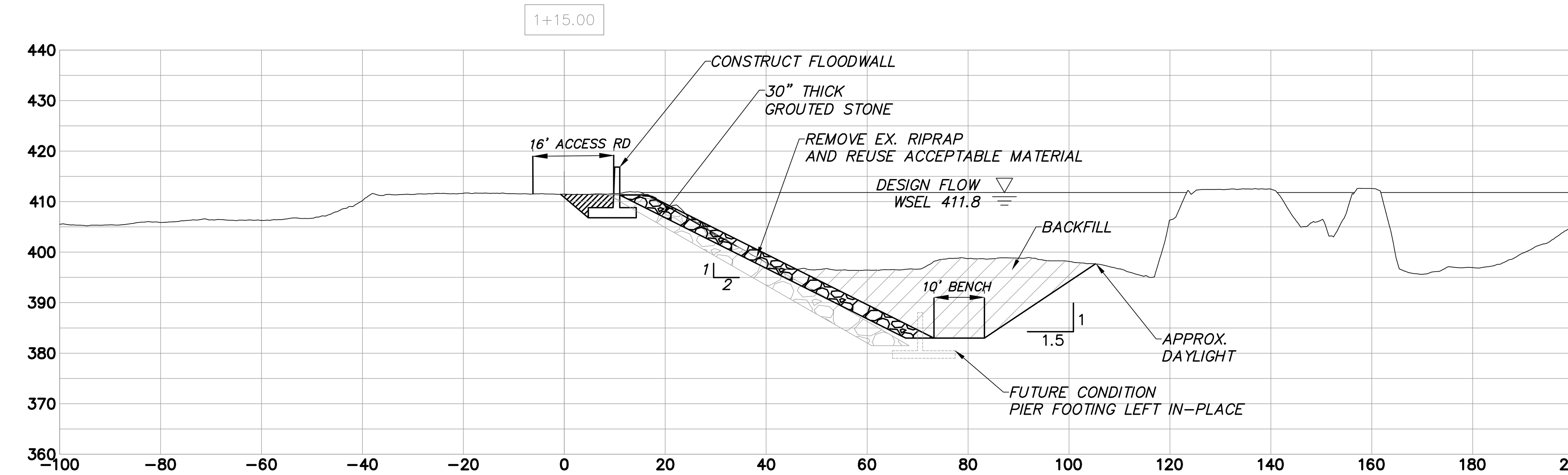

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COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION DISTRICT

SPEC. NO. –
PROJ. NO. –

MEINERS OAKS AND LIVE OAK ACRES PROJECT
LIVE OAK ACRES LEVEE

PLAN AND CROSS-SECTIONS
CROSS-SECTIONS (ALT 2)

SHEET 2 OF 2
DRAWING NO. Y-?-?

ATTACHMENT B

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Live Oak Acres Alternatives

Alternative 1: 1.5H:1V Concreted Riprap Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,331,000.00	$ 1,331,000
2	Clearing and Grubbing	ACR	6.5	$ 4,500.00	$ 29,250
3	Diversion and Control of Water	LS	1	$ 1,500,000.00	$ 1,500,000
4	Levee Slope Protection	LF	5,635	$ 2,083.71	$ 11,741,684
4.1	Grouted Stone	CY	36,292	$ 250.00	$ 9,073,009
4.2	Excavation	CY	104,205	$ 6.00	$ 625,228
4.3	Backfill (Toedown Construction)	CY	67,913	$ 5.75	$ 390,497
4.4	Compacted Fill (Levee Prism)	CY	2,213	$ 40.00	$ 88,511
4.5	Weepholes	LF	5,635	$ 80.00	$ 450,800
4.6	Riprap Removal	CY	26,549	$ 16.00	$ 424,788
4.7	Floodwall (near Santa Ana Blvd. Bridge)	LF	105	$ 1,000.00	$ 105,000
4.8	Floodwall (Station 12+40 to Station 19+14)	LF	760	$ 750.00	$ 570,000
4.9	Access Road	SF	2,770	$ 5.00	$ 13,851
5	Storm Drains	EA	2	$ 20,000.00	$ 40,000
5.1	Replace Outlet Structures and Extend Riverside End of Storm Drains	EA	2	$ 12,500.00	$ 25,000
5.2	Replace 24-inch Flap Gate	EA	1	$ 5,000.00	$ 5,000
5.3	Replace 48-inch Flap Gate	EA	1	$ 10,000.00	$ 10,000
				Subtotal (1)	$ 14,641,934
6				*Planning, Engineering, and Design:	
7				*Construction Management:	
				Subtotal (2):	$ 14,641,934
8				*Contingency (30%):	
*Note: the mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA’s direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.					
				Total Project Cost:	**$ 14,641,934**

Live Oak Acres Alternatives

Alternative 2: 2H:1V Concreted Riprap Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 994,000.00	$ 994,000
2	Clearing and Grubbing	ACR	6.5	$ 4,500.00	$ 29,250
3	Diversion and Control of Water	LS	1	$ 1,500,000.00	$ 1,500,000
4	Levee Slope Protection	LF	5,635	$ 1,486.27	$ 8,375,111
4.1	Grouted Stone	CY	28,064	$ 200.00	$ 5,612,889
4.2	Excavation	CY	108,140	$ 6.00	$ 648,839
4.3	Backfill (Toedown Construction)	CY	80,075	$ 5.75	$ 460,433
4.4	Compacted Fill (Levee Prism)	CY	2,213	$ 40.00	$ 88,511
4.5	Weepholes	LF	5,635	$ 80.00	$ 450,800
4.6	Riprap Removal	CY	26,549	$ 16.00	$ 424,788
4.7	Floodwall (near Santa Ana Blvd. Bridge)	LF	105	$ 1,000.00	$ 105,000
4.8	Floodwall (Station 12+40 to Station 19+14)	LF	760	$ 750.00	$ 570,000
4.9	Access Road	SF	2,770	$ 5.00	$ 13,851
5	Storm Drains	EA	2	$ 20,000.00	$ 40,000
5.1	Replace Outlet Structures and Extend Riverside End of Storm Drains	EA	2	$ 12,500.00	$ 25,000
5.2	Replace 24-inch Flap Gate	EA	1	$ 5,000.00	$ 5,000
5.3	Replace 48-inch Flap Gate	EA	1	$ 10,000.00	$ 10,000
				Subtotal (1)	$ 10,938,361
6				*Planning, Engineering, and Design:	
7				*Construction Management:	
				Subtotal (2):	$ 10,938,361
8				*Contingency (30%):	
*Note: the mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA's direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.					
				Total Project Cost:	**$ 10,938,361**

ATTACHMENT C

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Live Oak Acres Summary of Hydraulics

Approximate Levee Station	HEC-RAS XS RM	Channel Thalweg (feet)	Total Scour Depth	Existing Toe Down Protection Elevation	Existing Toe Down Defiency	Min Design Levee Toe Elev.	Min Design Levee Toe Elev.	Existing Computed Water-Surface Elevation (feet)		Future Dam Removal Condition Computed Water-Surface Elevation[1] (feet)		Existing Top-of-Levee Elevation (feet)	Computed Freeboard (feet)		FEMA Required Freeboard	Min. Design Levee TOL Elev.	Design Levee TOL Elev.
								100-Year	Design Flow	100-Year	Design Flow		100-Year	Design Flow			
46+89	10.13	452.81	6.60	450.13	-3.92	446.21	444.00	461.99	462.24	463.06	463.31	465.27	2.21	1.96	3.50	466.81	467.00
41+83	10.04	446.22	7.40	442.04	-3.22	438.82	437.00	455.64	455.93	456.46	456.75	458.04	1.58	1.29	3.00	459.75	460.00
36+69	9.94	436.92	7.40	434.51	-4.99	429.52	428.00	448.60	448.86	449.17	449.43	450.51	1.34	1.08	3.00	452.43	453.00
33+72	9.85	430.78	7.40	430.65	-7.27	423.38	422.00	442.06	442.35	442.56	442.85	446.65	4.09	3.80	3.00	445.85	446.00
28+59	9.75	424.51	7.40	423.98	-6.87	417.11	416.00	435.55	435.78	435.55	435.78	439.98	4.43	4.20	3.00	438.78	439.00
23+53	9.66	417.24	7.40	413.89	-4.05	409.84	408.00	428.88	429.21	429.93	430.26	432.89	2.96	2.63	3.00	433.26	434.00
18+50	9.56	412.61	7.40	410.86	-5.65	405.21	404.00	424.82	425.40	426.08	426.66	426.86	0.78	0.20	3.00	429.66	430.00
13+41	9.47	405.59	6.50	404.24	-5.15	399.09	397.00	419.78	420.14	419.84	420.20	420.24	0.40	0.04	3.00	423.20	424.00
8+40	9.38	404.50	6.50	397.30	0.70	398.00	396.00	413.99	414.51	414.32	414.84	419.01	4.69	4.17	3.00	417.84	418.00
3+69	9.29	395.34	6.50	393.20	-4.36	388.84	387.00	410.48	411.53	411.46	412.51	417.51	6.05	5.00	3.00	415.51	416.00
0+77	9.25	393.17	6.50	388.51	-1.84	386.67	383.00	409.41	410.60	410.51	411.70	410.50	-0.01	-1.20	4.00	415.70	416.00
	Santa Ana Blvd Bridge		8.50	387.00	-2.33	384.67	383.00										

(yellow)	2018 Thalweg is lower than what is shown in the model.
(pink)	Lower Event causes higher WSE, thus the lower event was used here.
(green)	Floodwall Section

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ATTACHMENT D

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Summary of Scour Calculations
(100-Year)

	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Flow Area (sq ft)	Top Width (ft)	Hydr Depth C (ft)	Bend Radius (ft)	Crossing Width (ft)	Crossing Depth (ft)	Max Depth (ft)	Bend Scour Depth (ft)	Contraction Scour (ft)	Pier Scour (ft)	Long Term Scour	Single Event Scour	**Total**	**Total**
	VenturaRiver	10.23	100 yr	28300	460.79	468.64	2848.05	964.44	3.43	2292	799	4.46	10.01	4.1	n/a	n/a	2.50	0.50	**6.57**	**6.6**
	VenturaRiver	10.13	100 yr	28300	454.16	461.99	3089.51	709.32	4.4	2292	799	4.46	10.01	4.1	n/a	n/a	2.50	0.50	**6.57**	**6.6**
	VenturaRiver	10.04	100 yr	28300	446.22	455.64	2431.11	592.68	4.25	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
	VenturaRiver	9.94	100 yr	28300	439.85	448.6	3018.67	722.96	4.24	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
	VenturaRiver	9.85	100 yr	28300	435.45	442.06	2456.79	606.63	4.33	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
	VenturaRiver	9.75	100 yr	28300	427.53	435.55	2826.63	683.82	4.13	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
	VenturaRiver	9.66	100 yr	28300	417.72	428.88	2432.16	535.25	4.54	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
	VenturaRiver	9.56	100 yr	28300	412.61	424.82	2662.04	368.51	7.22	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
Live Oak	VenturaRiver	9.47	100 yr	28300	407.52	419.78	2045.39	261.45	7.82	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.38	100 yr	28300	405.26	413.99	1934.84	289.11	6.82	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.29	100 yr	28300	395.34	410.48	2163.95	227.01	9.53	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.25	100 yr	28300	393.17	409.41	2190.51	220.07	11.24	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
				Bridge										3.7	2	8.0*	2.50	0.50	**8.20**	**8.2**
	VenturaRiver	9.23	100 yr	28300	393.25	405.43	1662.9	186.28	8.99	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.19	100 yr	28300	392.07	403.55	3085.49	2796.56	7.76	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.09	100 yr	28300	386.68	395.68	3362.07	2841.14	3.89	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.00	100 yr	28300	380.95	388.46	3370.24	2808.18	2.71	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**

Note: The bend scour depth is a function of the bend radius, the crossing width, the crossing depth and the max depth.
Single event scour based on Figures D-31 through D-35
Long Term scour is taken from Figures D-1 through D-5 and D-16 through D-20
*The Pier Scour component was not added to the total since the bank protection is out of the zone of influence from the pier scour.

Summary of Scour Calculations
(Design Flow)

Live Oak

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Top Width (ft)	Hydr Depth C (ft)	Bend Radius (ft)	Crossing Width (ft)	Crossing Depth (ft)	Max Depth (ft)	Bend Scour Depth (ft)	Contraction Scour (ft)	Pier Scour (ft)	Long Term Scour	Single Event Scour	Total	**Total**
VenturaRiver	10.23	110% of 100 yr	31130	460.79	468.87	1002.89	3.61	2292	808	4.56	10.24	4.1	n/a	n/a	2.50	0.50	6.60	**6.6**
VenturaRiver	10.13	110% of 100 yr	31130	454.16	462.24	716.43	4.65	2292	808	4.56	10.24	4.1	n/a	n/a	2.50	0.50	6.60	**6.6**
VenturaRiver	10.04	110% of 100 yr	31130	446.22	455.93	606.57	4.52	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.94	110% of 100 yr	31130	439.85	448.86	725.99	4.49	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.85	110% of 100 yr	31130	435.45	442.35	623.4	4.59	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.75	110% of 100 yr	31130	427.53	435.78	684.34	4.36	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.66	110% of 100 yr	31130	417.72	429.21	536.25	4.87	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.56	110% of 100 yr	31130	412.61	425.4	370.68	7.77	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.47	110% of 100 yr	31130	407.52	420.14	267.99	8.13	2232	282	7.77	9.25	4.0	n/a	n/a	2.50	0.50	6.47	**6.5**
VenturaRiver	9.38	110% of 100 yr	31130	405.26	414.51	291.7	7.29	2232	282	7.77	9.25	4.0	n/a	n/a	2.50	0.50	6.47	**6.5**
VenturaRiver	9.29	110% of 100 yr	31130	395.34	411.53	241.27	10.44	2232	282	7.77	9.25	4.0	n/a	n/a	2.50	0.50	6.47	**6.5**
VenturaRiver	9.25	110% of 100 yr	31130	393.17	410.6	249.81	12.13	2232	282	7.77	9.25	4.0	n/a	n/a	2.50	0.50	6.47	**6.5**
			Bridge									4.0	2	8.1*	2.50	0.50	8.50	**8.5**

Note: The bend scour depth is a function of the bend radius, the crossing width, the crossing depth and the max depth.
Single event scour based on Figures D-31 through D-35 in the Stillwater Sciences Sediment Report.
Long Term scour is taken from Figures D-1 through D-5 and D-16 through D-20 in the Stillwater Sciences Sediment Report.
*The Pier Scour component was not added to the total since the bank protection is out of the zone of influence from the pier scour.

ATTACHMENT E

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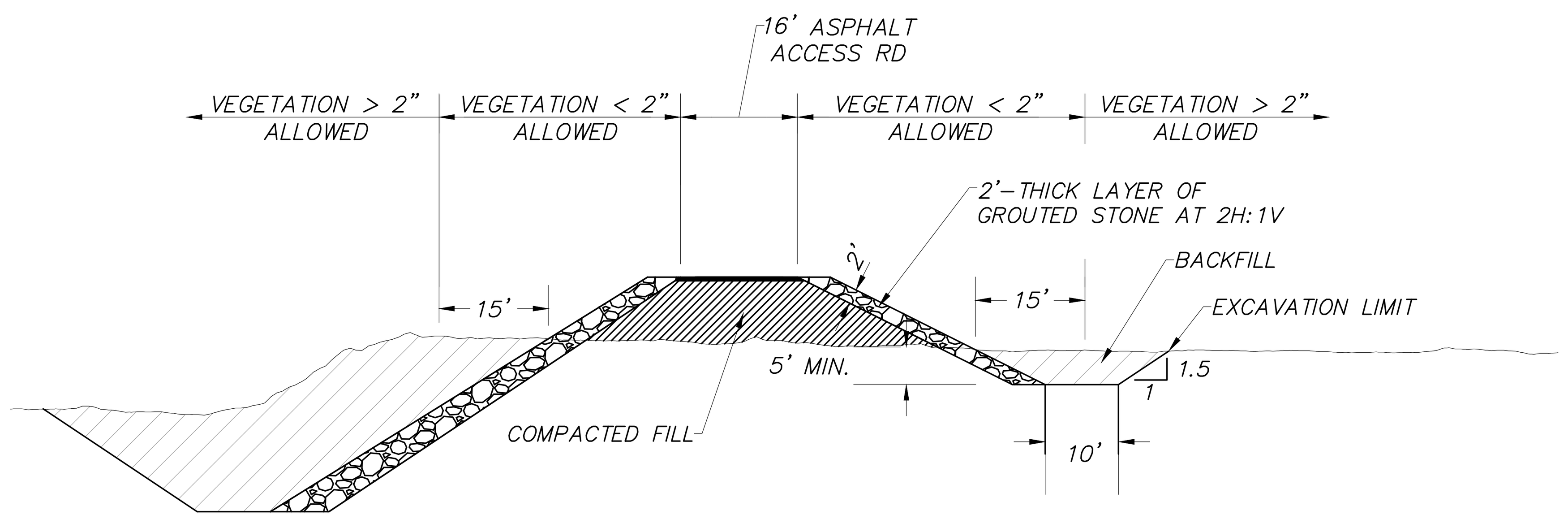
LIVE OAK ACRES LEVEE PROJECT
LANDSIDE IMPROVEMENT TYPICAL DETAILS

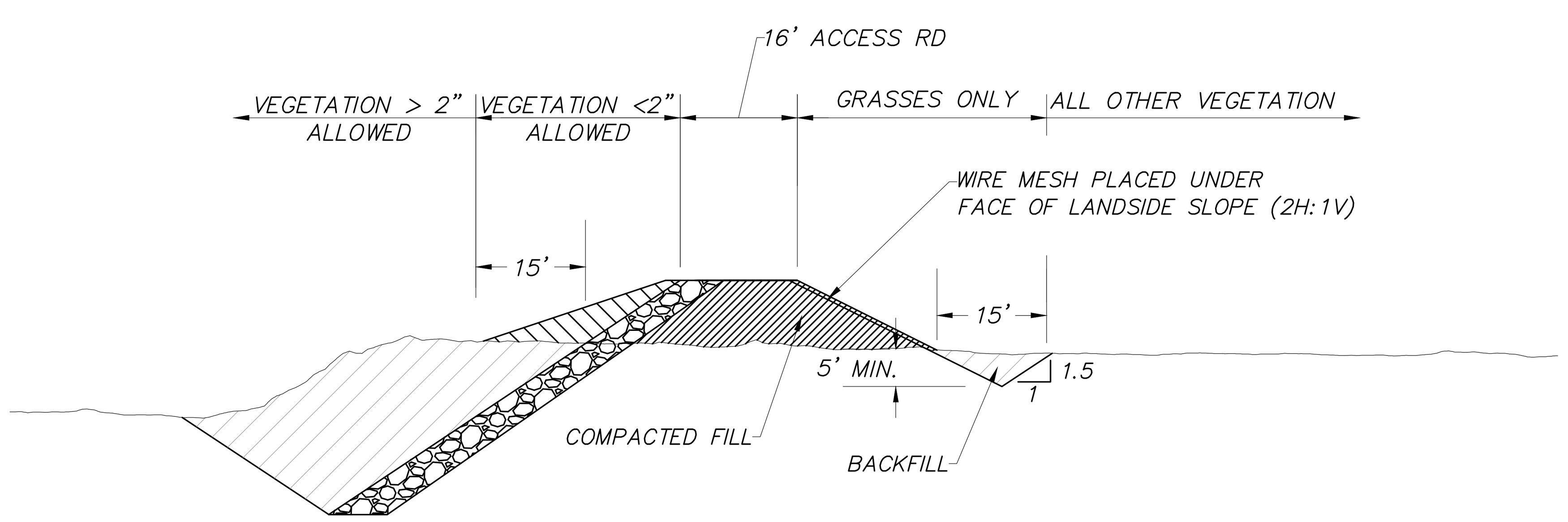
LANDSIDE IMPROVEMENT A

GROUTED STONE ON LANDSIDE SLOPE



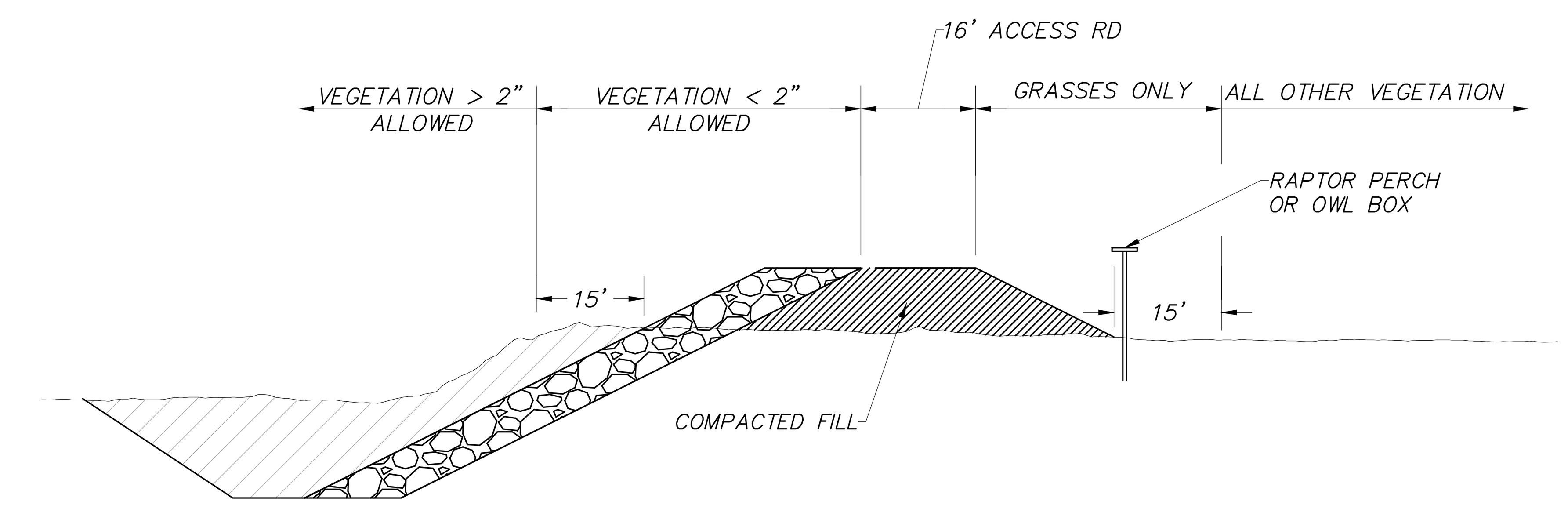
LANDSIDE IMPROVEMENT B

WIRE MESH



LANDSIDE IMPROVEMENT C

RAPTOR PERCH/OWL BOX



NOTES:

1. FOR SOLID RIVERSIDE SLOPE PROTECTION (i.e., GROUTED STONE) VEGETATION LESS THAN 2 INCHES IS PERMITTED WITHIN 15 FEET OF THE RIVERSIDE TOE; HOWEVER, FOR RIPRAP SLOPE PROTECTION ONLY GRASSES ARE PERMITTED IN THIS AREA.

PLOT DATE: 9/10/20

SAVE DATE: 9/10/20 ORLANDO.LOPES P:\WATR\139679 MEINERS OAKS AND LIVE OAK ACRES ALTERNATIVES\10 DESIGN\CONCEPT-LEVEL\LANDSIDE IMPROVEMENTS.DWG

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△	REVISION DESCRIPTION	APP.	DATE

DESIGNED –
DRAWN –
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PROJECT MANAGER DATE
DEPUTY DIRECTOR DATE
DISTRICT DIRECTOR DATE

COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION DISTRICT

SPEC. NO. –
PROJ. NO. –

MEINERS OAKS AND LIVE OAK ACRES LEVEES
LIVE OAK ACRES LEVEE
TYPICAL LANDSIDE IMPROVEMENTS

SHEET –
OF –
DRAWING NO. Y-?-?

1/2" x 1/2" mesh

Galvanized core wire mesh is coated with a thick layer of black PVC, tightly bonded to the wire. The entire hardware cloth mesh is thoroughly sealed and protected against rust and corrosion. This material will last! The 1/2" mesh, sometimes called 2 mesh, is lighter in weight and strength than the 16 gauge 1/2"x1/2" mesh and therefore costs less. Particularly useful for animal enclosures and exclusion barriers - applications where a light mesh, rust prevention and long life are desired. It can be used as low cost flooring for chukar pens, though we recommend the heavier 16 gauge material. 1/4" mesh is ideal for problem wildlife exclusion. The black color is virtually invisible when installed. And the mesh will last for years.

Vinyl Coated - 19 gauge, 1/2"x1/2" mesh, 24"x100' - 48 lbs.

SKU: HCVC224B-J @ **$129.72**

Vinyl Coated - 19 gauge, 1/2"x1/2" mesh, 36"x100' - 72 lbs.

SKU: HCVC236B-J @ **$194.34**

Vinyl Coated - 19 gauge, 1/2"x1/2" mesh, 48"x100' - 96 lbs.

SKU: HCVC248B-J (black), SKU: HCVC248G (green) @ **$258.90**

Vinyl Coated - 19 gauge, 1/2"x1/2" mesh, 60"x100' - 120 lbs.

SKU: HCVC260B-J @ **$333.36**

Vinyl Coated - 19 gauge, 1/2"x1/2" mesh, 72"x100' - 144 lbs.

SKU: HCVC272B-J @ **$400.04**

-J Standard gauge (Made in China)
-A American Made
-C Italian Made

Louis E. Page, Inc. is a family owned business. For three generations we've been dedicated to serving the needs of our customers. Our goal is to give you prompt and informative service at fair prices. Since 1893, we've taken great pride in our commitment to be a one-source distributor specializing in mesh and fencing. We keep an extensive inventory and we can special order items from many different mills. Let us help you find what you need.

Connie & Ben Houlihan *Houlihan Fence - St Louis. M*

Congratulations on this milestone! When our clients request mesh or welded wire, you are our go-to source! Thanks for being a leader in the industry & one we can reliably count on!

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P.O. Box 639, Sterling, MA 01564 (no pickup in Sterling)

800.225.0508

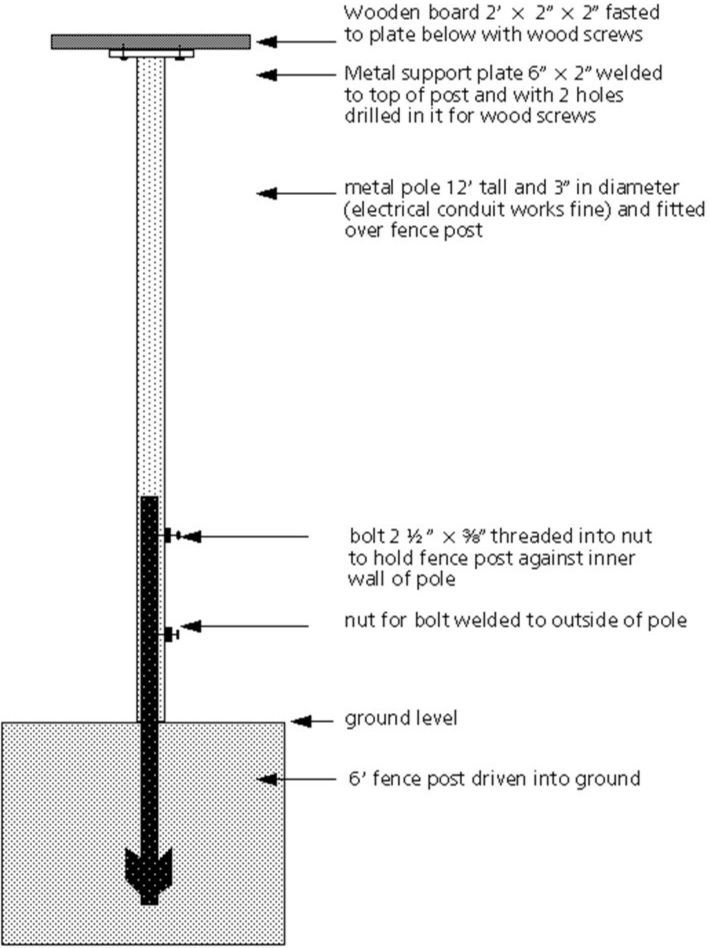
8:30 to 4:30 (EST) Mon through Fri

sales@louispage.com

Shipping Information

* Website prices reflect the prices from our default vendors. Occasionally we are unable to obtain the wire from these vendors; substitutions may be available and may result in a higher price. We will inform you of any price difference if this occurs. Prices are subject to change based on current vendor availability and current price of steel. If this occurs we will inform you of any price difference before processing your order.

Raptor Perch Design



ATTACHMENT II

Supporting Documents Related to the Intermediate Design

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ATTACHMENT F

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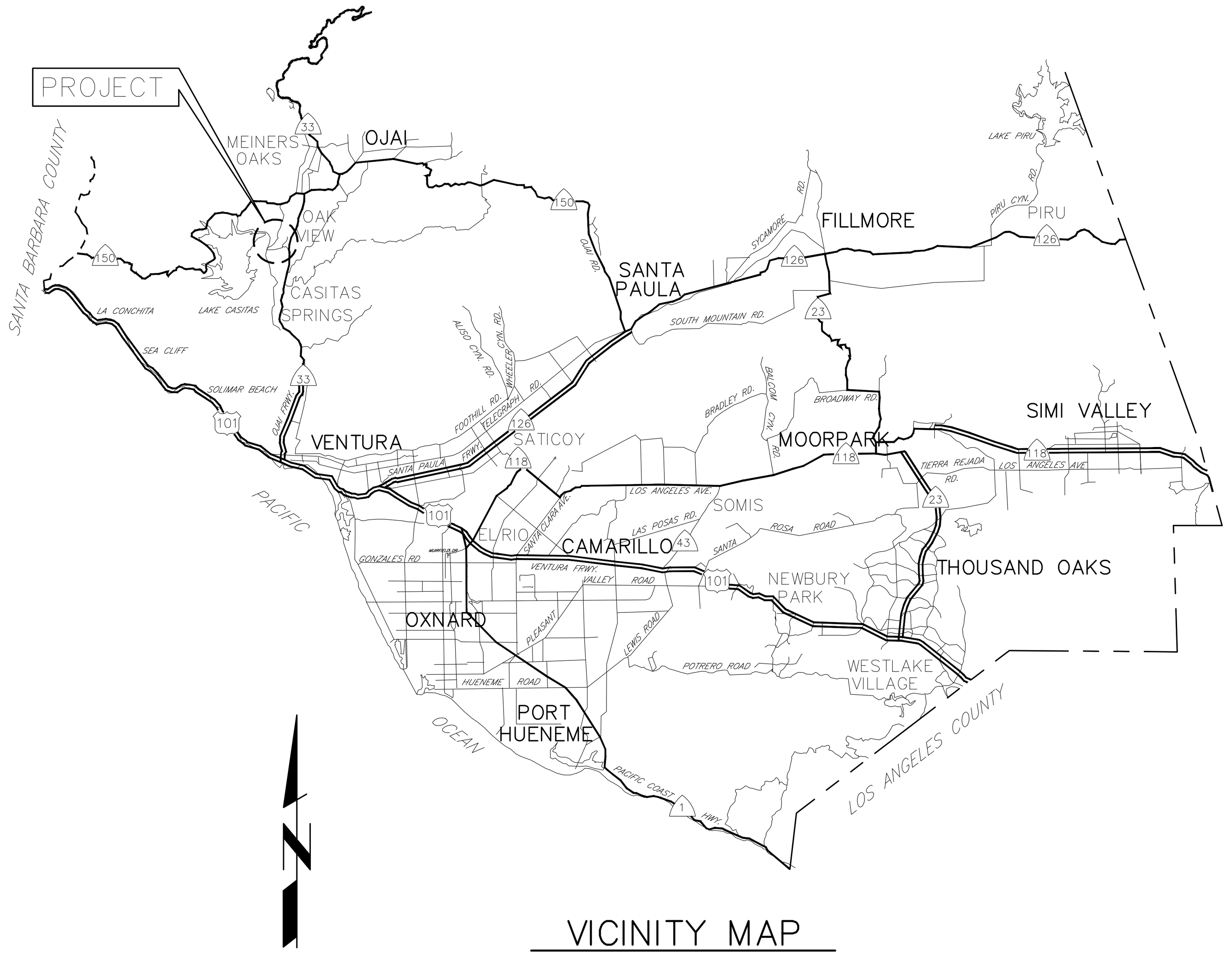


VICINITY MAP
N.T.S.

COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

ZONE 1
VENTURA RIVER LEVEE (VR-3)
AT LIVE OAK ACRES
IN THE COMMUNITY OF OAK VIEW

INDEX TO SHEETS

SHEET NO.	TITLE
1.	GENERAL PLAN
2.	AERIAL PHOTOGRAPH PLAN
3.	PLAN AND PROFILE – STA 0+00 TO STA 22+00
4.	PLAN AND PROFILE – STA 22+00 TO STA 44+00
5.	PLAN AND PROFILE – STA 44+00 TO STA 57+17.91
6.	CROSS SECTIONS – STA 0+50 TO STA 15+00
7.	CROSS SECTIONS – STA 20+00 TO STA 45+00
8.	CROSS SECTIONS – STA 50+00 TO STA 56+45
9.	TYPICAL SECTIONS
10.	DETAILS (1)
11.	DETAILS (2)

ABBREVIATIONS

@	AT
AC	ASPHALT CONCRETE
APPROX.	APPROXIMATE
CL	CENTER LINE
CR	CONCRETED RIPRAP
CMP	CORRUGATED METAL PIPE
CSP	CORRUGATED STEEL PIPE
DIA.	DIAMETER
EL	ELEVATION
EX.	EXISTING
EG	EXISTING GRADE
F/W	FLOODWALL
FL	FLOW LINE
FS	FINISH SURFACE
H	HORIZONTAL
INV.	INVERT
MAX.	MAXIMUM
MIN.	MINIMUM
N.	NORTH
NO.	NUMBER
O.C.	ON CENTER
P.I.P.	PROTECT IN PLACE
PMB	PROCESSED MISCELLANEOUS BASE
PVC	POLYVINYL CHLORIDE
RC	REINFORCED CONCRETE
RCB	REINFORCED CONCRETE BOX
RCP	REINFORCED CONCRETE PIPE
R/W	RIGHT-OF-WAY
S	SLOPE
STA.	STATION
TOL	TOP OF LEVEE
TYP	TYPICAL
V	VERTICAL
WSEL	WATER SURFACE ELEVATION

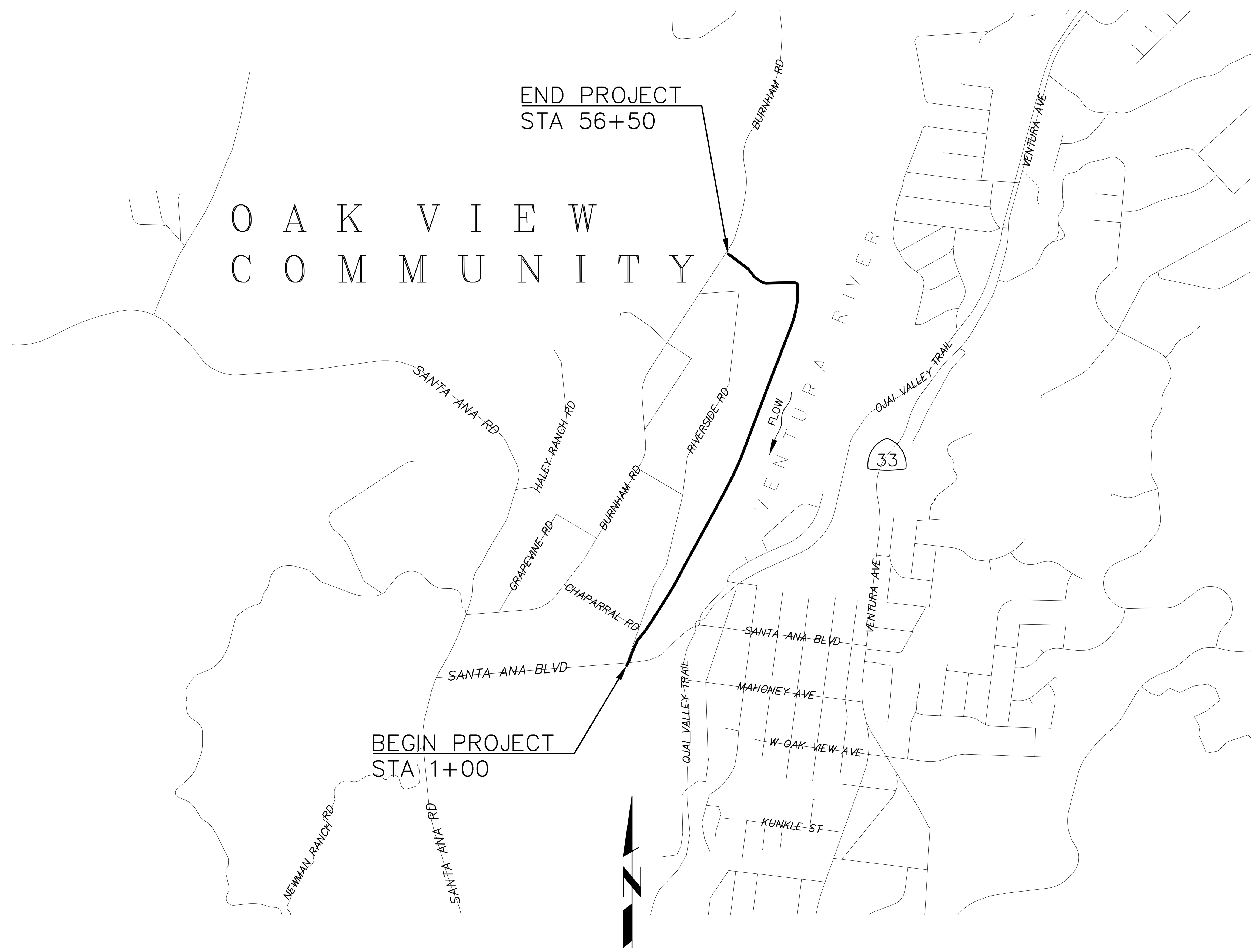
GENERAL NOTES

1. ELEVATIONS SHOWN ARE IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988.
2. STATIONS SHOWN ON DRAWINGS ARE ALONG CENTERLINE OF STRUCTURE AND/OR SURVEY CONTROL LINE.
3. NUMBERS IN (##) INDICATE BID ITEMS FOR WHICH PAYMENT WILL BE MADE.
4. LETTER AND NUMBER IN (X/XX) INDICATE THE DETAIL CALL-OUT AND SHEET ON WHICH REFERENCE DETAIL IS SHOWN.
5. NUMBERS IN (XX) REFER TO NOTES ON SAME SHEET UNLESS OTHERWISE NOTED.
6. TREES DESIGNATED BY [symbol] SHALL BE REMOVED. ALL OTHER TREES SHALL BE PROTECTED IN PLACE UNLESS INDICATED OTHERWISE.
7. [line symbol] DELINEATES LIMITS OF VCWPD RIGHT OF WAY.
8. [line symbol] DELINEATES LIMITS OF TEMPORARY WORK AREA.
9. TOPOGRAPHY AND CROSS SECTIONS FOR THIS PROJECT ARE BASED AN AERIAL LIDAR SURVEYS PERFORMED IN 2018.
10. SYMBOL [triangle] INDICATES THE LOCATION OF HORIZONTAL AND VERTICAL CONTROL POINTS WHICH WILL BE FURNISHED BY THE AGENCY FOR CONSTRUCTION USE.

    SURVEY CONTROL POINTS

PT ####	NORTHING/Y: XXXXXXXXXX	EASTING/X: XXXXXXXXXX	ELEV/Z: XXXXX
PT ####	NORTHING/Y: XXXXXXXXXX	EASTING/X: XXXXXXXXXX	ELEV/Z: XXXXX
PT ####	NORTHING/Y: XXXXXXXXXX	EASTING/X: XXXXXXXXXX	ELEV/Z: XXXXX

11. SOIL TEST BORINGS SHOWN FOR THE PROJECT WERE MADE ON XXXX AND THEIR LOCATION IS MARKED BY THE SYMBOL [symbol]. REFER TO THE SPECIFICATIONS FOR ADDITIONAL GEOTECHNICAL REPORT INFORMATION. SUBSURFACE SOIL INVESTIGATION RESULTS ARE FURNISHED FOR INFORMATION ONLY IN ACCORDANCE WITH SUBSECTION 2-7 OF THE STANDARD SPECIFICATIONS, AND NO WARRANTY IS MADE THEREFOR.
12. EXISTING IMPROVEMENTS WITHIN THE RIGHT OF WAY AND WORK AREAS SHALL REMAIN AND SHALL BE PROTECTED UNLESS OTHERWISE NOTED. DAMAGED IMPROVEMENTS SHALL BE REPLACED IN KIND TO A CONDITION EQUAL TO OR BETTER THAN THAT WHICH EXISTED PRIOR TO CONSTRUCTION.
13. UTILITIES ARE SHOWN AS KNOWN TO EXIST AT TIME OF SURVEY. UTILITIES MAY HAVE BEEN OMITTED, MISPLACED, AND/OR RELOCATED. CONTRACTOR SHALL EXERCISE CARE IN EXCAVATION AND SHALL PROTECT ALL UTILITIES.
14. CONTRACTOR SHALL NOTIFY UTILITY OWNERS A MINIMUM OF 48 HOURS PRIOR TO STARTING WORK IN AREAS AFFECTING THEIR FACILITIES.



GENERAL PLAN
1000 500 0 1000 2000
SCALE OF FEET

INDEX OF STANDARD PLANS USED BY REFERENCE

CALTRANS STANDARD PLANS, 2010 EDITION:
- –
- –
- –

SPPWC STANDARD PLANS, 2012 EDITION:
- –
- –
- –

UNDERGROUND SERVICE ALERT
1-800-422-4133
CALL USA/SC
FOR UNDERGROUND LOCATION
2 WORKING DAYS BEFORE YOU DIG

INTERMEDIATE DESIGN
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	REVISION	DESCRIPTION	APP.	DATE
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17885 VON KARMAN AVE.,
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#### DISTRICT DEPUTY DIRECTOR	DATE
#### DISTRICT DIRECTOR	DATE
#### AGENCY DIRECTOR	DATE

COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. _____

VENTURA RIVER LEVEE (VR-3)
AT LIVE OAK ACRES
GENERAL PLAN

SHEET 1 OF 11
DRAWING NO. WPD-1-XXX

NOTES:

1.

PLAN

200 0 200 400

SCALE OF FEET

INTERMEDIATE DESIGN
NOT FOR CONSTRUCTION

PLOT DATE 9/3/20

SAVE DATE: 9/3/20 LOPES, ORLANDO P:\WATR\139679 MEINERS OAKS AND LIVE OAK ACRES ALTERNATIVES\10 DESIGN\30% DESIGN\LIVE OAK ACRES\01 SHEETS\AERIAL.DWG

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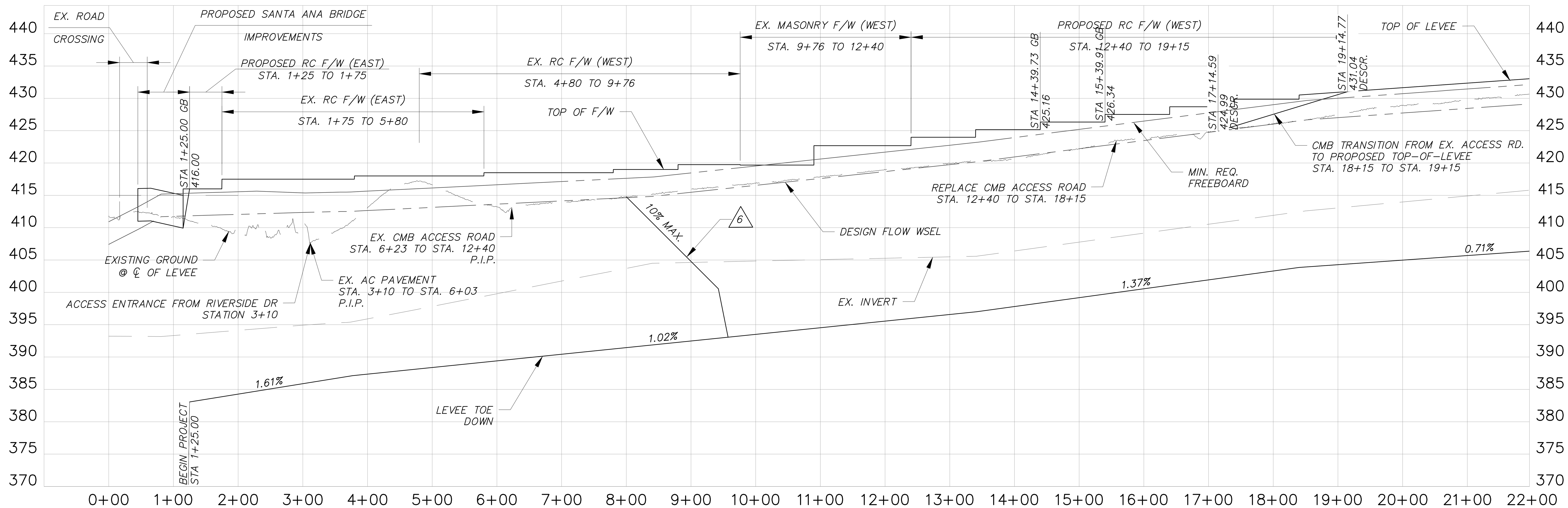
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. _____

VENTURA RIVER LEVEE (VR-3)
AT LIVE OAK ACRES

AERIAL PHOTOGRAPH PLAN

SHEET 2
OF 11
DRAWING NO.
WPD-1-XXX

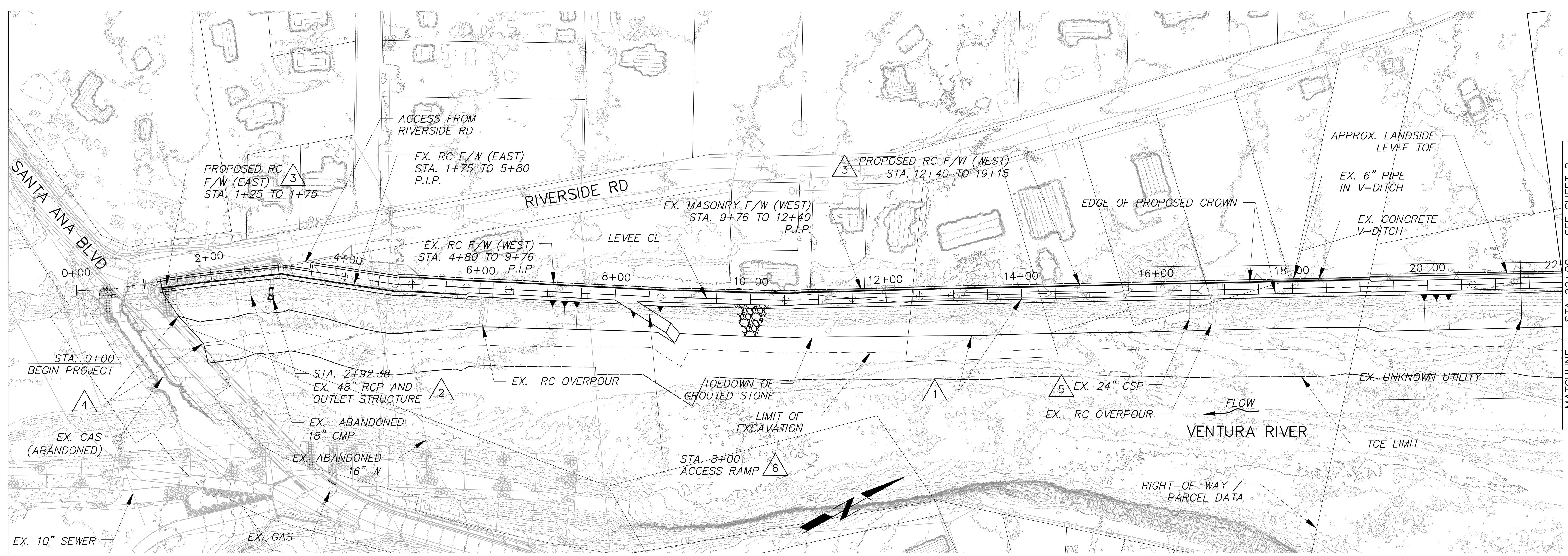


PROFILE

SCALE: HORZ: 1" = 100'
VERT: 1" = 10'

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN AND PROFILE HEREON, CROSS SECTIONS ON SHEETS 4 AND 5, AND TYPICAL SECTIONS ON SHEET 6.
2. REPLACE EX. OUTLET. P.I.P. 48" RCP, ADD FLAPGATE, AND EXTEND TO NEWLY CONSTRUCTED OUTLET. CONSTRUCT FLAPGATE AND OUTLET PER PLAN AND PROFILE HEREON.
3. CONSTRUCT REINFORCED CONCRETE FLOODWALL PER PLAN AND PROFILE HEREON.
4. TIE GROUTED STONE INTO SANTA ANA BRIDGE ABUTMENT IMPROVEMENTS.
5. REPLACE EX. 24" CSP WITH 24" RCP AND FLAPGATE, INLET STRUCTURE, AND OUTLET STRUCTURE.
6. CONSTRUCT ACCESS RAMP PER PLAN AND PROFILE HEREON AND DETAILS ON SHEET 10.



PLAN

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SCALE OF FEET

INTERMEDIATE DESIGN
NOT FOR CONSTRUCTION

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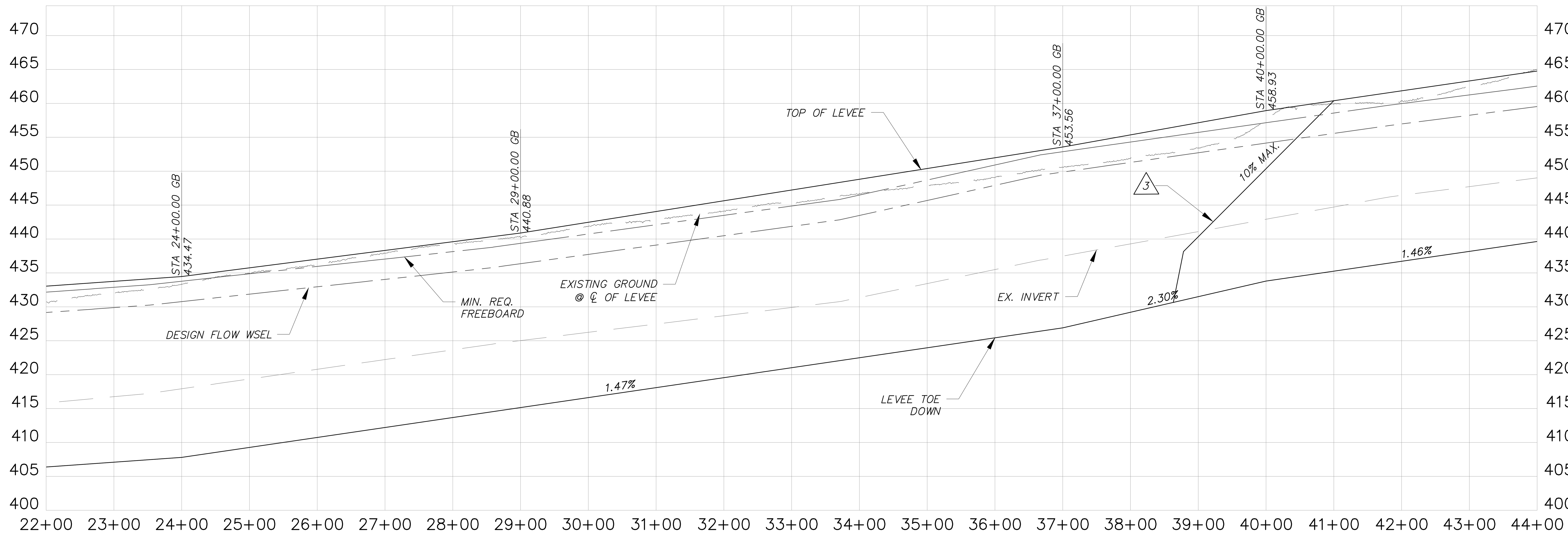
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. _____

VENTURA RIVER LEVEE (VR-3)
AT LIVE OAK ACRES
PLAN AND PROFILE – STA 0+00 TO STA 22+00

SHEET 3 OF 11
DRAWING NO. WPD-1-XXX

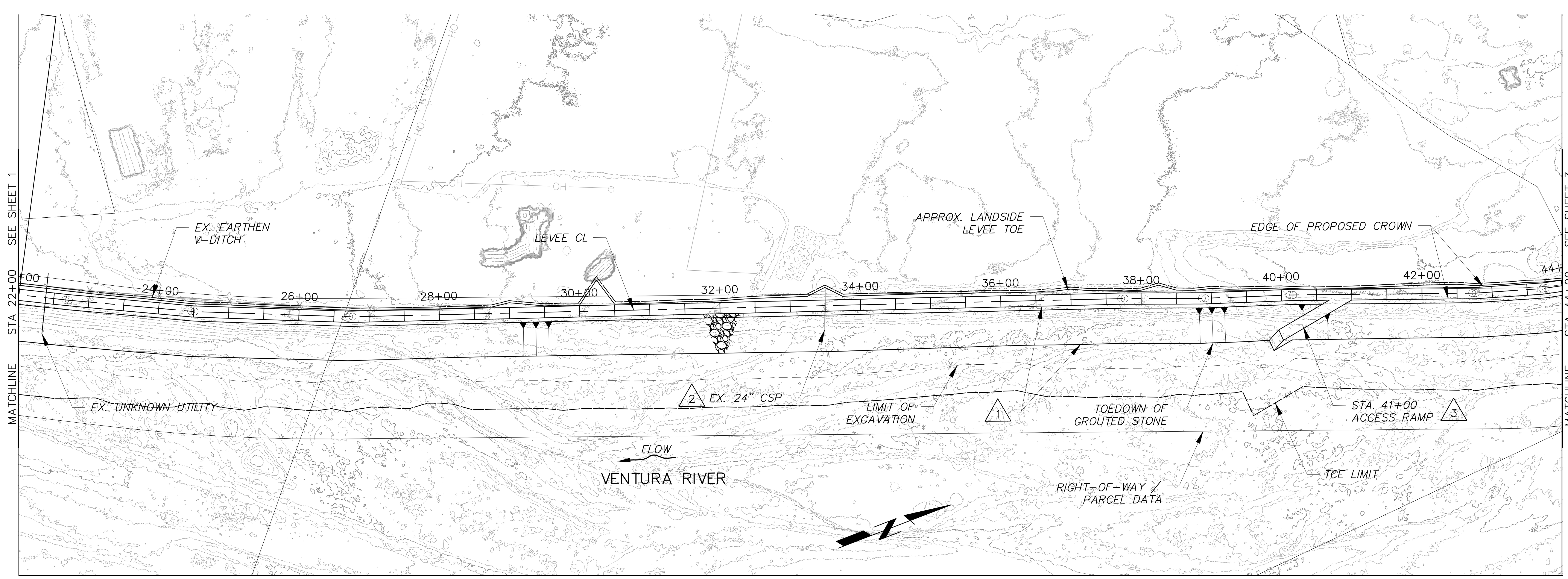


PROFILE

SCALE: HORZ: 1" = 100'
VERT: 1" = 10'

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN AND PROFILE HEREON, CROSS SECTIONS ON SHEETS 4 AND 5, AND TYPICAL SECTIONS ON SHEET 6.
2. REPLACE EX. 24" CSP WITH 24" RCP AND FLAPGATE, INLET STRUCTURE, AND OUTLET STRUCTURE.
3. CONSTRUCT ACCESS RAMP PER PLAN AND PROFILE HEREON AND DETAILS ON SHEET 10.



PLAN

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SCALE OF FEET

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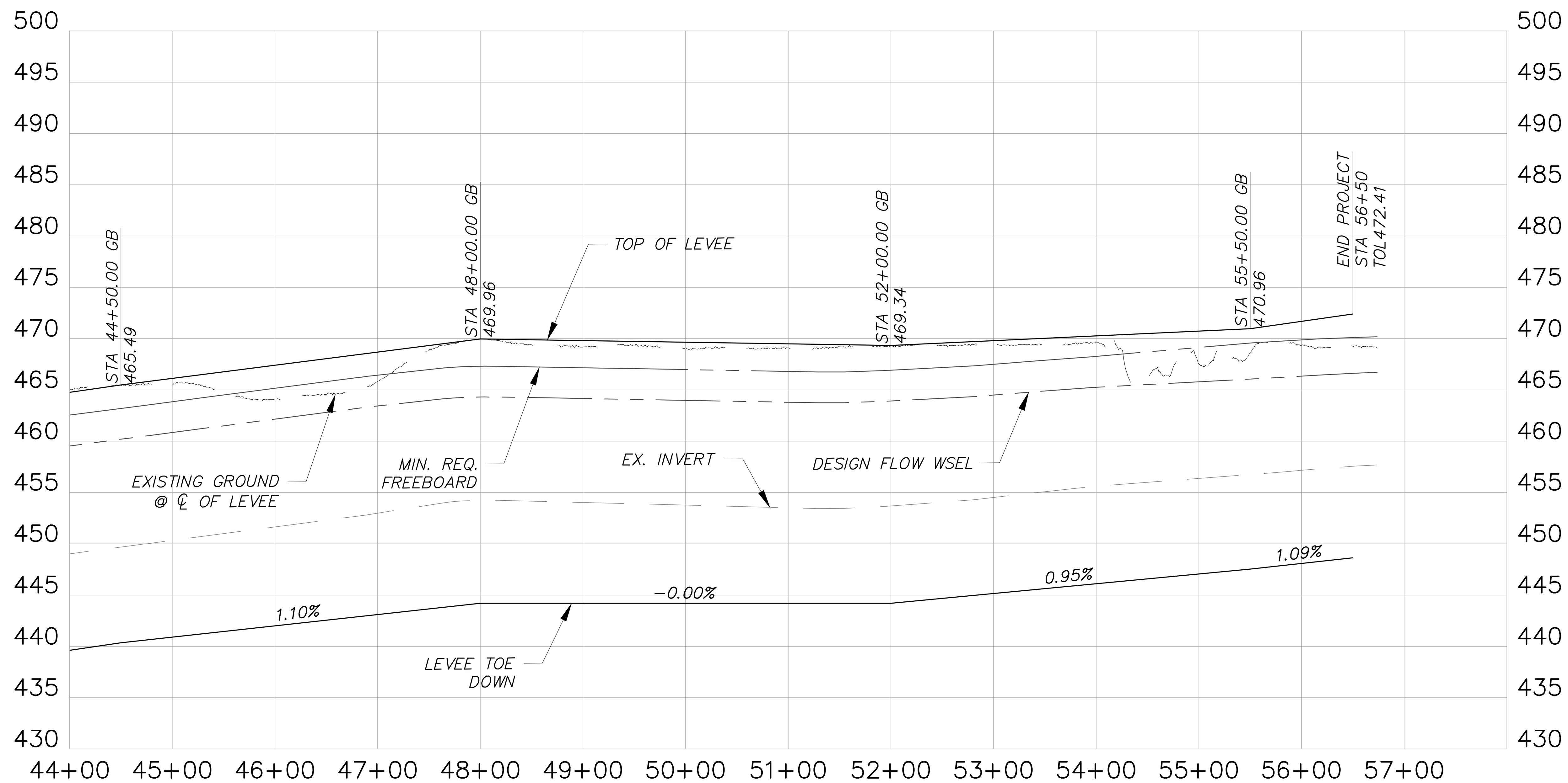
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. -----

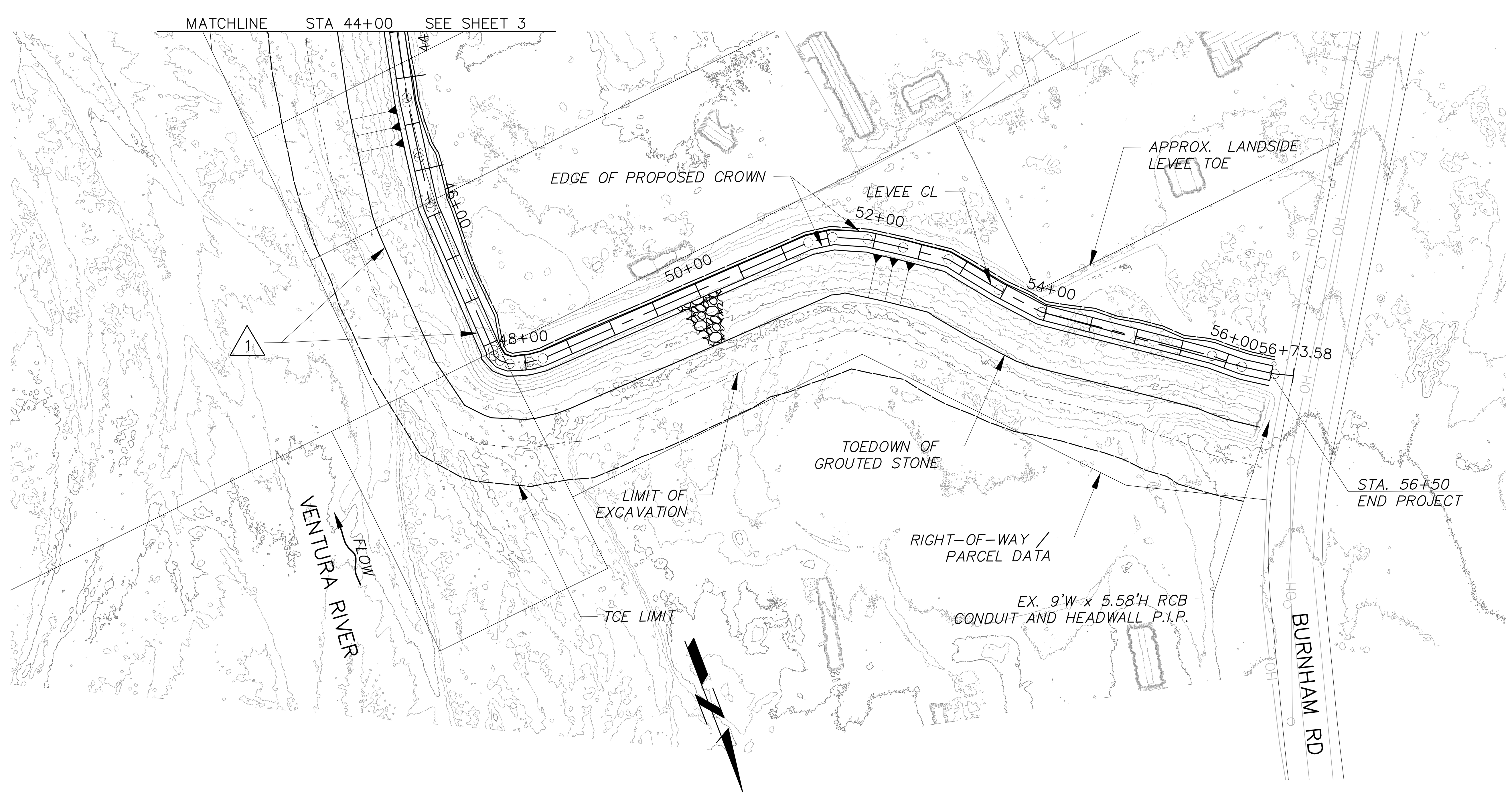
VENTURA RIVER LEVEE (VR-3)
AT LIVE OAK ACRES
PLAN AND PROFILE – STA 22+00 TO STA 44+00

SHEET 4 OF 11
DRAWING NO. WPD-1-XXX



PROFILE

SCALE: HORZ: 1" = 100'
VERT: 1" = 10'



PLAN

100 0 100 200
SCALE OF FEET

NOTES:

1. CONSTRUCT LEVEE BANK PROTECTION PER PLAN AND PROFILE HEREON, CROSS SECTIONS ON SHEETS 4 AND 5, AND TYPICAL SECTIONS ON SHEET 6.

INTERMEDIATE DESIGN
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DISTRICT DEPUTY DIRECTOR DATE
DISTRICT DIRECTOR DATE

COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. -----

VENTURA RIVER LEVEE (VR-3)
AT LIVE OAK ACRES

PLAN AND PROFILE – STA 44+00 TO STA 56+50

SHEET 5 OF 11
DRAWING NO. WPD-1-XXX

NOTE: DIMENSIONS OF FLOODWALL ARE BASED ON CALTRANS STANDARD RETAINING WALL DETAIL "B3–1A." STRUCTURAL CALCULATIONS AND A FLOODWALL DETAIL WILL BE INCLUDED DURING THE NEXT PHASE OF DESIGN.

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

PLOT DATE: 9/10/20

SAVE DATE: 9/3/20 LOPES, ORLANDO P:\WATR\T39679 MEINERS OAKS AND LIVE OAK ACRES ALTERNATIVES\10 DESIGN\30% DESIGN\LIVE OAK ACRES\01 SHEETS\CROSSSECTIONS.DWG

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PUBLIC WORKS AGENCY
WATERSHED PROTECTION

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PROJ. NO. –

VENTURA RIVER LEVEE (VR–3)
AT LIVE OAK ACRES
CROSS SECTIONS – STA 0+50 TO STA 15+00

SHEET 6 OF 11
DRAWING NO. WPD–ZONE 1–###

CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

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DISTRICT DIRECTOR — DATE

COUNTY OF VENTURA
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WATERSHED PROTECTION

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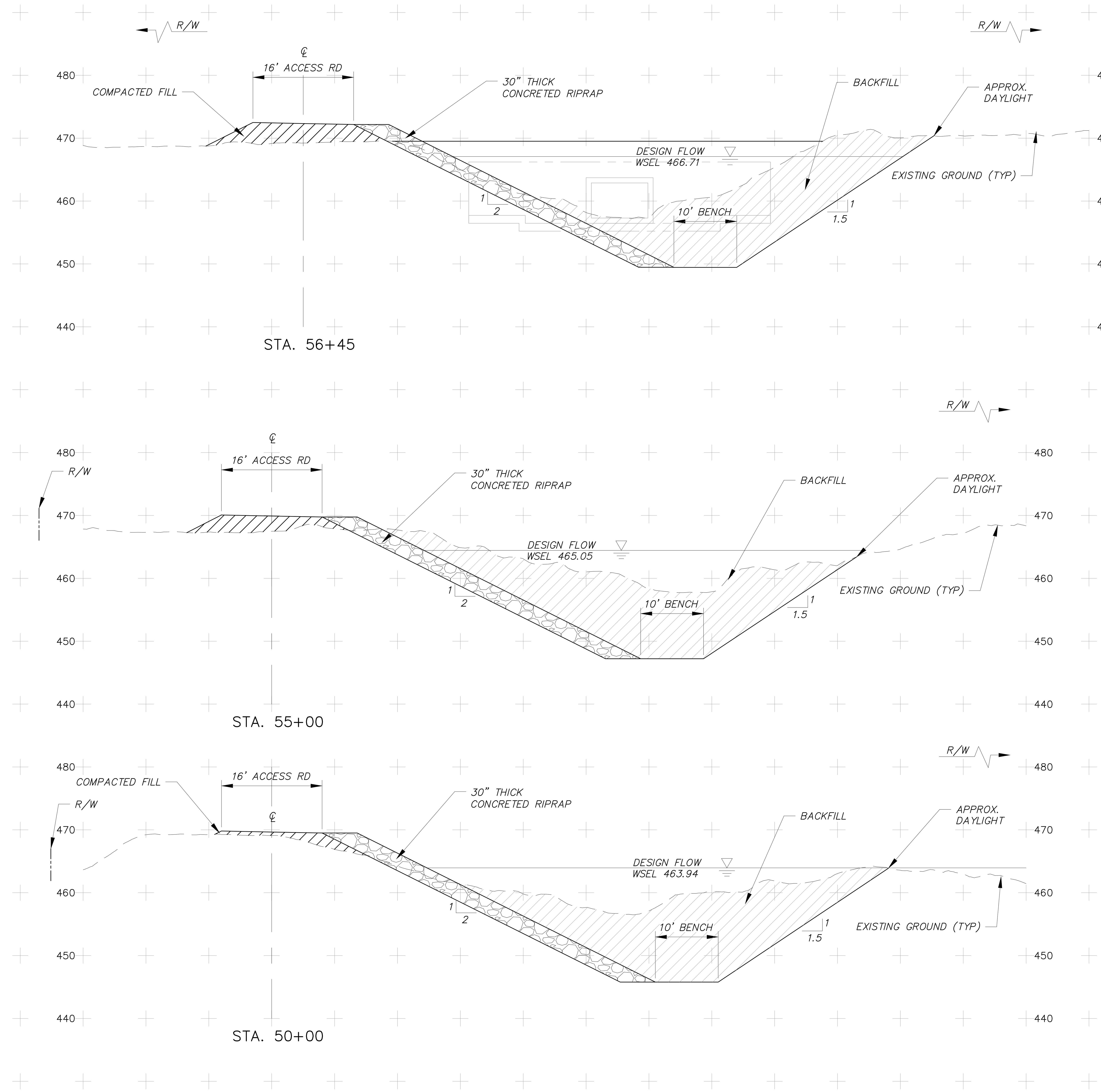
PROJ. NO. –

VENTURA RIVER LEVEE (VR-3)
AT LIVE OAK ACRES
CROSS SECTIONS – STA 20+00 TO STA 45+00

SHEET 7 OF 11
DRAWING NO. WPD-ZONE 1-####



CROSS SECTIONS

SCALE: HORZ: 1" = 10'
VERT: 1" = 10'

PLOT DATE: 9/10/20

SAVE DATE: 9/3/20 LOPES, ORLANDO P:\WATR\T39679 MEINERS OAKS AND LIVE OAK ACRES ALTERNATIVES\10 DESIGN\30% DESIGN\LIVE OAK ACRES\01 SHEETS\CROSSSECTIONS.DWG

D			
C			
B			
A			
△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH
17885 VON KARMAN AVE.,
SUITE 500
IRVINE, CA 92614

– DESIGNED
– DRAWN
– CHECKED

PROJECT MANAGER DATE
DEPUTY DIRECTOR DATE
DISTRICT DIRECTOR DATE

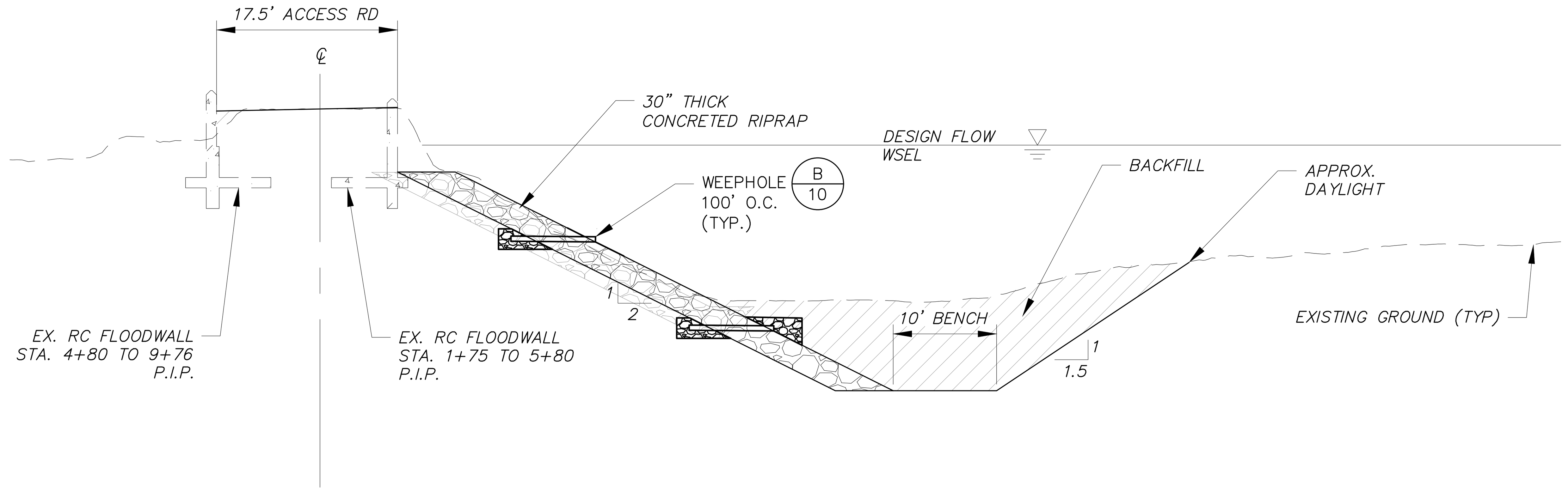
COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE (VR–3)
AT LIVE OAK ACRES

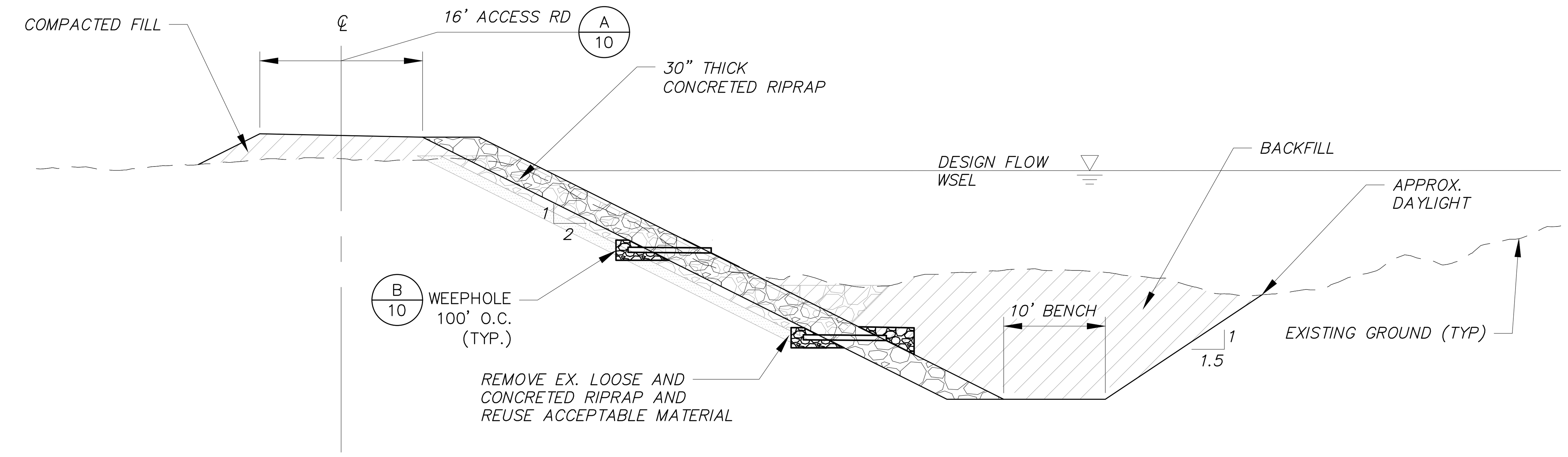
CROSS SECTIONS – STA 50+00 TO STA 55+00

SHEET 8
OF 11
DRAWING NO.
WPD–ZONE 1–####



TYPICAL LEVEE SECTION – STA. 4+80 TO 5+80

NOT TO SCALE



TYPICAL LEVEE SECTION – STA. 19+15 TO 56+50

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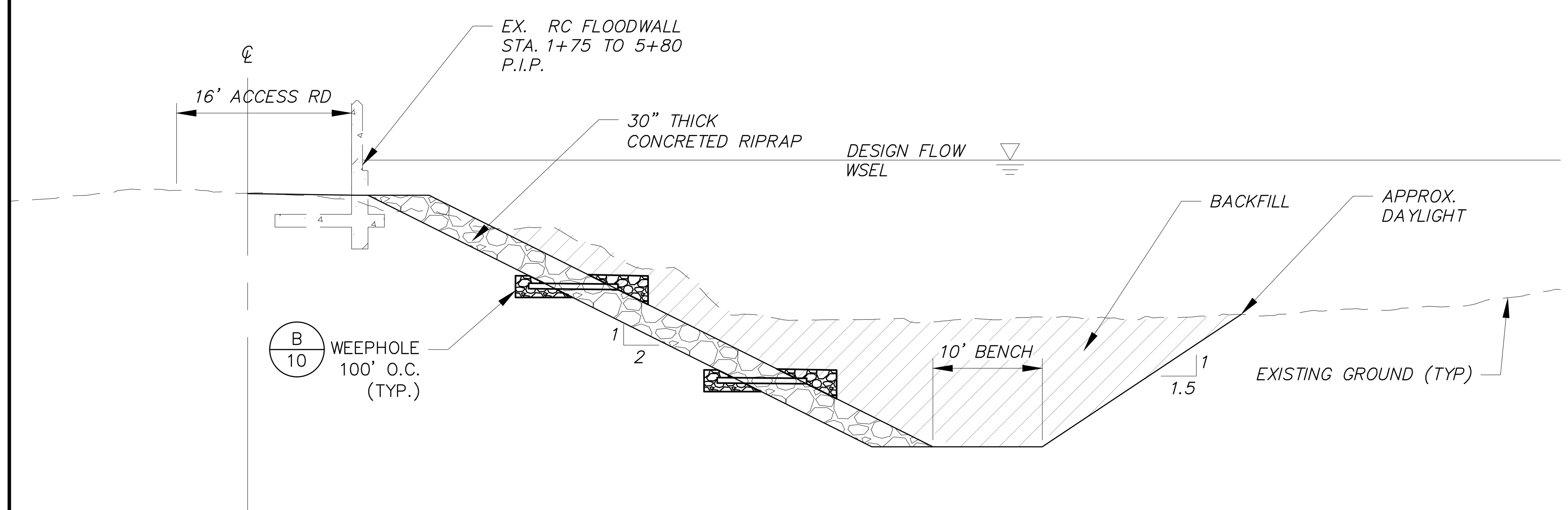

TYPICAL LEVEE SECTION – STA. 1+75 TO 4+80

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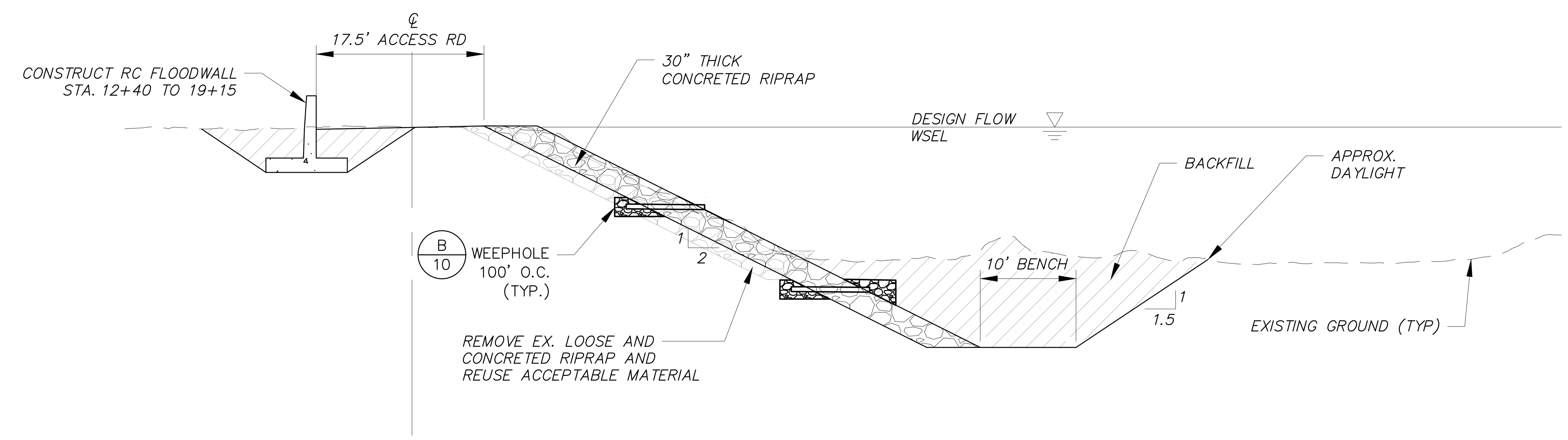

TYPICAL LEVEE SECTION – STA. 12+40 TO 19+15

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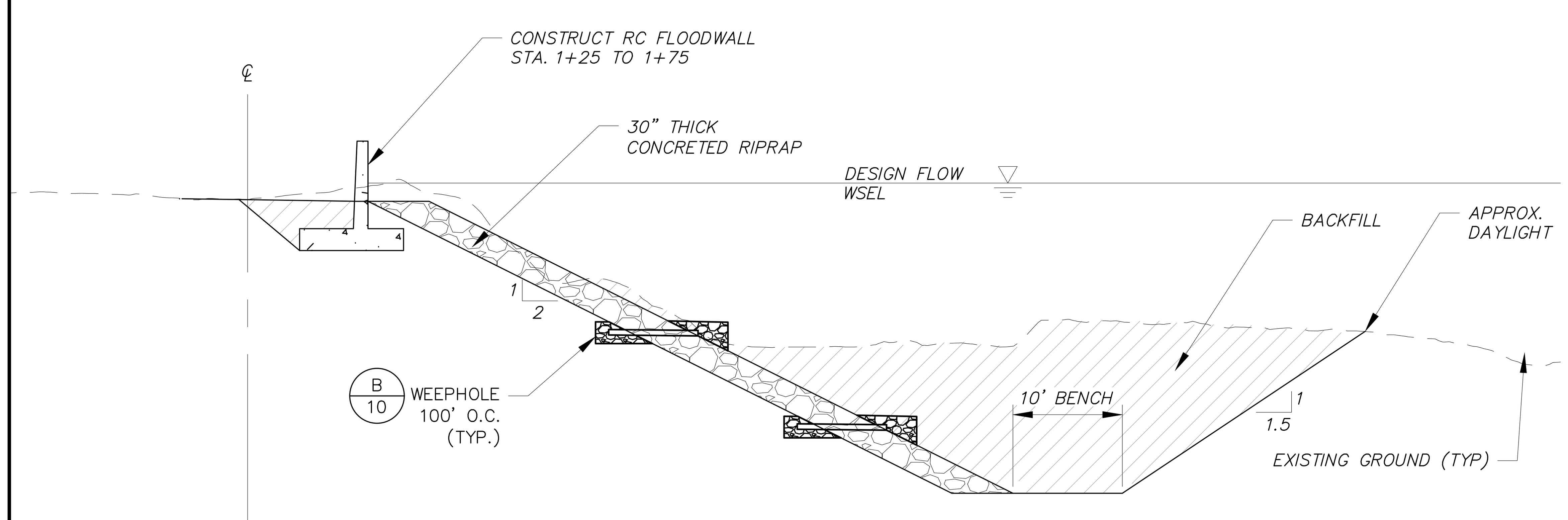

TYPICAL LEVEE SECTION – STA. 1+25 TO 1+75

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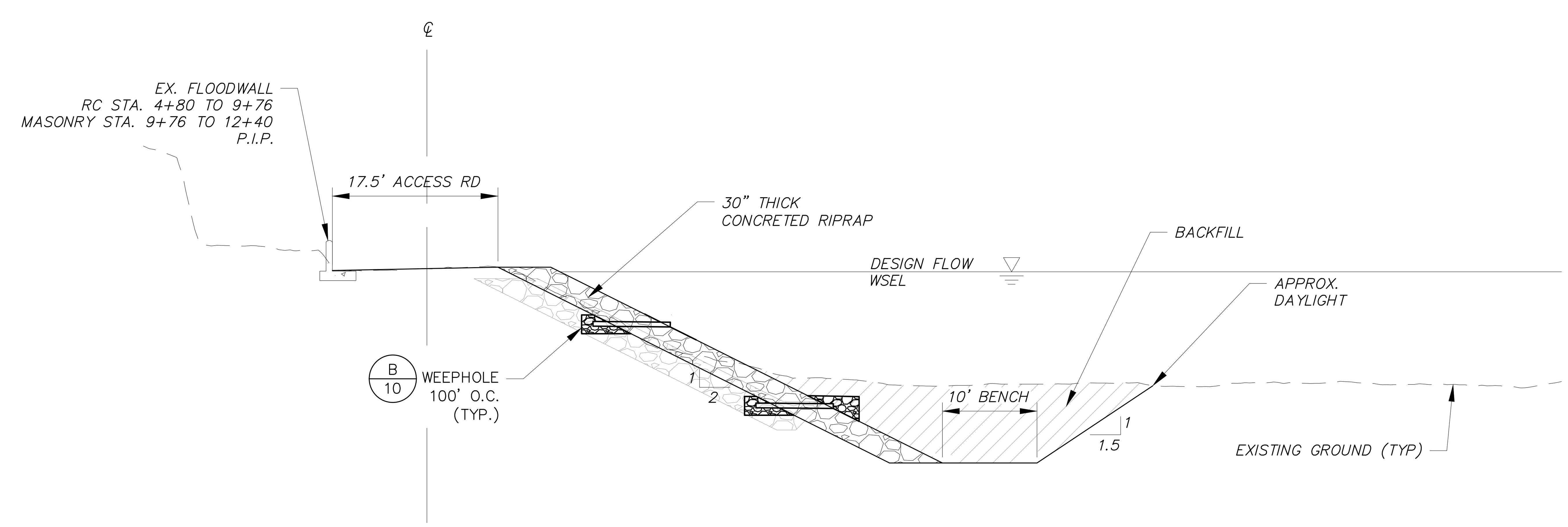

TYPICAL LEVEE SECTION – STA. 5+80 TO 12+40

NOT TO SCALE

D			
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△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH
17885 VON KARMAN AVE.,
SUITE 500
IRVINE, CA 92614

DESIGNED –
DRAWN –
CHECKED –

PROJECT MANAGER DATE
DEPUTY DIRECTOR DATE
DISTRICT DIRECTOR DATE

COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

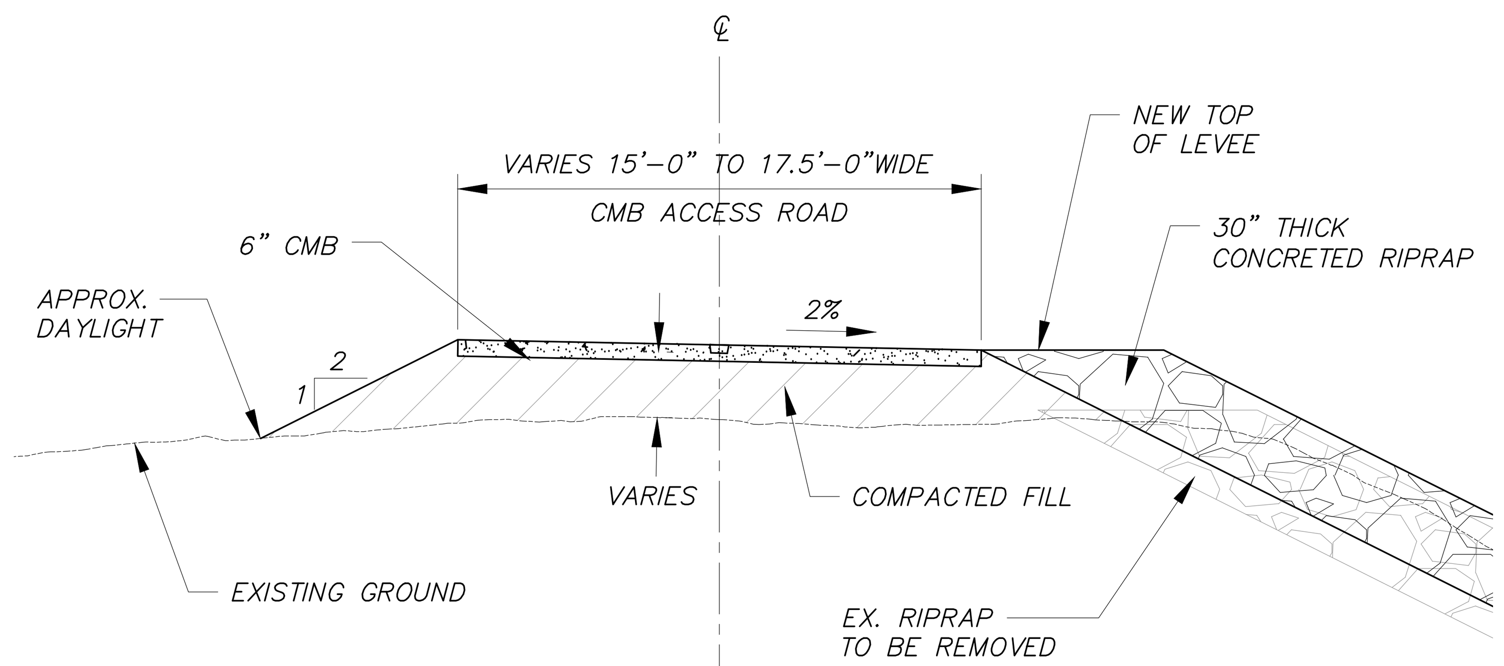
SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE (VR-3)
AT LIVE OAK ACRES

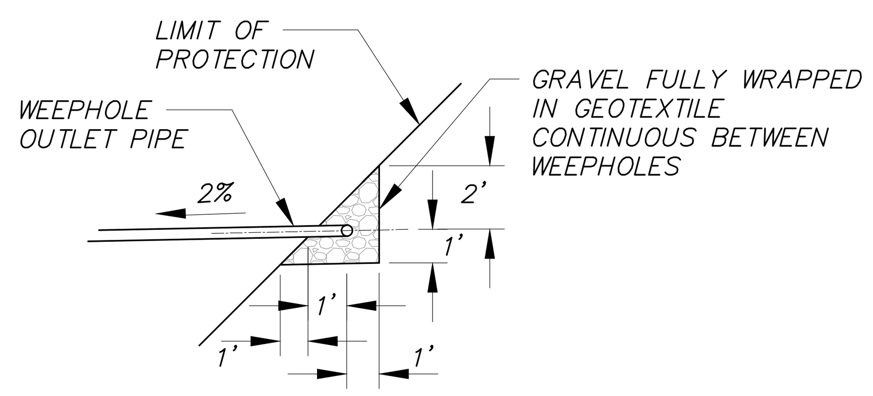
TYPICAL SECTIONS

SHEET 9 OF 11

DRAWING NO. WPD-ZONE Z-####



ASPHALT ACCESS ROAD DETAIL (A/–)
NOT TO SCALE



DETAIL (C/–)
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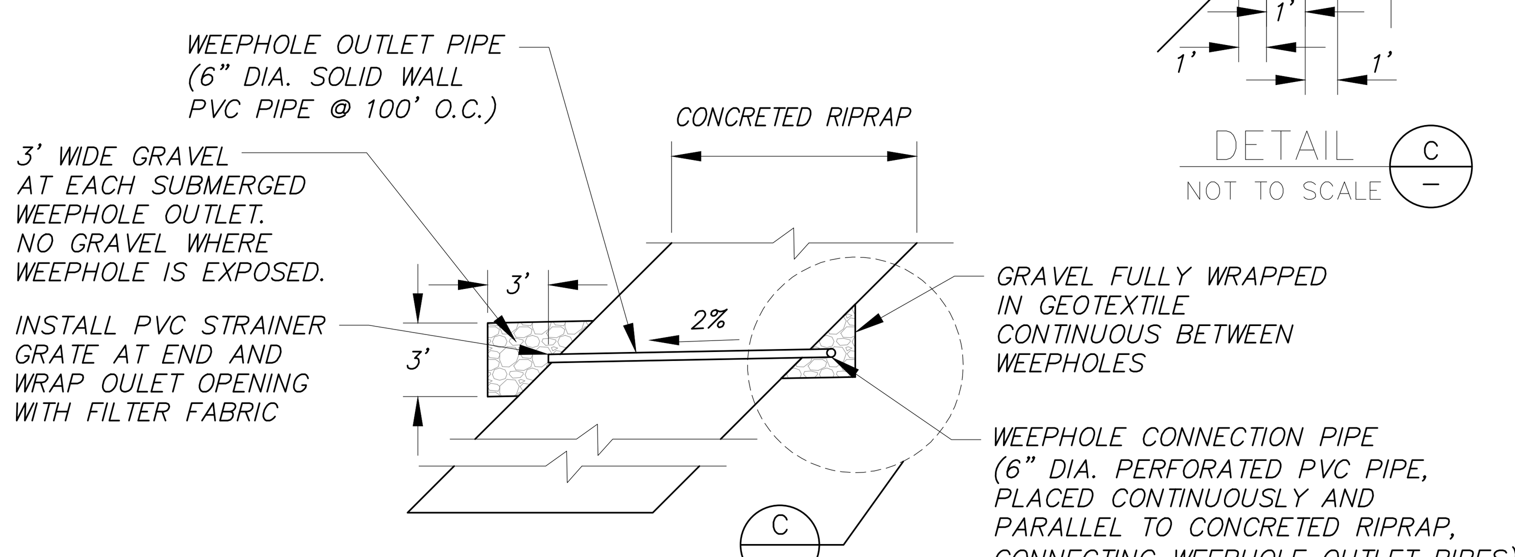

SECTION B–B
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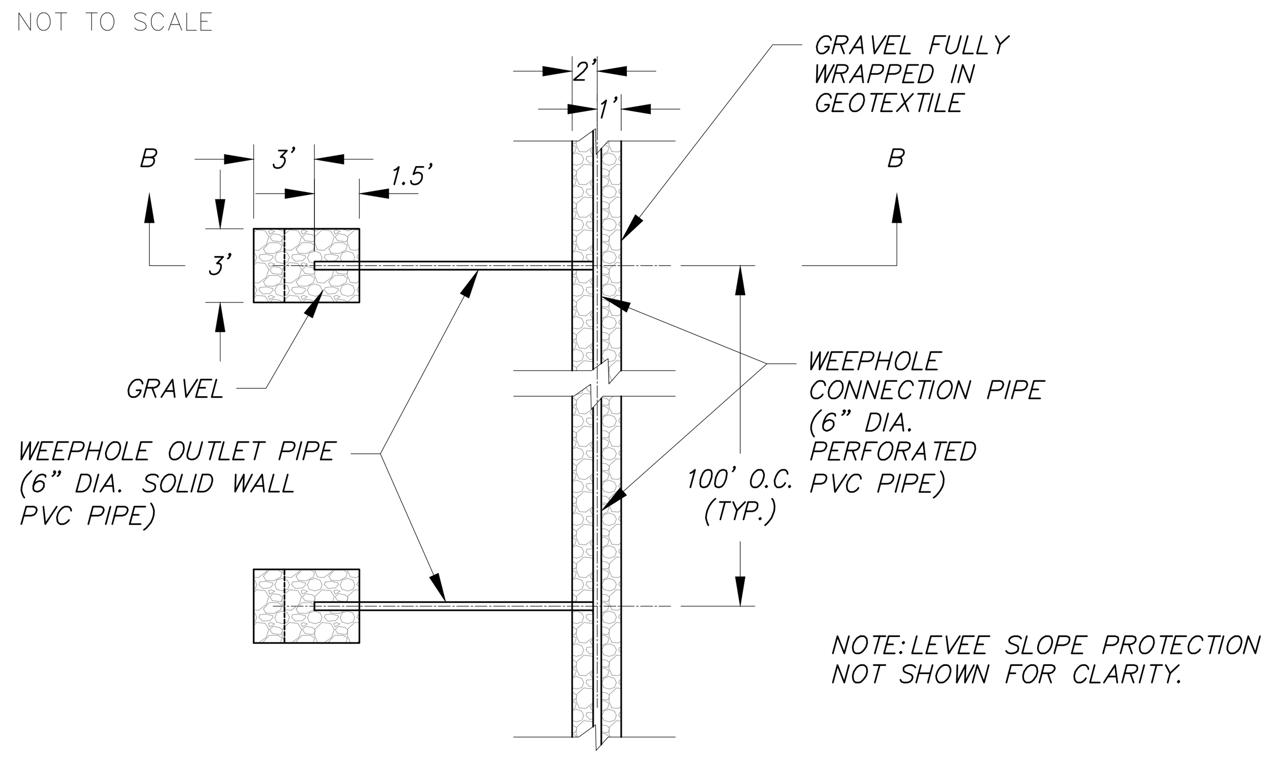
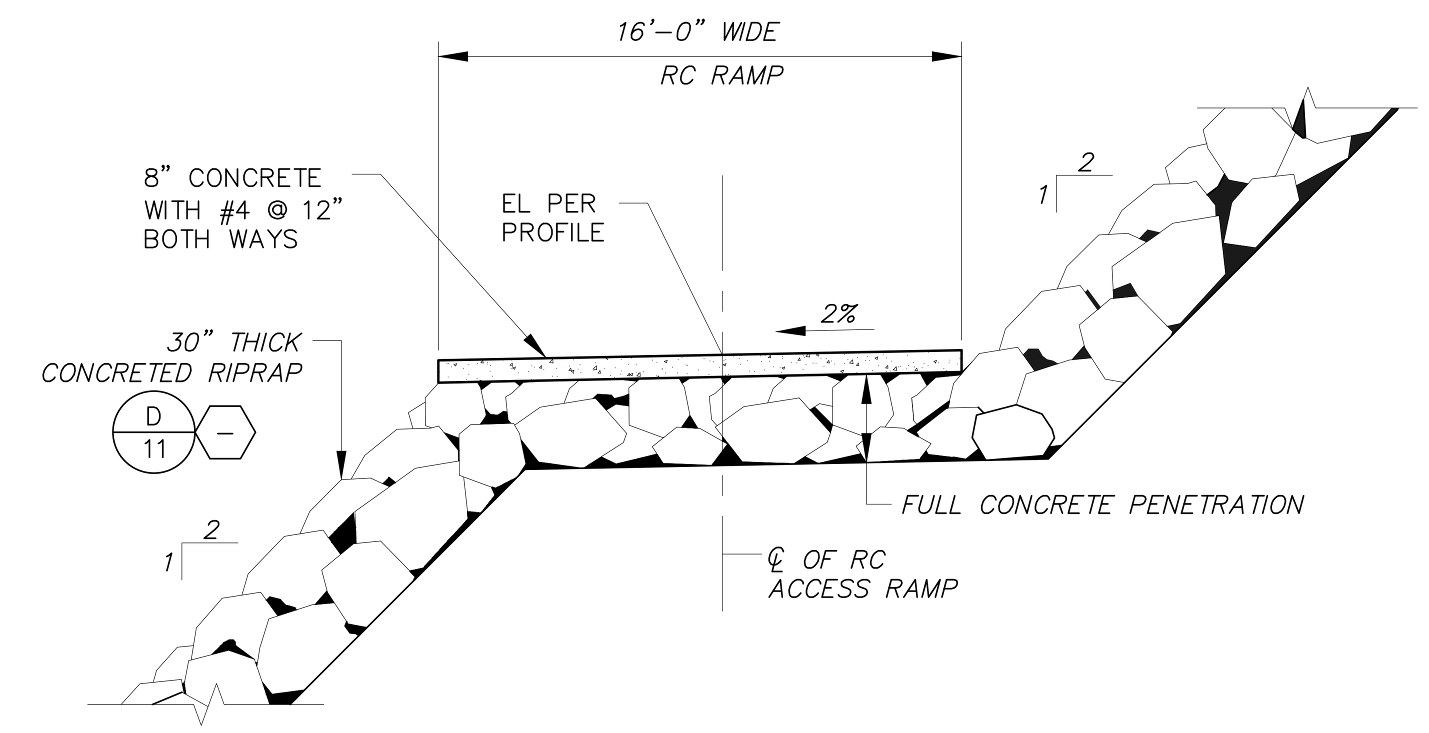


PLAN

TYPICAL WEEPHOLE DETAIL (B/–)
NOT TO SCALE



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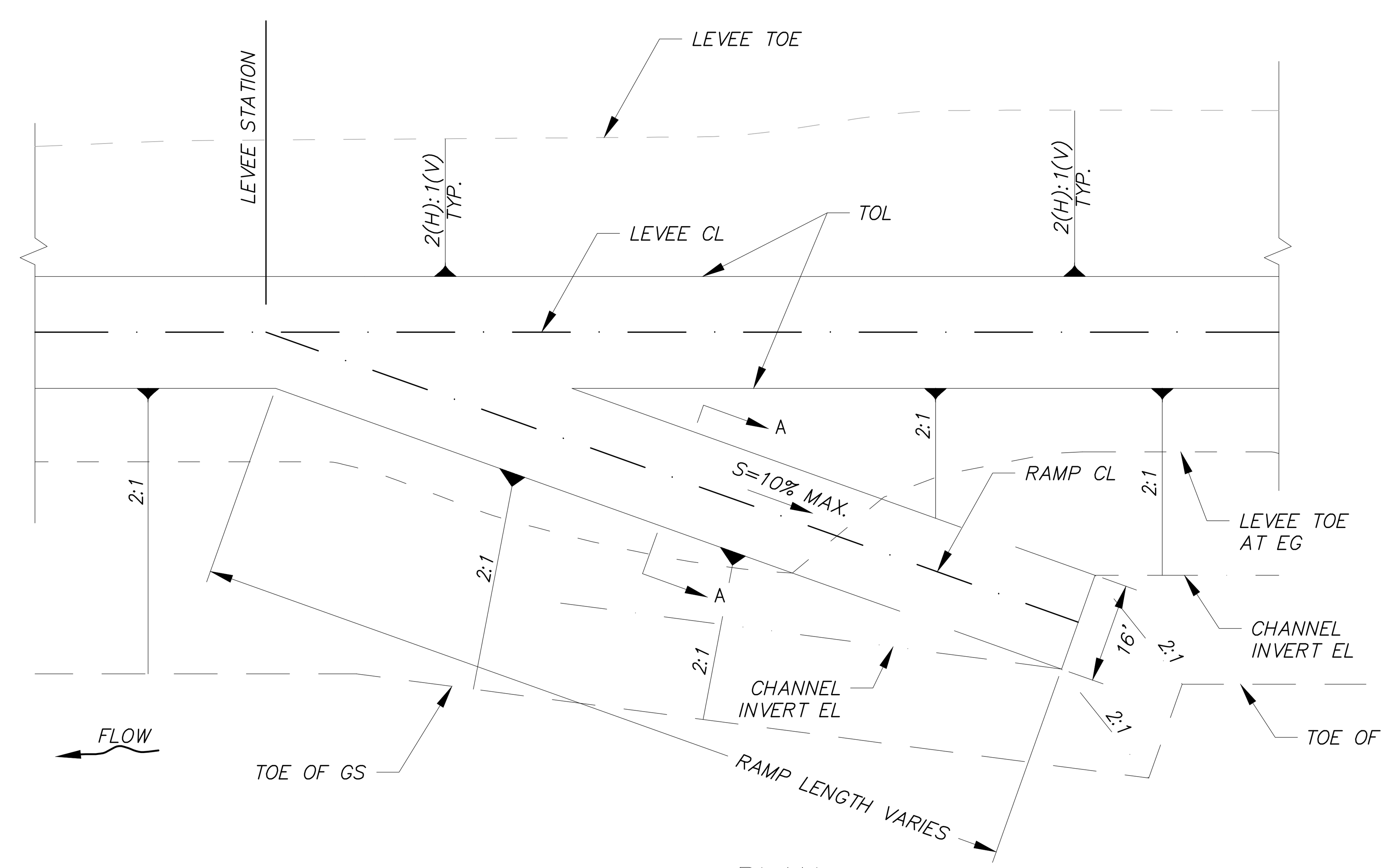


PLAN

TYPICAL ACCESS RAMP (C/–)
NOT TO SCALE

PLOT DATE: 9/10/20

SAVE DATE: 9/3/20 LOPES, ORLANDO P:\WATR\139679 MEINERS OAKS AND LIVE OAK ACRES ALTERNATIVES\10 DESIGN\30% DESIGN\LIVE OAK ACRES\01 SHEETS\TYPICALSECTIONS_DETAILS.DWG

D			
C			
B			
A			
△	REVISION DESCRIPTION	APP.	DATE

TETRA TECH
17885 VON KARMAN AVE.,
SUITE 500
IRVINE, CA 92614

DESIGNED –
DRAWN –
CHECKED –

PROJECT MANAGER DATE
DEPUTY DIRECTOR DATE
DISTRICT DIRECTOR DATE

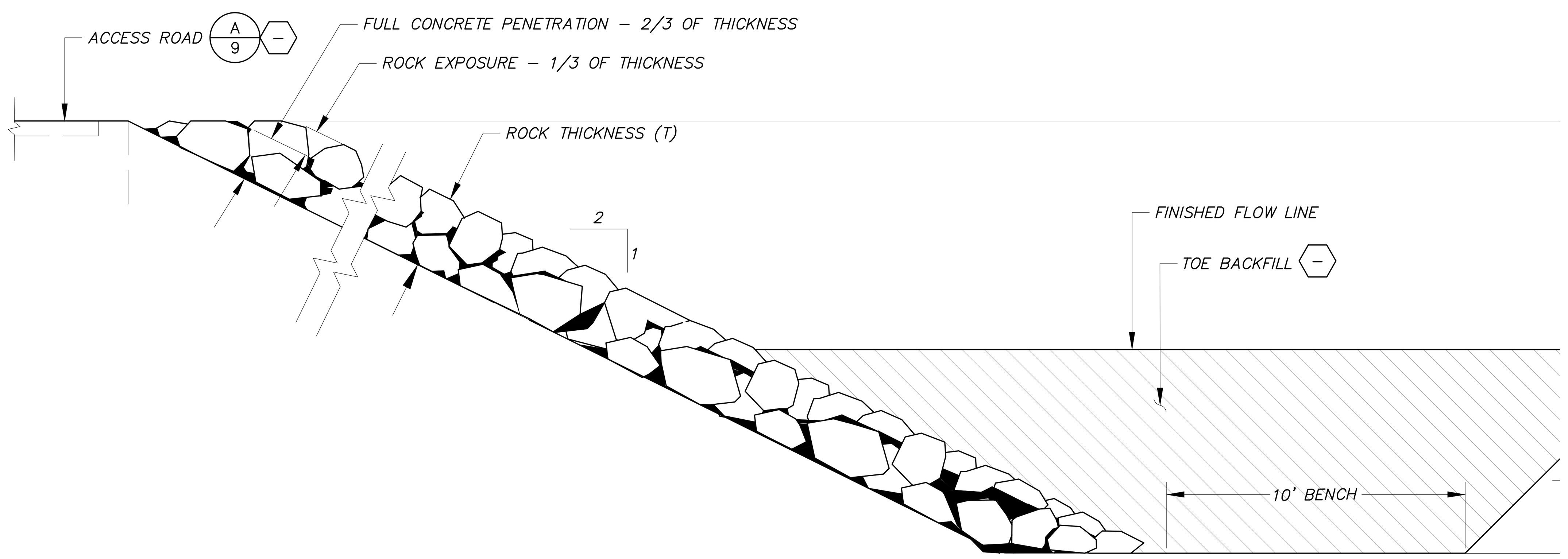
COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE (VR-3)
AT LIVE OAK ACRES
DETAILS (1)

SHEET 10
OF 11
DRAWING NO.
WPD-ZONE Z-####

ROCK RIPRAP (CLASS/DEPTH)	
ROCK CLASS	ROCK THICKNESS (T)
1/4	2'-6"



CONCRETED RIPRAP BANK PROTECTION DETAIL (D/–)

NOT TO SCALE

	REVISION DESCRIPTION	APP.	DATE
D			
C			
B			
A			
△			

TETRA TECH
17885 VON KARMAN AVE.,
SUITE 500
IRVINE, CA 92614

DESIGNED	–
DRAWN	–
CHECKED	–

PROJECT MANAGER DATE
DEPUTY DIRECTOR DATE
DISTRICT DIRECTOR DATE

COUNTY OF VENTURA
PUBLIC WORKS AGENCY
WATERSHED PROTECTION

SPEC. NO. –
PROJ. NO. –

VENTURA RIVER LEVEE (VR-3)
AT LIVE OAK ACRES

DETAILS (2)

SHEET 11 OF 11

DRAWING NO. WPD-ZONE Z-####

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ATTACHMENT G

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Live Oak Acres Intermediate Design

Selected Alternative: 2H:1V Concreted Riprap Protection

Item No.	Item Description	UOM	Quantity	Unit Cost	Total Cost
1	Mobilization (10% of Total Construction Cost)	LS	1	$ 1,005,000.00	$ 1,005,000
2	Clearing and Grubbing	ACR	16	$ 4,500.00	$ 72,000
3	Diversion and Control of Water	LS	1	$ 1,500,000.00	$ 1,500,000
4	Levee Slope Protection	LF	5,525	$ 1,478.05	$ 8,166,250
4.1	Concreted Rock Riprap (Import)	CY	17,661	$ 200.00	$ 3,532,104
4.2	Concreted Rock Riprap (50% Existing Reused)	CY	10,180	$ 90.00	$ 916,197
4.3	Excavation	CY	113,189	$ 6.00	$ 679,135
4.4	Backfill (Toedown Construction)	CY	88,426	$ 5.75	$ 508,451
4.5	Compacted Fill (Levee Prism)	CY	4,978	$ 40.00	$ 199,140
4.6	Weepholes	LF	11,300	$ 80.00	$ 904,000
4.7	Riprap Removal	CY	20,360	$ 16.00	$ 325,759
4.8	Floodwall (near Santa Ana Blvd. Bridge) (8 ft top to footing)	LF	50	$ 1,000.00	$ 50,000
4.9	Floodwall (Station 12+40 to Station 19+15) (6.5 ft top to footing)	LF	675	$ 750.00	$ 506,250
4.10	Access Road (CMB)	SY	90,869	$ 6.00	$ 545,214
5	Access Ramps	EA	2	$ 122,904.00	$ 245,808
5.1	Concreted Riprap	CY	1,080	$ 200.00	$ 216,000
5.2	Compacted Fill	CY	4,468	$ 6.00	$ 26,808
5.3	RC Pavement	SY	40	$ 75.00	$ 3,000
6	Storm Drains	EA	3	$ 22,500.00	$ 67,500
6.1	Replace Outlet Structure and Extend Riverside End of Storm Drain (48" RCP)	EA	1	$ 12,500.00	$ 12,500
6.2	Remove and replace existing pipes (24' RCP) (includes concrete outlet structure)	EA	2	$ 12,500.00	$ 25,000
6.3	Replace 24-inch Flap Gate	EA	2	$ 7,500.00	$ 15,000
6.4	Replace 48-inch Flap Gate	EA	1	$ 15,000.00	$ 15,000
				Subtotal (1)	$ 11,056,558
6				*Planning, Engineering, and Design:	
7				*Construction Management:	
				Subtotal (2):	$ 11,056,558
8				*Contingency (30%):	
*Note: the mitigation costs, PED costs (planning, engineering, design), construction management costs, and contingency costs were not included in the cost estimates shown in this report. At VCPWA’s direction, it was determined that these costs be removed from the estimates, since these components will need to be factored into the entire Matilija Dam Removal Project as a whole.					
				Total Project Cost:	**$ 11,056,558**

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ATTACHMENT H

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Selected Alternative - 2H:1V Grouted Stone

Item	XS	Limits	Limits	LF (reach)	Cross-Section Area (ft)	QUANTITY
EXCAVATION	**XS**	**Limits**	**Limits**	**LF**	**Cross-Section Area (ft2)**	**Quantity (CY)**
	+50	Begin	Begin	50	0	0.00
	1+50	1+25	2+50	125	724.4005	3353.71
	3+50	2+50	4+25	175	542.4803	3516.08
	5+00	4+25	7+50	325	339	4080.56
	10+00	7+50	12+50	500	422	7814.81
	15+00	12+50	17+50	500	448.2272	8300.50
	20+00	17+50	22+50	500	459.5504	8510.19
	25+00	22+50	27+50	500	479.4537	8878.77
	30+00	27+50	32+50	500	717.8075	13292.73
	35+00	32+50	37+50	500	630.5845	11677.49
	40+00	37+50	42+50	500	557.4719	10323.55
	45+00	42+50	47+50	500	622	11518.52
	50+00	47+50	52+50	500	593	10981.48
	55+00	52+50	55+73	323	627	7489.17
	56+45	55+73	56+50	78	550	1578.70
	FW from Sta. 1+75-1+25			50	56.277	104.2166667
	FW from Sta. 19+15-12+40			675	70.7441	1768.6025
						113189.09

BACKFILL	XS	Limits	Limits	LF	Cross-Section Area (ft2)	Quantity (CY)
	+50	Begin	Begin	50	0	0.00
	1+50	1+25	2+50	125	520	2407.41
	3+50	2+50	4+25	175	413.5066	2680.14
	5+00	4+25	7+50	325	336	4044.44
	10+00	7+50	12+50	500	334	6185.19
	15+00	12+50	17+50	500	257.4831	4768.21
	20+00	17+50	22+50	500	361.5504	6695.38
	25+00	22+50	27+50	500	369.4537	6841.74
	30+00	27+50	32+50	500	604.8075	11200.14
	35+00	32+50	37+50	500	518.5845	9603.42
	40+00	37+50	42+50	500	434.4719	8045.78
	45+00	42+50	47+50	500	506	9370.37
	50+00	47+50	52+50	500	494	9148.15
	55+00	52+50	55+73	323	512	6115.56
	56+45	55+73	56+50	78	460	1320.37
						88426.27

CONCRETED RIPRAP	XS	Limits	Limits	LF	Cross-Section Area (ft2)	Quantity (CY)
	+50	Begin	Begin	50	0	0.00
	1+50	1+25	2+50	125	149.1235	690.39
	3+50	2+50	4+25	175	128.9737	835.94
	5+00	4+25	7+50	325	126	1516.67
	10+00	7+50	12+50	500	132	2444.44
	15+00	12+50	17+50	500	129.2177	2392.92
	20+00	17+50	22+50	500	146.5112	2713.17
	25+00	22+50	27+50	500	140.4718	2601.33
	30+00	27+50	32+50	500	137.0601	2538.15
	35+00	32+50	37+50	500	141.6255	2622.69
	40+00	37+50	42+50	500	140.8395	2608.14
	45+00	42+50	47+50	500	137.7891	2551.65
	50+00	47+50	52+50	500	132.5727	2455.05
	55+00	52+50	55+73	323	126.0342	1505.41
	56+45	55+73	56+50	78	127	364.54
						27840.49

FLOODWALL	XS		Limits	LF	System (ea)	Cross-Section Area (ft2)
	+50		Begin	50	0	0
RC F/W (East)	1+50			50	1	28.332
	3+50			200	0	0
	5+00			150	0	0
	10+00			500	0	0
RC F/W (West)	15+00			675	1	20.499
	20+00			500	0	0
	25+00			500	0	0
	30+00			500	0	0
	35+00			500	0	0

40+00			500	0	0
45+00			500	0	0
50+00			500	0	0
55+00			500	0	0
56+45		End	145	0	0

Riprap Removal

XS	Limits	Limits	LF	Cross-Section Area (ft2)	Quantity (CY)
+50	Begin	Begin	50	0	0.00
1+50	1+25	2+50	125	104	481.48
3+50	2+50	4+25	175	104	674.07
5+00	4+25	7+50	325	106.7078	1284.45
10+00	7+50	12+50	500	106.7078	1976.07
15+00	12+50	17+50	500	106.7078	1976.07
20+00	17+50	22+50	500	186.4421	3452.63
25+00	22+50	27+50	500	143	2648.15
30+00	27+50	32+50	500	106.7078	1976.07
35+00	32+50	37+50	500	106.7078	1976.07
40+00	37+50	42+50	500	106.7078	1976.07
45+00	42+50	47+50	500	104.6953	1938.80
50+00	47+50	52+50	500	0	0.00
55+00	52+50	55+73	323	0	0.00
56+45	55+73	56+50	78	0	0.00
					20359.93

COMPACTED FILL

XS	Limits	Limits	LF	Cross-Section Area (ft2)	Quantity (CY)
+50	Begin	Begin	50	0	0.00
1+50	1+25	2+50	125	25.277	117.02
3+50	2+50	4+25	175	3.4328	22.25
5+00	4+25	7+50	325	0.4341	5.23
10+00	7+50	12+50	500	0.6769	12.54
15+00	12+50	17+50	500	53.7441	995.26
20+00	17+50	22+50	500	61.1287	1132.01
25+00	22+50	27+50	500	15.2497	282.40
30+00	27+50	32+50	500	8.6944	161.01
35+00	32+50	37+50	500	61.0767	1131.05
40+00	37+50	42+50	500	37.4942	694.34
45+00	42+50	47+50	500	9.5403	176.67
50+00	47+50	52+50	500	22	407.41
55+00	52+50	55+73	323	47	561.39
56+45	55+73	56+50	78	67	192.31
					5890.89

WEEPHOLES

XS		Limits	LF	System Riverside (ea)	System Landside (ea)
0 - 5650		Begin - End	5650	2	0

CMB Road

XS		Limits	LF	Width	Quantity (cy)
1815 - 5650	18+15	5650	3835	16	30680.00
					30680.00

Impact Area					Quantity (sf)	Quantity (acre)
Permanent					404223.75	9.28
Temporary					172120.94	3.95
TCE					187378.79	4.30
					Total	17.53

ATTACHMENT I

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Live Oak Acres Summary of Hydraulics

Approximate Levee Station	HEC-RAS XS RM	Channel Thalweg (feet)	Total Scour Depth	Existing Toe Down Protection Elevation	Existing Toe Down Defiency	Min Design Levee Toe Elev.	Min Design Levee Toe Elev.	Existing Computed Water-Surface Elevation (feet)		Future Dam Removal Condition Computed Water-Surface Elevation[1] (feet)		Existing Top-of-Levee Elevation (feet)	Computed Freeboard (feet)		FEMA Required Freeboard	Min. Design Levee TOL Elev.	Design Levee TOL Elev.
								100-Year	Design Flow	100-Year	Design Flow		100-Year	Design Flow			
46+89	10.13	452.81	6.60	450.13	-3.92	446.21	444.00	461.99	462.24	463.06	463.31	465.27	2.21	1.96	3.50	466.81	467.00
41+83	10.04	446.22	7.40	442.04	-3.22	438.82	437.00	455.64	455.93	456.46	456.75	458.04	1.58	1.29	3.00	459.75	460.00
36+69	9.94	436.92	7.40	434.51	-4.99	429.52	428.00	448.60	448.86	449.17	449.43	450.51	1.34	1.08	3.00	452.43	453.00
33+72	9.85	430.78	7.40	430.65	-7.27	423.38	422.00	442.06	442.35	442.56	442.85	446.65	4.09	3.80	3.00	445.85	446.00
28+59	9.75	424.51	7.40	423.98	-6.87	417.11	416.00	435.55	435.78	435.55	435.78	439.98	4.43	4.20	3.00	438.78	439.00
23+53	9.66	417.24	7.40	413.89	-4.05	409.84	408.00	428.88	429.21	429.93	430.26	432.89	2.96	2.63	3.00	433.26	434.00
18+50	9.56	412.61	7.40	410.86	-5.65	405.21	404.00	424.82	425.40	426.08	426.66	426.86	0.78	0.20	3.00	429.66	430.00
13+41	9.47	405.59	6.50	404.24	-5.15	399.09	397.00	419.78	420.14	419.84	420.20	420.24	0.40	0.04	3.00	423.20	424.00
8+40	9.38	404.50	6.50	397.30	0.70	398.00	396.00	413.99	414.51	414.32	414.84	419.01	4.69	4.17	3.00	417.84	419.01
3+69	9.29	395.34	6.50	393.20	-4.36	388.84	387.00	410.48	411.53	411.46	412.51	417.51	6.05	5.00	3.00	415.51	417.51
0+77	9.25	393.17	6.50	388.51	-1.84	386.67	383.00	409.41	410.60	410.51	411.70	410.50	-0.01	-1.20	4.00	415.70	416.00
	Santa Ana Blvd Bridge		8.50	387.00	-2.33	384.67	383.00										

2018 Thalweg is lower than what is shown in the model.

Lower Event causes higher WSE, thus the lower event was used here.

Floodwall Section

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ATTACHMENT J

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Summary of Scour Calculations
(100-Year)

	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Flow Area (sq ft)	Top Width (ft)	Hydr Depth C (ft)	Bend Radius (ft)	Crossing Width (ft)	Crossing Depth (ft)	Max Depth (ft)	Bend Scour Depth (ft)	Contraction Scour (ft)	Pier Scour (ft)	Long Term Scour	Single Event Scour	**Total**	**Total**
	VenturaRiver	10.23	100 yr	28300	460.79	468.64	2848.05	964.44	3.43	2292	799	4.46	10.01	4.1	n/a	n/a	2.50	0.50	**6.57**	**6.6**
	VenturaRiver	10.13	100 yr	28300	454.16	461.99	3089.51	709.32	4.4	2292	799	4.46	10.01	4.1	n/a	n/a	2.50	0.50	**6.57**	**6.6**
	VenturaRiver	10.04	100 yr	28300	446.22	455.64	2431.11	592.68	4.25	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
	VenturaRiver	9.94	100 yr	28300	439.85	448.6	3018.67	722.96	4.24	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
	VenturaRiver	9.85	100 yr	28300	435.45	442.06	2456.79	606.63	4.33	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
	VenturaRiver	9.75	100 yr	28300	427.53	435.55	2826.63	683.82	4.13	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
	VenturaRiver	9.66	100 yr	28300	417.72	428.88	2432.16	535.25	4.54	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
	VenturaRiver	9.56	100 yr	28300	412.61	424.82	2662.04	368.51	7.22	2227	684	4.25	8.02	4.7	n/a	n/a	2.50	0.50	**7.17**	**7.2**
Live Oak	VenturaRiver	9.47	100 yr	28300	407.52	419.78	2045.39	261.45	7.82	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.38	100 yr	28300	405.26	413.99	1934.84	289.11	6.82	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.29	100 yr	28300	395.34	410.48	2163.95	227.01	9.53	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.25	100 yr	28300	393.17	409.41	2190.51	220.07	11.24	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
				Bridge										3.7	2	8.0*	2.50	0.50	**8.20**	**8.2**
	VenturaRiver	9.23	100 yr	28300	393.25	405.43	1662.9	186.28	8.99	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.19	100 yr	28300	392.07	403.55	3085.49	2796.56	7.76	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.09	100 yr	28300	386.68	395.68	3362.07	2841.14	3.89	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**
	VenturaRiver	9.00	100 yr	28300	380.95	388.46	3370.24	2808.18	2.71	2232	280	7.22	8.73	3.7	n/a	n/a	2.50	0.50	**6.19**	**6.2**

Note: The bend scour depth is a function of the bend radius, the crossing width, the crossing depth and the max depth.
Single event scour based on Figures D-31 through D-35
Long Term scour is taken from Figures D-1 through D-5 and D-16 through D-20
*The Pier Scour component was not added to the total since the bank protection is out of the zone of influence from the pier scour.

Summary of Scour Calculations
(Design Flow)

Live Oak

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Top Width (ft)	Hydr Depth C (ft)	Bend Radius (ft)	Crossing Width (ft)	Crossing Depth (ft)	Max Depth (ft)	Bend Scour Depth (ft)	Contraction Scour (ft)	Pier Scour (ft)	Long Term Scour	Single Event Scour	Total	**Total**
VenturaRiver	10.23	110% of 100 yr	31130	460.79	468.87	1002.89	3.61	2292	808	4.56	10.24	4.1	n/a	n/a	2.50	0.50	6.60	**6.6**
VenturaRiver	10.13	110% of 100 yr	31130	454.16	462.24	716.43	4.65	2292	808	4.56	10.24	4.1	n/a	n/a	2.50	0.50	6.60	**6.6**
VenturaRiver	10.04	110% of 100 yr	31130	446.22	455.93	606.57	4.52	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.94	110% of 100 yr	31130	439.85	448.86	725.99	4.49	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.85	110% of 100 yr	31130	435.45	442.35	623.4	4.59	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.75	110% of 100 yr	31130	427.53	435.78	684.34	4.36	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.66	110% of 100 yr	31130	417.72	429.21	536.25	4.87	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.56	110% of 100 yr	31130	412.61	425.4	370.68	7.77	2227	684	4.52	8.25	4.9	n/a	n/a	2.50	0.50	7.38	**7.4**
VenturaRiver	9.47	110% of 100 yr	31130	407.52	420.14	267.99	8.13	2232	282	7.77	9.25	4.0	n/a	n/a	2.50	0.50	6.47	**6.5**
VenturaRiver	9.38	110% of 100 yr	31130	405.26	414.51	291.7	7.29	2232	282	7.77	9.25	4.0	n/a	n/a	2.50	0.50	6.47	**6.5**
VenturaRiver	9.29	110% of 100 yr	31130	395.34	411.53	241.27	10.44	2232	282	7.77	9.25	4.0	n/a	n/a	2.50	0.50	6.47	**6.5**
VenturaRiver	9.25	110% of 100 yr	31130	393.17	410.6	249.81	12.13	2232	282	7.77	9.25	4.0	n/a	n/a	2.50	0.50	6.47	**6.5**
			Bridge									4.0	2	8.1*	2.50	0.50	8.50	**8.5**

Note: The bend scour depth is a function of the bend radius, the crossing width, the crossing depth and the max depth.
Single event scour based on Figures D-31 through D-35 in the Stillwater Sciences Sediment Report.
Long Term scour is taken from Figures D-1 through D-5 and D-16 through D-20 in the Stillwater Sciences Sediment Report.
*The Pier Scour component was not added to the total since the bank protection is out of the zone of influence from the pier scour.

ATTACHMENT K

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TITLE: Live Oak Acres Intermediate Design
SUBJECT: Construction Durations
MADE BY: SKV
CHECKED BY:

JOB NO.:
DATE: 9/3/2020

INTERMEDIATE DESIGN

Item	Prod. Rate	Prod. Index	Work Hrs/Day	UOM	Quantity	Crews (EA)	Duration (Hrs.)	Duration (Days)
Mobilization	0.13	100%	8	DAY	20	1	160.0	20.00
Clearing and Grubbing	0.13	100%	8	ACRE	16	2	64.0	8.00
Diversion and Control of Water	0.01	100%	8	LS	1	1	80.0	10.00
Levee Slope Protection								
Concreted Rock Riprap (Import)	45.00	100%	8	CY	17,661	2	196.2	24.53
Concreted Rock Riprap (50% Ex. Reuse)	45.00	100%	8	CY	10,180	2	113.1	14.14
Excavation	196.00	100%	8	CY	113,189	4	144.4	18.05
Backfill (Toedown Construction)	102.00	100%	8	CY	88,426	4	216.7	27.09
Compacted Fill (Levee Prism)	102.00	100%	8	CY	4,978	2	24.4	3.05
Weephole	0.03	100%	8	LS	1	1	40.0	5.00
Riprap Removal	50.00	100%	8	CY	20,360	2	203.6	25.45
Floodwall (near Santa Ana Blvd)	2.50	100%	8	LF	50	1	20.0	2.50
Floodwall (Station 12+40)	3.50	100%	8	LF	675	1	192.9	24.11
Access Road (CMB)	675.00	100%	8	SY	90,869	1	134.6	16.83
Access Ramps								
Concreted Riprap	45.00	100%	8	CY	1,080	1	24.0	3.00
Compacted Fill	102.00	100%	8	CY	4,468	1	43.8	5.48
RC Pavement	5.00	100%	8	SY	40	1	8.0	1.00
Storm Drain Replacement (SD 4 & 6)								
Replace Outlet Structure… (48" RCP)	0.025	100%	8	LS	1.0	1	40.0	5.00
Remove and Replace 24" RCP	0.03	100%	8	LS	1	1	40.0	5.00
Replace 24" Flap Gate	0.13	100%	8	LS	1	1	8.0	1.00
Replace 48" Flap Gate	0.13	100%	8	LS	1	1	8.0	1.00
Demobilization	0.13	100%	8	DAY	10	1	80.0	10.00

TITLE:	Live Oak Acres Intermediate Design
SUBJECT:	Construction Durations
MADE BY:	SKV
CHECKED BY:	

Hauling Activities	UOM	Quantity	Assumed Truck Size	No. of Truck Trips
Concreted Rock Import	CY	17661	16	1104
Concreted Rock (50% Existing)	CY	5090	16	319
Excess Excavation	CY	28477	16	1780
Riprap Removal	CY	20360	16	1273
Floodwall Concrete	CY	345	12	29
CMB	CY	1685	16	106
Concreted Riprap	CY	1080	16	68
RC Pavement	CY	7	12	1
			Total Haul Truck Trips:	**4680**
			Total Construction Days:	154
			Avg. Haul Trucks per Day:	**30.3**
			Assumed No. of Laborers per Day (avg.):	20
			Assumed No. of Mgmt. and OH Staff per Day :	5
			Total Staff Vehicle Trips per Day:	25
			Avg. Daily Vehicle Trips:	**55.3**