Three Rivers Levee Improvement Authority

200-Year Goldfields Levee Project
Basis of Design Report - 100% Design
December 2019
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1.0 INTRODUCTION

1.1 Purpose and Scope

The 200-year Goldfields Levee Project (GF200YR) has been initiated by the Three Rivers Levee Improvement Authority (TRLIA) to provide 200-year flood protection to the urban areas of southern Yuba County (County) and to meet Federal Emergency Management Agency (FEMA) standards for 100-year flood protection for Reclamation District 784 (RD 784).

The purpose of this Basis of Design Report (BODR) is to document the basis for design of the GF200YR, which includes the plans, specifications, and cost estimates for the project.

1.2 Project Description

1.2.1 Background Information

In 2015, the TRLIA design team prepared the “Goldfields Flood Risk Reduction Feasibility Study: 200-year Project Section-Final Report” dated September 2015, which documented revisions to the 100-year project and presented detailed information on the alternatives considered for the GF200YR. In 2018, ENGEO Incorporated (ENGEO) prepared a Technical Memorandum entitled Preliminary Mitigation Alternatives dated May 30, 2018, which provided preliminary geotechnical stability alternatives for the GF200YR. Subsequently, ENGEO prepared a Technical Memorandum titled Preferred Underseepage Mitigation dated September 7, 2018 documenting the preferred underseepage mitigation. A mitigation cost analysis was prepared for the seepage berm and cutoff wall mitigation alternative for all four reaches of the GF200YR. The results of the cost analysis is provided in Appendix C.

The information contained in these technical memorandums was expanded into ENGEO’s Geotechnical Basis of Design Report dated December 4, 2019.

1.2.2 Project Location

The GF200YR includes approximately 2.6 miles of new levee embankment to extend and partially replace the existing Yuba River South Levee (YRSL) located upstream of recently completed levee improvements (Upper Yuba Levee Improvement Project or UYLIP). The YRSL is operated and maintained by RD 784. The GF200YR tie-in location to the YRSL is located in US Army Corps of Engineers (USACE) Levee Maintenance Unit 7 located approximately at levee mile (LM) 3.72. The locations of RD 784 levee maintenance Unit 7 and levee miles are shown on Figure 1.

The new levee would begin approximately 1,000 feet west of the existing YRSL terminus, and extend southeast to Hammonton-Smartville Road. The levee would then continue along the north side of Hammonton-Smartville Road, terminating
approximately 0.5 mile southwest of Hammonton Road. For the purposes of geotechnical analysis, ENGeo divided the new levee project into six segments (Reach 1a through Reach 4) to delineate areas of similar geotechnical conditions and/or proposed geotechnical remediation measures. Table 1-1 below shows the station limits of each Reach. Figure 2 provides a map of the levee reaches as well as existing and proposed features within the project area.

Table 1-1 – Reach Limits and Lengths

<table>
<thead>
<tr>
<th>Reach</th>
<th>Beginning Station</th>
<th>End Station</th>
<th>Reach Length (feet)</th>
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<tbody>
<tr>
<td>1a</td>
<td>50+00</td>
<td>59+50</td>
<td>950</td>
</tr>
<tr>
<td>1b</td>
<td>59+50</td>
<td>70+00</td>
<td>1,050</td>
</tr>
<tr>
<td>2a</td>
<td>70+00</td>
<td>95+00</td>
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<tr>
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The project also includes degrading the existing YRSL upstream of the new levee tie-in in order to allow floodwaters that enter the setback area to return to the Yuba River.

Areas waterward of the GF200YR levee currently drain from the elevated areas in the northeast to the lower areas located in the southwest and ultimately drain to the Linda Drain system, also known as the Horseman’s ditch. The Linda Drain facility is located on the southwesterly corner of the Brophy Road/Hammonton-Smartville Road intersection.

2.0 EXISTING SITE CONDITIONS

2.1 Existing Land Use

The alignment of the new levee embankment is situated within existing agriculture farmland and south of future aggregate mining operations in the Goldfields. Seven residences are located within the project area, including five along the new levee alignment between Stations 135+00 to 164+00. A significant irrigation canal (Brophy Water District Irrigation Canal) crosses the new levee alignment near Station 63+00. Several farm and mining operations access roads (e.g. Brophy Road and Road 1034) are within the project footprint.
2.2 General Site Features

2.2.1 Levee History

Historically, water surface elevations during high water events in the Yuba River do not reach the waterside levee slope south of the Yuba Goldfields. During the 1997 event (a significant event for the Yuba River watershed), flood flows exited the main Yuba River channel and flowed through the Yuba Goldfields, ultimately re-entering the channel at the upstream end of the YRSL. The exiting flows from the Goldfields were concentrated along the waterside toe of the YRSL and eroded approximately one-third of the levee embankment for a distance of approximately 1,200 feet downstream of the Goldfields. After the flood, the erosion damage was repaired by reconstructing the levee slope.

In 2011 and 2012, as a part of TRLIA’s Upper Yuba River Levee Improvement Project (UYLIP), a rock slope protection blanket was constructed immediately downstream of the Yuba Goldfields (measuring approximately 3,139 feet). The rock slope protection was two feet thick and was underlain by a layer of six-inch-thick bedding material and geotextile fabric. On the landside of the levee, a combined seepage/stability berm was constructed. The berm width varies from 80 to 150 feet (Stations 286+00 to 303+59). In addition to the levee improvements, piezometers were placed along the levee landslide toe approximately at Station 301+00 to monitor seepage through the levee. Other improvements to the YRSL downstream of the UYLIP were constructed by TRLIA in the early 2000s.

In 2016, existing tailing piles within the Yuba Goldfields were re-contoured to provide an interim, 100-year project to meet FEMA criteria. This project was initiated when hydraulic analyses of the Yuba River and Goldfields indicated that a failure of existing tailing piles could cause flooding to areas protected by recent levee improvements to the RD 784 levee system.

2.2.2 Existing Surface Features and Utilities

The GF200YR levee alignment crosses orchards, irrigation ditches, drainage ditches, farm access roads, a paved County roadway, paved residential driveways, and rice fields.

Brief descriptions of the typical existing surface features along the GF200YR levee, by reach, are included in Appendix A.

Various utilities including irrigation canals, storm drainage ditches, power poles and gravity drains exist along the GF200YR alignment. An inventory of all known existing utilities that may be present within the levee footprint is presented in Appendix B.

The existing YRSL upstream of the GF200YR tie-in, i.e., the portion being degraded, ranges in levee height from approximately 12.0 to 15.6 feet above the existing waterward levee toe grade. The existing crown width measures approximately 20 feet and is all-weather surfaced by aggregate base material. The landside slopes range from 3...
Horizontal: 1 Vertical (3H:1V) to 5H:1V. The waterside slopes are generally 3H:1V. On the waterside slope of the YRSL there is rock slope protection for the entire length between the GF200YR tie-in to the Yuba Goldfields. On the landside of the YRSL there is a stability berm with 5H:1V slope and an 80-foot seepage berm that extends for approximately 630 feet then transitions to a widened stability berm (top width 0 feet to 70 feet) with 3H:1V side slopes. The existing YRSL downstream of the GF200YR tie-in, i.e., the portion remaining in place, ranges in levee height approximately 10.7 to 11.7 feet above the existing waterward levee toe grade. The existing crown width measures approximately 20-feet and is all-weather surfaced by aggregate base material. The waterside slope features upstream of the tie-in location are similar for the downstream portion. On the landside slope downstream of the tie-in continues the 80-foot seepage berm noted for the upstream portion.

2.3 Surveying and Mapping

2.3.1 Project Datum

The horizontal datum for the project is based on California State Plane Zone 2. The vertical datum for the project is the North American Vertical Datum of 1988 (NAVD 88). It is noted that some early documents support the design reference of the National Geodetic Vertical Datum of 1929 (NGVD 29), and will require conversion to NAVD 88. This conversion is accomplished by adding 2.28 feet to the NGVD 29 elevation value (NGVD 29 + 2.28 = NAVD 88 Elevation). This conversion factor is specific to the project location and was determined by Wood Rodgers, Inc. (Wood Rodgers).

2.3.2 Topographic Information

Aerial topography and ortho-imagery for the GF200YR was prepared by Wood Rodgers and Synergy Mapping, Inc. (dated September 8, 2017). Vertical accuracy of the aerial topography is 0.5 foot (90% confidence level) and horizontal accuracy is 0.8 foot (90% confidence level). Other information specific to the design included California Department of Water Resources (DWR) Central Valley Floodplain Evaluation and Delineation (CVFED) Light-Detecting and Ranging (LiDAR) terrain data produced in 2008.

2.3.3 Parcel Boundary Information

Parcel boundary mapping was prepared by CTA Engineering & Surveying (CTA). CTA provided a resolved boundary base map dated August 8, 2018 using found monument markers and preliminary title reports. The boundary map resolution is currently on-going due to outstanding title report questions.
3.0 DESIGN CRITERIA

Criteria used for the GF200YR are based on published federal and state regulations and technical guidance documents. For levees to be accredited by FEMA, evidence must be provided that adequate design and operation and maintenance (O&M) systems are in place to provide reasonable assurance that protection from the base flood with a 1-percent annual chance of exceedance (i.e.: 100-year flood) exists. These requirements are outlined in the Code of Federal Regulations (44 CFR 65.10). California Code of Regulations (CCR) Title 23 requirements for levees in the Central Valley have general provisions similar in intent to those in FEMA’s 44 CFR 65.10.

In general, USACE criteria are employed for the design of levees based on the requirements of 44 CFR 65.10. This includes design criteria for levee geometry, seepage, slope stability, levee settlement and levee construction materials, as well as requirements for geotechnical site investigations, seepage analysis, slope stability analyses and settlement analysis. The California Department of Water Resources Urban Levee Design Criteria (ULDC), which was developed by DWR to provide guidance to local agencies in meeting 200-year Urban Level of Protection (ULOP) criteria, was also referenced in the development of project-specific design criteria.

Design criteria were established for the following levee system components or features and are discussed in the following sections:

- Hydraulics
  - Design Water Surface Elevation (DWSE)
  - Hydraulic top-of-levee (HTOL) elevation
- Top-of-Levee (TOL) Height
- General levee cross-section geometry
- Geotechnical criteria for the levee and foundation in regards to:
  - Underseepage and through seepage
  - Static slope stability
  - Rapid drawdown slope stability
  - Previous levee performance
  - Liquefaction and seismic stability
  - Levee settlement
  - Levee embankment materials

Additionally, there are requirements in regards to project features or facilities on or near the levee embankment that include:

- Pipeline and conduit penetrations
- Penetration by utility poles and supports and other structures
- Levee vegetation and encroachments
- Canals, pipelines, and other structures adjacent to the levee toe
• Erosion sites

Additional criteria are required for the design of internal drainage and irrigation water conveyance from the protected side of the levee, including adjacent roadways.

3.1 Hydraulic Criteria

Hydraulic analyses include criteria for developing the design water surface elevation (DWSE) and hydraulic top-of-levee (HTOL). Criteria specific to these elements are described below.

3.1.1 Design Water Surface Elevation

The DWSE for the 200-year flood events shall follow requirements set forth by DWR’s ULDC (Section 7.0) using the FEMA approach. Criteria specific to DWSE are described in MBK’s Goldfields 200-Year Levee Project – Hydraulic Analysis for the Determination of the Design Water Surface Elevation for the 100% Basis of Design.

3.1.2 Hydraulic Top-of-Levee Water Surface Elevation

DWR’s ULDC (Section 7.4 and 7.5) requires that seepage and slope stability also be evaluated for a water surface set at HTOL. As set forth in the ULDC, levees must be able to meet seepage and slope stability criteria relative to the HTOL water surface elevation. The HTOL water surface elevation is defined as the lower of the following two elevations:

- Median 200-year water surface plus 3 feet
- Median 500-year water surface

3.2 Top-of-Levee Height

The Top-of-Levee elevation is established for the purpose of reducing the risk of the levee overtopping. The appropriate TOL elevation is determined by establishing a DWSE and then adding the appropriate additional levee height (freeboard, calculated settlement and other considerations) in accordance with FEMA, USACE and ULDC guidance. The TOL elevations for the GF200YR are measured from the waterside levee crown hinge point.

Various agencies and guidelines provide different recommendations for this additional height.

- FEMA (44 CFR 65.10): Three feet of height is added to the 100-year DWSE for freeboard. However, an additional one foot of freeboard is often required near bridge crossings and other constrictions. It is noted that FEMA does not address a 200-year level of flood protection or associated freeboard value.
• USACE: Requires three feet of height over the DWSE (considering the deterministic approach) for freeboard. Note that a risk and uncertainty-based approach to determine the required levee height is not being used for this project.
• DWR ULDC (Section 7.2): States that a minimum of three feet of height for freeboard is added to the 200-year DWSE. However, where necessary, it also requires larger heights to protect the levee against high winds and wave run-up.

3.3 General Levee Cross-Sectional Geometry

The minimum levee cross section is based on a review of the following documents (see 7.0 Reference section for dates and additional references:

• USACE, Design & Construction of Levees, EM 1110-2-1913,
• USACE, Design Guidance for Levee Under-Seeage, ETL 1110-2-569
• USACE, Sacramento District Geotechnical Levee Practice (GLP)
• Central Valley Flood Protection Board (CVFPB) CCR Title 23
• DWR ULDC

The following minimum levee sections were selected for the levee design options:

• Minimum levee crown width: 20 feet
• Minimum patrol road width: 12 feet with a 2 foot-wide taper at each edge
• Waterside slope: 3H:1V or flatter
• Landside slope: 3H:1V or flatter for new levees or new landside slopes

3.4 Geotechnical Criteria

Geotechnical analyses include criteria for designing newly-constructed levee embankments for overall static stability and mitigation of potential through seepage and underseepage by constructing seepage berms and cutoff walls. Criteria specific to these stability elements are described in EN GEO’s Geotechnical Basis of Design Report dated December 4, 2019.

3.5 Penetrations and Encroachments

Penetrations and encroachments within the levee prism are generally not allowed without approval by CVFPB and USACE. The levee prism is defined as a surface with a top elevation equal to the design TOL and design slope projections (no steeper than 3H:1V for new slopes) that extend downward on both the waterside and landside slopes with a minimum crown of 20 feet. Where penetrations and encroachments cannot be avoided by the project, they will be incorporated into the project as outlined below.

3.5.1 Pipes and Conduits

All pipes/conduits crossing beneath the levee prism or within twenty (20) feet of the toe of landside levee/seepage berm toe and within fifteen (15) feet of the waterside levee toe
or projected levee toe will be replaced, removed or modified as necessary to meet the following criteria:

- Gravity pipes and box culverts beneath the levee crown shall meet Title 23 criteria (i.e.: 36 inches minimum, positive closure device, proper pipe material and fully-welded joints).

An inventory of all known existing pipe and conduits within the levee footprint is presented in Appendix B.

3.5.2 Utility Poles and Supports

Utility poles and supports that interfere with the proposed levee embankment and easement areas will be relocated prior to levee construction. Utility pole foundations within the levee prism and within twenty (20) feet of the toe of levee/seepage berm toe and within fifteen (15) feet on the waterside levee toe or projected levee toes will be relocated. Utility poles and supports may penetrate seepage berms provided they are constructed with a permanent, reinforced concrete foundation installed through the berm and into the foundation. Overhead crossings must meet minimum clearance requirements outlined in Title 23, twenty-five (25) feet for lines carrying 750 vols or more.

An inventory of all known existing utility poles within the levee footprint is presented in Appendix B.

3.5.3 Transportation Encroachments

Existing farm access ramps and County roadways that are impacted by the proposed levee embankment shall be replaced in-kind. Access ramps shall be no steeper than 10 percent.

An inventory of all known existing transportation encroachments within the levee footprint is presented in Appendix B.

3.5.4 Levee Vegetation

The USACE and ULDC requires a “vegetation-free zone” as detailed in ETL 1110-2-571. The vegetation-free zone contains the levee crown, the side slopes, and a 15-foot setback from the landside and waterside toes. For the GF200YR, only native grass species will be planted on the new levee slopes and any seepage berms. No woody vegetation is proposed to be installed as a part of the project.

3.6 Right-of-Way

In accordance with ULDC requirements, Right-of-way criteria for GF200YR:

- Allow adequate room for maintenance, inspection, patrolling during high water, and flood-fighting.
- Allow adequate room to expand facilities in the future.
• Prohibit excavations and land modifications that would endanger the integrity of the levee.

3.7 Internal Drainage Criteria

Criteria specific to internal drainage hydrology and hydraulics are described in MHM’s *Basis of Design Report, Interior Hydrology and Hydraulics Goldfields Levee* dated September 11, 2019 (Revised December 3, 2019).

At a minimum, the internal drainage design criteria is to not increase downstream flooding due to the GF200YR levee improvements.
4.0 PROJECT DESIGN

4.1 Hydraulic Design

4.1.1 Water Surface Elevations

MBK Engineers (MBK) presented the approach, methodology and hydraulic modeling results for the 200-year DWSE in documents titled “Goldfields 200-Year Levee Project – Approach for Development of the 200-Year Design Water Surface Elevation,” dated November 2, 2018, and “Goldfields 200-Year Levee Project – Hydraulic Analysis for the Determination of the Design Water Surface Elevation for the 100% Basis of Design”, dated November 27 2019. The MBK model simulates portions of the lower Yuba River, Feather River, the Yuba Goldfields, and the floodplain south of the Goldfields. The 200-year ULDC DWSE of 89.5 feet was calculated. An additional 6.5 feet was added to the WSE to allow for uncertainties in the performance of the dredge tailings within the Goldfields. Therefore, a Project DWSE of 96.0 feet is proposed and an HTOL of 99 feet is also proposed.

It should be clarified that development of the 200-year WSE for the GF200YR and TRLIA’s Upper Yuba Levee Improvement Project are significantly different. Specifically, since development of the UYLIP DWSE, new information about the movement and stability of tailings mounds in the Goldfields has become available, new hydrology has become available, a new 2-D model was developed, and the Goldfields levee is being designed to an event larger than a 200 year event to account for uncertainty in the performance of the mine tailings within the Goldfields. Further, the hydraulic conditions of the two reaches of levee are different. For the Goldfields portion, the DWSE is dependent on how much water enters the setback area from the Goldfields. The setback area acts as a storage basin with a relatively flat WSE. Whereas the WSE along the UYLIP reach of the levee has a gradient associated with the water flowing through this reach. The 1-foot difference in the physical top of levee elevations between these two levee reaches should not be misconstrued to mean that there is inadequate levee height at the UYLIP reach, for the reasons cited above. There is excess freeboard for both levee reaches for the ULDC certification, and the difference in levee height is a function of the robustness considered in the design process to reflect the conditions that are specific to the Goldfields levee.

4.1.2 YRSL Degrade Elevation

The degrade elevation of the YRSL significantly affects the WSE in the setback area as it serves as an exit point for waters to flow out of the setback area. The MBK hydraulic modeling optimized the YRSL degrade elevation at 93.5 feet.

4.1.3 Erosion and Scour

Rock slope protection that was installed along the waterside slope immediately downstream of the Yuba Goldfields as part of the Upper Yuba Levee Improvement
Project (PLM 2.2 to 6.1/ STA. 102+00 to 303+59) will remain in-place with the exception of the location around the new outfall pipes through the degraded levee. New outfall pipes will outfall waterward of the degraded levee. The invert of the outfall pipes will match existing waterward flowlines.

Although the ULDC DWSE of elevation 89.5 is not high enough to exit the setback area over the remnant levee, MBK reviewed the velocities along the waterside toe of the new levee, exiting the setback area over the remnant levee, and downstream of the tie-in along the waterside of the existing Yuba River South Levee under a condition with a similar water surface elevation as the project DWSE (which is greater than the 200 year). Under this scenario, velocities along the waterside toe of the new levee are less than 2 fps. Velocities over the remnant levee and downstream of the tie-in are higher, ranging from 1 – 9 fps. However, existing riprap exists along the waterside of the Yuba River South Levee would be retained following construction of the new levee, thus continuing to provide partial embankment protection for flows exiting the setback area over the degraded levee and immediately downstream. Because flows at the 200 year event have no, or low, velocities on the levee slope, and because the velocities for events larger than the 200 year are expected to cause minor erosion that will not threaten levee integrity, no embankment protection is proposed as part of the project. The RD will monitor and understands that minor erosion repairs may be needed after flood events that are larger than the 200 year event.

4.1.4 Wind Setup and Wave Run-up Analysis
Mead & Hunt submitted a wind and wave run-up analysis, “TRLIA Goldfields Levee Evaluation Wind Wave Analysis”, dated August 13, 2019. Mead & Hunt used wind data collected at Beale Air Force Base in Yuba County from the National Oceanic and Atmospheric Administration (NOAA) website. Three sites were selected for analysis at locations that have maximum fetch lengths (1.28 to 1.69 miles) and wind speeds (37.4 to 54.5 miles per hour).

The calculated combined wind setup and wave run-up heights ranged from 2.2 to 2.9 feet. In accordance with ULDC (Section 7.17) because the combined wind setup and wave run-up is less than three feet, there is no effect on the top of levee elevation.

4.2 Geotechnical Design
4.2.1 Underseepage
Where seepage exit gradients do not meet the criteria outlined in Section 3.4.1, mitigation is required. The primary underseepage mitigation measure for the GF200YR is a cutoff wall. Additionally, the tie in with the existing YRSL in approximately the first 330 feet area of Reach 1a has both a cutoff wall and a seepage berm to provide an overlap in seepage mitigation between the new levee and the previously-constructed UYLIP
Project. Table 4-1 (below) provides details of each mitigation measure by reach. The specific methodology and results of underseepage analyses are included in ENGEO’s Basis of Design Report dated December 4, 2019.

4.2.2 Through-Seepage

For through-seepage, the emergence of the phreatic line on the landside levee slope and the composition of the levee materials to be used in construction were evaluated. Levees shown to have a phreatic line emerging on the landside levee slope, at either the DWSE condition or the HTOL condition, were evaluated for piping potential and the potential for through-seepage-induced sloughing of the landside slope. Because the proposed levee will be constructed from primarily fine-grained soil that is resistant to erosion and because the levee slopes will be constructed no steeper than 3:1, through-seepage was judged to be a non-issue. The specific methodology and results of through-seepage analyses are included in ENGEO’s Basis of Design Report dated December 4, 2019.

4.2.3 Slope Stability

Three cases were analyzed for slope stability. For Case I, landside long-term steady-state seepage conditions at the DWSE were analyzed. For Case II, landside long-term steady-state seepage conditions at the HTOL were analyzed. For Case III, rapid drawdown from the DWSE was analyzed. In all cases the required factor of safety was achieved without additional stability mitigation features. The specific methodology and results of slope stability analyses are included in ENGEO’s Basis of Design Report dated December 4, 2019.

4.2.4 Geotechnical Mitigations

Geotechnical mitigation measures are presented below in Table 4-1 and are shown graphically on Figure 2 at the end of this report. This mitigation measure layout serves as the basis for the 100% Designs.
### Table 4-1 – Summary of Geotechnical Mitigation Measure by Reach

<table>
<thead>
<tr>
<th>Reach</th>
<th>Length (feet)</th>
<th>Geotechnical Mitigation Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>950</td>
<td>50+00 to 59+50, Cutoff Wall Tip Depth 55 feet, 52+25 to 53+70, 65-foot-wide undrained seepage berm, observation wells</td>
</tr>
<tr>
<td>1b</td>
<td>1,050</td>
<td>59+50 to 70+00, Cutoff Wall Tip Depth 70 feet</td>
</tr>
<tr>
<td>2a</td>
<td>2,500</td>
<td>70+00 to 95+00, Cutoff Wall Tip Depth 35 feet</td>
</tr>
<tr>
<td>2b</td>
<td>1,100</td>
<td>95+00 to 106+00, Cutoff Wall Tip Depth 60 feet</td>
</tr>
<tr>
<td>3a</td>
<td>5,040</td>
<td>106+00 to 156+40, Cutoff Wall Tip Depth 45 feet</td>
</tr>
<tr>
<td>3b</td>
<td>800</td>
<td>156+40 to 164+40, Cutoff Wall Tip Depth 40 feet</td>
</tr>
<tr>
<td>4</td>
<td>2,463</td>
<td>164+40 to 189+03, No Mitigation Required</td>
</tr>
</tbody>
</table>

#### 4.2.5 Seepage Cutoff Walls

Soil-Bentonite (SB) cutoff walls are recommended for the GF200YR, as shown above in Table 4-1. Cutoff walls would mitigate under-seepage by providing a seepage barrier within the levee foundation. Cutoff walls range in depth from 35 to 70 feet below the existing ground surface, extending at least five (5) feet into low permeability strata. The cutoff wall depths are conducive to using conventional excavation method, although other methods could be used.

Conventional cutoff walls are constructed using an excavator with a long-stick boom capable of digging a trench to a maximum depth of approximately 75 to 85 feet. The trench width is typically 36 inches (3 feet).

To construct a cutoff wall, the existing ground is cleared, grubbed, and stripped of all vegetation. After stripping, a cutoff wall workpad is constructed uniformly with compacted levee embankment material that meets the requirements set by the project specifications. The workpad would be sixty (60) feet wide at its top, a minimum one (1) foot deep with 2H:1V side slopes, and would be centered along the cutoff wall alignment. During the cutoff wall trench excavation, a bentonite slurry is used to fill the trench as it is excavated to prevent caving of the trench sidewalls while the backfill material is mixed. The excavated soil is then mixed with the bentonite slurry to achieve the required cutoff wall permeability, and then placed back into the trench. After the initial set of the soil-bentonite backfill, and a three-week settlement monitoring period (or shorter period if approved by the engineer), the levee embankment is constructed with levee embankment material that meets the requirements of the plans and specifications.

**Figure 3** (included at the end of this BODR) provides typical cutoff wall construction details.
4.2.6 Undrained Seepage Berms

An undrained seepage berm is also recommended as a mitigation measure along the new YRSL shown above in Table 4-1.

Undrained seepage berms are soil prisms extended landward of the levee that provide additional resistance to high subsurface seepage gradients. These berms reduce exit gradients to acceptable values by extending the overall seepage path. The undrained berms for the GF200YR will be approximately 65 feet wide and approximately 700 feet long adjacent to both Reach 1A and the existing YRSL. Berm heights vary from five (5) feet at the levee toe to three (3) at the berm toe, with typical cross slopes of 1.5 to 2 percent. Berms can be constructed of levee embankment or random fill material, or levee degrade material that meets the requirements for seepage berm fill.

On the existing YRSL side, the existing 80-foot berm width is increased by 50-feet over a distance of approximately 440 feet.

Figure 4 and Figure 5 (attached at the end of this BODR) includes typical seepage berm construction details.

4.2.7 Observation Wells

Observation wells shall be installed at the toe of the transition berm to add redundancy and robustness. The observation wells will be installed at a depth of approximately 70 feet below the ground surface.

4.3 Civil Design

The following sections discuss various civil and construction-related considerations in preparing the 100% Design Project.

4.3.1 Landside and Waterside Right-of-Way

To provide an area for construction staging and access and O&M activities, and area for potential future improvements, TRLIA is acquiring up to 50 feet of property landward and waterward of the new levee toes. Where landside seepage berm mitigation is constructed, the 50 feet landward corridor is established as an offset from the new seepage berm toe. For the landward acquisition area along Hammonton-Smartville Road (Stations 100+00 to 189+00), the landward acquisition corridor will be a minimum of 20 feet wide from the existing County Right-of-Way.

To provide continuous landside levee toe O&M access, TRLIA is constructing a minimum 15-foot-wide toe road that will include an all-weather road surface.

To ensure that drainage patterns are not situated against the new levee waterside embankment, drainage ditches are designed at the edge of the easement acquisition area.
4.3.2 Maintain Patrol Access from YRSL to Yuba Goldfields

To maintain operation and maintenance access along the YRSL (UYLIP) crown to the Yuba Goldfields, the levee degrade will ramp down 10H:1V from the top of the existing YRSL levee to the degrade elevation, then continue at a generally flat slope until ramping back up at a 10H:1V slope to the existing top-of-levee at the corner of the Yuba Goldfields. The top three (3) inches of the existing gravel patrol road shall be stripped and salvaged for use to reconstruct patrol road upon completion of levee degrade operations. Salvaged material shall be placed in the bottom 3 inches of the six (6) inch aggregate surfacing patrol road.

4.3.3 Internal Drainage

The setback area south of the Goldfields and the degraded levee will drain to detention basins prior to exiting the setback area through a gravity pipe outfall through the levee embankment during normal events. Detention basin system (Brophy Road Detention Basin, Detention Basin Causeway, and Road 1034 Detention Basin) are located on the waterside of the levee near the intersection of Brophy Road and Hammonton-Smartville Road. The gravity pipe will outfall into the existing Linda Drain system at the southwesterly corner of the Brophy Road/Hammonton-Smartville Road intersection. The internal drainage system will be designed to ensure that existing flooding south of the new levee is not worsened and, to the extent practicable, improve drainage handling. Internal drainage system design includes the following:

- Waterside local drainage ditches will be located at the edge of waterside access corridor parallel to the levee and will drain to the detention basin.
- Minimum detention basin size: 92.0 acre-feet.
- Detention basin storage height: 82.2 foot elevation
- Detention basin will include storage areas in the Brophy Road Detention Basin, Detention Basin Causeway, and Road 1034 Detention Basin
- The detention basin pipe outfall to Linda Drain system
- Outfall pipe to include a positive closure device and flap gate.

4.3.4 Pipe Crossings

Two gravity pipe crossings have been identified through the proposed levee embankment. One crossing conveys existing Brophy Water District Irrigation Canal flows, and one will be a new culvert installed for the purpose of discharging internal drainage from a newly constructed detention basin (as described in Section 4.3.3 above). Both pipe facilities will be installed in accordance with Title 23 standards for pipelines through a levee.

An additional gravity pipe crossing will be installed under the degraded portion of the YRSL to drain intermediate flows from the setback area following inundation during a flood event (high flows will drain towards the river and low flows will drain towards the
detention basin). Upon completion of the project the degraded YRSL portion will no longer be considered a levee therefore the pipe crossing layout through the degraded area will be designed in accordance with Title 23 standards for pipelines within the floodway.

Table 4-2 – Summary of Pipe Crossings

<table>
<thead>
<tr>
<th>Name</th>
<th>Station</th>
<th>Capacity, cfs</th>
<th>No. and Size of Pipe Crossing</th>
<th>Depth From Top of Levee to Top of Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brophy Water District</td>
<td>62+95</td>
<td>75-80</td>
<td>1-8-feet x 5-feet box culvert</td>
<td>15.0 feet</td>
</tr>
<tr>
<td>Detention Basin Outfall</td>
<td>103+79</td>
<td>25 (100-yr)</td>
<td>1-36 inch</td>
<td>15.4 feet</td>
</tr>
<tr>
<td>YRSL Outfall</td>
<td>EYRSL 295+00</td>
<td>50</td>
<td>3-36 inch</td>
<td>N/A</td>
</tr>
</tbody>
</table>

4.3.5 Adjacent Canals

The existing Brophy Water District’s irrigation canal will be realigned to cross under and perpendicular to the new levee embankment. A concrete box culvert will be installed under the levee to extend the irrigation canal under the levee. In accordance with USACE requirements a positive closure device will be included waterside of the levee crown to be able to close the canal during a flood event. Landward of the new levee, the irrigation canal will extend beyond the 50-foot acquisition and turn south to parallel to the new levee alignment. The canal alignment will continue to parallel the new levee alignment until it ties into the existing irrigation canal layout.

4.3.6 Electrical Transmission Towers, Power Poles and Overhead Utilities

Power poles located within the new levee footprint or within 15 feet of the landside or waterside levee toe will be relocated to be a minimum of 20 feet outside of the levee toe as necessary. Overhead crossings will be raised or replaced to meet minimum clearance requirements outlined in Title 23, twenty-five (25) feet for lines carrying 750 volts or more. Design of power pole and overhead crossing relocations will be completed by the utility owner Pacific Gas and Electric Company (PG&E). The existing Western Area Power Administration (WAPA) transmission tower at STA 113 and the existing PG&E transmission power at STA 159 will be able to remain in-place as the levee alignment was adjusted to transition around the existing towers to maintain a minimum 10-feet clearance. The project construction contractor will be required to coordinate all work with the utility owners during construction.

4.3.7 Roadway Crossings and Access Ramps

One existing public roadway will be impacted by the new levee alignment. Brophy Road, where it coincides with the levee footprint, will be removed as a part of the levee clearing and grubbing operations. After cutoff wall and levee embankment construction, a side-
on access ramp will route traffic up and over the new levee. This ramp will be paved and able to accommodate existing farming equipment access needs.

Additionally, up to six aggregate surface access ramps will be constructed to maintain waterward access. These ramps will be constructed along both the waterside and landside slopes of the new levee embankment at a spacing of approximately 2,300 to 4,500 feet.

Table 4-3 – Summary of Roadway Crossings

<table>
<thead>
<tr>
<th>Name</th>
<th>Approximate Station</th>
<th>Roadway Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brophy Water District (north)</td>
<td>60+25</td>
<td>Aggregate</td>
</tr>
<tr>
<td>Brophy Water District (south)</td>
<td>65+50</td>
<td>Aggregate</td>
</tr>
<tr>
<td>Wilbur Parcel (north/south)</td>
<td>84+00</td>
<td>Aggregate</td>
</tr>
<tr>
<td>Brophy Road</td>
<td>107+91</td>
<td>Asphalt</td>
</tr>
<tr>
<td>Road 1034</td>
<td>133+50</td>
<td>Aggregate</td>
</tr>
<tr>
<td>Triangle Parcel (Beale)</td>
<td>163+00</td>
<td>Aggregate</td>
</tr>
</tbody>
</table>

4.3.8 Demolition of Existing Structures

Various structures that lie within the GF200YR area require demolition. Residential homes, barns, drainage pipes, domestic/irrigation wells and fences that are located within the levee footprint or within fifty (50) feet of the landside and waterside levee toe are proposed for removal on the 100% Design Plans. Existing domestic/irrigation wells and septic systems within the demolition area should be demolished in accordance with Yuba County Standards.

4.3.9 Tree and Vegetation Removal

All trees and vegetation located within landside and waterside right-of-way limits as described in Section 4.3.1 will be identified to be removed as part of the clearing and grubbing operations. In addition, all trees and vegetation within the interior drainage detention basin footprint or its perimeter access easement will be removed.

4.3.10 Construction Limits and Staging Areas

A Construction Limit for construction of the project features will be made available to the project contractor and is identified on the 100% Design Plans. The construction limit will generally include the levee footprint and a 50-foot-wide corridor measured from levee toes along the landside and waterside to accommodate hauling, staging, and other construction-related activities. The landside construction limit along Hammonton-Smartville Road will provide a minimum 20-foot-wide corridor between levee embankment and County Right-of-Way.

SB cutoff wall construction will require a batch plant and material staging area ranging from two to three acres in size. The area will generate and supply trench stabilization
fluid to the work areas. Large tanks for water storage, bulk bag supplies of bentonite, a cyclone mixer, pumps, and generators will be located adjacent to the slurry generation ponds. The exact locations of the temporary staging areas will be dependent on the contractor’s means and methods.

4.3.11 Construction Water Source

It is anticipated that construction water will be made available to the contractor through one of the irrigation water districts. Coordination of available water sources is on-going. Typical water requirements for cutoff wall construction include:

- A pH of 7.0, plus or minus 1.0
- Total dissolved solids of 500 ppm, or less
- Hardness less than 50 ppm (recommendation only)
- Oil, organics, acids, alkali, or other deleterious substances less than 50 ppm

The proposed water supply facilities should be tested to ensure that supplied water can meet these requirements.

4.3.12 Site Access

Access to the GF200YR construction site will be provided by state and county roadways including State Route (SR) 70, SR 65, North Beale Road, Hammonton-Smartville Road and existing YRSL patrol road. Stabilized construction entrances will be constructed at the roadway entrances as part of the project’s stormwater pollution prevention plans and/or best management practices in accordance with General Provisions and Special Provisions.

4.3.13 Excavated Material and Stripping Material

ENGEO’s test results from subsurface explorations indicate that most of the existing subsurface materials that will be excavated as part of project construction can be reused for levee embankment, seepage berm, and levee toe road fill. In addition, where excavated materials do not meet embankment specifications, they can be blended with import fill to meet embankment fill specifications. On-site material not usable for incorporation into the levee embankment fill will be placed in seepage berm or levee toe road fill areas as identified on the 100% Design Plans. YRSL degrade materials that meet the requirements for levee embankment fill can also be used for levee improvements.

The existing ground surface beneath the new levee footprint (landside toe to waterside toe) and seepage berm will be stripped a minimum of 12 inches. This material will be stockpiled, without separating organics, and reapplied to the completed levee surface.

Refer to Figure 6 for a materials distribution chart showing the anticipated off-site material borrow and wasting volumes for the project.
4.3.14 Borrow Sources

Borrow materials for levee improvements may be imported from adjacent, off-site, and/or commercial borrow sources.

Refer to Figure 6 for a materials distribution chart showing the anticipated off-site material borrow and wasting volumes for the project.

4.3.15 Quantity Calculations

Quantities shown in the alternative mitigation cost estimates were determined based on ENGEO’s recommended mitigation configurations. Typical cross sections and spreadsheets were developed to estimate construction quantities. Earthwork quantities were calculated using Civil 3D modeling of the proposed levee geometry within the terrain model (developed from topographic surveys and verified with spreadsheet calculations) (Average-End Area method) and assumed shrinkage factor of 20 percent. The quantity analysis is provided in Appendix C.

4.3.16 Schedule

It is anticipated that construction of the GF200YR will be completed in a single year, 2020. Earthwork operations, including tie-in of the new levee and degrading of the YRSL, will take place during the typical non-rain season (April through November), and outside of the CVFPB-designated flood season (November 1 to April 15).

Other construction activities, such as levee crown surfacing, site cleanup and demobilization may take place during the flood season as necessary and subject to approval by the CVFPB.
5.0 REGULATORY COMPLIANCE

5.1 Environmental Impact Report

An Environmental Impact Report (EIR) is required in order to provide California Environmental Quality Act (CEQA) compliance for the project. This work is being performed by GEI Consultants, Inc. (GEI). On September 15, 2015, TRLIA certified the project’s Environmental Impact Report (State Clearinghouse No. 2014062045). On May 10, 2018, TRILA filed a Notice of Preparation (NOP) of a Supplemental EIR (SEIR) to update the previous EIR with supplemental information on the proposed project occurring since 2015. The SEIR was certified in January 2019.

5.2 Agency Approvals and Permits

Several permits and authorizations are required for the project and may include:

- USACE
  - Section 404 of the Clean Water Act
- United States Fish and Wildlife Service
  - Federal Endangered Species Act
- California Department of Fish and Wildlife
  - California Endangered Species Act
  - California Fish and Game Code Section 1602
- California State Office of Historic Preservation
  - Section 106 of the National Historic Preservation Act
- Central Valley Flood Protection Board
  - Encroachment permit
- Central Valley Regional Water Quality Control Board (Region 5)
  - Section 401 of the Clean Water Act, water quality certification
  - Section 402 of the Clean Water Act, National Pollutant Discharge Elimination System (NPDES)
  - Water Discharge Requirements (WDR) for effects on waters of the state
- California Department of Water Resources
  - State Plan of Flood Control acceptance
- Feather River Air Quality Management District
  - Authority to Construct/Permit to Operate
- Yuba County
  - Construction authorization/grading permits
6.0 REFERENCES

6.1 Design Criteria Documents

6.1.1 US Army Corps of Engineers (USACE)

Engineer Technical Letters (ETL)

USACE, Design Guidelines for Levee Under-seepage, ETL 1110-2-569, May 1, 2005

USACE, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures, ETL 1110-2-571, April 10, 2009

Engineer Regulations (ER)

USACE, Quality Management, ER 1110-1-12, September 30, 2006.


Engineer Manuals (EM)


Other

USACE, Sacramento District, Geotechnical Levee Practice, April 11, 2008
6.1.2 Other Federal Agencies


6.1.3 State/County Agencies

California Code of Regulation, Title 23 Waters, Division 1 Central Valley Flood Protection Board, Chapter 1 Organization, Powers, and Standards


County of Yuba, Department of Public Works, Design Standards, December 15, 1994

6.2 Other Reference Documents


ENGEIO Inc., Geotechnical Basis of Design Report, December 4, 2019

ENGEIO Inc., Geotechnical Data Report, February 4, 2019


MBK Engineers Inc., Technical Memorandum, Subject: Goldfields 200-Year Levee Project – Hydraulic Analysis for the Determination of the Design Water Surface Elevation for the 100% Basis of Design, November 27, 2019


Mead and Hunt Inc., Draft TRLIA Goldfields, Levee Evaluation, Wind Wave Analysis, August 13, 2019

GEI, Feasibility Study, Goldfields Flood Risk Reduction Feasibility Study, September 2015
GEI, Environmental Impact Report, Yuba Goldfields 200-Year Flood Protection Project, September 15, 2015

## 7.0 ACRONYMS AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM</td>
<td>American Society of Testing and Materials</td>
</tr>
<tr>
<td>BODR</td>
<td>Basis of Design Report</td>
</tr>
<tr>
<td>CCR</td>
<td>California Code of Regulations</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>cfs</td>
<td>Cubic feet per second</td>
</tr>
<tr>
<td>CVFPB</td>
<td>Central Valley Flood Protection Board</td>
</tr>
<tr>
<td>DWR</td>
<td>California Department of Water Resources</td>
</tr>
<tr>
<td>DWSE</td>
<td>Design Water Surface Elevation</td>
</tr>
<tr>
<td>EM</td>
<td>Engineer Manual</td>
</tr>
<tr>
<td>ETL</td>
<td>Engineer Technical Letter</td>
</tr>
<tr>
<td>ER</td>
<td>Engineer Regulation</td>
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<td>Federal Emergency Management Agency</td>
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<td>FOS</td>
<td>Factor of Safety</td>
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<td>GLP</td>
<td>Geotechnical Levee Practice</td>
</tr>
<tr>
<td>H</td>
<td>Horizontal</td>
</tr>
<tr>
<td>HTOL</td>
<td>Hydraulic Top of Levee</td>
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<tr>
<td>LL</td>
<td>Liquid Limit</td>
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<tr>
<td>MHM</td>
<td>MHM Engineers and Surveyors</td>
</tr>
<tr>
<td>NAD83</td>
<td>North American Vertical Datum of 1988</td>
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<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
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<td>PG&amp;E</td>
<td>Pacific Gas and Electric</td>
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<td>PI</td>
<td>Plasticity Index</td>
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<tr>
<td>R&amp;U</td>
<td>Risk and Uncertainty</td>
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<tr>
<td>SB</td>
<td>Soil-Bentonite</td>
</tr>
<tr>
<td>TCE</td>
<td>Temporary construction easement</td>
</tr>
<tr>
<td>TOL</td>
<td>Top of Levee</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>TRLIA</td>
<td>Three Rivers Levee Improvement Authority</td>
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<tr>
<td>ULDC</td>
<td>Urban Levee Design Criteria</td>
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<td>USACE</td>
<td>United States Army Corps of Engineers</td>
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<tr>
<td>V</td>
<td>Vertical</td>
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<td>Wood Rodgers Inc.</td>
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<td>Water Surface Elevation</td>
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<td>YRSL</td>
<td>Yuba River South Levee</td>
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Figures

Figure 1 - Location Map
Figure 2 - Mitigation Measure by Reach
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Figure 4 - Typical Levee Sections: 65’ Wide
  Undrained Seepage Berm
Figure 5 - Typical Levee Sections: 50’ Wide
  Undrained Seepage/Transition Berm
Figure 6 - Material Distribution Chart
Mitigation Measures:
- Cutoff Wall
- Seepage Berm
- No Mitigation (Levee Only)
- Drain Ditch
- Irrigation Canal
- Levee Stationing
- Parcel Line

SOURCES: Parcel Lines provided by Yuba County GIS Data, Project Levee provided by Wood Rodgers, Base Map provided by Esri

FIGURE 2
MITIGATION MEASURE BY REACH

TRRIA
200-YR GOLDFIELDS LEVEE PROJECT
YUBA COUNTY, CALIFORNIA
December, 2019
NOTE:
1. LEVEE HEIGHT SHOWS AT 16.7 FEET.
   ACTUAL LEVEE SLOPE DIMENSIONS VARIES
   BASED ON LEVEE HEIGHT.
2. O&M CORRIDOR ALONG COUNTY ROADWAY
   WILL REQUIRE A MINIMUM 20 FOOT WIDTH.
65' WIDE UNDRAINED SEEPAGE BERM (TYPICAL)

**Scale:** 1" = 20'

**Note:**

1. Levee height shows at 16.7 feet. Actual levee slope dimensions vary based on levee height.
50' WIDE UNDRAINED SEEPAGE/TRANSITION BERM (TYPICAL)

SCALE: 1"=20'

EXISTING SEEPAGE BERM

NEW SEEPAGE/TRANSITION BERM 2.0%

STRIP 0.5', SCARIFY 1.0' AND COMPACT PRIOR TO PLACING FILL ON EXISTING SEEPAGE BERM

STRIP 1.0', SCARIFY 1.0' AND COMPACT PRIOR TO PLACING TILL BEYOND EXISTING SEEPAGE BERM

EXISTING GRADE

50' MIN

9' MIN

O&M CORRIDOR

10'

3' MIN

APPARENT THEORETICAL LEVEE TOE

MATCH EXISTING GRADE

EXISTING YRSL LEVEE

WATERSIDE

LANDSIDE

50' WIDE UNDRAINED SEEPAGE/TRANSITION BERM

TRJIA
200-YR GOLDFIELDS LEVEE PROJECT
Yuba County, California
December, 2019
Appendices

Appendix A - Existing Surface Features
Appendix B - Existing Utility Inventory
Appendix C - Mitigation Alternative Cost Estimate
Appendix A
Existing Surface Features
APPENDIX A

Existing Surface Conditions

Reach 1A (STA 50+00 – 59+50)

Reach 1A begins at approximately 1000 feet west of the YRSL levee terminus at Station 50+00. Reach 1A ties into with the existing YRSL levee, continues across an 80’ seepage berm, crosses a 50’ O&M corridor and then continues through agricultural land. The proposed levee crosses two unpaved farming roads approximately at Station 51+90 and 57+00.

Reach 1B (STA 59+50 – 70+00)

Reach 1B begins at approximately 600 feet southeast of the YRSL tie-in location. Reach 1B impacts orchard crop land. The proposed levee crosses two unpaved farming roads approximately at Station 62+75 and 63+25. An approximately 25’ wide irrigation channel at Station 63+00 is impacted by the proposed work. Existing irrigation pipes are located within proposed levee footprint. An existing irrigation well is located waterward of proposed levee approximately at Station 61+50.

Reach 2A (STA 70+00 – 95+00)

Reach 2A begins at approximately 1800 feet southeast of the YRSL tie-in location in the middle of orchard crop land, and continues 1,900 feet Southeast. Reach 2A impacts orchard crop land. There are two unpaved farming roads within the reach at Station 83+00 and 85+50.

Reach 2B (STA 95+00 – 106+00)

Reach 2B begins at approximately 3700 feet southeast of the YRSL tie-in location in the middle of orchard crop land, and continues 1,900 feet Southeast, ending at the Northwest corner of the Brophy Road and Hammonton-Smartville Road intersection. Reach 2B impacts orchard crop land and one paved roadway crossing. The Brophy Road crossing is a paved road at Station 105+90. There is an unpaved farming road within the reach at Station 105+65. An overhead electrical utility crossing exists at approximately STA 105+75.
Reach 3A (STA 106+00 – 156+40)

Reach 3A begins at the Northwest corner of the Brophy Road and Hammonton-Smartville Road intersection, follows along the northerly side Hammonton-Smartville Road Northeast for 5,020 feet. The reach impacts orchard crop land. There is one unpaved farming road that follows the easterly side of Brophy road and the northerly side of Hammonton-Smartville Road. The reach impacts orchard crop land from Station 106+50 to 135+00. From station 135+00 to 156+40 the existing land is residential land with residential structures from Station 154+00 to 156+40. There are two overhead electrical transmission crossings and four overhead utility service crossings. There is also an underground electrical utility service at approximately Station 143+30. Both paved and unpaved roads and driveways exist at approximately Station 114+00, 114+35, 134+85, 135+20, 143+30, 151+00 and 155+75. Overhead utilities and drainage ditches follow the northerly edge of Hammonton-Smartville Road for the entire reach. A full list of encroachments for this reach can be found in Appendix B.

Reach 3B (STA 156+40 – 164+40)

Reach 3B begins approximately 5,000 feet east of the Brophy Road and Hammonton-Smartville Road intersection and continues northeast along the north side of Hammonton-Smartville Road for 1,000 feet. From station 156+40 to 164+00 the existing land is residential land. There is one overhead electrical transmission crossings and two overhead utility service crossings. One of the transmission towers, Station 158+50, is located within the vicinity of the levee embankment. Unpaved driveways and roadways exist at approximately Station 156+80, 161+00 and 164+50. Overhead utilities and drainage ditches follow the northerly edge of Hammonton-Smartville Road for the entire reach. A full list of encroachments for this reach can be found in Appendix B.

Reach 4 (STA 164+40 – 189+03)

Reach 4 begins approximately 6,000 feet east of the Brophy Road and Hammonton-Smartville Road intersection and continues northeast along the north side of Hammonton-Smartville Road for 2,200 feet, ending approximately 0.5 miles southwest of the Hammonton Road and Hammonton-Smartville Road intersection tying into an existing utility/aesthetics berm. The existing land in the reach is used for agricultural (rice field) purposes. There are three unpaved farming roads within the reach at Station 164+50, 173+50 and 187+60. There is an existing 15” drain pipe at Station 189+00. Overhead utilities and drainage ditches follow the northerly edge of Hammonton-Smartville Road for the entire reach.
<table>
<thead>
<tr>
<th>Number</th>
<th>Station</th>
<th>Encroachment</th>
<th>Encroachment Owner</th>
<th>APN</th>
<th>Name</th>
<th>Address</th>
<th>Phone</th>
<th>Type</th>
<th>Notes</th>
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<td>1</td>
<td>64+25</td>
<td>Irrigation Canal</td>
<td>Brophy Water District</td>
<td>018-150-063</td>
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<td>2649 D. North Beale Rd. Marysville CA, 95901</td>
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<td>PG&amp;E</td>
<td>018-180-082</td>
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<td>PO Box 997300, Sacramento, CA, 95899</td>
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<td>OH Util</td>
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<td>3</td>
<td>112+90</td>
<td>Transmission Tower</td>
<td>Western Area Power</td>
<td>018-150-057</td>
<td>Administration (WAPA)</td>
<td>114 Parkshore DR. Folsom CA, 95630</td>
<td>916-353-4400</td>
<td>Util Tower</td>
<td>30' outside of footprint, tower to remain</td>
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<td>Overhead electrical crossing - Transmission</td>
<td>PG&amp;E</td>
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<td>Cost w/Contingency</td>
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<td>Mobilization and Demobilization</td>
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<td>LS</td>
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<td>27,820 LF</td>
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<td>Clearing and Grubbing</td>
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<td>$288,041</td>
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<td>$292,906</td>
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<td>Levee Degrading/ Excavation</td>
<td>28,230 CY</td>
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<td>Class 2 Aggregate (Patrol Road)</td>
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<td>Haul and Dispose of Unsuitable Material</td>
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