2.3.2 Proposed Project Elements

Levee Improvements

A total of approximately 2 miles of levees within three segments of a 3-mile reach of the existing east levee in the Eastside Bypass between Sand Slough and the Mariposa Bypass would be improved to meet levee seepage and stability criteria (summarized in SJRRP Draft PEIS/R Section "Minimize Flood Risk from Restoration Flows"). The three levee improvement segments (Reach O-1, Reach O-3, and Reach O-4) are shown in **Figure 2-11** with levee improvements described below.

Levee improvements would include reinforcing approximately 1,500 linear feet of levee in Reach O-1, 5,900 linear feet of levee in Reach O-3, and 2,600 linear feet of levee in Reach O-4 with cutoff walls. Sand or gravelly soils of higher permeability in the levee or levee foundation can transmit water via seepage during high-water stages. Cutoff walls are designed to reduce levee through-seepage and underseepage by providing a lens of low-permeability material through the higher permeability materials in the levee and levee foundation to essentially cut off the flow. Cutoff walls would be installed to depths sufficient to minimize seepage through the levee and/or beneath it to meet or exceed USACE levee design criteria. For cutoff walls designed to block through-seepage, the intent is to construct a wall deep enough to block flow through the levee and alter the flow path of seepage to reduce landside impacts. Cutoff walls for underseepage are generally installed to depths that would tie into existing lower permeability soil layers in the levee foundation below the permeable material. The depths for cutoff walls necessary to limit underseepage and through-seepage at the design water surface elevation to gradients specified by USACE are determined by geotechnical modeling and analyses. For the proposed levee improvements, the top portion of the existing levee would be degraded, a bentonite cutoff wall up to approximately 35-feet deep would be placed in the middle of the levee crown for improved stability, and then the top portion of the existing levee would be reconstructed using select levee fill material. The improvement would allow conveyance of up to 2,500 cfs. A conceptual design schematic of a cutoff wall installed along the levee centerline is shown in **Figure 2-12**.

Eastside Bypass Control Structure Modifications

To provide fish passage, the Eastside Bypass Control Structure would be modified by removing the sill, boards, and energy dissipation blocks. In addition, an approximately 380-foot-long rock ramp would be constructed downstream of the structure to provide easy passage from the downstream pool to the structure (**Figure 2-13**). The ramp would extend from bank to bank. It would be constructed by filling the large pool downstream of the structure with approximately 13,000 cubic yards of compacted fill up to subgrade elevation, and then adding a 2.5- to 3.5-foot-thick top layer of approximately 11,500 tons of Engineered Streambed Material (ESM) comprised of rock mixes with particle sizes ranging from boulders to sand and silt.

Currently, the channel downstream of the structure is incised. Fill for the base of the ramp would come from excavating benches in the channel downstream, if the material is suitable. Approximately 100-foot-wide benches with 3:1 side slopes, starting at the end of the ramp to approximately 1,000 feet downstream, would be constructed, inundating at flows around 1,000 cfs. If the existing material is not suitable, the benches would not be excavated, and fill would need to be imported.

There is currently a stream gage site dedicated to collecting stream flow data approximately 550 feet downstream of the Eastside Bypass Control Structure. To make sure the gage is outside of the influence of the new rock ramp and can accurately measure stage, the gage would be replaced and relocated up to 1,000 feet downstream of the rock ramp.

Figure 2-11.   Levee Improvement Segments

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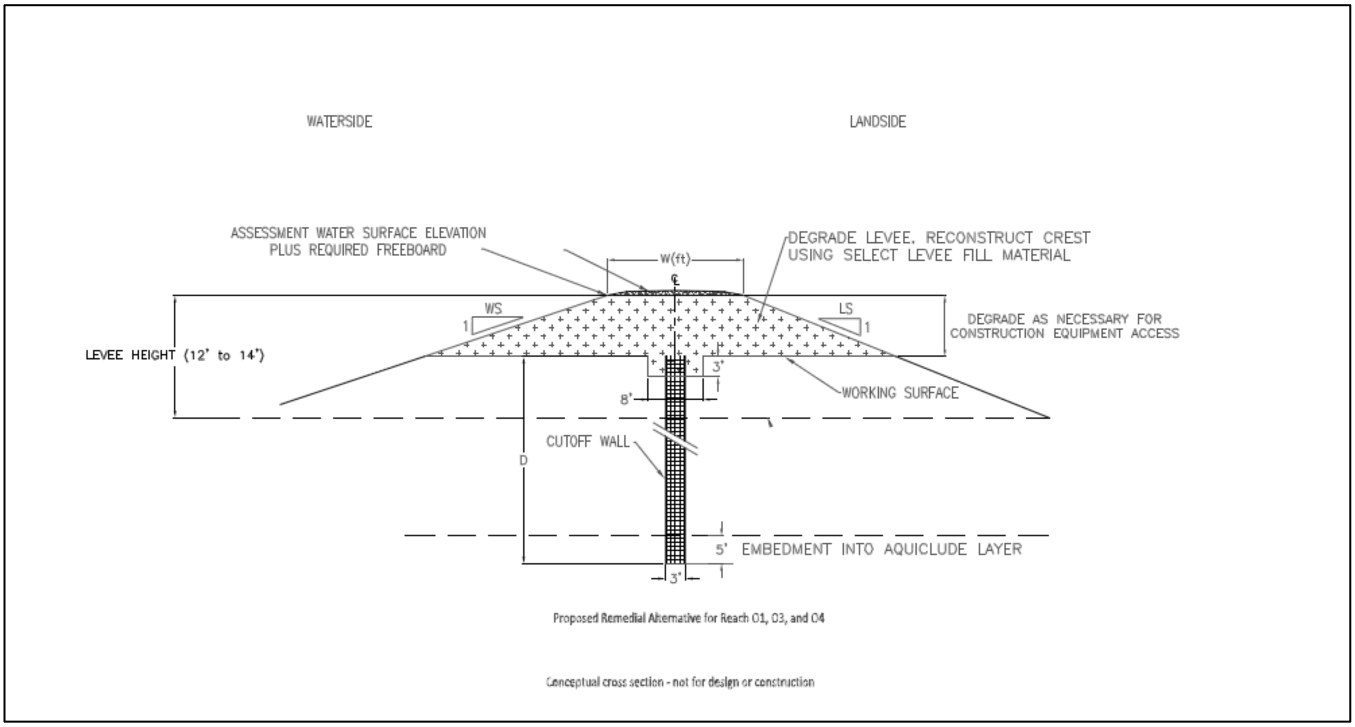
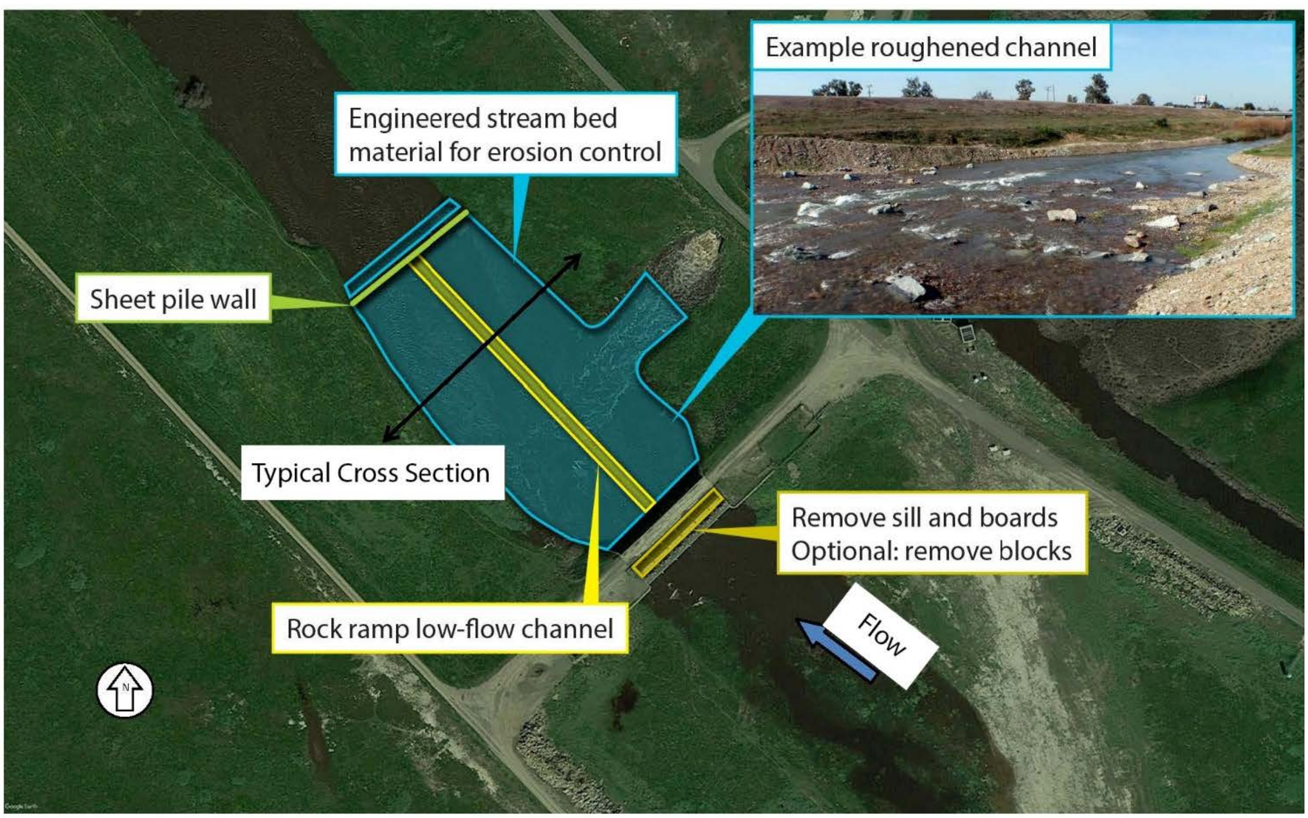
Source: California Department of Water Resources 2017, adapted by GEI Consultants, Inc., 2017

Figure 2-12. Typical Levee Improvement Cross Section



Source: California Department of Water Resources 2017

Figure 2-13. Eastside Bypass Control Structure Rock Ramp Plan View



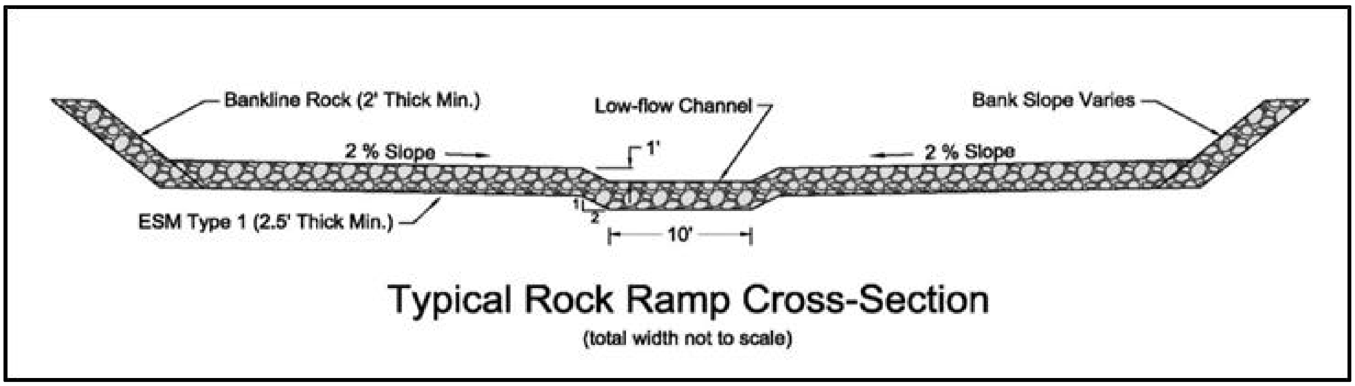
Source: California Department of Water Resources 2017

The slope of the rock ramp would be about 1 percent. To stabilize the ramp, approximately 30-foot-long sheet piles would be driven approximately 20 feet into the existing ground, so the top of the sheet pile matches the final grade elevation of the ramp. The piles would then be backfilled with ESM. Hydraulic controls downstream of the ramp cause the bottom end of the ramp to be backwatered at low flows.

The ramp would be constructed of rock mixes with two different gradations. The upper 50 feet features a larger rock mix to help protect the ramp from potential high velocities if the gates are operated on the structure to divert flows into the Mariposa Bypass during flood flows, or to allow for maintenance downstream of the structure. Gradation of the ESM for this upper portion of the ramp ranges from light class riprap (1.8-foot diameter) down to silt and sand. The top portion of the ramp also features a boulder weir, set slightly higher than the invert of the control structure, that helps stabilize the ramp and creates backwater conditions to provide fish passage through the control structure. All boulders are approximately 3 feet in diameter. If necessary, the upper 50 feet of the ramp between the end of the existing structure and boulder weir may be grouted to prevent erosion from high velocities, with the top upper most layer of material that would not be grouted to mimic a more natural channel, if possible. The remaining part of the ramp has a gradation featuring slightly smaller size boulders (3-foot diameter) down to silt and sand. A larger rock gradation may also be placed near the gated culvert outflow structure (see Figure 2-3) downstream of the structure to help alleviate erosion.

The ramp also features a 1-foot-deep low-flow channel that has a 10-foot bottom width and 2:1 side slopes, making its top width 14 feet (**Figure 2-14**). Hydraulic modeling determined that the low-flow channel has a depth of 1 foot of water depth at a flow of less than 45 cfs to meet the minimum flow depth criterion for fish passage. The water surface profiles at 8,000 cfs for the existing and design conditions, as well as a profile of the ramp and sheet pile wall, are shown in **Figure 2-15**.

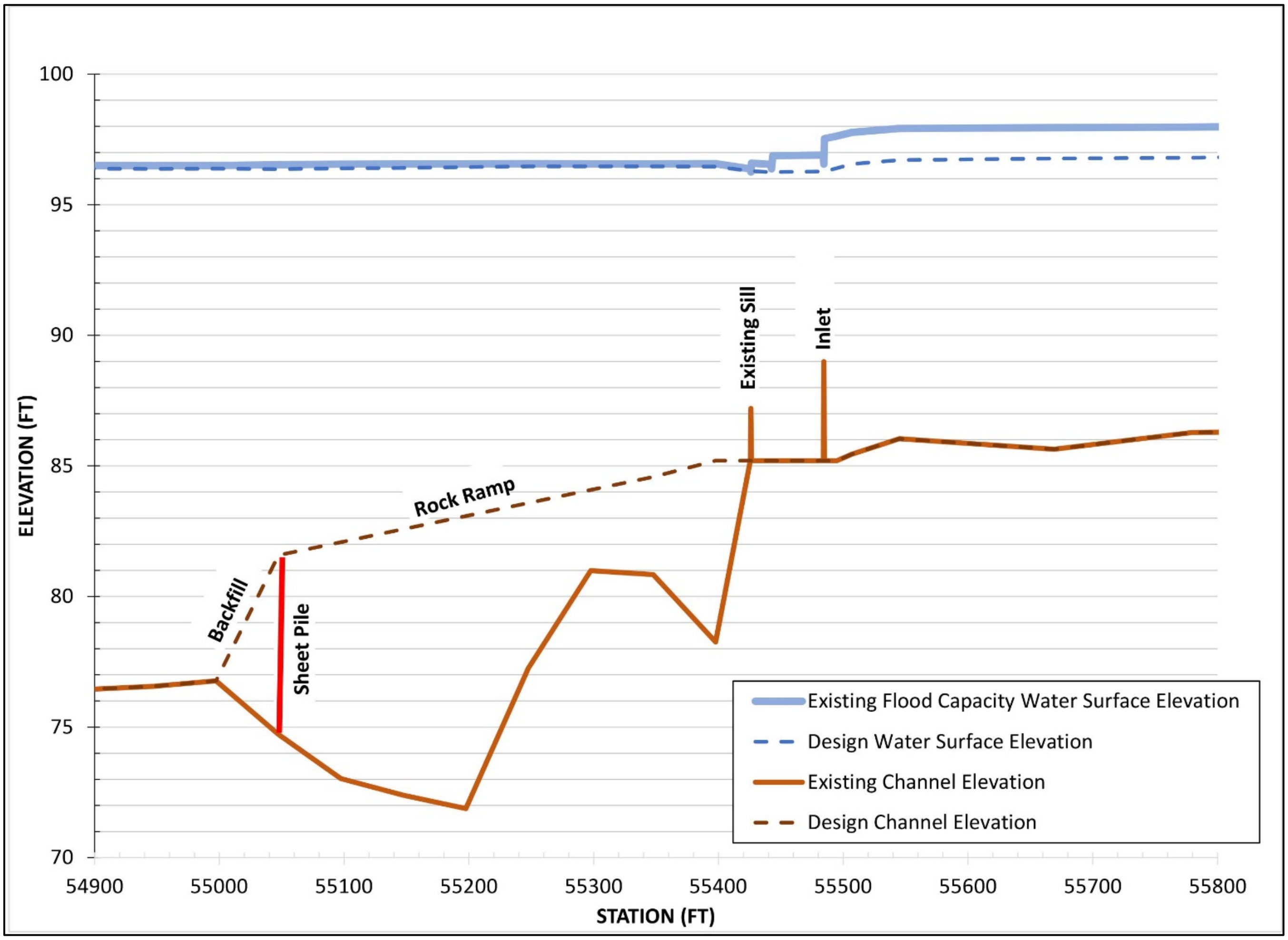
Figure 2-14. Eastside Bypass Control Structure Typical Cross Section



Source: California Department of Water Resources 2017

Average design velocities for SJRRP fishways (rock ramp) must not exceed 4.0 feet per second (fps). In addition, non-pool-type fishways (e.g., rock ramps) that are longer than 200 feet should have average velocities less than 3.0 fps. If that criterion cannot be met, resting areas should be incorporated into the design. For native resident fish, it is recommended that average velocities be kept below 2.5 fps to enable their upstream movement. A one-dimensional model was developed to ensure that the rock ramp meets the criteria for fish passage and flood control. Modeling also informed design features, such as the ramp slope, sizing of the low-flow channel, sizing of ramp and bank materials, and measures to protect the ramp from erosion.

Figure 2-15. Eastside Bypass Control Structure Design Water Surface Elevation



Source: California Department of Water Resources 2017

Modeled water-surface profiles in the project area for Restoration Flows up to 4,500 cfs and flood flows up to 8,000 cfs in the project area show velocities less than 3 fps throughout the entire ramp at all flows, except at the upper most end of the ramp between 600 cfs and 850 cfs (velocities slightly exceed 3 fps). Velocities through the Eastside Bypass Control Structure with the project are lower than 3 fps at flows below about 2,000 cfs, and are below 6 fps below about 8,000 cfs. The depth of water through the rock ramp and Eastside Bypass Control Structure is greater than 1 foot at a flow of 45 cfs and greater than 3.3 feet at a flow greater than 1,000 cfs.

The design meets passage criteria for Chinook salmon and steelhead at all flows from 45 cfs to 4,500 cfs under Restoration Flow releases, but up to 6,000 cfs for flood flows. For white and green sturgeon, project passage criteria are met at flows from 1,000 cfs to 8,000 cfs for both Restoration Flow releases and flood flows, and for Pacific lamprey from 45 cfs to 1,500 cfs for Restoration Flow releases. In general, the velocities within the Eastside Bypass Control Structure exceed the 5 fps velocity criterion for culverts that are between 60 – 100 feet long (National Marine Fisheries Service 2011) for flood flows ranging between 6,000 cfs and 8,000 cfs. However, it is assumed that adult Chinook salmon and steelhead could burst through the Eastside Bypass Control Structure during higher flood flows. The flow ranges meeting passage criteria for native resident species will depend on final design and are variable and shown below. **Table 2-3** summarizes the range of flows that the rock ramp would provide passage when compared to the design criteria by species in **Table 2-2**. The safe passage range is based on average depth and velocity. Greater passage may be provided in the outer edges of the ramp where velocities would be less.

Table 2-3. Summary of Passage Flows by Species at Modified Eastside Bypass Control Structure

Species	Unimpeded Flow Passage Range (cubic feet per second)
Chinook salmon (adult)	45 – 6,000[1,2]
Central Valley steelhead	45 – 6,000[1,2]
White or green sturgeon	1,000 – 8,000[1]
Pacific lamprey	45 – 1,500[2,3,4]
Other native fish	45 – 250[4,5]

Notes:
1 Impended passage during flood event may occur if gates are operated.
2 Velocities through the bays of the structure exceed the 5 feet per second velocity criterion for culverts between 60 – 100 feet long for flows between 6,000 to 8,000 cubic feet per second. Existing bays of the Eastside Bypass Control Structure, which could be considered culverts, are approximately 70 ft long.
3 Based on an assumed average velocity of 2.8 feet per second.
4 Range of flow could be higher by allowing passage of slower-moving fish on the channel fringes.
5 Based on an assumed average velocity of 2.5 feet per second.
Source: California Department of Water Resources 2017

At 8,000 cfs, the water surface elevation matches that for the existing condition for the segment downstream from the bottom end of the ramp. Throughout the ramp, water surface changes range from a 0.02-foot decrease to a 0.06-foot increase when compared to the existing condition. Decreases in water surface elevation were seen throughout most of the rest of the Eastside Bypass Control Structure with a water surface decrease of just over 1 foot upstream of the control structure for the design condition. Because velocities would increase upstream as a result of lowering the water surface, bank erosion control measures (i.e., riprap, etc.) immediately upstream of the Eastside Bypass Control Structure could be implemented, if necessary.

Operating conditions at the modified control structure would influence how the flow is split between the Eastside Bypass and the Mariposa Bypass. The design condition shows there is nearly 700 cfs of additional flows that would be diverted through the Eastside Bypass Control Structure when compared to the existing condition at design flood flows. If needed, the gates could be operated or the boards could be placed back into the Eastside Bypass Control Structure during flood flows to divert additional flows into the Mariposa Bypass. In the rare event that the gates may be operated during flood events and flood flows need to be diverted into the Mariposa Bypass, or if maintenance needs to occur downstream of the Eastside Bypass Control Structure, fish passage through the structure could be impeded although both of these situations are unlikely to occur often and maintenance can be scheduled when salmonids are not present.

Dan McNamara Road Modifications

To provide fish passage at Dan McNamara Road, the existing single low-flow culvert would be replaced with a series of up to three pre-cast concrete box culverts, each approximately 12-feet wide and 10-feet