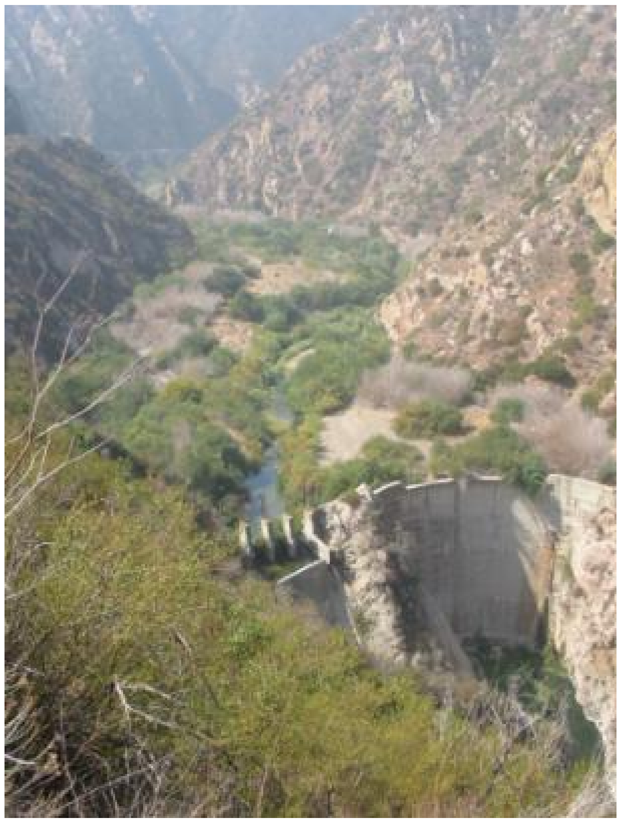
Malibu Creek Ecosystem Restoration Project

Los Angeles and Ventura Counties, California

Appendix F

Cost Engineering



U.S. Army Corps of Engineers
Los Angeles District

November 2020

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1.0 INTRODUCTION AND ALTERNATIVES DESCRIPTIONS

This Appendix presents all relevant assumptions and construction methodologies used on all alternatives for the Malibu Creek Ecosystem Restoration Feasibility Study.

The study area is located about 30 miles (mi) west of the city of Los Angeles. Approximately 2/3 of the 109 sq. mi watershed is located in the northwest portion of the Los Angeles County area and the remaining 1/3 is in Ventura County. Malibu Creek Watershed is within the Santa Monica Mountains, in a mix of urban development and open space. Malibu Creek drains into Malibu Lagoon and Santa Monica Bay.

Malibu Creek drains 109 sq. mi of the Santa Monica Mountains, where the reach from Malibu Lagoon to Malibu Dam is 10 mi Rindge Dam, built in the 1920's, is located about 2 mi upstream from the confluence with the Pacific Ocean. The dam is a concrete arch structure 108 feet (ft) in height with an arc length of 140 ft at its crest (excluding spillway & rock outcrop) and 80 ft at its base. The dam is 2 ft thick at the crest and 12 ft thick at the base. 60-lb steel railroad ties run horizontally and vertically throughout the dam and serve as reinforcement for the structure. The height from the top of the arch structure to bedrock is approximately 117 ft. The top of dam elevation is approximately 298 ft.

A gated spillway was built in a rock outcrop on the western side adjacent to the arch dam abutment. The spillway had four radial gates, each measuring 11 ft high by 8 ft wide, and had a maximum capacity of 7,000 cubic feet per second (cfs). The spillway crest elevation is approximately 285 ft.

Rindge Dam is the largest disruption to stream flow and aquatic and terrestrial habitat connectivity on Malibu Creek between Malibu Dam and the Pacific Ocean. The dam creates a barrier to the endangered steelhead trout's spawning ground upstream of Malibu Creek. Currently, the geotechnical assessment estimates that 780,000 cubic yards (cy) of sediment is impounded behind the dam. The impounded sediment is defined as three distinct layers. The extent of the impounded sediment area is presented in **Figure 1.1-1**. The uppermost layer (Unit 1) is composed of fluvial deposition, which contains sand, gravel, cobbles and larger rocks and is the layer that continues to erode and aggrade during storm events with overall increases in deposition occurring in the future. The sand-dominant (Unit 2) sediment, which underlies Unit 1, comprises nearly half the total volume of impounded sediment and contains about 73 % sand, 22% silt, and 5% gravel and rock. Unit 2 sediment is likely source of beach nourishment. Unit 2 is underlain by a silt-clay dominant layer (Unit 3).

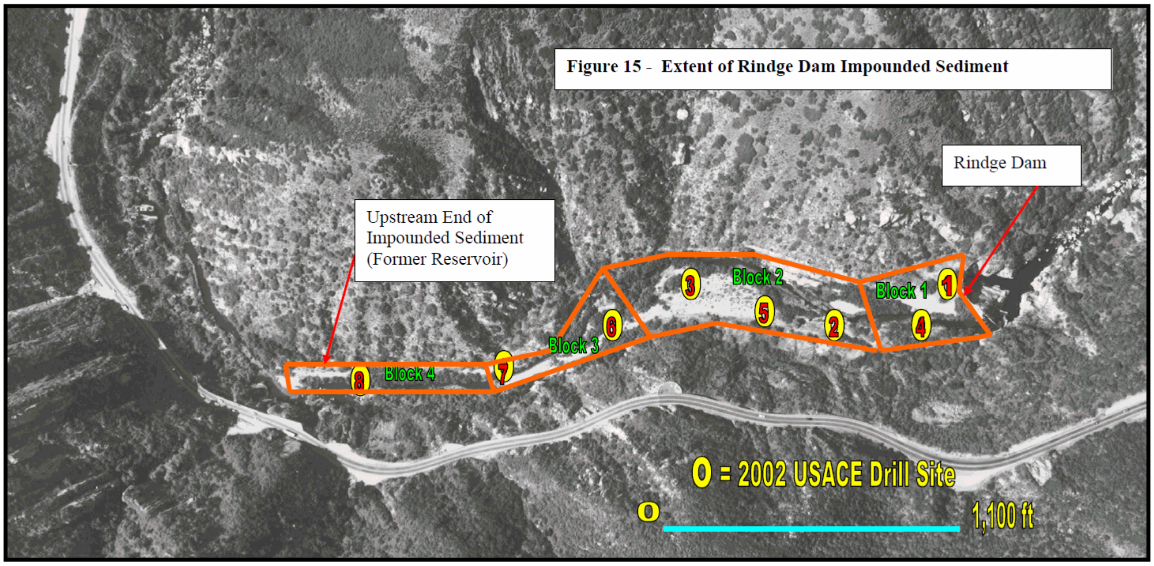

Figure 1.1-1 Extent of Rindge Dam Impounded Sediment

The study objectives are listed in the main report; please refer to the main report for information regarding study objectives.

The sediment behind the dam could be used to nourish downstream beaches in the City of Malibu and elsewhere in the Los Angeles (LA) County.

Most storms in the Southern California coastal area are of the general winter type, with hours of light to moderate steady precipitation, but with occasionally heavy showers or thunderstorms embedded. Local thunderstorms can occur in southern California at any time of the year, but are least common and least intense during the late spring. These local thunderstorms can at times result in very heavy rain for short periods of time over small areas, causing very rapid runoff from small drainages. Some of the smaller tributaries within the Malibu Creek watershed can be especially vulnerable to this type of storm. General summer storms in southern California are quite rare; but on occasion a tropical storm from off the west coast of Mexico can drift far enough northward to bring rain, occasionally heavy, to southern California, sometimes with very heavy thunderstorms embedded. Most of the major flood events in the history of Southern California have been the result of general winter storms, but several local thunderstorms have produced significant flows on various LA County streams.

The flow in Malibu Creek and its tributaries can vary rapidly. Portions of the upper watershed are highly urbanized. Runoff from urban watersheds is characterized by high flood peaks of short duration that result from high-intensity rainfall on watersheds that have a high percentage of impervious cover. Flood hydrographs from single storm events are typically of less than 12 hours duration and are almost always less than 48 hours duration.

The study area of Malibu Creek is undeveloped through the canyon reaches, but the creek is narrow and steep. In the mountains, runoff concentrates quickly from the steep slopes; hydrographs show that the stream flow increases rapidly in response to effective rainfall.

High rainfall rates, in combination with the effects of shallow surface soils, impervious bedrock, and fan shaped stream systems, steep gradients, and occasional denudation of the area by fire, result in intense debris-laden floods. Flows originating in the upper watershed flow through the lower canyon portion of the study area at high velocities, upstream and downstream of Rindge Dam. The bed slope decreases and the overbank area increases where Malibu Creek emerges from the canyon about a mile below Rindge Dam resulting in a reduction in flow velocities and a potential increase in sediment deposition.

Aside from dams along Malibu Creek and tributaries, little of the rest of the tributary reaches have channel structures that affect runoff. There are some short reaches of Malibu Creek tributaries that have been armored, primarily near road and bridge crossings.

Malibu Creek flows were once seasonal, but are now predominantly perennial due to other water sources resulting from storm runoff, local runoff, imported water, and permitted reclaimed water discharge.

The following base alternatives compare different methods for the demolition, removal, and disposal of the Rindge Dam and spillway as well as methods of removal for the sediment currently impounded by the Rindge Dam. Additionally, Alternatives 2, 3, and 4 have sub-alternatives that consider the enhancement of seven existing upstream barriers to allow passage of fish and other wildlife.

Once constructed, any of these alternatives requires minimal operation and maintenance (O&M) during dry seasons. Monitoring of structures to ensure their proper functioning and endurance is needed. Monitoring frequency varies, depending on frequency and severity of storm events. O&M was considered over a 50-year project life.

Maintenance on Alternatives 2a, 3a, and 4a involves repair of the south access road every other year and removal of trash each year. Sediment removal maintenance is unnecessary and it is, therefore, eliminated from further O&M consideration. It is anticipated that an annual inspection involving a team consisting of a biologist, an H&H engineer, and a civil design engineer are needed.

For Alternatives 2b(s), 3b(s), and 4b(s), sediment control for the upstream barriers (CC2, CC3, LV2, and LV3) is done twice a year to allow for low flow conveyance for the purpose of providing suitable passage of aquatic species. An annual inspection involving a team consisting of a biologist, an H&H engineer, and a civil design engineer are needed every year.

The costs related to maintenance and inspections were developed in coordination with the Project Delivery Team (PDT) and were factored into the annual O&M costs.

1.1 Alternative 1: No Action

Existing Rindge Dam and spillway remain in place. Sediment impounding will continue behind the Dam until equilibrium is reached between sediment impoundment and sediment flow downstream through the spillway. The downstream creek elevations are be expected to rise as the sediment trapping characteristics of the Dam diminish. This alternative limits migratory species to areas below the Dam.

1.2 Alternatives 2(s): Dam Removal with Mechanical Transport (trucking / barge transport)

This plan contributes to the primary study ecological restoration objective to restore the Malibu Creek ecosystem, (with some additional benefits to Las Virgenes Creek and Cold Creek), while maintaining downstream ecosystem and riparian management activities. This plan is expected to result in significant benefits to the ecosystem. The plan is to lower the dam height at the same rate as the impounded sediment is removed from behind the dam using mechanical means (excavators, bulldozers etc.) over a course of seven to eight years, from April to October. During the remainder of the year, work on the project ceases due to city and environmental limitations.

The first year of the project is dedicated to site prep: clearing, dewatering and ramp construction. The dam and the sediment from behind the dam will be removed over a 6 to 7 year time span. Construction will be limited to outside the rainy season and the sediment removed from behind the dam will either go to down-coast of Malibu Pier or the Calabasas Landfill. Calabasas Landfill is open from 8 am – 5 pm Monday through Saturday and closed Sundays. All sediment will be removed with loaders and highway trucks. The last year the creek invert is stabilized and trimmed. Work will consist of rock placement and grading to create a series of pools and riffles to enhance the natural characteristic of the project area.

As part of a project partnering effort, the sandy material, which comprises a large volume of the sediment to be removed, will used as beach nourishment material. Identified beach site is located down-coast of Malibu Pier.

The Southern California Dredged Materials Management Team (SC-DMMT), which is the regulatory body that reviews and approves placement of dredged materials in ocean or on beaches, on February 27, 2013, agreed in concept to consider allowing both on-beach placement and near-shore placement of the impounds sand-rich layer, while recognizing that its 22% fines content is at the upper end of the maximum percentage of fines accepted for on-beach placement.

As per standard procedures, prior to any placement, transect sampling is required to verify gradation compatibility with both near-shore and on-shore placements; if sediment is shown to be compatible, regular, confirmatory gradation sampling of the material at the dam site also have to be done as the excavation proceeds, to assure the gradation remains within the tolerable range. In addition, any approved placement scenario will be subject to continued testing for unsuitable materials as excavation of the impound proceeds

Gravel and clay-silt layers have no interested end-users to date, and is modeled to be wasted in a landfill. It should be usable as a landfill daily cover but there are no interested landfill managers within a reasonable hauling range.

1.3 Alternatives 3(s): Dam Removal with Natural Transport (natural erosion)

This alternative consists on removing the Rindge Dam in phases, in 5-ft increments, over the life of the project (50 yrs) and allowing the impounded sediment to be transported downstream naturally into the Pacific.

Rather than trucking away the impounded sediment, construction activities consist of removing the dam and spillway, only. After each 5-ft increment is removed, construction ceases until the natural creek flows during the winter storm season had transported the sediment downstream. Since no impounded material is being excavated and hauled off-site, this alternative does not provide any beach nourishment materials to the local beaches. In the final year of construction, grading of the creek will occur along the entire project length. Due to the reliance on natural weather patterns.

To mitigate the potential of flooding created by increased downstream sedimentation, this alternative requires that floodwalls be created on each side of the channel between Cross Creek Bridge and the Pacific Coast Highway. **Figure 1.3-1** shows the expected layout of the floodwalls. Both floodwalls are 3,100 ft long, 14-in thick, and 10 ft tall. The floodwalls are anchored using drilled-hole-cast-in-place (DHCP) piles placed to a depth of 25 ft. Bedrock depth is potentially as high as 50 ft, and is, therefore, not being considered as a potential issue.

As part of the natural removal process of the sedimentation, significant environmental impacts to migratory fish habitat and the Malibu Lagoon are expected as well as significant (4 ft +) sediment deposition downstream of the project. Potential benefits for Alternatives 3(s) are a largely reduced volume of trucking, affecting both the impact on air quality and local traffic, as well as a reduction in the cost of material disposal.

Figure 1.3-1 Downstream Floodwalls. Downstream Mitigation Layout

1.4 Alternatives 4(s): Dam Removal with Hybrid Mechanical (trucking) and Natural Transport (natural erosion)

This alternative is a combination of Alternatives 2(s) and 3(s). Construction activities are similar to Alternative 2; the dam height is lowered at the same rate as the impounded sediment using mechanical means, with the removed sediment being trucked off-site. The difference with Alternatives 4(s) is that at the end of each construction season, from season 2 through season 4, a five foot increment of the dam is removed below the local sediment grade, to allow a controlled volume of sediment to erode naturally downstream during the winter storm season.

The first year of the project is dedicated to site preparation, clearing, dewatering and ramp construction. The dam and the sediment from behind the dam are removed over a 6 to 7 year time span. At the end of each construction period an additional 5 ft of the dam is removed so sediment could be washed away during the rainy season. Construction is limited to outside the rainy season and the sediment mechanically removed from behind the dam is hauled to local beaches or the Calabasas Landfill.

As part of a project partnering effort, the sandy material, which comprises a large volume of the sediment to be removed, will used as beach nourishment material. Identified beach site is located down-coast of Malibu Pier.

In the final year of construction, grading of the creek will occur along the entire project length. Work consists of rock placement and grading to create a series of pools and riffles to enhance the natural characteristic of the project area. To mitigate the potential of flooding created by increased downstream sedimentation, this alternative requires floodwalls construction on each side of the channel between Cross Creek Bridge and the Pacific Coast Highway. Both floodwalls are 3,100 ft long and 5 ft in height. The floodwalls are anchored using drilled-hole-cast-in-place piles. Bedrock depth is potentially at 50 ft depth, and is, therefore, not being considered as a potential issue. The potential benefit of alternatives 4(s) is a reduction in the amount of sediment to be removed, resulting in a lessening of impact on air quality, local traffic and lowered material disposal costs. **Figure 1.4-1** shows an aerial view of the project area.

Figure 1.4-1 Project Area

USACE coordinated with the Cost Engineering Planning Center of Expertise (Walla Walla District) on 2013 for the development of contingencies. Based on those coordination meetings, it was decided to not have separate abbreviated risk analyses for Alternative 2(s); 3 (s); and 4(s). On 2016, all costs were refined/updated, the risks analyses were revisited and cost products submitted for ATR.

2.0 COST ESTIMATE BASIS

2.1 <u>Unit Cost Basis</u>

2.1.1 Direct Cost

Components of construction include the following five cost elements: labor, permanent materials, construction equipment, subcontracts, and contractor's expendable supplies. The key factors in determining the cost of each of these elements is the productivity of the work force and the construction equipment used to perform the various work activities. Productivity rates for the sediment excavation work were selected to reflect local weather, site conditions, work week hours, estimated volume, appropriate construction techniques, schedule sequencing, and experience gained on previous construction projects of similar nature.

Most costs were determined using databases for the individual components of labor, materials, and equipment. In some cases, costs from the bid tabulations of construction projects were selected to represent the actual cost of similar portions of this project. Where used, these historic values were escalated to dollar values and adjusted for economies of scale and other factors to provide an accurate reflection of the cost to do the work over the lifetime of the project. A third source of prices included commercially available construction cost data guides. Generally, costs were grouped for the most significant impact items, such as excavation, transportation of sediment, and concrete removal.

Labor rates used to develop the estimate were obtained from the latest Davis-Bacon Wage Rates for Los Angeles County, Heavy Construction.

Equipment rates are based on the Department of the Army EP 1110-1-8 "Construction Equipment Ownership and Expense Schedule", Region 7.

Crews were developed for project specific applications and are listed in the crew database.

2.1.2 Quantity and Material Analysis

For the alternatives involving removal of impounded sediment, the sediment is assumed to be alluvial. The sediment is generally distributed in three layers. The upper layer predominantly consists of gravel, cobbles, and other rocks. The middle layer is predominantly sand. The bottom layer is mostly a combination of silt, sand and clay. The sediment distribution was simplified in the following breakdown show in **Table 2.1-1**.

Table 2.1-1 Sediment Distribution

Material Classification	Sediment Qtys
Rock/Gravel	200,000 CY
Sand	340,000 CY
Clay/Silt	230,000 CY
TOTAL	**770,000 CY**

Actual sediment volume available amounts to 780,000 CY. However, upstream 10,000 CY impounded material is narrow and thin; and it has no appreciable sand. This 10,000 CY is left in-place and eroded to grade naturally by the creek as recommended by the 2003 Geotechnical Impound investigation report. Therefore, the net sediment removal volume is 770,000 CY.

Based on consultation with USACE Geology, the impounded sediment will not swell upon excavation due extremely low relative density of the fine material, and the loose nature of the granular material. Geotechnical investigations and several Soil Penetration Tests (SPT) performed upon the impounded sediment indicated deposit are very loose even at the deepest layers. All material is in Loose Cubic Yards (LCY).

2.1.3 Equipment Selection

Equipment selection and sizing were developed through cost engineer experience.

2.2 Real Estate

Lands as well as temporary storage fees for the storage of re-useable materials at the Calabasas Landfill were identified and provided by USACE.

According to information provided by the Design Planning Report, the Calabasas Landfill could provide temporary storage for up to approximately 565,000 CY of roughly separated sand/cobble/gravel/boulder material for a ten-year period. The estimated time period is 2023-2030. Between 2023 and 2030, approximately 12 acres in stockpile area could be made available at the Calabasas Landfill for temporary storage. The site incurs costs associated with receiving this material, including dozer work associated with receiving the dirt, additional street sweeping and dust control.

2.3 Relocations

Relocations associated with the upstream barriers were estimated in detail by Cost Engineering.

2.4 Assumptions

2.4.1 Site Access/Preparation and Mobilization

The dam can be accessed through an existing, unpaved road off Malibu Canyon. Site access improvements are required for approximately 800 linear feet of temporary road for widening, as necessary, to accommodate construction traffic and for normal maintenance of the roadway surface and drainage culverts during the contract period. No other improvements are anticipated.

Temporary haul roads will be required to be established for excavation of the sediment material. Maximum grades should generally not exceed 15%. Mobilization and demobilization encompass the cost of transporting and setting up heavy pieces of equipment.

The current estimate considers constraints on construction activities for protection of threatened and endangered species.

Vegetation is cleared along the pioneer road, access maintenance road, and sediment removal area. Ground trees, trash, and areas difficult to access encompass 25% of the total area and they are manually cleared with brush-saws, track-hoes, and chippers. 75% of the total area is cleared with dozers and mulched.

The Sheriff's Overlook is a small overlook area off the Malibu Canyon Road just south of the project site. During construction, Sheriff's Overlook will be used as a staging and an oversight area for construction teams. A trailer for construction crews can be placed to provide optimal views of the dam deconstruction and truck and equipment routes to and from the construction site. Upon completion of construction activities, the trailer will be removed and any debris or equipment located at Sheriff's Overlook will be cleared from the area.

The cost estimate includes installation of guard rail fencing around the outlook and installing gravel for vehicles parking/roads.

Aesthetic and educational components are included as measures, particularly at Sheriff's Overlook above Rindge Dam and adjacent to Malibu Canyon Road. Post construction, Sheriff's Overlook will remain a dirt turnout for vehicles driving along Malibu Canyon Road. Interruptive signs will be placed displaying images and facts about the history of the Rindge Dam.

The disposal site is located 7.5 mi north of the project area. The LA County beach potentially receiving sand material from the project is approximately 5 miles from the dam.

Due to a lack of turnaround space available on the access road leading to the dam, two (2) ramps are constructed for truck traffic. One ramp will allow vehicles to travel northbound, towards the landfill, and the other allowing vehicles to travel southbound, towards the beach.

There is already an existing 12-ft wide ramp in the southbound direction, but it is in a state of disrepair. Repair of the existing ramp involves rebuilding the bottom area of the ramp (approximately 15,700 cy of fill) to a length of 1,000 ft. Additional work on the southbound ramp is required to allow for loaded truck traffic. The ramp is widened to 15 ft and reduced to a grade of 15%. Widening and re-grading the southbound ramp requires 55,000 cy of fill material.

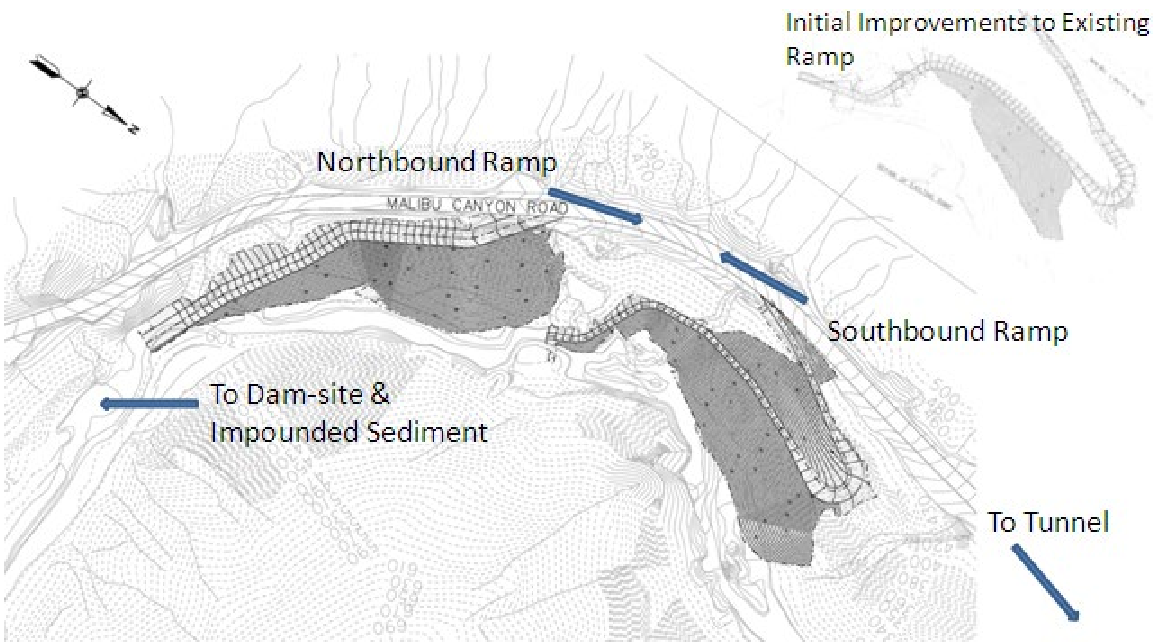

Figure 2.4-1 Northbound and Southbound Access Ramp Plans

2.4.2 Diversion and Control of Water

A cofferdam shall be used, upstream of the sediment removal area, for temporary control of water. The cofferdam permits construction and modification of the diversion channel as construction proceeds. The cofferdam will be constructed of compacted earthen fill

material harnessed at the project site. The cofferdam will be approximately 30 ft long, 6 ft wide at the top (with 1:2 side slopes), and 6 ft high. Low flow water will travel from the cofferdam to the existing spillway via a 36-in diameter corrugated metal pipe (CMP) approximately 4,100 ft in length. It was decided to keep the pipeline above ground to allow for maximum flexibility during the removal of sediment material, concrete arc section, and spillway. The CMP will be anchored using 4 ft long metal stakes placed every 50 ft along both sides of the pipe. During the second year of construction, the CMP line is aligned such that all bypassed water is discharged from the Spillway.
At the end of each construction season, the CMP will be removed and transported to the contractor's yard for storage (i.e. to prevent damage during winter flows). The pipeline will then be reinstalled at the beginning of the next construction season. The cofferdam will also be demolished at the end of each construction season and re-constructed at the beginning of the next.

A total of 11 wells will be used to provide de-watering for the project site. These wells will be installed in the first year of the project and extend to the final project depth. The wells will be trimmed down to current invert level periodically throughout construction.

Since turbidity is a major environmental consideration during construction, the USACE validated the assumptions above relating to dewatering with a local dewatering contractor on February 1, 2013. The dewatering contractor suggested the use of de-silting tanks to treat the water before it’s discharged into the CMP line, combined with other bypassed waters, and ultimately released downstream via the existing spillway. The dewatering contractor also reviewed sieve data collected out in the field by the USACE Geologist and provided a recommendation with regards to the design of the well screens which has proven effective with fine material 200 and smaller.

2.4.3 Rindge Dam Structural Demolition

For estimating purposes, the removal of the arch dam section is assumed to be performed using conventional high-impact breakers, blasting, and diamond-wire saw-cutting methods.

The diamond-wire system consists of a diamond-impregnated wire made to length for each cut and a hydraulically-powered drive system. Diamond wire is routed to envelope the area to be cut (requiring drilled holes), then guided into a drive wheel on the power unit. The drive wheel rotates and pulls the wire through the concrete. The diamond wire is best suited for cutting or notching composites of dissimilar materials. Since the Rindge Dam arch is a composite of concrete, rebar and railroad ties, the cutting action of the diamond wire conforms to the work. The gentle cutting action of the diamond wire does not smear one material into another and does not snag at the border between two materials. Diamond wire saw-cutting will provide smooth surfaces, facilitate excavation of notch portions of the arch dam section, improve control of the excavation grade, provide smooth working surfaces for excavation of each layer, and permit removal of the concrete in large blocks (rather than attempting to confine rubble to the working surface and removing the rubble by loaders).

The diamond wire saw method for demolition of the dam arch is used for the purposes of preparing cost estimates and demonstrates the technical feasibility of this method when combined with use of cranes, assumed blocks weighing less than 19 tons each, and methods to safely anchor and lift the blocks. It is not intended to preclude consideration of other methods for dam arch concrete removal considered during PED or Construction, as long as the consequences of other methods are clearly understood, evaluated, and coordinated with appropriate agencies.

This demolition method allows for compliance with environmental requirements relating to turbidity and discharging waste material into Waters of the United States.

Vertical and angled drill holes will be required for production blasting of the base of the dam to the final excavation level. Two inch diameter drill holes were assumed to be located on a 4 ft pattern for production blasting of the concrete, with blasting mats used to confine the concrete rubble for removal using a crane and a loader.

Spillway removal shall consist of pre-splitting the concrete from the rock substratum, drilling and micro-blasting the surface to fracture the concrete, and manually breaking the concrete. The spillway will be removed in stages for all of the action alternatives and effectively occur in parallel with the demolition of the dam.

All the debris from the dam and spillway will be taken to the Calabasas Landfill for disposal.

2.4.4 Construction Logic and duration

Activity durations were based on engineering judgment and experience.

2.4.5 Waste Disposal

The Calabasas Landfill is located off of Lost Hills Road in Agoura, CA at the upper end of the watershed. The landfill is approximately 7.5 mi from Rindge Dam, mostly along Malibu Canyon Road, named Las Virgenes Road after crossing Mulholland Drive. All waste materials will be removed from the site and transported to the Calabasas landfill.

The cost estimate assumes that all waste concrete will be dumped at the Calabasas Landfill. An estimated 3,460 cy of concrete will be in large blocks, weighing approximately 19 tons each. An estimated 540 cy of concrete from the foundation demolition will be fractured and broken into manageable pieces before hauling and disposal. 2,000 cy of concrete from the spillway demolition, micro-blasted and demolished into small pieces, will also be hauled to the landfill. Additional costs required to crush all waste concrete for disposal (with any reinforcing steel removed) is assumed to take place at the disposal site and is included in the disposal cost.

Additional waste disposal will result from de-vegetation activity. The green waste associated with vegetation removal will also be sent to the Calabasas Landfill.

2.4.6 Hauling

Typical construction equipment used for hauling includes flatbed trucks, low boys, and dump trucks.

Removal of the concrete arch requires approximately 163 truck trips; each truck hauls two blocks at a time. The blocks are loaded onto the trucks with a crane.

The arc foundation concrete requires removal of approximately 15 feet of concrete from the surface (base) of the dam to the bedrock. The arc foundation amounts to approximately 540 CY of concrete to be removed and hauled away.

The spillway requires a total of approximately 100 trips to transport 2,000 CY.
Flatbed trucks and dump body trucks will be used for hauling the foundation and spillway concrete.

Truck traffic for sediment removal at Rindge Dam varies greatly based on the chosen alternative. Haul loads cannot exceed 80,000 pounds. The contractor will be required to make appropriate repairs to project-induced impacts to the road surface from trucks entering and exiting Malibu Canyon Road during interim construction years, and after construction is complete, in the vicinity of the access ramps to the Rindge Dam impounded sediment area. The overall distance for construction-related road repairs is estimated to be 0.5 miles in length from the Malibu Canyon Road tunnel to the midpoint between the two ramps for the northbound direction to allow for normal use after construction, and an equal 0.5 mile distance from the mid-point of the two ramps for the southbound direction of the road."

2.4.7 Site Clean-up

Final channel cleanup, including removal of any concrete rubble and boulders, must be performed during the low-flow period (April through October).

2.4.8 Site Restoration

A site restoration plan will be developed to provide natural-looking contours following removal of the sediment and dam. The river channel contains large boulders, which will be push aside as necessary for fish passage and potential recreational use of the river, if possible.

2.4.9 Monitoring & Adaptive Management

An environmental mitigation cost were developed with input from the environmental coordinator and biologist. Cost includes: seeding, weeding, maintenance for five years, and biological monitoring for five years.

2.4.10 Road Improvement Plan

Heavy construction traffic associated with hauling materials from the dam site to designated disposal areas may cause damage to some of the existing roadways in the area. Malibu Canyon Road is designed and constructed to accept standard truck traffic. Two types of roadway repairs were considered; spot patching with resurfacing, or total replacement. The alternative for spot patching, as needed, is difficult to evaluate due to the inability to identify with any confidence the extent of potential damage and the amount of patching that may be required. It is anticipated that dips and ruts will be typical repair requirements, which could involve long sections of the road. The spot patching alternative includes resurfacing of the entire roadway with two layers of bituminous surface treatment. On March 20, 2013, the PDT assumed that the total replacement alternative (i.e. 0.5 mi) ensures that all potential deficiencies are addressed.

2.4.11 Beneficial use of Sediment Material

The SC-DMMT agreed in concept to consider allowing on-beach placement and near-shore placement of the sand-rich layer. The existing condition of the sand-rich material is 22% fines and 5% gravel with the remaining content being sand. Although this level of fines (silty material) is at the upper end of what is generally be accepted for on-beach placement, no amount of screening has been assumed at this time. The sand is trucked from the project site to the beach down-coast of Malibu Pier or trucked to Ventura Harbor and then barged to near-shore Malibu Beach.

2.5 Indirect Costs (Contractor Markups)

The contractors and subcontractors' field office overhead, home office overhead, and profit were established using historical rates for similarly sized jobs and represent the contractor's cost of doing business and assuming the risks associated with construction work. A dewatering subcontractor, fencing subcontractor, drilling/blasting subcontractor, paving subcontractor, landscape subcontractor, demolition subcontractor, trucking subcontractor, and environmental restoration subcontractor were included in the estimate.

Disposal fees do not carry contractor’s markups on all the alternatives. Disposal fees represent approximately 70% of the total sediment removal cost. Typically, disposal fees carry markups, however, since disposal fees represent such a large percentage of the estimated cost, adding contractor’s markups would artificially inflate the estimate. In a bidding or negotiated contract carrying disposal fees of this magnitude, contractors would not apply full markups on top of the disposal fees.

2.6 Owner Cost

The following Owner Costs are applied to the CWE.

2.6.1 Planning Engineering and Design (PE&D)

Planning Engineering and Design (PE&D), including Engineering During Construction (EDC) was estimated as a percentage 30% of the Construction cost prior to addition of the applicable contingency.

2.6.2 Construction Management or Supervision & Administration (S&A)

Construction Management was estimated as a percentage of the construction cost prior to addition of the applicable contingency.

2.7 Schedule of Work

Due to the traffic conditions on Malibu Canyon/Las Virgenes Road, truck use for hauling on this road will be restricted to the hours of 9 AM to 3 PM daily. On school days, hauling is disallowed from 2:00 PM to 3:30 PM. Therefore, assume road use from 9 AM to 2 PM (5 work hours per day) while school is in session for any material hauled to the Calabasas landfill. On non-school days, the work day is 9 AM to 3 PM (6 hours).

During the summer time frame, sediment is not allowed to be hauled to the beach. Therefore, sediment is temporarily held a Site F. Site F is located outside the sediment impounded area near the dam. During the winter time frame, sand sediment is hauled from Site F to the beach.

After the addition of daily operational restrictions, the job requires one year of set up and site preparation, and 6 or 7 years of sediment hauling to complete the job, for a 7-year to 8-year total project length.

Truck hauling to the Calabasas Landfill will occur 6 days a week. No hauling to the landfill will occur on Sundays or federal holidays. Estimated construction duration is approximately 7 to 8 years followed with rehabilitation of the highway and the environmental mitigation work. The construction season is defined as 1-April to 15-October. During the winter period, no work will be done and no equipment will be on-site. During construction, the contractor will be responsible for checking the weather conditions every day and evacuating all personnel and equipment in the event inclement weather is forecasted. The existing cost estimate has accounted for contractor mobilization and de-mobilization during each year of construction.

3.0 UPSTREAM BARRIERS ASSESSMENT

A list has been compiled of 7 high-priority man-made barriers upstream of the Rindge Dam that have been identified as additional blockages to the migration of local fish species. Each one will be prioritized to see if its removal, modification or replacement can add migratory fish access to a large amount of additional habitat upstream of the dam for a relatively small incremental expense. An Indicator Species for the Malibu Creek Ecosystem Restoration is southern steelhead trout (*Oncoryhnchus mykiss*), a federally-listed endangered species. Prioritization of fish barriers should begin with a mention of the keystone barrier, which is the Rindge Dam. It is important to note that natural barriers to the trout were identified in previous studies, but are not included in the prioritization. Generally speaking, the natural barriers are fish-passable under at least some flow conditions. This section discusses only the upstream barriers and makes no further mention of Rindge Dam.

Man-made barriers are considered a limiting factor and are, therefore, the only barriers included in this assessment. Recommendations were developed by Camp Dresser & McKee Inc. based on field assessment, barrier removal practices generally accepted by NOAA, NMFS, and CDFG, and the 2005 Abramson and Grimmer report. The actions “Remove invasives and monitor” is considered a part of every recommendation and should be included in all barrier renovation/removal plans, but are omitted here for brevity. Additionally, during construction, it is necessary to demolish and rebuild only one lane at a time where there is a County road running above (if applicable). The contractor is required to block only one-half of the barrier/bridge at a time, and allow for staggered two-way passage on the other lane using flag-men or automated signals at night. Fire department access to any construction site and passage across the road above must be maintained at all times during construction; wildfires being a major issue in Malibu.

CC5 (Cold Canyon Road Culvert) may have more than 6-inches of concrete on the invert, but from project photographs, the invert has eroded away with time. If more of the concrete is removed, there is a risk in exposing the corrugated metal pipe (CMP). Over time, the corrugated metal pipe will corrode and break down, and when this happens along the invert of a culvert it jeopardizes the structural integrity of the entire culvert. The concrete inverts of LV3 and LV4 also cannot be chipped away for similar reasons. From researching other projects plan sets, concrete inverts generally have about 4-inches of concrete placed over the reinforcing rebar, which is insufficient for a passage channel to be made. In addition, when concrete is removed from a box culvert, the structural characteristics of the culvert are changed and there is a risk of reducing the overall structural capacity.

In contrast to carving a channel in each invert, it was assumed that there would be a need to construct a channel along the inverts of CC5, LV3, and LV4. The construction at CC5 requires building a channel along the 130 ft-long invert of the culvert, and do limited work upstream and downstream of the culvert to ensure low flows still pass through the structure. For LV3 and LV4, it is necessary to modify the invert of the box culvert and the entire concrete apron upstream and downstream of each structure. In addition to the concrete apron modification, there is a need to modify the stream bed enough to ensure low flows pass through LV3 and LV4 and modify the sill structures to ensure fish can overcome the vertical drop at each one.

3.1 <u>Upstream Barriers Assumptions</u>

USACE developed the following upstream barrier plans for the feasibility-level cost estimates. These plans are considered to be technically feasible, economical, and compatible with the project objectives.

3.1.1 Site Access/Preparation

The current estimate assumes no constraints on construction activities will be necessary for protection of threatened and endangered species.

Vegetation must be cleared in and around the project sites and access maintenance roads, as needed. For the majority of the upstream barrier sites, it is assumed that vegetation will have to be manually cleared with brush-saws, track-hoes, and chippers. Some barrier sites, where equipment access is not an issue, allow for clearing using small dozers. Disposal of materials using rental dumpsters was assumed.

3.1.2 Diversion and Control of Water

For most of the upstream barrier alternatives, it is assumed that a temporary cofferdam of varying heights per alternative is installed upstream of the construction area. Installation of a temporary 36-inch CMP allows for water conveyance through the construction site, enabling fish passage during construction.

For some of the upstream barrier alternatives, a lack of staging area and/or access issues requires that the temporary cofferdam be built using sandbags. These cofferdams require the construction of a trench/sump to pump the water downstream of the construction site using hosing.

3.1.3 Structural Demolition for all 9 Upstream Alternatives

The demolition for each of the upstream alternatives varies based upon existing conditions (see **Figure 3.4-1** for a location of each barrier).

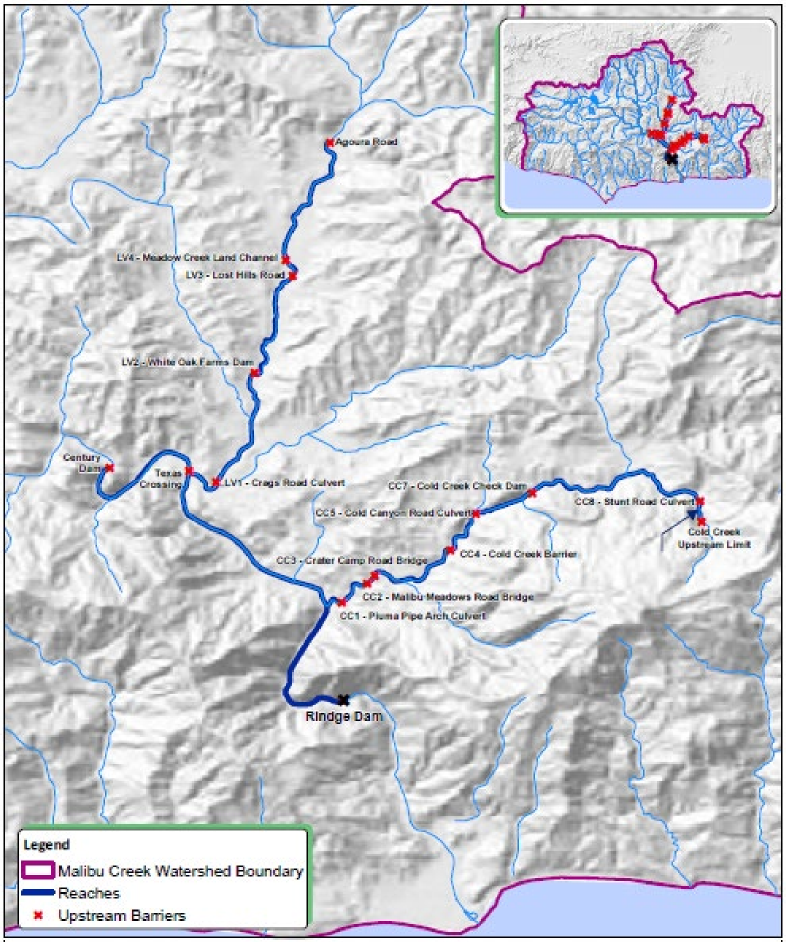

Figure 3.4-1 Locations of Upstream Barriers

The following descriptions highlight some of the differing site conditions at each site and identify what the planned method is for improving fish passage to meet the project objective:

LV1 - Crags Road Culvert Crossing

The existing concrete box culvert, the existing concrete abutments, and the existing concrete wing walls will be removed and replaced with a pre manufactured 75 ft long, 20 ft wide clear span bridge. This new bridge will span the entire creek and eliminate the current reduction in the creek cross section. The new bridge's deck elevation will match the top elevation of the existing structure.

The use of a pre-manufactured bridge will reduce construction time since the bridge will be delivered to the site and placed on the new abutments with a crane. Prior to installing the new bridge, the new wing walls and bridge abutments will have to be constructed on both banks of the creek. The creek bed will have to be re-graded to fill any voids left by the removal of the existing structures. Construction is estimated to take 15 days.

The creek flow will have to be diverted during removal of all the existing structures and construction of the new abutments and wing walls. Water diversion will also be necessary while any work is being performed within the creek. The creek will not need to be diverted while the pre manufactured bridge is being placed on the abutments. Dewatering will also be necessary during construction of the new bridge wing walls and the new bridge abutments.

De-vegetation will be required for the removal of the existing bridge wing walls and abutments along with construction of the new bridge wing walls and abutments. Additional clearing will be required at the designated staging area for the project. All areas that are cleared will be restored once construction is complete.

No traffic control measures will be required since this bridge is used for maintenance vehicle and fire truck access.

LV2 - White Oak Dam

The existing 6 ft dam will be removed in stages over 3 years to minimize any erosion and scour problems. The creek will have to be diverted each year to protect any crews and equipment being used to remove the dam. However, work in the creek will be kept at a minimum since the dam will be removed by a backhoe stationed on the creek bank. Dewatering will not be required. Demolition is estimated to take 15 days each year. Clearing will be limited to a 40 ft by 40 ft area on either side of the cofferdam, which will ensure the backhoe, has adequate space to work. These areas will have to be cleared every year of dam removal. All areas that are cleared will be restored once the dam removal is completed. Once the dam is removed, no further work will be done to restore the creek.

LV3 - Lost Hills Road Culvert & LV4 - Meadow Creek Lane Crossing

Both LV3 and LV4 will have to be treated as a single project because fish have to pass through both barriers to reach the habitat areas upstream of LV4. These structures will not be removed; rather, a low flow channel will be constructed along the invert of each structure and along the portion of the stream between LV3 and LV4.

The low flow channel for LV3 will be built on top of the existing concrete invert. This channel will be 6 inches deep and start at the downstream end of the concrete apron, extend upstream through the culvert structure, and terminate at the end of the upstream concrete apron. This channel will be 3 feet wide and will ensure there is enough water traveling at low enough velocities for fish passage. The drop at the downstream end of the concrete invert will not be modified. The low flow channel for LV4 will be similar to the channel passing through LV3 and allow fish to travel upstream to the designated habitat areas. Construction is estimated to take 50 days.

The invert of the creek between LV3 and LV4 will have to be cleared and re-graded to provide a low flow channel that will connect the concrete channels along LV3 and LV4. This area will be restored once construction is complete.

The creek flow will have to be diverted during construction of both concrete low flow channels and while the creek invert between LV3 and LV4 is being re-graded. Limited dewatering will be necessary along the creek between LV3 and LV4 to ensure adequate working conditions for construction equipment.

Additional clearing will be required at the designated staging area for the project and along any invert access ramps. The staging area will be restored once construction is completed.

Some traffic control measures may be required during construction hours to facilitate the movement of equipment from the staging area to the construction site.

CC1 - Piuma Culvert

The existing CMP arch culvert, the concrete lining along the creek invert, and the stone head walls will be replaced by a 12 ft pre-cast arch culvert with new concrete footings and concrete head walls on both sides of the creek. The width and height of the new culvert will match the existing CMP culvert and the road elevations across the culvert will be the same as the existing roadway.

The existing metal arch culvert, stone wing walls, and concrete invert will be removed in two stages. The first stage will be from the upstream inlet to the centerline of the road, the second state will be from the centerline of the road to the downstream outlet. The culvert must be removed in two parts so the traffic along the road can be diverted into one lane across the bridge. Traffic control measures will be required during and after construction hours to ensure traffic can safely be reduced down to one lane across the creek.

The pre-cast culvert will reduce construction time since the culvert will be delivered to the site and placed on the footings with a crane. Prior to installing the new culvert sections, new headwalls and footings will have to be constructed. Construction is estimated to take 30 days.

The concrete invert of the creek will be replaced with a natural channel. The creek bed under the culvert will have to be re-graded to compensate for the small elevation drop at the end of the existing concrete invert.

Temporary shoring will be required to preserve the road while the existing metal culvert and stone wing walls are being removed. The temporary shoring will be placed perpendicular to the centerline of the road and run parallel to the existing CMP culvert for 46 ft. The temporary shoring will be required on the north and south sides of the existing structure and will be removed once the new bridge abutments and wing walls are completed.

The creek flow will have to be diverted during removal of all the existing structures and construction of the new footings and headwalls. The creek will also have to be diverted while any work is being performed within the creek bed. Dewatering will be necessary during construction of the new culvert footings and headwalls.

Clearing will be required for the removal of the existing culvert wing walls and abutments, along with construction of the new culvert footings and headwalls. Additional clearing will be required at the designated staging area for the project. All areas that are cleared will be restored once construction has been completed.

CC2 - Malibu Meadows Road Crossing

The existing structure is a wood deck, steel beam bridge with the concrete invert and CMU abutments and wing walls. This structure will be removed and replaced with a 70 ft long and 25 ft wide pre-manufactured bridge with concrete abutments and wing walls on both sides of the creek. The new bridge will have a longer span than the existing structure to help eliminate the reduction of the creek cross section, and the bridge deck elevation will match the existing bridge deck elevation.

The pre-manufactured bridge will reduce construction time since the bridge will be delivered to the site and placed on the new abutments with a crane. Prior to installing the new bridge, new wing walls and bridge abutments will have to be constructed on both banks of the creek. Construction is estimated to take 30 days.

The existing concrete invert will be removed and replaced with a modified stream bed. The stream bed improvements will have to be designed to compensate for a 5 ft drop at the end of the existing concrete invert while still allowing fish to swim upstream. The stream bed improvements will have to prevent head cutting upstream of the new bridge.

The creek flow will have to be diverted during removal of all the existing structures and construction of the new abutments and wing walls. The creek flows will also have to be diverted while any work is being performed within the creek bed. The creek will not need to be diverted while the pre-manufactured bridge is being installed. Dewatering will also be necessary during construction of the wing walls and abutments.
Clearing will be required for the removal of the existing wing walls and abutments along with construction of the new abutments and wing walls. Additional clearing will be required at the designated staging area for the project. All areas that are cleared will be restored once construction has been completed.

Traffic control measures will only be in place to warn drivers of a closed bridge. All traffic will be redirected through neighboring streets.

CC3-Crater Camp Road Crossing

This site is assumed to be the same as CC2, except there is no gas line running along the bridge. This structure will be replaced in like manner to CC2, with minor changes to specific lengths and measurements.

CC4 - Cold Creek Barrier (Dam)

Cold Creek Barrier (Dam) is excluded from the project.

CC5 - Cold Canyon Road Culvert

The existing 25 ft diameter concrete culvert cannot be removed so a low flow channel will be built along the culvert's invert to allow fish passage upstream. The channel will be 6 inches deep and 3 ft wide and will ensure flows are slow enough and deep enough for fish passage during low flow conditions. The downstream portion of the culvert will not be modified, because fish can use existing ponds to make their way into the low flow channel. The creek invert near the inlet of the culvert will have to be cleared and re-graded to ensure flows can enter the low flow channel.

Creek flows will need to be diverted during construction but no dewatering will be necessary. Construction is estimated to take 15 days. No traffic control will be necessary.

Construction Logic and duration

Activity durations were based on engineering judgment and experience. Construction durations vary per alternative from 15 days to 5 months.

3.1.4 Waste Disposal

The Calabasas Landfill is located at Lost Hills Road in Agoura, CA at the upper end of the watershed. For the 7 upstream barriers, it was assumed that waste disposal is carried on via rented waste dumpsters per the suggestion of the local sponsor. The cost estimate assumes waste will be dumped at the Calabasas Landfill without further handling.

3.1.5 Hauling

Typical construction equipment used for hauling includes flatbed trucks, low boys, and dump trucks. Hauling is performed 6 days per week during daylight hours.

3.1.6 Site Clean-up

Final channel cleanup, including removal of any concrete rubble and boulders, must be performed during the low-flow period (April through October). All upstream barrier alternatives are assumed to have varying rock landscaping requirements based upon the project site to help enhance migratory fish passage.

3.1.7 Monitoring & Adaptive Management

Environmental monitoring and adaptive management scope and costs were provided by the USACE LA Planning Division Environmental Resources representative with assistance from Cost Engineering.

4.0 SYNOPSIS AND CONTINGENCY

4.1.1 Synopsis

Feasibility-level designs and estimates have been prepared for the sediment removal and demolition of Rindge Dam and Spillway as well as for the 7 upstream barrier alternatives. The current studies confirm that dam removal is technically feasible and can be safely performed in a manner compatible with sediment management requirements and project objectives. Dam removal activities will require a period of approximately 7 to 8 years to complete for removal Alternatives 2(s) and 4(s). Dam removal period for Alternatives 3(s) is dependent on seasonal storm levels to allow natural sediment erosion transport; it is estimated to take about 50 years for all the sediment to be naturally transported downstream.

4.1.2 Contingency methodology

Contingencies were calculated using the Abbreviated Risk Analysis (ARA) process. ARA produces an overall project contingency together with an independent discrete contingency for Real Estate; Construction; Pre-construction, Engineering and Design; and Construction Management. The overall project contingency for each alternative encompass the combined contingencies. However, the Cost Estimate Summaries employed the discrete independent contingencies for Real Estate; Construction; Pre-construction, Engineering and Design; and Construction Management; instead of the overall combined project contingency.

4.1.3 Construction Contingency Input Approach

The construction contingency for each alternative is comprised of the combined input of each construction element. The break out of the construction elements carry different risks related to the costs and a combined construction contingency is calculated. The combined resulting construction contingency percent was applied to all the construction elements within each alternative.

4.1.4 Major Risks

While conservative sediment quantities were submitted to Cost Engineering, the PDT analyzed the potential risk of quantity variations, swelling and unknowns in preparing the risk analyzes, thereby avoiding double-counting quantity risks.

Overall, the PDT risk evaluation gave the highest degree of uncertainty to “environmental considerations” and “environmental monitoring”.

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WALLA WALLA COST ENGINEERING
MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For Project No. 104745

SPL – Malibu Creek Ecosystem Restoration Study

The Malibu Creek Ecosystem Restoration Study, as presented by Los Angles District, has undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of October 14, 2020, the Cost MCX certifies the estimated total project cost:

NER Plan:

Total First Costs (FY21):	$264,999,000 (Cost ATR Certified)
Fully Funded Costs:	$312,338,000

LPP Plan:

Total First Costs (FY21):	$279,209,000 (Cost ATR Certified)
Fully Funded Costs:	$329,944,000

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management through the period of Federal Participation.

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Michael P. Jacobs, PE, CCE
Chief, Cost Engineering MCX
Walla Walla District

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: Malibu Creek Ecosystem Restoration
PROJECT No: P2 104745
LOCATION: Los Angeles County, CA

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: October 13, 2020

NER ALTERNATIVE

This Estimate reflects the scope and schedule in: Malibu Creek Ecosystem Restoration Study - Chief's Report

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2021									
						Effective Price Level Date: 1 Oct 2020									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: 1 Oct 2019 ($K)	**TOTAL FIRST COST ($K)**	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*				*M*	*N*	*O*
01	LANDS AND DAMAGES - "Cost to Cure" for CC2 (Malibu Meadows Road Crossing) and CC3 (Crater Camp Road Crossing)	2,296	987	43%	3,283	3%	2,357	1,014	3,371		3,371	20%	2,835	1,219	4,054
02	RELOCATIONS- Upstream Barriers Modification/Removal along Las Virgenes Creek and Cold Creek	3,979	1,711	43%	5,690	3%	4,099	1,762	5,861		5,861	12%	4,585	1,971	6,556
06	FISH & WILDLIFE FACILITIES - Rindge Dam Demolition and Sediment Removal	111,876	48,105	43%	159,981	3%	115,222	49,544	164,766		164,766	18%	135,428	58,232	193,660
06	FISH & WILDLIFE FACILITIES - Biological Resources Monitoring and Adaptive Management	6,805	2,926	43%	9,731	3%	7,009	3,014	10,023		10,023	20%	8,377	3,602	11,979
18	CULTURAL RESOURCE PRESERVATION	1,477	634	43%	2,111	3%	1,522	652	2,174		2,174	18%	1,795	769	2,564
	CONSTRUCTION ESTIMATE TOTALS:	126,433	54,363		180,796		130,209	55,986	186,195	0	186,195	18%	153,020	65,793	218,813
01	LANDS AND DAMAGES	2,711	678	25%	3,389	3%	2,784	696	3,480		3,480	11%	3,090	773	3,863
30	PLANNING, ENGINEERING & DESIGN	42,522	18,285	43%	60,807	5%	44,469	19,116	63,585		63,585	18%	52,674	22,646	75,320
31	CONSTRUCTION MANAGEMENT	7,851	3,375	43%	11,226	5%	8,211	3,528	11,739		11,739	22%	10,032	4,310	14,342
	PROJECT COST TOTALS:	179,517	76,701	43%	**256,218**	3%	185,673	79,326	**264,999**	0	**264,999**	18%	218,816	93,522	**312,338**

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CHIEF, A-E MANAGEMENT, COST AND VALUE ENGINEERING, Mark Cooke, P.E.

ESTIMATED TOTAL PROJECT COST: **312,338**

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PROJECT MANAGEMENT, Susan Ming, P.E.

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CHIEF, REAL ESTATE, Cheryl Connett

Van Crist
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CHIEF, ENGINEERING, Eric Stevens, P.E.

Filename: NER - TPCS - Malibu 10.13.20
TPCS

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Malibu Creek Ecosystem Restoration
LOCATION: Los Angeles County, CA
This Estimate reflects the scope and schedule in feasibility report; Malibu Creek Ecosystem Restoration Study - Chief's Report

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: October 13, 2020

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		30 Jan 2020		Program Year (Budget EC):			2021					
		Effective Price Level:		1 Oct 2019		Effective Price Level Date:			1 Oct 2020					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
	PED Phase: DM, Geotechnical Investigations, Updates													
06	FISH & WILDLIFE FACILITIES -- Installation Geotechnical Instrumentation and Data Management	3,180	1,367	43%	4,547	3.0%	3,275	1,408	4,683	2023Q1	5.8%	3,466	1,490	4,956
	CONSTRUCTION ESTIMATE TOTALS:	3,180	1,367	43%	4,547		3,275	1,408	4,683			3,466	1,490	4,956
01	LANDS AND DAMAGES		-		-	0.0%	0	0	0	-	0.0%	0	0	0
30	PRECONSTRUCTION ENGINEERING & DESIGN (PED) - GI Funds													
	Project Management	86	37	**43%**	123	4.6%	90	39	129	2022Q1	4.0%	94	41	135
	Planning & Environmental Compliance	261	112	43%	373	4.6%	273	117	390	2022Q1	4.0%	284	122	406
	Engineering & Design	4,011	1,725	43%	5,736	4.6%	4,195	1,804	5,999	2022Q1	4.0%	4,363	1,876	6,239
	Reviews, ATRs, IEPRs, VE	423	182	43%	605	4.6%	442	190	632	2022Q1	4.0%	460	198	658
	Life Cycle Updates (cost, schedule, risks)	69	30	43%	99	4.6%	72	31	103	2022Q1	4.0%	75	32	107
	Contracting & ReprographicsContracting	40	17	43%	57	4.6%	42	18	60	2022Q1	4.0%	44	19	63
	Engineering During Construction	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	Real Estate and Planning During Construction	40	17	43%	57	4.6%	42	18	60	2022Q1	4.0%	44	19	63
	Project Operation	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
			PED Subtotal:		7,050		PED Subtotal:		7,373		0.0%	PED Subtotal:		7,671
31	CONSTRUCTION MANAGEMENT										0.0%			
	Construction Management	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	Project Operation:	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	Project Management	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	CONTRACT COST TOTALS:	8,110	3,487		11,597		8,431	3,625	12,056			8,830	3,797	**12,627**
COST SPLIT														
75.0%	**FEDERAL COST TOTALS:**			0	8,698			0	9,042					9,470
25.0%	**NON-FEDERAL COSTS TOTALS:**			0	2,899				3,014					3,157

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Malibu Creek Ecosystem Restoration
LOCATION: Los Angeles County, CA
This Estimate reflects the scope and schedule in feasibility report; Malibu Creek Ecosystem Restoration Study - Chief's Report

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: October 13, 2020

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		30 Jan 2020		Program Year (Budget EC):			2021					
		Effective Price Level:		1 Oct 2019		Effective Price Level Date:			1 Oct 2020					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
	Contract #1 - Veg Clearing; Initial Ramps Establishment; Arc, Spillway and Sediment Removal													
02	RELOCATIONS- Upstream Barriers Modification/Removal along Las Virgenes Creek and Cold Creek	2,259	971	43%	3,230	3.0%	2,327	1,000	3,327	2024Q1	8.9%	2,534	1,089	3,623
06	FISH & WILDLIFE FACILITIES - Rindge Dam Demolition and Sediment Removal	33,005	14,192	43%	47,197	3.0%	33,993	14,617	48,610	2024Q1	8.9%	37,019	15,918	52,937
06	FISH & WILDLIFE FACILITIES - Biological Resources Monitoring and Adaptive Management	1,696	729	43%	2,425	3.0%	1,747	751	2,498	2024Q1	8.9%	1,903	818	2,721
18	CULTURAL RESOURCE PRESERVATION	422	181	43%	603	3.0%	435	186	621	2024Q1	8.9%	474	203	677
	CONSTRUCTION ESTIMATE TOTALS:	37,383	16,073	43%	53,456		38,502	16,554	55,056			41,930	18,028	59,958
01	LANDS AND DAMAGES	2,044	511	25%	2,555	2.7%	2,099	525	2,624	2023Q1	7.7%	2,261	566	2,827
30	PLANNING, ENGINEERING & DESIGN (PE&D)													
2.5%	Project Management	935	402	43%	1,337	4.6%	977	420	1,397	2023Q1	7.9%	1,054	453	1,507
1.0%	Planning & Environmental Compliance	374	161	43%	535	4.6%	391	168	559	2023Q1	7.9%	422	181	603
17.0%	Engineering & Design	6,355	2,733	43%	9,088	4.6%	6,646	2,858	9,504	2023Q1	7.9%	7,169	3,083	10,252
1.0%	Reviews, ATRs, IEPRs, VE	374	161	43%	535	4.6%	391	168	559	2023Q1	7.9%	422	181	603
1.0%	Life Cycle Updates (cost, schedule, risks)	374	161	43%	535	4.6%	391	168	559	2023Q1	7.9%	422	181	603
1.0%	Contracting & ReprographicsContracting	374	161	43%	535	4.6%	391	168	559	2023Q1	7.9%	422	181	603
5.0%	Engineering During Construction	1,869	804	43%	2,673	4.6%	1,955	841	2,796	2024Q1	11.9%	2,187	941	3,128
2.0%	Real Estate and Planning During Construction	748	321	43%	1,069	4.6%	782	336	1,118	2024Q1	11.9%	875	376	1,251
0.0%	Project Operation	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
30.5%			PE&D Subtotal:		16,306		PE&D Subtotal:		17,051		0.0%	PE&D Subtotal:		18,550
31	CONSTRUCTION MANAGEMENT										0.0%			
7.0%	Construction Management	2,617	1,125	43%	3,742	4.6%	2,737	1,176	3,913	2024Q1	11.9%	3,062	1,315	4,377
0.0%	Project Operation:	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
0.0%	Project Management	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	CONTRACT COST TOTALS:	53,446	22,613		76,059		55,262	23,382	78,644			60,226	25,486	**85,712**
COST SPLIT														
65.0%	**FEDERAL COST TOTALS:**			0	47,777			0	49,413					53,875
35.0%	**NON-FEDERAL COSTS TOTALS:**			0	28,281				29,231					31,837

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Malibu Creek Ecosystem Restoration
LOCATION: Los Angeles County, CA
This Estimate reflects the scope and schedule in feasibility report; Malibu Creek Ecosystem Restoration Study - Chief's Report

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: October 13, 2020

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		30 Jan 2020		Program Year (Budget EC):			2021					
		Effective Price Level:		1 Oct 2019		Effective Price Level Date:			1 Oct 2020					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
	Contract #2 - Arc, Spillway and Sedimement Removal ~ Mid 40 lf													
01	LANDS AND DAMAGES - CC2-Malibu Meadows Rd Crossing	1,337	575	43%	1,913	2.7%	1,373	591	1,964	2025Q1	15.4%	1,585	682	2,267
02	RELOCATIONS- Upstream Barriers Modification/Removal along Las Virgenes Creek and Cold Creek	1,612	693	43%	2,305	3.0%	1,660	714	2,374	2026Q1	15.3%	1,914	823	2,737
06	FISH & WILDLIFE FACILITIES - Rindge Dam Demolition and Sediment Removal	28,166	12,111	43%	40,277	3.0%	29,008	12,473	41,481	2026Q1	15.3%	33,449	14,383	47,832
06	FISH & WILDLIFE FACILITIES - Biological Resources Monitoring and Adaptive Management	1,286	553	43%	1,839	3.0%	1,325	570	1,895	2026Q1	15.3%	1,528	657	2,185
18	CULTURAL RESOURCE PRESERVATION	422	181	43%	603	3.0%	435	186	621	2026Q1	15.3%	502	214	716
	CONSTRUCTION ESTIMATE TOTALS:	32,823	14,113	43%	46,936		33,801	14,534	48,335			38,978	16,759	55,737
01	LANDS AND DAMAGES	342	86	25%	428	2.7%	351	88	439	2025Q1	15.4%	405	102	507
30	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	821	353	43%	1,174	4.6%	858	369	1,227	2025Q1	16.0%	995	428	1,423
1.0%	Planning & Environmental Compliance	328	141	43%	469	4.6%	343	147	490	2025Q1	16.0%	398	171	569
17.0%	Engineering & Design	5,580	2,399	43%	7,979	4.6%	5,835	2,509	8,344	2025Q1	16.0%	6,768	2,910	9,678
1.0%	Reviews, ATRs, IEPRs, VE	328	141	43%	469	4.6%	343	147	490	2025Q1	16.0%	398	171	569
1.0%	Life Cycle Updates (cost, schedule, risks)	328	141	43%	469	4.6%	343	147	490	2025Q1	16.0%	398	171	569
1.0%	Contracting & ReprographicsContracting	328	141	43%	469	4.6%	343	147	490	2025Q1	16.0%	398	171	569
5.0%	Engineering During Construction	1,641	706	43%	2,347	4.6%	1,716	738	2,454	2026Q1	20.3%	2,064	888	2,952
2.0%	Real Estate and Planning During Construction	656	282	43%	938	4.6%	687	295	982	2026Q1	20.3%	826	355	1,181
0.0%	Project Operation	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
30.5%			PED Subtotal:		14,315		PED Subtotal:		14,967		0.0%	PED Subtotal:		17,510
31	CONSTRUCTION MANAGEMENT										0.0%			
7.0%	Construction Management	2,617	1,125	43%	3,742	4.6%	2,737	1,176	3,913	2026Q1	20.3%	3,292	1,415	4,707
0.0%	Project Operation:	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
0.0%	Project Management	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	CONTRACT COST TOTALS:	45,793	19,628		65,421		47,357	20,297	67,654			54,920	23,541	**78,461**
COST SPLIT														
65.0%	**FEDERAL COST TOTALS:**			0	42,246			0	43,690					50,670
35.0%	**NON-FEDERAL COSTS TOTALS:**			0	23,175				23,964					27,791

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Malibu Creek Ecosystem Restoration
LOCATION: Los Angeles County, CA
This Estimate reflects the scope and schedule in feasibility report; Malibu Creek Ecosystem Restoration Study - Chief's Report

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: October 13, 2020

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared: 30 Jan 2020				Program Year (Budget EC): 2021								
		Effective Price Level: 1 Oct 2019				Effective Price Level Date: 1 Oct 2020								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
	Contract #3 - Arc/Foundation, Spillway and Sediment Removal ~ Lower 40 lf													
01	LANDS AND DAMAGES - CC3 Crater Camp Road Crossing	958	412	43%	1,370	2.7%	984	423	1,407	2028Q1	27.0%	1,250	537	1,787
02	RELOCATIONS- Upstream Barriers Modification/Removal along Las Virgenes Creek and Cold Creek	109	47	43%	156	3.0%	112	48	160	2028Q1	22.1%	137	59	196
06	FISH & WILDLIFE FACILITIES - Rindge Dam Demolition and Sediment Removal	47,524	20,435	43%	67,959	3.0%	48,946	21,046	69,992	2029Q1	25.6%	61,494	26,441	87,935
06	FISH & WILDLIFE FACILITIES - Biological Resources Monitoring and Adaptive Management	3,823	1,644	43%	5,467	3.0%	3,937	1,693	5,630	2029Q1	25.6%	4,946	2,127	7,073
18	CULTURAL RESOURCE PRESERVATION	633	272	43%	905	3.0%	652	280	932	2029Q1	25.6%	819	352	1,171
	CONSTRUCTION ESTIMATE TOTALS:	53,047	22,810	43%	75,857		54,631	23,490	78,121			68,646	29,516	98,162
01	LANDS AND DAMAGES	325	81	25%	406	2.7%	334	83	417	2028Q1	27.0%	424	105	529
30	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	1,326	570	43%	1,896	4.6%	1,387	596	1,983	2028Q1	29.4%	1,795	772	2,567
1.0%	Planning & Environmental Compliance	530	228	43%	758	4.6%	555	238	793	2028Q1	29.4%	718	308	1,026
17.0%	Engineering & Design	9,018	3,878	43%	12,896	4.6%	9,431	4,055	13,486	2028Q1	29.4%	12,208	5,249	17,457
1.0%	Reviews, ATRs, IEPRs, VE	530	228	43%	758	4.6%	555	238	793	2028Q1	29.4%	718	308	1,026
1.0%	Life Cycle Updates (cost, schedule, risks)	530	228	43%	758	4.6%	555	238	793	2028Q1	29.4%	718	308	1,026
1.0%	Contracting & ReprographicsContracting	530	228	43%	758	4.6%	555	238	793	2028Q1	29.4%	718	308	1,026
5.0%	Engineering During Construction	2,652	1,141	43%	3,793	4.6%	2,774	1,193	3,967	2029Q1	34.4%	3,727	1,603	5,330
2.0%	Real Estate and Planning During Construction	1,061	456	43%	1,517	4.6%	1,109	477	1,586	2029Q1	34.4%	1,490	641	2,131
0.0%	Project Operation	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
30.5%			PED Subtotal:		23,136		PED Subtotal:		24,194		0.0%	PED Subtotal:		31,589
31	CONSTRUCTION MANAGEMENT										0.0%			
7.0%	Construction Management	2,617	1,125	43%	3,742	4.6%	2,737	1,176	3,913	2029Q1	34.4%	3,678	1,580	5,258
0.0%	Project Operation:	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
0.0%	Project Management	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	CONTRACT COST TOTALS:	72,168	30,973		103,141		74,623	32,022	106,645			94,840	40,698	**135,538**
COST SPLIT														
65.0%	**FEDERAL COST TOTALS:**			0	66,778			0	69,048					87,756
35.0%	**NON-FEDERAL COSTS TOTALS:**			0	36,364				37,597					47,782

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: Malibu Creek Ecosystem Restoration
PROJECT No: P2 104745
LOCATION: Los Angeles County, CA

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: October 13, 2020

LPP (RECOMMENDED) ALTERNATIVE

This Estimate reflects the scope and schedule in: Malibu Creek Ecosystem Restoration Study - Chief's Report

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis) Program Year (Budget EC): 2021; Effective Price Level Date: 1 Oct 2020						TOTAL PROJECT COST (FULLY FUNDED)			
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: 1 Oct 2019 ($K)	**TOTAL FIRST COST** ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*				*M*	*N*	*O*
01	LANDS AND DAMAGES - "Cost to Cure" for CC2 (Malibu Meadows Road Crossing) and CC3 (Crater Camp Road Crossing)	2,296	1,010	44%	3,306	3%	2,357	1,037	3,394		3,394	20%	2,835	1,247	4,082
02	RELOCATIONS- Upstream Barriers Modification/Removal along Las Virgenes Creek and Cold Creek	3,979	1,751	44%	5,730	3%	4,099	1,803	5,902		5,902	12%	4,589	2,019	6,608
06	FISH & WILDLIFE FACILITIES - Rindge Dam Demolition and Sediment Removal	119,026	52,371	44%	171,397	3%	122,586	53,938	176,524		176,524	18%	144,609	63,627	208,236
06	FISH & WILDLIFE FACILITIES - Biological Resources Monitoring and Adaptive Management	6,340	2,790	44%	9,130	3%	6,530	2,873	9,403		9,403	19%	7,802	3,433	11,235
18	CULTURAL RESOURCE PRESERVATION	1,173	517	44%	1,690	3%	1,208	533	1,741		1,741	18%	1,420	627	2,047
	CONSTRUCTION ESTIMATE TOTALS:	132,814	58,439		191,253		136,780	60,184	196,964	0	196,964	18%	161,255	70,953	232,208
01	LANDS AND DAMAGES	2,492	623	25%	3,115	3%	2,559	639	3,198		3,198	11%	2,851	712	3,563
30	PLANNING, ENGINEERING & DESIGN	45,385	19,974	44%	65,359	5%	47,466	20,889	68,355		68,355	19%	56,326	24,785	81,111
31	CONSTRUCTION MANAGEMENT	7,101	3,123	44%	10,224	5%	7,425	3,267	10,692		10,692	22%	9,071	3,991	13,062
	PROJECT COST TOTALS:	187,792	82,159	44%	**269,951**	3%	194,230	84,979	**279,209**	0	**279,209**	18%	229,503	100,441	**329,944**

CHIEF, A-E MANAGEMENT, COST AND VALUE ENGINEERING, Mark Cooke, P.E.

ESTIMATED TOTAL PROJECT COST: 329,944

PROJECT MANAGEMENT, Susan Ming, P.E.

CHIEF, REAL ESTATE, Cheryl Connett

CHIEF, ENGINEERING, Eric Stevens, P.E.

**** CONTRACT COST SUMMARY ****

PROJECT: Malibu Creek Ecosystem Restoration
LOCATION: Los Angeles County, CA
This Estimate reflects the scope and schedule in feasibility report; Malibu Creek Ecosystem Restoration Study - Chief's Report

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: October 13, 2020

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared: 30 Jan 2020				Program Year (Budget EC): 2021								
		Effective Price Level: 1 Oct 2019				Effective Price Level Date: 1 Oct 2020								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
	PED Phase: DM, Geotechnical Investigations, Updates													
06	FISH & WILDLIFE FACILITIES -- Installation Geotechnical Instrumentation and Data Management	3,180	1,399	**44%**	4,579	3.0%	3,275	1,441	4,716	2023Q1	5.8%	3,466	1,525	4,991
	CONSTRUCTION ESTIMATE TOTALS:	3,180	1,399	44%	4,579		3,275	1,441	4,716			3,466	1,525	4,991
01	LANDS AND DAMAGES		-		-	0.0%	0	0	0	-	0.0%	0	0	0
30	PRECONSTRUCTION ENGINEERING & DESIGN (PED) - GI Funds													
	Project Management	86	38	44%	124	4.6%	90	40	130	2022Q1	4.0%	94	42	136
	Planning & Environmental Compliance	261	115	44%	376	4.6%	273	120	393	2022Q1	4.0%	284	125	409
	Engineering & Design	4,922	2,166	44%	7,088	4.6%	5,147	2,265	7,412	2022Q1	4.0%	5,353	2,355	7,708
	Reviews, ATRs, IEPRs, VE	429	189	44%	618	4.6%	449	198	647	2022Q1	4.0%	467	206	673
	Life Cycle Updates (cost, schedule, risks)	69	30	44%	99	4.6%	72	31	103	2022Q1	4.0%	75	32	107
	Contracting & ReprographicsContracting	40	18	44%	58	4.6%	42	19	61	2022Q1	4.0%	44	20	64
	Engineering During Construction	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	Real Estate and Planning During Construction	40	18	44%	58	4.6%	42	19	61	2022Q1	4.0%	44	20	64
	Project Operation	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
			PED Subtotal:		8,421		PED Subtotal:		8,807		0.0%	PED Subtotal:		9,161
31	CONSTRUCTION MANAGEMENT										0.0%			
	Construction Management	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	Project Operation:	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	Project Management	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	CONTRACT COST TOTALS:	9,027	3,973		13,000		9,390	4,133	13,523			9,827	4,325	**14,152**
COST SPLIT														
75.0%	**FEDERAL COST TOTALS:**			0	9,750			0	10,142					10,614
25.0%	**NON-FEDERAL COSTS TOTALS:**			0	3,250				3,381					3,538

**** CONTRACT COST SUMMARY ****

PROJECT: Malibu Creek Ecosystem Restoration
LOCATION: Los Angeles County, CA
This Estimate reflects the scope and schedule in feasibility report; Malibu Creek Ecosystem Restoration Study - Chief's Report

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: October 13, 2020

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		30 Jan 2020		Program Year (Budget EC):			2021					
		Effective Price Level:		1 Oct 2019		Effective Price Level Date:			1 Oct 2020					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
	Contract #1 - Veg Clearing; Initial Ramps Establishment; Arc, Spillway and Sediment Removal													
02	RELOCATIONS- Upstream Barriers Modification/Removal along Las Virgenes Creek and Cold Creek	2,259	994	44%	3,253	3.0%	2,327	1,024	3,351	2024Q1	8.9%	2,534	1,115	3,649
06	FISH & WILDLIFE FACILITIES - Rindge Dam Demolition and Sediment Removal	29,868	13,142	44%	43,010	3.0%	30,762	13,535	44,297	2024Q1	8.9%	33,501	14,740	48,241
06	FISH & WILDLIFE FACILITIES - Biological Resources Monitoring and Adaptive Management	1,389	611	44%	2,000	3.0%	1,430	629	2,059	2024Q1	8.9%	1,557	685	2,242
18	CULTURAL RESOURCE PRESERVATION	293	129	44%	422	3.0%	302	133	435	2024Q1	8.9%	329	145	474
	CONSTRUCTION ESTIMATE TOTALS:	33,809	14,876	44%	48,685		34,821	15,321	50,142			37,921	16,685	54,606
01	LANDS AND DAMAGES	1,805	451	25%	2,256	2.7%	1,853	463	2,316	2023Q1	7.7%	1,996	499	2,495
30	PLANNING, ENGINEERING & DESIGN (PE&D)													
2.5%	Project Management	845	372	44%	1,217	4.6%	884	389	1,273	2023Q1	7.9%	954	420	1,374
1.0%	Planning & Environmental Compliance	338	149	44%	487	4.6%	354	156	510	2023Q1	7.9%	382	168	550
17.0%	Engineering & Design	5,748	2,529	44%	8,277	4.6%	6,011	2,645	8,656	2023Q1	7.9%	6,484	2,853	9,337
1.0%	Reviews, ATRs, IEPRs, VE	338	149	44%	487	4.6%	354	156	510	2023Q1	7.9%	382	168	550
1.0%	Life Cycle Updates (cost, schedule, risks)	338	149	44%	487	4.6%	354	156	510	2023Q1	7.9%	382	168	550
1.0%	Contracting & ReprographicsContracting	338	149	44%	487	4.6%	354	156	510	2023Q1	7.9%	382	168	550
5.0%	Engineering During Construction	1,690	744	44%	2,434	4.6%	1,768	778	2,546	2024Q1	11.9%	1,978	870	2,848
2.0%	Real Estate and Planning During Construction	676	298	44%	974	4.6%	707	312	1,019	2024Q1	11.9%	791	349	1,140
0.0%	Project Operation	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
30.5%			PE&D Subtotal:		14,851			PE&D Subtotal:	15,534		0.0%		PE&D Subtotal:	16,899
31	CONSTRUCTION MANAGEMENT										0.0%			
7.0%	Construction Management	2,367	1,041	44%	3,408	4.6%	2,475	1,089	3,564	2024Q1	11.9%	2,768	1,218	3,986
0.0%	Project Operation:	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
0.0%	Project Management	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	CONTRACT COST TOTALS:	48,292	20,907		69,200		49,935	21,621	71,556			54,420	23,566	**77,986**
COST SPLIT														
65.0%	**FEDERAL COST TOTALS:**			0	43,514			0	45,006					49,069
35.0%	**NON-FEDERAL COSTS TOTALS:**			0	25,686				26,550					28,917

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Malibu Creek Ecosystem Restoration
LOCATION: Los Angeles County, CA
This Estimate reflects the scope and schedule in feasibility report; Malibu Creek Ecosystem Restoration Study - Chief's Report

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering

PREPARED: October 13, 2020

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		30 Jan 2020		Program Year (Budget EC):			2021					
		Effective Price Level:		1 Oct 2019		Effective Price Level Date:			1 Oct 2020					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
	Contract #2 - Arc, Spillway and Sedimement Removal ~ Mid 40 lf													
01	LANDS AND DAMAGES - CC2-Malibu Meadows Rd Crossing	1,337	588	44%	1,926	2.7%	1,373	604	1,977	2025Q1	15.4%	1,585	697	2,282
02	RELOCATIONS- Upstream Barriers Modification/Removal along Las Virgenes Creek and Cold Creek	1,612	709	44%	2,321	3.0%	1,660	730	2,390	2026Q1	15.3%	1,914	842	2,756
06	FISH & WILDLIFE FACILITIES - Rindge Dam Demolition and Sediment Removal	33,932	14,930	44%	48,862	3.0%	34,947	15,377	50,324	2026Q1	15.3%	40,298	17,731	58,029
06	FISH & WILDLIFE FACILITIES - Biological Resources Monitoring and Adaptive Management	1,529	673	44%	2,202	3.0%	1,575	693	2,268	2026Q1	15.3%	1,816	799	2,615
18	CULTURAL RESOURCE PRESERVATION	440	194	44%	634	3.0%	453	200	653	2026Q1	15.3%	522	231	753
	CONSTRUCTION ESTIMATE TOTALS:	38,850	17,094	44%	55,944		40,008	17,604	57,612			46,135	20,300	66,435
01	LANDS AND DAMAGES	352	88	25%	440	2.7%	362	90	452	2025Q1	15.4%	418	104	522
30	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	971	427	44%	1,398	4.6%	1,016	447	1,463	2025Q1	16.0%	1,179	519	1,698
1.0%	Planning & Environmental Compliance	388	171	44%	559	4.6%	406	179	585	2025Q1	16.0%	471	208	679
17.0%	Engineering & Design	6,604	2,906	44%	9,510	4.6%	6,907	3,039	9,946	2025Q1	16.0%	8,012	3,525	11,537
1.0%	Reviews, ATRs, IEPRs, VE	388	171	44%	559	4.6%	406	179	585	2025Q1	16.0%	471	208	679
1.0%	Life Cycle Updates (cost, schedule, risks)	388	171	44%	559	4.6%	406	179	585	2025Q1	16.0%	471	208	679
1.0%	Contracting & ReprographicsContracting	388	171	44%	559	4.6%	406	179	585	2025Q1	16.0%	471	208	679
5.0%	Engineering During Construction	1,942	855	44%	2,797	4.6%	2,031	894	2,925	2026Q1	20.3%	2,443	1,075	3,518
2.0%	Real Estate and Planning During Construction	777	342	44%	1,119	4.6%	813	358	1,171	2026Q1	20.3%	978	431	1,409
0.0%	Project Operation	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
30.5%			PED Subtotal:		17,063		PED Subtotal:		17,845		0.0%	PED Subtotal:		20,878
31	CONSTRUCTION MANAGEMENT										0.0%			
7.0%	Construction Management	2,367	1,041	44%	3,408	4.6%	2,475	1,089	3,564	2026Q1	20.3%	2,977	1,310	4,287
0.0%	Project Operation:	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
0.0%	Project Management	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	CONTRACT COST TOTALS:	53,418	23,438		76,856		55,236	24,237	79,473			64,026	28,096	**92,122**
COST SPLIT														
65.0%	**FEDERAL COST TOTALS:**			0	49,670			0	51,364					59,540
35.0%	**NON-FEDERAL COSTS TOTALS:**			0	27,186				28,109					32,582

Filename: LPP - TPCS - Malibu 10.13.20
TPCS

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Malibu Creek Ecosystem Restoration
LOCATION: Los Angeles County, CA
This Estimate reflects the scope and schedule in feasibility report; Malibu Creek Ecosystem Restoration Study - Chief's Report

DISTRICT: Los Angeles District
POC: Juan Dominguez, Cost Engineering
PREPARED: October 13, 2020

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared: 30 Jan 2020				Program Year (Budget EC): 2021								
		Effective Price Level: 1 Oct 2019				Effective Price Level Date: 1 Oct 2020								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
	Contract #3 - Arc/Foundation, Spillway and Sediment Removal ~ Lower 40 lf													
01	LANDS AND DAMAGES - CC3 Crater Camp Road Crossing	958	422	44%	1,380	2.7%	984	433	1,417	2028Q1	27.0%	1,250	550	1,800
02	RELOCATIONS- Upstream Barriers Modification/Removal along Las Virgenes Creek and Cold Creek	109	48	44%	157	3.0%	112	49	161	2029Q1	25.6%	141	62	203
06	FISH & WILDLIFE FACILITIES - Rindge Dam Demolition and Sediment Removal	52,046	22,900	44%	74,946	3.0%	53,602	23,585	77,187	2029Q1	25.6%	67,344	29,631	96,975
06	FISH & WILDLIFE FACILITIES - Biological Resources Monitoring and Adaptive Management	3,422	1,506	44%	4,928	3.0%	3,525	1,551	5,076	2029Q1	25.6%	4,429	1,949	6,378
18	CULTURAL RESOURCE PRESERVATION	440	194	44%	634	3.0%	453	200	653	2029Q1	25.6%	569	251	820
	CONSTRUCTION ESTIMATE TOTALS:	56,975	25,070	44%	82,045		58,676	25,818	84,494			73,733	32,443	106,176
01	LANDS AND DAMAGES	335	84	25%	419	2.7%	344	86	430	2028Q1	27.0%	437	109	546
30	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	1,424	627	44%	2,051	4.6%	1,490	656	2,146	2028Q1	29.4%	1,929	849	2,778
1.0%	Planning & Environmental Compliance	570	251	44%	821	4.6%	596	262	858	2028Q1	29.4%	772	339	1,111
17.0%	Engineering & Design	9,686	4,262	44%	13,948	4.6%	10,129	4,457	14,586	2028Q1	29.4%	13,112	5,770	18,882
1.0%	Reviews, ATRs, IEPRs, VE	570	251	44%	821	4.6%	596	262	858	2028Q1	29.4%	772	339	1,111
1.0%	Life Cycle Updates (cost, schedule, risks)	570	251	44%	821	4.6%	596	262	858	2028Q1	29.4%	772	339	1,111
1.0%	Contracting & ReprographicsContracting	570	251	44%	821	4.6%	596	262	858	2028Q1	29.4%	772	339	1,111
5.0%	Engineering During Construction	2,849	1,253	44%	4,102	4.6%	2,979	1,310	4,289	2029Q1	34.4%	4,003	1,760	5,763
2.0%	Real Estate and Planning During Construction	1,139	501	44%	1,640	4.6%	1,192	524	1,716	2029Q1	34.4%	1,602	704	2,306
0.0%	Project Operation	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
30.5%			PED Subtotal:		25,024		PED Subtotal:		26,169		0.0%	PED Subtotal:		34,173
31	CONSTRUCTION MANAGEMENT										0.0%			
7.0%	Construction Management	2,367	1,041	44%	3,408	4.6%	2,475	1,089	3,564	2029Q1	34.4%	3,326	1,463	4,789
0.0%	Project Operation:	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
0.0%	Project Management	0	0		0	0.0%	0	0	0	0	0.0%	0	0	0
	CONTRACT COST TOTALS:	77,055	33,842		110,896		79,669	34,988	114,657			101,230	44,454	**145,684**
COST SPLIT														
65.0%	**FEDERAL COST TOTALS:**			0	71,810			0	74,248					94,340
35.0%	**NON-FEDERAL COSTS TOTALS:**			0	39,086				40,409					51,344

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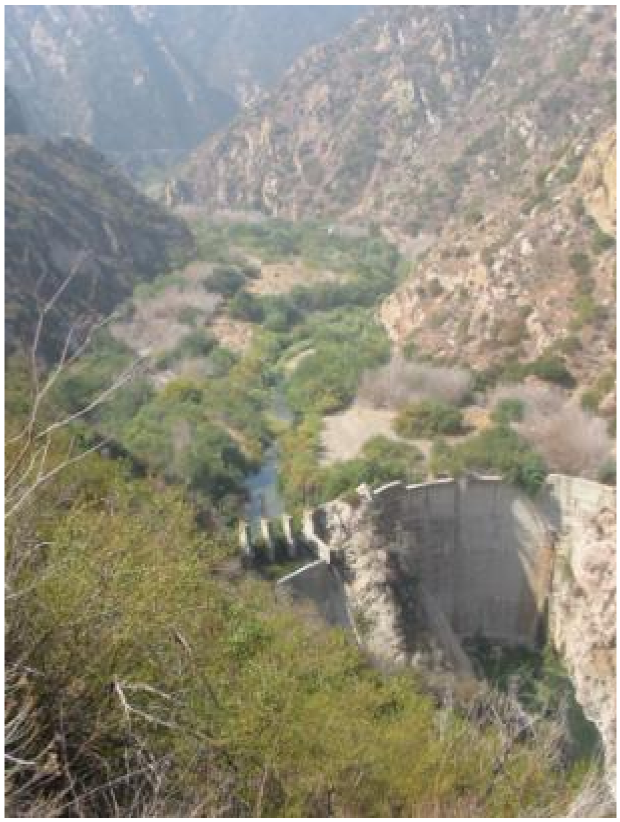
Malibu Creek Ecosystem Restoration Project

Los Angeles and Ventura Counties, California

LPP

Cost Engineering



U.S. Army Corps of Engineers
Los Angeles District

November 2020

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1.0 INTRODUCTION

This Appendix presents the assumptions and construction methodologies used on the Locally Preferred Plan (LPP) alternative for the Malibu Creek Ecosystem Restoration Feasibility Study.

The LPP alternative includes the demolition, removal, and disposal of the Rindge Dam arch and spillway as well as removal of the sediment currently impounded behind the Rindge Dam. Additionally, the LPP alternative considers the enhancement of seven (7) existing upstream barriers to allow passage of fish and other wildlife.

The study area is located about 30 miles (mi) west of the city of Los Angeles. Approximately 2/3 of the 109 sq. mi watershed is located in the northwest portion of the Los Angeles County area and the remaining 1/3 is in Ventura County. Malibu Creek Watershed is within the Santa Monica Mountains, in a mix of urban development and open space. Malibu Creek drains into Malibu Lagoon and Santa Monica Bay.

Malibu Creek drains 109 sq. mi of the Santa Monica Mountains, where the reach from Malibu Lagoon to Malibu Dam is 10 mi Rindge Dam, built in the 1920’s, is located about 2 mi upstream from the confluence with the Pacific Ocean. The dam is a concrete arch structure 108 feet (ft) in height with an arc length of 140 ft at its crest (excluding spillway & rock outcrop) and 80 ft at its base. The dam is 2 ft thick at the crest and 12 ft thick at the base. 60-lb steel railroad ties run horizontally and vertically throughout the dam and serve as reinforcement for the structure. The height from the top of the arch structure to bedrock is approximately 117 ft. The top of dam elevation is approximately 298 ft.

A gated spillway was built in a rock outcrop on the western side adjacent to the arch dam abutment. The spillway had four radial gates, each measuring 11 ft high by 8 ft wide.

Rindge Dam is the largest disruption to stream flow and aquatic and terrestrial habitat connectivity on Malibu Creek between Malibu Dam and the Pacific Ocean. The dam creates a barrier to the endangered steelhead trout's spawning ground upstream of Malibu Creek. Currently, the geotechnical assessment estimates that 780,000 cubic yards (cy) of sediment is impounded behind the dam. The impounded sediment is defined as three distinct layers. The extent of the impounded sediment area is presented in **Figure 1.1-1**. The uppermost layer (Unit 1) is composed of fluvial deposition, which contains sand, gravel, cobbles and larger rocks and is the layer that continues to erode and aggrade during storm events with overall increases in deposition occurring in the future. The sand-dominant (Unit 2) sediment, which underlies Unit 1, comprises nearly half the total volume of impounded sediment and contains about 73 % sand, 22% silt, and 5% gravel and rock. Unit 2 sediment is likely source of beach nourishment. Unit 2 is underlain by a silt-clay dominant layer (Unit 3).

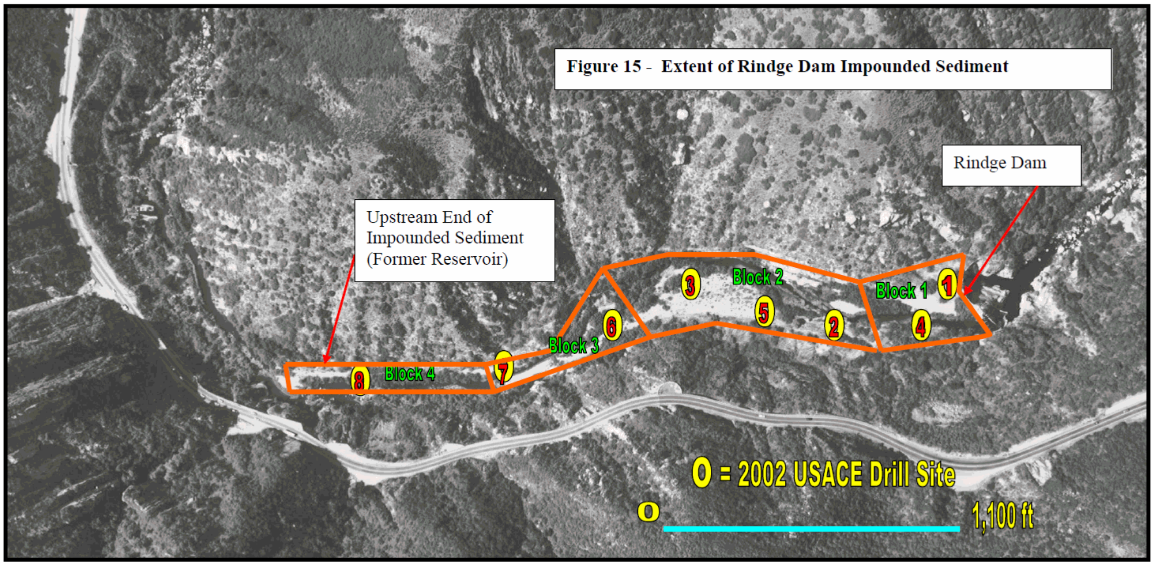

Figure 1.1-1 Extent of Rindge Dam Impounded Sediment

The study objectives are listed in the main report; please refer to the main report for information regarding study objectives.

The sediment behind the dam could be used to nourish downstream beaches in the City of Malibu and elsewhere in the Los Angeles (LA) County.

Most storms in the Southern California coastal area are of the general winter type, with hours of light to moderate steady precipitation, but with occasionally heavy showers or thunderstorms embedded. Local thunderstorms can occur in southern California at any time of the year, but are least common and least intense during the late spring. Most of the major flood events in the history of Southern California have been the result of general winter storms.

The study area of Malibu Creek is undeveloped through the canyon reaches, but the creek is narrow and steep. In the mountains, runoff concentrates quickly from the steep slopes; hydrographs show that the stream flow increases rapidly in response to effective rainfall. High rainfall rates, in combination with the effects of shallow surface soils, impervious bedrock, and fan shaped stream systems, steep gradients, and occasional denudation of the area by fire, result in intense debris-laden floods. Flows originating in the upper watershed flow through the lower canyon portion of the study area at high velocities, upstream and downstream of Rindge Dam. The bed slope decreases and the overbank area increases where Malibu Creek emerges from the canyon about a mile below Rindge Dam resulting in a reduction in flow velocities and a potential increase in sediment deposition.

1.1 LPP Alternative (formerly Alternative 2b2): Dam Removal with Mechanical Transport (trucking / barge transport)

This plan contributes to the primary study ecological restoration objective to restore the Malibu Creek ecosystem, (with some additional benefits to Las Virgenes Creek and Cold

Creek), while maintaining downstream ecosystem and riparian management activities. This plan is expected to result in significant benefits to the ecosystem. The plan is to lower the dam height at the same rate as the impounded sediment is removed from behind the dam using mechanical means (excavators, bulldozers etc.) over a course of seven to eight (8) years, from April to October. During the remainder of the year, work on the project ceases due to city and environmental limitations.

The first year of the project is dedicated to site prep: clearing, dewatering and ramp construction. The dam and the sediment from behind the dam will be removed over a 7 year time span. Construction will be limited to outside the rainy season and the sediment removed from behind the dam will either go to down-coast of Malibu Pier or the Calabasas Landfill. Calabasas Landfill is open from 8 am – 5 pm Monday through Saturday and closed Sundays. All sediment will be removed with loaders and highway trucks. The last year the creek invert is stabilized and trimmed. Work will consist of rock placement and grading to create a series of pools and riffles to enhance the natural characteristic of the project area.

Sandy material is trucked approximately 41 miles one-way to Ventura Harbor and barged down the coast approximately 40 miles to Malibu for near-shore placement.

The Southern California Dredged Materials Management Team (SC-DMMT), which is the regulatory body that reviews and approves placement of dredged materials in ocean or on beaches, on February 27, 2013, agreed in concept to consider allowing both on-beach placement and near-shore placement of the impounds sand-rich layer, while recognizing that its 22% fines content is at the upper end of the maximum percentage of fines accepted for on-beach placement.

As per standard procedures, prior to any placement, transect sampling is required to verify gradation compatibility with both near-shore and on-shore placements; if sediment is shown to be compatible, regular, confirmatory gradation sampling of the material at the dam site also have to be done as the excavation proceeds, to assure the gradation remains within the tolerable range. In addition, any approved placement scenario will be subject to continued testing for unsuitable materials as excavation of the impound proceeds

Gravel and clay-silt layers have no interested end-users to date, and is modeled to be wasted in a landfill. It may be usable as a landfill daily cover, but there are no interested landfill managers within a reasonable hauling range.

2.0 RINDGE DAM AND SEDIMENT REMOVAL COST ESTIMATE BASIS

2.1 <u>Unit Cost Basis</u>

2.1.1 Direct Cost

Components of construction include the following five cost elements: labor, permanent materials, construction equipment, subcontracts, and contractor's expendable supplies. The key factors in determining the cost of each of these elements is the productivity of the work force and the construction equipment used to perform the various work activities. Productivity rates for the sediment excavation work were selected to reflect local weather, site conditions, work week hours, estimated volume, appropriate construction techniques, schedule sequencing, and experience gained on previous construction projects of similar nature.

Most costs were determined using databases for the individual components of labor, materials, and equipment. In some cases, costs from the bid tabulations of construction projects were selected to represent the actual cost of similar portions of this project. Where used, these historic values were escalated to dollar values and adjusted for economies of scale and other factors to provide an accurate reflection of the cost to do the work over the lifetime of the project. A third source of prices included commercially available construction cost data guides. Generally, costs were grouped for the most significant impact items, such as excavation, transportation of sediment, and concrete removal.

Labor rates used to develop the estimate were obtained from the latest Davis-Bacon Wage Rates for Los Angeles County, Heavy Construction.

Equipment rates are based on the Department of the Army EP 1110-1-8 “Construction Equipment Ownership and Expense Schedule”, Region 7.

Crews were developed for project specific applications and are listed in the crew database.

2.1.2 Quantity and Material Analysis

Sediment is assumed to be alluvial. The sediment is generally distributed in three layers. The upper layer predominantly consists of gravel, cobbles, and other rocks. The middle layer is predominantly sand. The bottom layer is mostly a combination of silt, sand and clay. The sediment distribution was simplified in the following breakdown show in **Table 2.1-1**.

Table 2.1-1 Sediment Distribution

Material Classification	Volumes
Rock/Gravel	200,000 CY
Sand	340,000 CY
Clay/Silt	230,000 CY
TOTAL	**770,000 CY**

Actual sediment volume available amounts to 780,000 CY. However, upstream 10,000 CY impounded material is narrow and thin; and it has no appreciable sand. This 10,000 CY is left in-place and eroded to grade naturally by the creek as recommended by the 2003 Geotechnical Impound investigation report. Therefore, the net sediment removal volume is 770,000 CY.

Based on consultation with USACE Geology, the impounded sediment will not swell upon excavation due extremely low relative density of the fine material, and the loose nature of the granular material. Geotechnical investigations and several Soil Penetration Tests (SPT) performed upon the impounded sediment indicated deposit are very loose even at the deepest layers. All material is in Loose Cubic Yards (LCY).

2.1.3 Equipment Selection

Equipment selection and sizing were developed through cost engineer experience.

2.2 Real Estate

According to information provided by the Design Planning Report, the Calabasas Landfill can provide temporary storage for up to approximately 565,000 CY of roughly separated sand/cobble/gravel/boulder material for a ten-year period. The estimated time period is 2023-2027. Between 2023 and 2027, approximately 12 acres in stockpile area could be made available at the Calabasas Landfill for temporary storage. The site incurs costs associated with receiving this material, including dozer work associated with receiving the dirt, additional street sweeping and dust control.

2.3 Relocations

Relocations associated with the upstream barriers were estimated in detail by Cost Engineering.

2.4 Assumptions

2.4.1 Site Access/Preparation and Mobilization

The dam can be accessed through an existing, unpaved road off Malibu Canyon. Site access improvements are required for approximately 800 linear feet of temporary road for widening, as necessary, to accommodate construction traffic and for normal maintenance of the roadway surface and drainage culverts during the contract period. No other improvements are anticipated.

Temporary haul roads will be required to be established for excavation of the sediment material. Maximum grades should generally not exceed 15%. Mobilization and demobilization encompass the cost of transporting and setting up heavy pieces of equipment.

The current estimate considers constraints on construction activities for protection of threatened and endangered species.

Vegetation is cleared along the pioneer road, access maintenance road, and sediment removal area. Ground trees, trash, and areas difficult to access encompass 25% of the total area and they are manually cleared with brush-saws, track-hoes, and chippers. 75% of the total area is cleared with dozers and mulched.

The Sheriff's Overlook is a small overlook area off the Malibu Canyon Road just south of the project site. During construction, Sheriff's Overlook will be used as a staging and an oversight area for construction teams. A trailer for construction crews can be placed to provide optimal views of the dam deconstruction and truck and equipment routes to and from the construction site. Upon completion of construction activities, the trailer will be removed and any debris or equipment located at Sheriff's Overlook will be cleared from the area.

The cost estimate includes installation of guard rail fencing around the outlook and installing gravel for vehicles parking/roads.

Post construction, Sheriff's Overlook will remain a dirt turnout for vehicles driving along Malibu Canyon Road. Interruptive signs will be placed displaying images and facts about the history of the Rindge Dam.

The disposal site (Calabasas Landfill) is located 7.5 mi north of the project area. The LA County beach potentially receiving sand material from the project is approximately 5 miles from the dam.

Due to a lack of turnaround space available on the access road leading to the dam, two (2) ramps are constructed for truck traffic. One ramp will allow vehicles to travel northbound, towards the landfill, and the other allowing vehicles to travel southbound, towards the beach.

There is already an existing 12-ft wide ramp in the southbound direction, but it is in a state of disrepair. Repair of the existing ramp involves rebuilding the bottom area of the ramp (approximately 15,700 cy of fill) to a length of 1,000 ft. Additional work on the southbound ramp is required to allow for loaded truck traffic. The ramp is widened to 15 ft and reduced to a grade of 15%. Widening and re-grading the southbound ramp requires 55,000 cy of fill material.

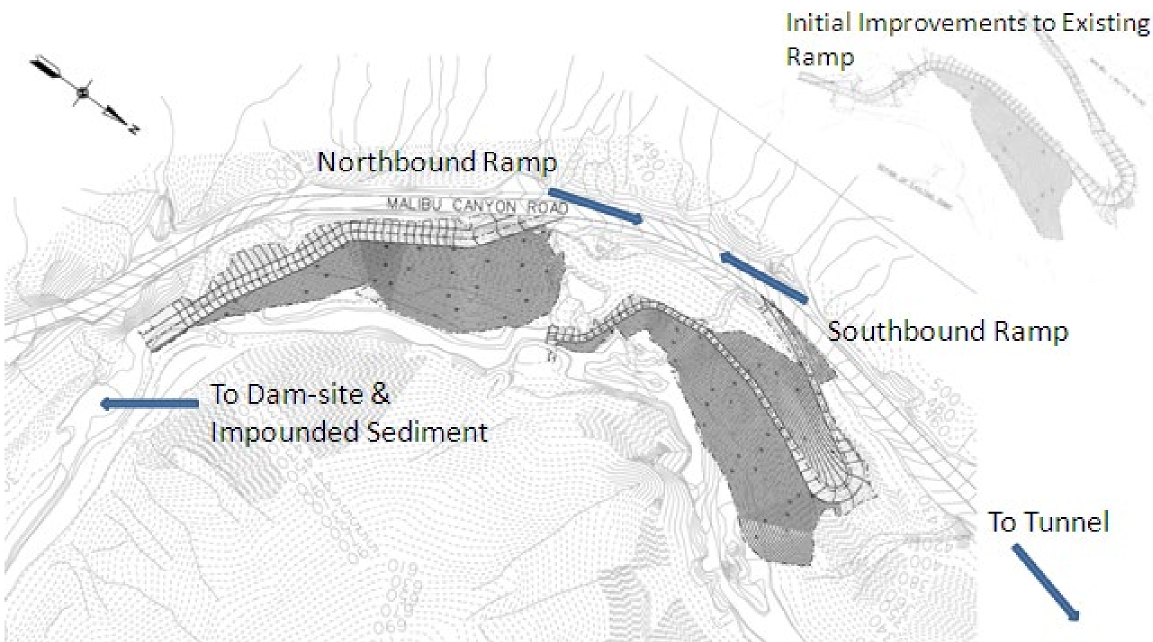

Figure 2.4-1 Northbound and Southbound Access Ramp Plans

2.4.2 Diversion and Control of Water

A cofferdam shall be used, upstream of the sediment removal area, for temporary control of water. The cofferdam permits construction and modification of the diversion channel as construction proceeds. The cofferdam will be constructed of compacted

earthen fill material harnessed at the project site. The cofferdam will be approximately 30 ft long, 6 ft wide at the top (with 1:2 side slopes), and 6 ft high. Low flow water will travel from the cofferdam to the existing spillway via a 36-in diameter corrugated metal pipe (CMP) approximately 4,100 ft in length. It was decided to keep the pipeline above ground to allow for maximum flexibility during the removal of sediment material, concrete arc section, and spillway. The CMP will be anchored using 4 ft long metal stakes placed every 50 ft along both sides of the pipe. During the second year of construction, the CMP line is aligned such that all bypassed water is discharged from the Spillway.
At the end of each construction season, the CMP will be removed and transported to the contractor's yard for storage (i.e. to prevent damage during winter flows). The pipeline will then be reinstalled at the beginning of the next construction season. The cofferdam will also be demolished at the end of each construction season and re-constructed at the beginning of the next.

A total of 11 wells will be used to provide de-watering for the project site. These wells will be installed in the first year of the project and extend to the final project depth. The wells will be trimmed down to current invert level periodically throughout construction.

Since turbidity is a major environmental consideration during construction, the USACE validated the assumptions above relating to dewatering with a local dewatering contractor on February 1, 2013. The dewatering contractor suggested the use of de-silting tanks to treat the water before it's discharged into the CMP line, combined with other bypassed waters, and ultimately released downstream via the existing spillway. The dewatering contractor also reviewed sieve data collected out in the field by the USACE Geologist and provided a recommendation with regards to the design of the well screens which has proven effective with fine material 200 and smaller.

2.4.3 Rindge Dam Structural Demolition

For estimating purposes, the removal of the arch dam section is assumed to be performed using conventional high-impact breakers, blasting, and diamond-wire saw-cutting methods.

The diamond-wire system consists of a diamond-impregnated wire made to length for each cut and a hydraulically-powered drive system. Diamond wire is routed to envelope the area to be cut (requiring drilled holes), then guided into a drive wheel on the power unit. The drive wheel rotates and pulls the wire through the concrete. The diamond wire is best suited for cutting or notching composites of dissimilar materials. Since the Rindge Dam arch is a composite of concrete, rebar and railroad ties, the cutting action of the diamond wire conforms to the work. The gentle cutting action of the diamond wire does not smear one material into another and does not snag at the border between two materials. Diamond wire saw-cutting will provide smooth surfaces, facilitate excavation of notch portions of the arch dam section, improve control of the excavation grade, provide smooth working surfaces for excavation of each layer, and permit removal of the concrete in large blocks (rather than attempting to confine rubble to the working surface and removing the rubble by loaders). This demolition method allows for compliance with environmental requirements relating to turbidity and discharging waste material into Waters of the United States.

Vertical and angled drill holes were assumed to be required for production blasting of the dam foundation to the final excavation level.

Spillway removal consists of pre-splitting the concrete from the rock substratum, drilling and micro-blasting the surface to fracture the concrete, and manually breaking the concrete. The spillway will be removed in stages for all of the action alternatives and effectively occur in parallel with the demolition of the dam.

All the debris from the dam and spillway will be taken to the Calabasas Landfill for disposal.

2.4.4 Waste Disposal

The Calabasas Landfill is located off of Lost Hills Road in Agoura, CA at the upper end of the watershed. The landfill is approximately 7.5 mi from Rindge Dam, mostly along Malibu Canyon Road, named Las Virgenes Road after crossing Mulholland Drive. All waste materials will be removed from the site and transported to the Calabasas landfill.

The cost estimate assumes that all waste concrete will be dumped at the Calabasas Landfill. An estimated 3,460 cy of concrete will be in large blocks, weighing approximately 19 tons each. An estimated 540 cy of concrete from the foundation demolition will be fractured and broken into manageable pieces before hauling and disposal. 2,000 cy of concrete from the spillway demolition, micro-blasted and demolished into small pieces, will also be hauled to the landfill. Additional costs required to crush all waste concrete for disposal (with any reinforcing steel removed) is assumed to take place at the disposal site and is included in the disposal cost.

Additional waste disposal will result from de-vegetation activity. The green waste associated with vegetation removal will also be sent to the Calabasas Landfill.

2.4.5 Hauling

Typical construction equipment used for hauling includes flatbed trucks, low boys, and dump trucks.

The arc foundation concrete requires removal of approximately 15 feet of concrete from the surface (base) of the dam to the bedrock. The arc foundation amounts to approximately 540 CY of concrete to be removed and hauled away.

The spillway removal requires flatbed trucks and dump body trucks for hauling the foundation and spillway concrete. The spillway amounts to approximately 2,000 CY of concrete to be removed and hauled away.

Haul loads cannot exceed 80,000 pounds. The contractor may be required to make some repairs to the Malibu Canyon Road to allow for normal use after construction.

2.4.6 Road Improvement Plan

Heavy construction traffic associated with hauling materials from the dam site to designated disposal areas may cause damage to some of the existing roadways in the area. Malibu Canyon Road is designed and constructed to accept standard truck traffic. Two types of roadway repairs were considered; spot patching with resurfacing, or total replacement. The alternative for spot patching, as needed, is difficult to evaluate due to the inability to identify with any confidence the extent of potential damage and the amount of patching that may be required. It is anticipated that dips and ruts will be typical repair requirements, which could involve long sections of the road. The spot patching alternative also included resurfacing 0.5 miles of roadway with two layers of bituminous surface treatment. On March 20, 2013, the PDT recommended the total replacement alternative (i.e. 0.5 mi) to ensure that all potential deficiencies are addressed.

2.4.7 Site Clean-up

Final channel cleanup, including removal of any concrete rubble and boulders, may be performed during the low-flow period (April through October).

2.4.8 Site Restoration

A site restoration plan will be developed to provide natural-looking contours following removal of the sediment and dam. The river channel contains large boulders, which will be push aside as necessary for fish passage and potential recreational use of the river, if possible.

2.4.9 Monitoring & Adaptive Management

An environmental mitigation cost were developed with input from the environmental coordinator and biologist. Cost includes: seeding, weeding, maintenance for five years, and biological monitoring for five years.

2.4.10 Sand-rich Sediment Hauling

The SC-DMMT agreed in concept to consider allowing on-beach placement and near-shore placement of the sand-rich layer. The existing condition of the sand-rich material is 22% fines and 5% gravel with the remaining content being sand. Although this level of fines (silty material) is at the upper end of what is generally be accepted for near-shore placement, no amount of screening has been assumed at this time.
Sandy material is trucked approximately 41 miles one-way to Ventura Harbor and barged down the coast approximately 40 miles to Malibu for near-shore placement.

2.5 Indirect Costs (Contractor Markups)

The contractors and subcontractors' field office overhead, home office overhead, and profit were established using historical rates for similarly size jobs and represent the contractor's cost of doing business and assuming the risks associated with construction work. A dewatering subcontractor, fencing subcontractor, drilling/blasting subcontractor, paving subcontractor, landscape subcontractor, demolition subcontractor, and environmental restoration subcontractor were included in the estimate.

For all the alternatives, disposal fees do not carry contractor’s markups. Disposal fees represent approximately 70% of the total sediment removal cost. Typically, disposal fees carry markups, but since the disposal fees represent such a large percentage of the estimate adding contractor’s markups would artificially inflate the estimate

2.6 Owner Cost

The following Owner Costs are applied to the CWE.

2.6.1 Planning Engineering and Design (PE&D) and Pre-construction Engineering and Design (PED)

Planning Engineering and Design (PE&D), including Engineering During Construction (EDC), and Preconstruction Engineering and Design were estimated per labor-hour for each discipline, broken out per phase and contract.

2.6.2 Construction Management or Supervision & Administration (S&A)

Construction Management was estimated as a percentage of the construction cost prior to addition of the applicable contingency.

2.7 Schedule of Work

Due to traffic conditions on Malibu Canyon/Las Virgenes Road, truck use for hauling on this road will be restricted to the hours of 9 AM to 3 PM daily. On school days, hauling is disallowed from 2:00 PM to 3:30 PM. Therefore, assume road use from 9 AM to 2 PM (5 work hours per day) while school is in session for any material hauled to the Calabasas landfill. On non-school days, the work day is 9 AM to 3 PM (6 hours).

After the addition of daily operational restrictions, the job requires one year of set up and site preparation, and 7 years of sediment hauling to complete the job. Construction schedule totals 8 years.

Truck hauling will occur 6 days a week. No hauling to the landfill will occur on Sundays or federal holidays. Estimated construction duration is approximately 8 years including rehabilitation of the highway and environmental mitigation work. The construction season is defined as 1-April to 15-October. During the winter period, no work will be done and no equipment will be on-site. During construction, the contractor will be responsible for checking the weather conditions every day and evacuating all personnel and equipment in the event inclement weather is forecasted. The existing cost estimate has accounted for contractor mobilization and de-mobilization during each year of construction.

3.0 UPSTREAM BARRIERS COST ESTIMATE BASIS

A list has been compiled of 7 high-priority man-made barriers upstream of the Rindge Dam that have been identified as additional blockages to the migration of local fish species. Barriers removal, modification or replacement can add migratory fish access to a large amount of additional habitat upstream of the dam for a relatively small incremental expense.

Man-made barriers are considered a limiting factor and are, therefore, the only barriers included in this assessment. During construction, it is necessary to demolish and rebuild only one lane at a time where there is a County road running above (if applicable). The contractor is required to block only one-half of the barrier/bridge at a time, and allow for staggered two-way passage on the other lane using flag-men or automated signals at night. Fire department access to any construction site and passage across the road above must be maintained at all times during construction.

CC5 (Cold Canyon Road Culvert) may have more than 6-inches of concrete on the invert, but from project photographs, the invert has eroded away with time. If more of the concrete is removed, there is a risk in exposing the corrugated metal pipe (CMP). Over time, the corrugated metal pipe will corrode and break down, and when this happens along the invert of a culvert it jeopardizes the structural integrity of the entire culvert. The concrete inverts of LV3 and LV4 also cannot be chipped away for similar reasons. From researching other projects plan sets, concrete inverts generally have about 4-inches of concrete placed over the reinforcing rebar, which is insufficient for a passage channel to be made. In addition, when concrete is removed from a box culvert, the structural characteristics of the culvert are changed and there is a risk of reducing the overall structural capacity.

In contrast to carving a channel in each invert, it was assumed that there would be a need to construct a channel along the inverts of CC5, LV3, and LV4. The construction at CC5 requires building a channel along the 130 ft-long invert of the culvert, and do limited work upstream and downstream of the culvert to ensure low flows still pass through the structure. For LV3 and LV4, it is necessary to modify the invert of the box culvert and the entire concrete apron upstream and downstream of each structure. In addition to the concrete apron modification, there is a need to modify the stream bed enough to ensure low flows pass through LV3 and LV4 and modify the sill structures to ensure fish can overcome the vertical drop at each one.

3.1 <u>Upstream Barriers Plans</u>

USACE developed the following upstream barrier plans for the feasibility-level cost estimates. These plans are considered to be technically feasible, economical, and compatible with the project objectives.

3.1.1 Site Access/Preparation

The current estimate assumes no constraints on construction activities will be necessary for protection of threatened and endangered species.

Vegetation must be cleared in and around the project sites and access maintenance roads, as needed. For the majority of the upstream barrier sites, it is assumed that vegetation will have to be manually cleared with brush-saws, track-hoes, and chippers. Some barrier sites, where equipment access is not an issue, allow for clearing using small dozers. Disposal of materials using rental dumpsters was assumed.

3.1.2 Diversion and Control of Water

For most of the upstream barrier alternatives, it is assumed that a temporary cofferdam of varying heights per alternative is installed upstream of the construction area. Installation of a temporary 36-inch CMP allows for water conveyance through the construction site, enabling fish passage during construction.

For some of the upstream barrier alternatives, a lack of staging area and/or access issues requires that the temporary cofferdam be built using sandbags. These cofferdams require the construction of a trench/sump to pump the water downstream of the construction site using hosing.

3.1.3 Demolition of Upstream Barriers

The demolition for each of the upstream barriers varies based upon existing conditions (see **Figure 3.4-1** for a location of each barrier).

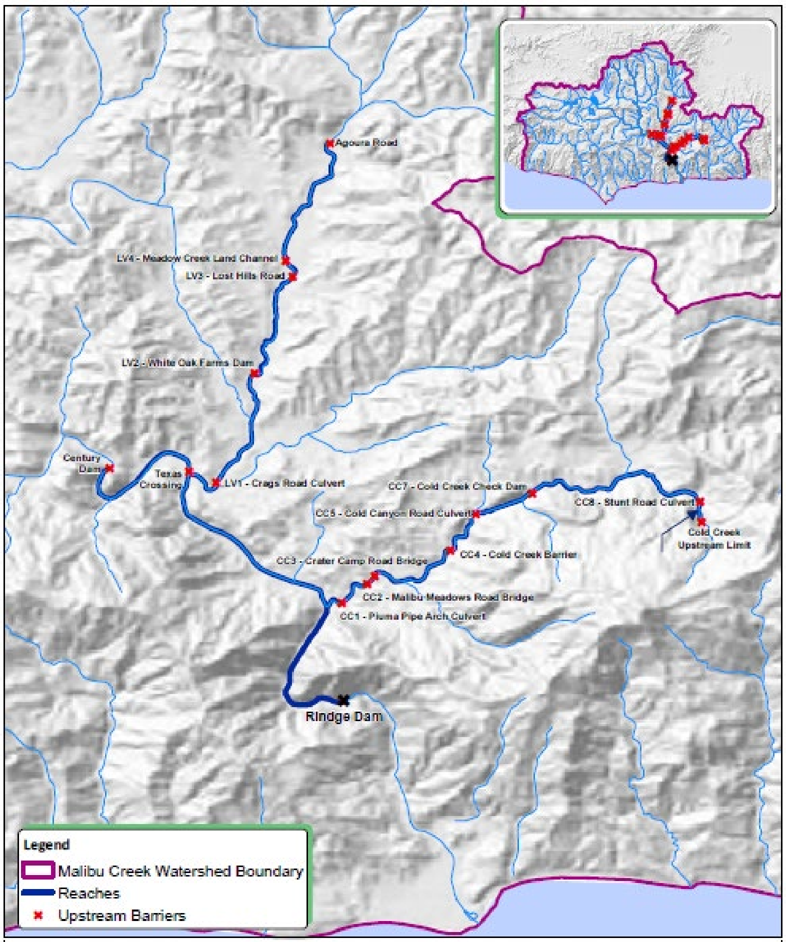

Figure 3.4-1 Locations of Upstream Barriers

The following descriptions highlight some of the differing site conditions at each site and identify what the planned method is for improving fish passage to meet the project objective:

LV1 - Crags Road Culvert Crossing

The existing concrete box culvert, the existing concrete abutments, and the existing concrete wing walls will be removed and replaced with a pre manufactured 75 ft long, 20 ft wide clear span bridge. This new bridge will span the entire creek and eliminate the current reduction in the creek cross section. The new bridge’s deck elevation will match the top elevation of the existing structure.

The use of a pre-manufactured bridge will reduce construction time since the bridge will be delivered to the site and placed on the new abutments with a crane. Prior to installing the new bridge, the new wing walls and bridge abutments will have to be constructed on both banks of the creek. The creek bed will have to be re-graded to fill any voids left by the removal of the existing structures. Construction is estimated to take 45 days.

The creek flow will have to be diverted during removal of all the existing structures and construction of the new abutments and wing walls. Water diversion will also be necessary while any work is being performed within the creek. The creek will not need to be diverted while the pre manufactured bridge is being placed on the abutments. Dewatering will also be necessary during construction of the new bridge wing walls and the new bridge abutments.

De-vegetation will be required for the removal of the existing bridge wing walls and abutments along with construction of the new bridge wing walls and abutments. Additional clearing will be required at the designated staging area for the project. All areas that are cleared will be restored once construction is complete.

No traffic control measures will be required since this bridge is used for maintenance vehicle and fire truck access.

LV2 - White Oak Dam

The existing 6 ft dam will be removed in stages to minimize any erosion and scour problems. The creek will have to be diverted each year to protect any crews and equipment being used to remove the dam. However, work in the creek will be kept at a minimum since the dam will be removed by a backhoe stationed on the creek bank. Dewatering will not be required. Demolition is estimated to take 15 days each year. Clearing will be limited to a 40 ft by 40 ft area on either side of the cofferdam, which will ensure the backhoe, has adequate space to work. These areas will have to be cleared every year of dam removal. All areas that are cleared will be restored once the dam removal is completed. Once the dam is removed, no further work will be done to restore the creek.

LV3 - Lost Hills Road Culvert & LV4 - Meadow Creek Lane Crossing

Both LV3 and LV4 will have to be treated as a single project because fish have to pass through both barriers to reach the habitat areas upstream of LV4. These structures will not be removed; rather, a low flow channel will be constructed along the invert of each structure and along the portion of the stream between LV3 and LV4.

The low flow channel for LV3 will be built on top of the existing concrete invert. This channel will be 6 inches deep and start at the downstream end of the concrete apron, extend upstream through the culvert structure, and terminate at the end of the upstream concrete apron. This channel will be 3 feet wide and will ensure there is enough water traveling at low enough velocities for fish passage. The drop at the downstream end of the concrete invert will not be modified. The low flow channel for LV4 will be similar to the channel passing through LV3 and allow fish to travel upstream to the designated habitat areas. Construction is estimated to take 50 days.

The invert of the creek between LV3 and LV4 will have to be cleared and re-graded to provide a low flow channel that will connect the concrete channels along LV3 and LV4. This area will be restored once construction is complete.

The creek flow will have to be diverted during construction of both concrete low flow channels and while the creek invert between LV3 and LV4 is being re-graded. Limited dewatering will be necessary along the creek between LV3 and LV4 to ensure adequate working conditions for construction equipment.

Additional clearing will be required at the designated staging area for the project and along any invert access ramps. The staging area will be restored once construction is completed.

Some traffic control measures may be required during construction hours to facilitate the movement of equipment from the staging area to the construction site.

<u>CC1 - Piuma Culvert</u>

The existing CMP arch culvert, the concrete lining along the creek invert, and the stone head walls will be replaced by a 12 ft pre-cast arch culvert with new concrete footings and concrete head walls on both sides of the creek. The width and height of the new culvert will match the existing CMP culvert and the road elevations across the culvert will be the same as the existing roadway.

The existing metal arch culvert, stone wing walls, and concrete invert will be removed in two stages. The first stage will be from the upstream inlet to the centerline of the road, the second state will be from the centerline of the road to the downstream outlet. The culvert must be removed in two parts so the traffic along the road can be diverted into one lane across the bridge. Traffic control measures will be required during and after construction hours to ensure traffic can safely be reduced down to one lane across the creek.

The pre-cast culvert will reduce construction time since the culvert will be delivered to the site and placed on the footings with a crane. Prior to installing the new culvert sections, new headwalls and footings will have to be constructed. Construction is estimated to take 30 days.

The concrete invert of the creek will be replaced with a natural channel. The creek bed under the culvert will have to be re-graded to compensate for the small elevation drop at the end of the existing concrete invert.

Temporary shoring will be required to preserve the road while the existing metal culvert and stone wing walls are being removed. The temporary shoring will be placed perpendicular to the centerline of the road and run parallel to the existing CMP culvert for 46 ft. The temporary shoring will be required on the north and south sides of the existing structure and will be removed once the new bridge abutments and wing walls are completed.

The creek flow will have to be diverted during removal of all the existing structures and construction of the new footings and headwalls. The creek will also have to be diverted while any work is being performed within the creek bed. Dewatering will be necessary during construction of the new culvert footings and headwalls.

Clearing will be required for the removal of the existing culvert wing walls and abutments, along with construction of the new culvert footings and headwalls. Additional clearing will be required at the designated staging area for the project. All areas that are cleared will be restored once construction has been completed.

CC2 - Malibu Meadows Road Crossing

The existing structure is a wood deck, steel beam bridge with the concrete invert and CMU abutments and wing walls. This structure will be removed and replaced with a 70 ft long and 25 ft wide pre-manufactured bridge with concrete abutments and wing walls on both sides of the creek. The new bridge will have a longer span than the existing structure to help eliminate the reduction of the creek cross section, and the bridge deck elevation will match the existing bridge deck elevation.

The pre-manufactured bridge will reduce construction time since the bridge will be delivered to the site and placed on the new abutments with a crane. Prior to installing the new bridge, new wing walls and bridge abutments will have to be constructed on both banks of the creek. Construction is estimated to take 30 days.

The existing concrete invert will be removed and replaced with a modified stream bed. The stream bed improvements will have to be designed to compensate for a 5 ft drop at the end of the existing concrete invert while still allowing fish to swim upstream. The stream bed improvements will have to prevent head cutting upstream of the new bridge.

The creek flow will have to be diverted during removal of all the existing structures and construction of the new abutments and wing walls. The creek flows will also have to be diverted while any work is being performed within the creek bed. The creek will not need to be diverted while the pre-manufactured bridge is being installed. Dewatering will also be necessary during construction of the wing walls and abutments.
Clearing will be required for the removal of the existing wing walls and abutments along with construction of the new abutments and wing walls. Additional clearing will be required at the designated staging area for the project. All areas that are cleared will be restored once construction has been completed.

Traffic control measures will only be in place to warn drivers of a closed bridge. All traffic will be redirected through neighboring streets.

CC3-Crater Camp Road Crossing

This site is assumed to be the same as CC2, except there is no gas line running along the bridge. This structure will be replaced in like manner to CC2, with minor changes to specific lengths and measurements.

CC4 - Cold Creek Barrier (Dam)

Cold Creek Barrier (Dam) is excluded from the project.

CC5 - Cold Canyon Road Culvert

The existing 25 ft diameter concrete culvert cannot be removed so a low flow channel will be built along the culvert's invert to allow fish passage upstream. The channel will be 6 inches deep and 3 ft wide and will ensure flows are slow enough and deep enough for fish passage during low flow conditions. The downstream portion of the culvert will not be modified, because fish can use existing ponds to make their way into the low flow channel. The creek invert near the inlet of the culvert will have to be cleared and re-graded to ensure flows can enter the low flow channel.

Creek flows will need to be diverted during construction but no dewatering will be necessary. Construction is estimated to take 15 days. No traffic control will be necessary.

Construction Logic and duration

Activity durations were based on engineering judgment and experience. Construction durations vary per alternative from 15 days to 5 months.

3.1.4 Waste Disposal

The Calabasas Landfill is located at Lost Hills Road in Agoura, CA at the upper end of the watershed. For the 7 upstream barriers, it was assumed that waste disposal is carried on via rented waste dumpsters per the suggestion of the local sponsor. The cost estimate assumes waste will be dumped at the Calabasas Landfill without further handling.

3.1.5 Hauling

Typical construction equipment used for hauling includes flatbed trucks, low boys, and dump trucks. Hauling is performed 6 days per week during daylight hours.

3.1.6 Site Clean-up

Final channel cleanup, including removal of any concrete rubble and boulders, must be performed during the low-flow period (April through October). All upstream barrier alternatives are assumed to have varying rock landscaping requirements based upon the project site to help enhance migratory fish passage.

3.1.7 Monitoring & Adaptive Management

Environmental monitoring and adaptive management scope and costs were provided by the USACE LA Planning Division Environmental Resources representative with assistance from Cost Engineering.

4.0 SYNOPSIS

4.1.1 Synopsis

Feasibility-level designs and estimates have been prepared for the sediment removal and demolition of Rindge Dam and Spillway as well as for the 7 upstream barrier alternatives. The current studies confirm that dam removal is technically feasible and can be safely performed in a manner compatible with sediment management requirements and project objectives. Dam removal activities will require a period of approximately 8 years.

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US Army Corps
of Engineers®

Malibu Creek Ecosystem Restoration Project

Los Angeles and Ventura Counties, California

Locally Preferred Plan (LPP)

Project Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers,
Los Angeles District

Prepared by:

Los Angeles District, U.S. Army Corps of Engineers

November 2020

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EXECUTIVE SUMMARY

The US Army Corps of Engineers (USACE), Los Angeles District, presents this cost and schedule risk analysis (CSRA) report regarding the risk findings and recommended contingencies for the Malibu Creek Ecosystem Restoration Project. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated June 30, 2016, a formal risk analysis, *Monte-Carlo* based-study was conducted by the Project Development Team (PDT) on remaining costs. The purpose of this risk analysis study is to present the cost and schedule risks considered, those determined and respective project contingencies at a recommend 80% confidence level of successful execution to project completion.

This project contributes to the primary study ecological restoration objective to restore the Malibu Creek ecosystem, (with some additional benefits to Las Virgenes Creek and Cold Creek), while maintaining downstream ecosystem and riparian management activities. This plan is expected to result in significant benefits to the ecosystem.

The Locally Preferred Plan (LPP) alternative includes the demolition, removal, and disposal of the Rindge Dam arch and spillway as well as removal the sediment currently impounded behind the Rindge Dam. Additionally, the LPP alternative considers the enhancement of seven (7) existing upstream barriers to allow passage of fish and other wildlife. The study area is located about 30 miles (mi) west of the city of Los Angeles.

The estimated project base cost for the LPP alternative work approximates $187.6M. Based on the results of the risk analysis, Cost Engineering recommends a contingency value of $82.2M on the remaining work or approximately 44% of base project cost

Los Angeles District, Cost Engineering performed a risk analysis using the *Monte Carlo* technique for the estimated construction costs, supported by the district PDT input. The following table ES-1 portrays the development of the construction contingencies. The contingency is based on an 80% confidence level, as per USACE Civil Works guidance. Knowing that estimates can fluctuate to a certain degree over time with little to no change in risk, it is common to rely on the per cent of contingency applied against the costs under study. For example, the estimated project cost of $187.6M was the basis for the risk model. The current construction estimate may have changed to a minor degree with no change in risks.

Table ES-1. Construction Contingency Results

Baseline Estimate Cost	**$187,603,000**	
Confidence Level	**Project Cost ($) with Contingency**	**Contingency**
50%	$262,644,200	40%
80%	**$269,762,000**	**44%**
90%	$273,900,380	46%

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The PDT worked through the risk register on: November 30, 2017. Furthermore, Jacksonville District was interviewed on October 24, 2017 providing lessons learned and potential risks resulting from a similar Ecosystem Restoration Project. On February 10, 2020 the TPC was reprised and the CSRA updated. The key risk drivers identified through sensitivity analysis suggest a cost contingency of $52.2M and schedule risks adding another potential of $30.0M, both at an 80% confidence level.

Cost Risks: From the CSRA, the key or greater Cost Risk items include:

- <u>ES-6: Disposal Site Changing</u> - Concern of an alternative disposal site for the removed sediment. Risk could present an opportunity if a closer or cheaper alternative disposal site is identified. Currently, gravel-rich and clay/silt-rich material amount to ~60% of the total sediment volume and it is disposed at the closest landfill, the Calabasas Landfill. Disposal fees are high at the landfill. Worst case scenario is for the landfill capacity to pose an issue.
  Sand-rich material amounts to ~40% of the total sediment volume and it is hauled to Ventura Harbor. Harbor availability for sediment transfer from truck to barge may pose a risk, also.
- <u>TR-2: Slope Stabilization / Landslides</u> - Concerns of landslides during and after excavation. Construction-related impacts to earth resources, through movement of earth by heavy equipment, would result in potential destabilization and erosion of soils in the vicinity of construction activities at and adjacent to Rindge Dam, in the area of accumulated sediment upstream of the Dam, and in constructed access roads and staging areas, and at the disposal sites. Destabilization effects to Malibu Canyon Road could expose people and structures to potential substantial adverse effects due to landslides and slope instability if not mitigated. Soil stabilization methods may be required on side slope below Malibu Canyon Road following excavation of sediment. Continuous monitoring/confirmatory test may be required.
  The costs associated with remediation of landslide concerns during construction are difficult to predict due to the limited understanding of the actual geologic conditions and the scope of necessary remediation. Some uncertainties/unknowns are better addressed during PED - field investigations. We will characterize the field conditions in the future during PED, but it does not reduce the risk. We are reducing the uncertainty by doing testing. The County commented about possible failure of the access ramps. The toe has been eroded by stream flow. The worst case scenario would be down into the sediment in the impound area and a landslide moves completely eliminating Malibu Canyon Road, cutting off access to the construction site; potentially killing or damaging equipment; creating an earthen dam in the canyon that would then have to be removed.

- CA-2: Inefficient Contractor - There is a possibility that a new contractor obtains one of the contracts and is unable to perform the work. The nature of this type of work makes this likely. However, there are a lot capable contractors in the area that are experienced and the work is not complex. The Contractor has to coordinate with many different entities. It is likely we will go open-bid because of the nature of the work. Construction entails traditional earth moving equipment, but it is tricky to work in constrained space at the bottom of the canyon. Worst case scenario: we get 1 bad contractor and have to add 1 new contract (1 year delay).
- ES-7: Soil Parameters – Civil and Geotechnical Design assisted in the development of quantities. Geology believes reasonable quantity estimates were developed. Geotechnical investigations and Soil Penetration Tests (SPT) were performed on the impounded sediment within the last few years. Blow count tests indicated soil properties with extremely low relative density. The PDT feels the impounded sediment is in its loose state and the baseline estimate was based on in-situ Loose Cubic Yards (LCY). But, there is a possibility for increased quantities based on potential swell factors. The PDT feels the quantities are appropriate and material swelling will not be an issue (Unlikely to happen), but if the material does swell it will add large costs (Significant impact) and delay the schedule.
- CO-2: Debris Flow Risk: Terms such as debris-flow and mudflow are misnomers. Mud does not slide, it flows. These terms are used to describe shallow slope-failure phenomena. Debris-flow are triggered by heavy rain in vulnerable areas such as over-steepened slopes. Proper planning and engineering can mitigate the harmful effects of rainstorm-triggered slope failures and potential slope instability. During construction a natural plateau or bench will temporarily exist during excavation. The debris plateau refers to the difference in height of remaining impounded sediment vs. remaining dam arch. This is not "debris" in terms of trash, but all impounded material trapped behind the arch. Sediment volume calculations/quantities are likely to change due to the intermittent nature of the construction sequence. Sediment removal is not continuous. A rain event could create ponding behind the dam, becomes a jurisdictional condition (DSOD). However, construction is taking place outside the raining season. Removing the arch and mining the sediment in the same time frame is staged, but leaves the possibility of "debris flow" for that exposed volume of sediment. Risk may have downstream effects (turbidity, swamp road crossings, consultation with ESA) because it's an uncontrolled release of flow. Risk may result in emergency actions, but no project shutdown.
- CO-5: Access Road Re-Construction - Re-construction of access road slope may pose difficulties. Slope stability concerns during Access Road Construction may increase the costs and cause delays. After the 1st year, the current estimate assumes 25% of the initial volume is required to rebuild the ramps on sub-sequent years.

Worst case scenario would represent rebuilding the complete ramp. Representing a cost increase of $1M per re-construction year.

- ES-2: Diversion and Control of Water - Variations in flows are likely. Diversion and control of water costs are highly likely to be impacted.
- CA-1: Numerous Separate Contracts - Current estimate is based on three (3) fixed-price contracts. Number of contracts will impact cost and schedule. The current breakdown and estimate assumes a reasonable approach to the number of contracts. However, less than optimal funding would increase the number of contracts (possibly one contract per year) and change the conditions downstream of the dam. Resulting cost impacts involve additional Engineering and Design costs. Schedule risks are possible but marginal in magnitude.
- ES-3: Dewatering - Preliminary estimate is subject to change based on pump test results and yearly replacement of dewatering platforms and instrumentation. Cost and schedule are very likely to change.
- CO-5: Access Road Re-Construction - Re-construction of slope may pose difficulties. Slope stability during Access Road Construction may increase the costs and cause delays. After the 1st year, the current estimate assumes 25% of the initial volume is required to rebuild the ramps on sub-sequent years. Worst case scenario would represent rebuilding the complete ramp. Representing a cost increase of $1M per re-construction year.
- ES-9: PED and CM Cost Increases - Increase in PED and CM Costs (30 & 31 Accounts). Project features are in the preliminary stages. This item captures the risk that the costs for PED and CM could increase from beyond the currently estimated cost.
- EX-1: Internal Low or not studied risks - This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule. This item is added based on standard items noted as being required for all formal cost and schedule risk analyses, such as sufficient studies, based on forthcoming policy based on Agency Technical Review comment/resolution. This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule.

Schedule Risks: The schedule risk indicates some uncertainty of key risk items; time duration growth that can translate into added costs. Over time, risks increase on out-year contracts where there is greater potential for change in new scope requirements, uncertain market conditions, and unexpected high inflation. The key or greater Cost Risk items include:

- EX-3: Political/Legal Opposition – There are locals opposed to certain aspects. They could potentially attempt to file a suit against the project. There remains the possibility that political opposition/legal opposition could delay the project or any individual event. It could also create a delay in the activities as well.

- TR-2: Slope Stabilization / Landslides - Concerns of landslides during and after excavation. Construction-related impacts to earth resources, through movement of earth by heavy equipment, would result in potential destabilization and erosion of soils in the vicinity of construction activities at and adjacent to Rindge Dam, in the area of accumulated sediment upstream of the Dam, and in constructed access roads and staging areas, and at the disposal sites. Destabilization effects to Malibu Canyon Road could expose people and structures to potential substantial adverse effects due to landslides and slope instability if not mitigated. Soil stabilization methods may be required on side slope below Malibu Canyon Road following excavation of sediment. Continuous monitoring/confirmatory test may be required.
  The costs associated with remediation of landslide concerns during construction are difficult to predict due to the limited understanding of the actual geologic conditions and the scope of necessary remediation. Some uncertainties/unknowns are better addressed during PED - field investigations. We will characterize the field conditions in the future during PED, but it does not reduce the risk. We are reducing the uncertainty by doing testing. The County commented about possible failure of the access ramps. The toe has been eroded by stream flow. The worst case scenario would be down into the sediment in the impound area and a landslide moves completely eliminating Malibu Canyon Road, cutting off access to the construction site; potentially killing or damaging equipment; creating an earthen dam in the canyon that would then have to be removed.
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- ES-6: Disposal Site Changing - Concern of an alternative disposal site for the removed sediment. Risk could present an opportunity if a closer or cheaper alternative disposal site is identified. Currently, gravel-rich and clay/silt-rich material amount to ~60% of the total sediment volume and it is disposed at the closest landfill, the Calabasas Landfill. Disposal fees are high at the landfill. Worst case scenario is for the landfill capacity to pose an issue.
  Sand-rich material amounts to ~40% of the total sediment volume and it is hauled to Ventura Harbor. Harbor availability for sediment transfer from truck to barge may pose a risk, also.

- ES-3: Dewatering - Preliminary estimate is subject to change based on pump test results and yearly replacement of dewatering platforms and instrumentation. Cost and schedule are very likely to change.
- RG-3 – Wildlife/ESA - Concern of greater schedule delays associated with other species (IEPR concern). Red legged frogs, monitoring and relocation. Steel head relocations concerns are captured in the estimate. Some isolated areas in the construction zone, possible relocation outside the project footprint. This risk affects mostly the Upstream Barriers (Red legged frogs). Worst case scenario involves finding an endangered species at the dam site, at the beginning of the season, pre-construction, or during construction and resulting delays. At the upstream barriers sites the weight of the risk is higher, but this work is not on the project critical path.
- PM-1: Insufficient Funding - Project may be funded on some years, but we are not certain that the project will be funded the amount it is requesting or skip a year. Project may be terminated if it doesn't receive funding. Impact on project resourcing and sequencing. Required appropriations are large for each contract. Currently, the project is broken down into 3 contracts.

Recommendations: The PDT must include the recommended cost and schedule contingencies and incorporate risk monitoring and mitigation on those identified risks. Further iterative study and update of the risk analysis throughout the project life-cycle is important in support of the remaining project work within an approved budget and appropriation.

MAIN REPORT

1.0 PURPOSE

Under the auspices of the US Army Corps of Engineers (USACE), Los Angeles District, this report presents a recommendation for the total project cost and schedule contingencies for the Malibu Creek Ecosystem Restoration Project.

2.0 BACKGROUND

The LPP alternative includes the demolition, removal, and disposal of the Rindge Dam arch and spillway as well as removal the sediment currently impounded behind the Rindge Dam. Additionally, the LPP alternative considers the enhancement of seven (7) existing upstream barriers to allow passage of fish and other wildlife. The study area is located about 30 miles (mi) west of the city of Los Angeles.

The study area is located about 30 miles (mi) west of the city of Los Angeles. Approximately 2/3 of the 109 sq. mi watershed is located in the northwest portion of the Los Angeles County area and the remaining 1/3 is in Ventura County. Malibu Creek Watershed is within the Santa Monica Mountains, in a mix of urban development and open space. Malibu Creek drains into Malibu Lagoon and Santa Monica Bay.

Malibu Creek drains 109 sq. mi of the Santa Monica Mountains, where the reach from Malibu Lagoon to Malibu Dam is 10 mi Rindge Dam, built in the 1920's, is located about 2 mi upstream from the confluence with the Pacific Ocean. The dam is a concrete arch structure 108 feet (ft) in height with an arc length of 140 ft at its crest (excluding spillway & rock outcrop) and 80 ft at its base. The dam is 2 ft thick at the crest and 12 ft thick at the base. 60-lb steel railroad ties run horizontally and vertically throughout the dam and serve as reinforcement for the structure. The height from the top of the arch structure to bedrock is approximately 117 ft. The top of dam elevation is approximately 298 ft.

As a part of this effort, Los Angeles District requested that the USACE Cost Engineering Directory of Expertise for Civil Works (Cost Engineering MCX) provide an agency technical review (ATR) of the cost estimate, schedule and risk analysis for the Locally Preferred Plan (LPP).

3.0 REPORT SCOPE

The scope of the risk analysis report is to identify cost and schedule risks with a resulting recommendation for contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE)

Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, and ER 1110-2-1302, Civil Works Cost Engineering. The report presents the contingency results for cost risks for construction features. The CSRA excludes Real Estate costs and does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the Micro Computer Aided Cost Estimating System (MCACES) cost estimate, project schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the Los Angeles District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of concerns, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering MCX. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering MCX.
- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated June 30, 2016.

4.0 METHODOLOGY / PROCESS

Cost Engineering performed the Cost and Schedule Risk Analysis, relying on local Los Angeles District staff to provide expertise and information gathering. The Los Angeles PDT conducted the initial risk identification workshop on November 30, 2017. The initial risk identification meeting also included qualitative analysis to produce a risk register that served as the draft framework for the risk analysis. Furthermore, Jacksonville District was interviewed on October 24, 2017 providing lessons learned and potential risks resulting from a similar Ecosystem Restoration Project.

Participants in the risk identification meeting of November 30, 2017 included:

Name	Office	Representing
Susan Ming	USACE - SPL	Project Manager
James Hutchison	USACE - SPL	Lead Planner
Lawrence Smith	USACE - SPL	Biologist
Moosub Eom	USACE - SPL	Hydraulics
Chris Spitzer	USACE - SPL	Geotechnical
Jesse Ray	USACE - SPL	Environmental Coordinator
Frank Mallette	USACE - SPL	Design
Ronald Spencer	USACE - SPL	Survey
Mark Chatman	USACE - SPL	Geology
Michael Hallisy	USACE - SPL	Economics
Matt Wesley	USACE - SPL	Coastal Engineering
Lisa Sandoval	USACE - SPL	Real Estate
Suzanne Goode	Cal Dept of Parks and Recreations	Liaison
Jamie King	Cal Dept of Parks and Recreations	Liaison

Meg McDonald	USACE - SPL	Cultural Resources
Juan Dominguez	USACE - SPL	Cost / Facilitator

Participants in sharing lessons learned from Jacksonville District on October 24, 2017 included:

Name	Office	Representing
Donna George	Jacksonville District	Interviewed on 10-24-17
Tiphanie Mattis	Jacksonville District	Interviewed on 10-24-17
Michael Dorg	Jacksonville District	Interviewed on 10-24-17

Participants in updating the risk analysis on February 10, 2020 included:

Name	Office	Representing
Susan Ming	USACE - SPL	Project Manager
James Hutchison	USACE - SPL	Lead Planner

The draft CSRA model was completed January 12, 2018 and submitted for recertification. On February 9, 2018, ATR comments were received and addressed. On February 23, 2018, the CSRA model was modified based on additional verbal ATR comments. On February 12, 2020, the TPC template was reprised to 2020 price levels and the CSRA was updated accordingly.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence. Per regulation and guidance, the P80 confidence level (80% confidence level) is the normal and accepted cost confidence level. District Management has the prerogative to select different confidence levels, pending approval from Headquarters, USACE.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost MCX guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

A formal PDT meeting was held for the purposes of identifying and assessing risk factors. The meeting (conducted on November 30, 2017) included capable and qualified representatives from multiple project team disciplines and functions, including project management, cost engineering, design, and the California Department of Parks and Recreation (CDPR).

The initial formal meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Additionally, numerous conference calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a larger portion of the project cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the Malibu Ecosystem Restoration project.

a. The Los Angeles District provided MII MCACES (Micro-Computer Aided Cost Estimating Software) files electronically. The MII and CWE files prepared on November 21, 2017 were the basis for the initial cost and schedule risk analyses. The MII and CWE files were updated on February 1, 2020.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the Feasibility Level.

c. The Cost Engineering MCX guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

d. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk “watch list”.

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Contingency and Sensitivity Analysis

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project cost at intervals of confidence (probability).

Table 1 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50, P80 and P90 confidence levels are also provided for illustrative purposes only.

Cost contingency for the Construction risks (including schedule impacts converted to dollars) was quantified as approximately $82.2 Million at the P80 confidence level (44% of the baseline construction cost estimate).

Table 1. Construction Cost Contingency Summary

Baseline Estimate Cost	$187,603,000	
Confidence Level	**Project Cost ($) with Contingency**	**Contingency**
50%	$262,644,200	40%
80%	**$269,762,000**	**44%**
90%	$273,900,380	46%

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

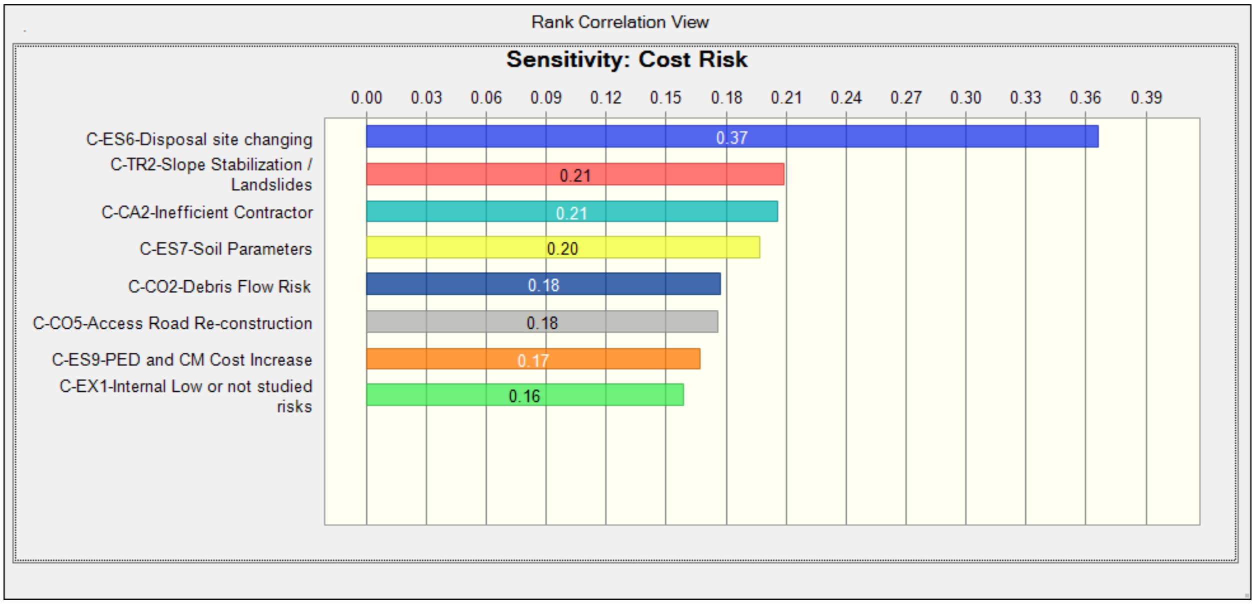
Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers and the respective value variance are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

Figure 1. Cost Sensitivity Analysis



6.3 Schedule and Contingency Risk Analysis

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project duration at intervals of confidence (probability).

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P90 confidence levels are also provided for illustrative purposes.

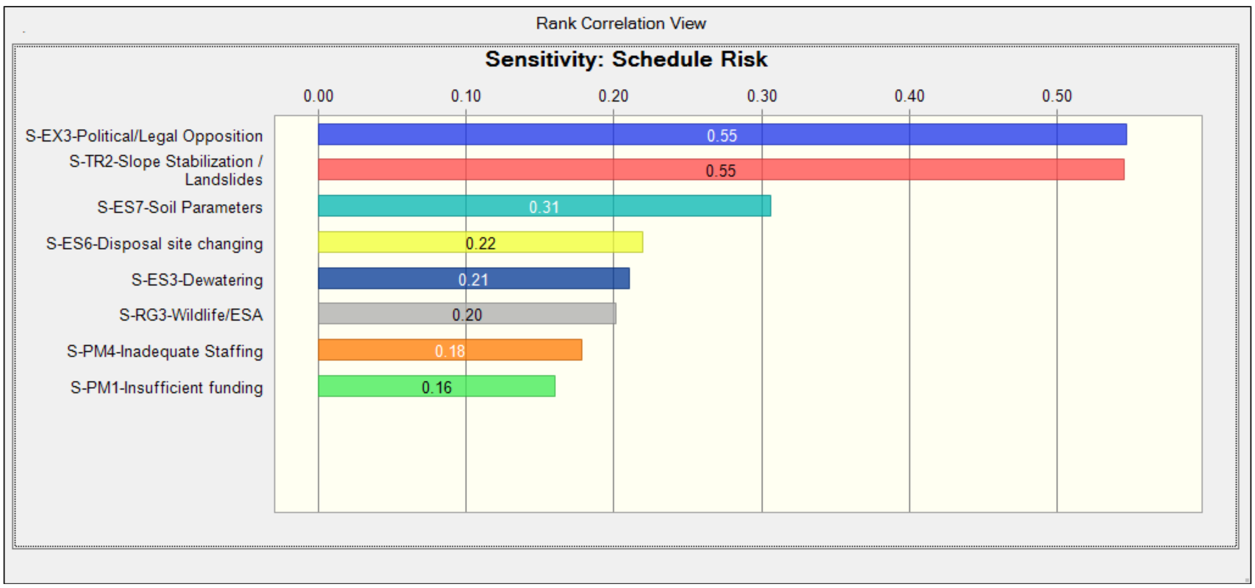
Schedule duration contingency was quantified as 91 months based on the P80 level of confidence. These contingencies were used to calculate the projected residual fixed cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected residual fixed costs.

Table 2. Schedule Duration Contingency Summary

Base Case Schedule	132 months	
Confidence Level	**Schedule Duration (Months) w/ Contingency**	**Contingency (months)**
50%	211 months	79 months
80%	223 months	91 months
90%	229 months	96 months

Figure 2. Schedule Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Project cost and schedule comparison summaries are provided in Table 3 and Table 4 respectively. Additional major findings and observations of the risk analysis are listed below.

Cost Risks: From the CSRA, the key or greater Cost Risk items of include:

- <u>ES-6: Disposal Site Changing</u> - Concern of an alternative disposal site for the removed sediment. Risk could present an opportunity if a closer or cheaper alternative disposal site is identified. Currently, gravel-rich and clay/silt-rich material amount to ~60% of the total sediment volume and it is disposed at the closest landfill, the Calabasas Landfill. Disposal fees are high at the landfill. Worst case scenario is for the landfill capacity to pose an issue.
  Sand-rich material amounts to ~40% of the total sediment volume and it is hauled to Ventura Harbor. Harbor availability for sediment transfer from truck to barge may pose a risk, also.
- <u>TR-2: Slope Stabilization / Landslides</u> - Concerns of landslides during and after excavation. Construction-related impacts to earth resources, through movement of earth by heavy equipment, would result in potential destabilization and erosion of soils in the vicinity of construction activities at and adjacent to Rindge Dam, in the area of accumulated sediment upstream of the Dam, and in constructed access roads and staging areas, and at the disposal sites. Destabilization effects to Malibu Canyon Road could expose people and structures to potential substantial adverse effects due to landslides and slope instability if not mitigated. Soil stabilization methods may be required on side slope below Malibu Canyon Road following excavation of sediment. Continuous monitoring/confirmatory test may be required.
  The costs associated with remediation of landslide concerns during construction are difficult to predict due to the limited understanding of the actual geologic conditions and the scope of necessary remediation. Some uncertainties/unknowns are better addressed during PED - field investigations.

We will characterize the field conditions in the future during PED, but it does not reduce the risk. We are reducing the uncertainty by doing testing. The County commented about possible failure of the access ramps. The toe has been eroded by stream flow. The worst case scenario would be down into the sediment in the impound area and a landslide moves completely eliminating Malibu Canyon Road, cutting off access to the construction site; potentially killing or damaging equipment; creating an earthen dam in the canyon that would then have to be removed.

- CA-2: Inefficient Contractor - There is a possibility that a new contractor obtains one of the contracts and is unable to perform the work. The nature of this type of work makes this likely. However, there are a lot capable contractors in the area that are experienced and the work is not complex. The Contractor has to coordinate with many different entities. It is likely we will go open-bid because of the nature of the work. Construction entails traditional earth moving equipment, but it is tricky to work in constrained space at the bottom of the canyon. Worst case scenario: we get 1 bad contractor and have to add 1 new contract (1 year delay).
- ES-7: Soil Parameters – Civil and Geotechnical Design assisted in the development of quantities. Geology believes reasonable quantity estimates were developed. Geotechnical investigations and Soil Penetration Tests (SPT) were performed on the impounded sediment within the last few years. Blow count tests indicated soil properties with extremely low relative density. The PDT feels the impounded sediment is in its loose state and the baseline estimate was based on in-situ Loose Cubic Yards (LCY). But, there is a possibility for increased quantities based on potential swell factors. The PDT feels the quantities are appropriate and material swelling will not be an issue (Unlikely to happen), but if the material does swell it will add large costs (Significant impact) and delay the schedule.
- CO-2: Debris Flow Risk: Terms such as debris-flow and mudflow are misnomers. Mud does not slide, it flows. These terms are used to describe shallow slope-failure phenomena. Debris-flow are triggered by heavy rain in vulnerable areas such as over-steepened slopes. Proper planning and engineering can mitigate the harmful effects of rainstorm-triggered slope failures and potential slope instability. During construction a natural plateau or bench will temporarily exist during excavation. The debris plateau refers to the difference in height of remaining impounded sediment vs. remaining dam arch. This is not "debris" in terms of trash, but all impounded material trapped behind the arch. Sediment volume calculations/quantities are likely to change due to the intermittent nature of the construction sequence. Sediment removal is not continuous. A rain event could create ponding behind the dam, becomes a jurisdictional condition (DSOD). However, construction is taking place outside the raining season. Removing the arch and mining the sediment in the same time frame is staged, but leaves the possibility of "debris flow" for that exposed volume of sediment. Risk may have downstream effects (turbidity, swamp road

crossings, consultation with ESA) because it's an uncontrolled release of flow. Risk may result in emergency actions, but no project shutdown.

- CO-5: Access Road Re-Construction - Re-construction of access road slope may pose difficulties. Slope stability concerns during Access Road Construction may increase the costs and cause delays. After the 1st year, the current estimate assumes 25% of the initial volume is required to rebuild the ramps on sub-sequent years.
  Worst case scenario would represent rebuilding the complete ramp. Representing a cost increase of $1M per re-construction year.
- ES-2: Diversion and Control of Water - Variations in flows are likely. Diversion and control of water costs are highly likely to be impacted.
- CA-1: Numerous Separate Contracts - Current estimate is based on three (3) fixed-price contracts. Number of contracts will impact cost and schedule. The current breakdown and estimate assumes a reasonable approach to the number of contracts. However, less than optimal funding would increase the number of contracts (possibly one contract per year) and change the conditions downstream of the dam. Resulting cost impacts involve additional Engineering and Design costs. Schedule risks are possible but marginal in magnitude.
- ES-3: Dewatering - Preliminary estimate is subject to change based on pump test results and yearly replacement of dewatering platforms and instrumentation. Cost and schedule are very likely to change.
- CO-5: Access Road Re-Construction - Re-construction of slope may pose difficulties. Slope stability during Access Road Construction may increase the costs and cause delays. After the 1st year, the current estimate assumes 25% of the initial volume is required to rebuild the ramps on sub-sequent years. Worst case scenario would represent rebuilding the complete ramp. Representing a cost increase of $1M per re-construction year.
- ES-9: PED and CM Cost Increases - Increase in PED and CM Costs (30 & 31 Accounts). Project features are in the preliminary stages. This item captures the risk that the costs for PED and CM could increase from beyond the currently estimated cost.
- EX-1: Internal Low or not studied risks - This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule. This item is added based on standard items noted as being required for all formal cost and schedule risk analyses, such as sufficient studies, based on forthcoming policy based on Agency Technical Review comment/resolution. This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule.

Schedule Risks: The high value of schedule risk indicates a significant uncertainty of key risk items, time duration growth that can translate into added costs. Over time, risks increase on those out-year contracts where there is greater potential for change in new scope requirements, uncertain market conditions, and unexpected high inflation. The key or greater Cost Risk items include:

- EX-3: Political/Legal Opposition – There are locals opposed to certain aspects. They could potentially attempt to file a suit against the project. There remains the possibility that political opposition/legal opposition could delay the project or any individual event. It could also create a delay in the activities as well.
- TR-2: Slope Stabilization / Landslides - Concerns of landslides during and after excavation. Construction-related impacts to earth resources, through movement of earth by heavy equipment, would result in potential destabilization and erosion of soils in the vicinity of construction activities at and adjacent to Rindge Dam, in the area of accumulated sediment upstream of the Dam, and in constructed access roads and staging areas, and at the disposal sites. Destabilization effects to Malibu Canyon Road could expose people and structures to potential substantial adverse effects due to landslides and slope instability if not mitigated. Soil stabilization methods may be required on side slope below Malibu Canyon Road following excavation of sediment. Continuous monitoring/confirmatory test may be required.
  The costs associated with remediation of landslide concerns during construction are difficult to predict due to the limited understanding of the actual geologic conditions and the scope of necessary remediation. Some uncertainties/unknowns are better addressed during PED - field investigations. We will characterize the field conditions in the future during PED, but it does not reduce the risk. We are reducing the uncertainty by doing testing. The County commented about possible failure of the access ramps. The toe has been eroded by stream flow. The worst case scenario would be down into the sediment in the impound area and a landslide moves completely eliminating Malibu Canyon Road, cutting off access to the construction site; potentially killing or damaging equipment; creating an earthen dam in the canyon that would then have to be removed.
- ES-7: Soil Parameters – Civil and geotechnical design assisted in the development of quantities. Geotech believes reasonable quantity estimates were developed. Geotechnical investigations and Soil Penetration Tests (SPT) were performed on the impounded sediment within the last few years. Blow count tests indicated soil properties with extremely low relative density. The PDT feels the impounded sediment is in its loose state and the baseline estimate was based on in-situ Loose Cubic Yards (LCY). But, there is a possibility for increased quantities based on potential swell factors. The PDT feels the quantities are appropriate and material swelling will not be an issue (Unlikely to happen), but if the material does swell it will add large costs (Significant impact) and delay the schedule.
- ES-6: Disposal Site Changing - Concern of an alternative disposal site for the removed sediment. Risk could present an opportunity if a closer or cheaper alternative disposal site is identified. Currently, gravel-rich and clay/silt-rich material amount to ~60% of the total sediment volume and it is disposed at the closest landfill, the Calabasas Landfill. Disposal fees are high at the landfill. Worst case scenario is for the landfill capacity to pose an issue.

Sand-rich material amounts to ~40% of the total sediment volume and it is hauled to Ventura Harbor. Harbor availability for sediment transfer from truck to barge may pose a risk, also.

- ES-3: Dewatering - Preliminary estimate is subject to change based on pump test results and yearly replacement of dewatering platforms and instrumentation. Cost and schedule are very likely to change.
- RG-3 – Wildlife/ESA - Concern of greater schedule delays associated with other species (IEPR concern). Red legged frogs, monitoring and relocation. Steel head relocations concerns are captured in the estimate. Some isolated areas in the construction zone, possible relocation outside the project footprint. This risk affects mostly the Upstream Barriers (Red legged frogs). Worst case scenario involves finding an endangered species at the dam site, at the beginning of the season, pre-construction, or during construction and resulting delays. At the upstream barriers sites the weight of the risk is higher, but this work is not on the project critical path.
- PM-1: Insufficient Funding - Project may be funded on some years, but we are not certain that the project will be funded the amount it is requesting or skip a year. Project may be terminated if it doesn't receive funding. Impact on project resourcing and sequencing. Required appropriations are large for each contract. Currently, the project is broken down into 3 contracts.

Table 3. Construction Cost Comparison Summary (Uncertainty Analysis)

Most Likely Cost Estimate	**$187,603,000**		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	**$238,255,810**	**$50,652,810**	**27.00%**
10%	**$251,388,020**	**$63,785,020**	**34.00%**
20%	**$255,140,080**	**$67,537,080**	**36.00%**
30%	**$258,892,140**	**$71,289,140**	**38.00%**
40%	**$260,768,170**	**$73,165,170**	**39.00%**
50%	**$262,644,200**	**$75,041,200**	**40.00%**
60%	**$264,520,230**	**$76,917,230**	**41.00%**
70%	**$266,396,260**	**$78,793,260**	**42.00%**
80%	**$269,603,320**	**$82,159,320**	**44.00%**
90%	**$273,900,380**	**$86,297,380**	**46.00%**
100%	**$288,908,620**	**$101,305,620**	**54.00%**

Table 4. Construction Schedule Comparison Summary (Uncertainty Analysis)

Most Likely Schedule Duration	132.1 Months		
Confidence Level	**Project Duration**	**Contingency**	**Contingency %**
0%	**171.7 Months**	**39.6 Months**	**30.00%**
10%	**195.5 Months**	**63.4 Months**	**48.00%**
20%	**200.8 Months**	**68.7 Months**	**52.00%**
30%	**204.8 Months**	**72.7 Months**	**55.00%**
40%	**208.7 Months**	**76.6 Months**	**58.00%**
50%	**211.4 Months**	**79.3 Months**	**60.00%**
60%	**215.3 Months**	**83.2 Months**	**63.00%**
70%	**218.0 Months**	**85.9 Months**	**65.00%**
80%	**223.2 Months**	**91.1 Months**	**69.00%**
90%	**228.5 Months**	**96.4 Months**	**73.00%**
100%	**257.6 Months**	**125.5 Months**	**95.00%**

7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

The CSRA study serves as a "road map" towards project improvements and reduced risks over time. Timely coordination and risk resolution between the Sponsor and USACE is needed in areas of ROW, site access and staging, and funding needs and updates as applicable. The PDT must include the recommended cost and schedule contingencies and incorporate risk monitoring and mitigation on those identified risks.

Further iterative study and update of the risk analysis throughout the project life-cycle is important in support of remaining within an approved budget and appropriation.

Risk Management: Project leadership should use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

				Project Cost			Project Schedule		
CREF	**Risk/Opportunity Event**	**Risk Event Description**	**PDT Discussions on Impact and Likelihood**	**Likelihood ©**	**Impact ©**	**Risk Level ©**	**Likelihood (S)**	**Impact (S)**	**Risk Level (S)**
Organizational and Project Management Risks (PM)									
PM1	Insufficient funding	Fed projects are subject to annual appropriations. Non-Federal Sponsor also has competing budgetary priorities.	Project may be funded on some years, but we are not certain that the project will be funded the amount it is requesting or skip a year. Project may be terminated if it doesn't receive funding. Impact on project resourcing and sequencing. Required appropriations are large for each contract. Currently, the project is broken down into 3 contracts; breaking out the project into 3 contracts lessens the impact. Federal Funding Issues. All Fed projects are subject to annual appropriations, which are a function of budget priorities. Currently, ecosystem restoration projects are considered a lower priority than flood and coastal storm risk management and deep draft navigation. The project must also compete with other ER projects nationwide for funding. Given these conditions, there is uncertainty regarding the potential annual funding that will be allocated for this project. Non-Federal Funding Issues. The NF Sponsor is responsible for providing all LERRD for the project as well as a significant cash contribution (estimated at over $57 million). Completion of the project will depend on the NF Sponsor providing their cash contributions in a timely manner to match the federal share and the provision of LERRD as necessary to maintain project schedules. The NF Sponsor has provided a Statement of Financial Capability, but also has competing budgetary priorities which may vary from year to year through completion of the Project. Risk carries significant impact on cost and schedule.	Likely	Significant	**High**	Likely	Significant	**High**

PM2	Internal Red Tape	New requirements for review (ATR, IEPR, etc.) may cause delays in the project schedule.	New guidance processes have been assimilated and policy is better understood and budgeted. Estimate accounts for additional review costs. Having to delay the project phases, potential new requirements (changes in process) may cause inefficiencies but impacts to cost and schedule are minimal.	Possible	Marginal	**Low**	Possible	Marginal	**Low**
PM3	Scope Confidence of U/S Barriers	Concern regarding adding additional features	From a civil perspective the PDT doesn't see a major change in scope. Scope changes may encompass: (1) a reduction in cost by having the U/S Barriers Lost Hills Rd Culvert (LV3) and Meadow Crk Lane Crossing (LV4) built by someone else; (2) an increase in cost due to night trucking could be a possibility, but it is unlikely because the owner of the road wants work to stop by 3 PM; (3) additional EIS requirement is very unlikely. A design change, such as night trucking allowance, could cause a variance to the contract cost and schedule.	Possible	Significant	**Medium**	Possible	Significant	**Medium**
PM4	Inadequate Staffing	Resources in PM, Design, Geotechnical, Economics, and Construction are currently overloaded in terms of workload and priorities.	The PDT has been performing well. However, there are many competing demands. The COE may reach out to AE firms to help out reducing the staffing risk, but the schedule may be affected by unavailability of key members.	Possible	Marginal	**Low**	Possible	Moderate	**Medium**
PM5	Continuing Contract Clause	If each multi-year construction contract is not fully funded, the Continuing Contract Clause will need to be exercised to make subsequent year's award.	A continuing contract permits USACE to obligate the government to the entire contract amount at award and fund the contract incrementally until completion. If the initial construction is not fully funded, the Continuing Contract Clause will need to be exercised to make a subsequent years awards. The Standard Continuing Contract Clause increases the risk of contractors increasing their prices.	Possible	Moderate	**Medium**	Unlikely	Marginal	**Low**

Contract Acquisition Risks (CA)									
CA1	Numerous Separate Contracts	If optimal funding was received, then there would be fewer contracts required. However, increasing the number of contracts may change conditions downstream of the dam.	Current estimate is based on three (3) fixed-price contracts. Number of contracts will impact cost and schedule. The current breakdown and estimate assumes a reasonable approach to the number of contracts. However, less than optimal funding would increase the number of contracts (possibly one contract per year) and change the conditions downstream of the dam. Resulting cost impacts involve additional Engineering and Design costs. Schedule risk are possible but marginal in magnitude.	Possible	Critical	**High**	Possible	Marginal	**Low**
CA2	Inefficient Contractor	There is a possibility that a new contractor obtains one of the contracts and is unable to perform the work.	The nature of this type of work makes this likely. However, there are a lot capable contractors in the area that are experienced and the work is not complex. The Contractor has to coordinate with many different entities. It is likely we will go open-bid because of the nature of the work. Construction entails traditional earth moving equipment, but it is tricky to work in constrained space at the bottom of the canyon. Worst case scenario: we get 1 bad contractor and have to add 1 new contract (1 year delay).	Likely	Marginal	**Medium**	Likely	Moderate	**Medium**
CA3	Hauling Contractors	Numeorus hauling time restrictions	This may or may not come to play in this project. Reduced number of prospective bidders due to job time restrictions. Hauling restrictions such as limiting hauling time to 5-6 hours per day may affect/reduce the number of prospective bidders and/or inflate cost. The estimate accounts for hauling time restrictions, however, schedule costs can be impacted.	Possible	Marginal	**Low**	Possible	Moderate	**Medium**

General Technical Risks (TR)									
TR1	Piuma Bridge Weight Limitations	The local agencies have expressed concern regarding weight limitations on Piuma Bridge along Malibu Canyon Road.	The Malibu Canyon Rd Bridge does not have any weight restriction sign postings and based on our data from the Bridge Capacity System the bridge is rated as PPPPP which means that it is rated to withstand significant truck loads. Risk is not modeled for impact to this project in terms of cost and schedule. Emails from the Sponsor and the County indicate this risk is minimal.	Unlikely	Marginal	**Low**	Unlikely	Marginal	**Low**
TR2	Slope Stabilization / Landslides	Concerns of landslides during and after excavation. Construction-related impacts to earth resources, through movement of earth by heavy equipment, would result in potential destabilization and erosion of soils in the vicinity of construction activities at and adjacent to Rindge Dam, in the area of accumulated sediment upstream of the Dam, and in constructed access roads and staging areas, and at the disposal sites	Destabilization effects to Malibu Canyon Road could expose people and structures to potential substantial adverse effects due to landslides and slope instability if not mitigated. Soil stabilization methods may be required on side slope below Malibu Canyon Road following excavation of sediment. Continuous monitoring/confirmatory test may be required. The costs associated with remediation of landslide concerns during construction are difficult to predict due to the limited understanding of the actual geologic conditions and the scope of necessary remediation. Some uncertainties/unknowns better addressed during PED - field investigations. The question remains, how do we take into consideration field investigations moving forward during construction? We will characterize the field conditions in the future during PED, but it does not reduce the risk. We are reducing the uncertainty by doing testing. We might learn during after testing and investigation are conducted that cost and schedules will increase. The County commented about possible failure of the access ramps. The toe has been eroded by stream flow.	Possible	Critical	**High**	Possible	Critical	**High**

TR3	Beach Compatibility Not an issue for the LPP - only potential for the NER	Material distribution versus placement site may be altered. Sand-rich layer may be beach compatible or non-beach compatible.	Risk captures the uncertainty of the material going to where we are envisioning. In particular, the sand-rich layer. Worst case scenario would be for the sand sediment being non-beach compatible. Applicable to NER because of grain size, we did the field testing and had a prior consultant (Lou Crandle?) we have good characterization to give us confidence on what this material looks like, came out clean for multiple uses (on land and shoreline placement). There might be variation, gradation has been reviewed by SCDMMT and we're high and fine buit not too fine, we can put it on the beach. If we place the material near shore, ocean currents will remove the fine grained fraction. Greater risk going with beach placement vs shoreline placement. LPP: unlikely & negligible NER (cost and schedule): possible & moderate (material sorting or diversion required). Risk is captured under Risk ES6 (Disposal Site Changing)	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
TR4	Roads Repair	In the vicinity of the ramps themselves, fully loaded trucks could induce wear and tear	Roadway repair is variable and has been considered. Other work such as flagging and dust control was estimated in accordance with time frames. Malibu Canyon Road and Pacfic Coast Hwy, etc... trucking is a small percentage of the overall traffic. The risk of causing any damage is small (LA County). We will develop a road repair plan for the disturbed areas. Impacted areas will be the site ingress and egress points.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
Lands and Damages (LD)									
LD1	Utility Impacts	Investigations have identified a high pressure gas line, overhead power line, and a water line which are public utilities. However, one water line which was identified as needing to be relocated is owned by the homeowner's association. Currently it is anticipated the sponsor will coordinate with the homeowner's association to address the waterline as part of the relocation of the affected bridge.	This would not have a cost impact, but historically has impacted the schedule. This associated with the U/S Barriers relocations.	Unlikely	Negligible	**Low**	Likely	Marginal	**Medium**

LD2	LERRDS Acquisition	Schedule delays relating to LERRDS acquisition with upstream barriers.	Cold creek, homeowners association, CC2 and CC3 uncertainties on community reaction (potentially litigious). Potential delays in acquiring easements. Depending on the inconvenience of construction, potential delay in schedule. We have some room to absorb impacts and delays because this is not on the critical path. Homeowner association likely favors bridge replacement but legal issues/challenges still possible.	Possible	Moderate	**Medium**	Possible	Negligible	**Low**
LD3	State Land Permits -Site F Not an issue for the LPP - only potential for the NER	Not a risk because sponsor owns real estate for Site F. Exclude from the risk analysis.	Do not model in the risk analysis.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
LD4	Ventura Harbor Permit LPP - only	In the LPP, it describes trucking sediment to barges at Ventura Harbor for beach placement by Malibu pier. These effort need to be coordinated with Ventura Port District	This may not have an impact to costs, but unforeseen circumstances may impact the schedule.	Unlikely	Negligible	**Low**	Possible	Moderate	**Medium**

Regulatory Environmental Risks (RG)									
RG1	Traffic Impacts Not an issue for the LPP - only potential for the NER	Work in this area will be lengthy and extensive, so this will result possible impacts and aggravation due to congestion. DOT involvement will be important is moving forward.	The PDT feels that the costs associated with this issue has been adequately captured in the cost estimate. May have to conduct a traffic plan that requires review (may require a traffic engineer). Exiting the site into traffic will affect (NER: Malibu Canyon & PCH). Cost and Schedule impacts will be resolved during PED. We will develop a traffic plan.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
RG2	Nesting Birds	Concern of greater cost buffer associated with the nesting bird item (IEPR concern).	Based on recent surveys of the entire work area there is suitable nesting habitat on a lot of the canyon slopes. Thus, there is some likelihood that a nest may come into play in an adjacent un-grubbed area that we need to buffer away from. We always commit to come in before nesting season and remove nests. Minor costs and schedule delays are expected.	Very Likely	Negligible	**Low**	Very Likely	Negligible	**Low**

RG3	Wildlife/ESA	Concern of greater schedule delays associated with other species (IEPR concern).	Red legged frogs, monitoring and relocation. Steel head relocations concerns are captured in the estimate. Some isolated areas in the construction zone, possible relocation outside the project footprint. This risk affects mostly the Upstream Barriers (Red legged frogs). Worst case scenario involves finding an endangered specie at the dam site, at the beginning of the season, pre-construction, or during construction and resulting delays. At the upstream barriers sites the weight of the risk is higher, but this work is not on the project critical path.	Possible	Negligible	**Low**	Possible	Significant	**Medium**
RG4	Water Turbidity	Potential for increased turbidity during the winter season during and immediately after the construction season due to sediment at cleared excavation areas not being vegetated and being exposed to flow of water.	Permit requires project life water turbidity monitoring; not just during active construction. There is a potential of increased turbidity if there is a long lapse between one contract to the next. Runoff and construction dust will also increase turbidity (surface water). Water Board Permit is required. There is weekly testing of water quality to account for increase in turbidity. Extended time between contracts and during high flow events the BMPs will need to be updated. Increased turbidity would be similar to turbidity levels under larger storm events. These impacts are adverse but will be temporary, seasonal and limited in duration. The PDT feels that water turbidity risks increase at the dam site, but costs will be negligible. The schedule is not impacted.	Likely	Negligible	**Low**	Unlikely	Negligible	**Low**
RG5	Increased run-off during construction seasons	Additional sediment from the site may be transported downstream. One or several storms require rapid (and partial) demobilization from the Dam area. Established access ramps and diversion/control of water may be impacted.	Damage not likely to be significant during construction cycles, but storm runoff can possibly wash away temporary infrastructure for access and affect establishment of dewatering wells, Cost and schedule may increase to conduct repairs. If there is a delay in award of the next construction contract, risks of this scenario occurring increase. Downstream impacts to the environment include sediment deposition and additional water turbidity.	Possible	Significant	**Medium**	Possible	Significant	**Medium**

RG6	Post-Review Discoveries (Cultural Artifacts/Human Remains)	The Santa Monica and Malibu coastal areas represent one of the most intensely studied archeological regions in the state of California. Cultural artifacts may be found during excavation requiring mining/other construction activities to be temporarily suspended.	Finding cultural artifacts during excavation may delay the construction schedule while appropriate consultation measures and removal of artifacts occur. Greater chance of finding artifacts or human remains at upland barriers and temporary stockpile areas. Cost impacts are low, In a worst case scenario, construction work could stop up to 30 days around a specified buffer zone, but remaining areas will stay open for the contractor to continue working. Overall schedule delays are negligible.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
Construction Risks (CO)									
CO1	Dam Arch Stability	Arch safety risk during demolition	Arch demolition occurs together with the sediment removal operations. The number, size, and locations of arch cut-off notches coincide with the sediment removal; as the sediment is removed the arch demolition proceeds. We reduce the risk because we are keeping the static load behind the arch constant; a dynamic load is not imparted on the arch.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
CO2	Debris Flow Risk	During construction a natural plateau or bench will temporarily exist during excavation. The debris plateau refers to the difference in height of remaining impounded sediment vs. remaining dam arch. This is not "debris" in terms of trash, but all impounded material trapped behind the arch.	Sediment volume calculations/quantities are likely to change due to the intermittent nature of the construction sequence. Sediment removal is not continuous. Sediment removal cost and schedules are possibly impacted. During the construction scenario, we get the dam cut down first (in stages) ahead of sediment removal. Possibility, not covered. Risk could occur. Rain event could create ponding behind the dam, becomes a jurisdictional condition (DSOD). However, construction is taking place outside the raining season. Removing the arch and mining the sediment in the same time frame is staged, but leaves the possibility of "debris flow" for that exposed volume of sediment. Risk may have downstream effects (turbidity, swamp road crossings, consultation with ESA) because it's an uncontrolled release of flow. Risk may result in emergency actions, but no project shutdown.	Possible	Moderate	**Medium**	Possible	Moderate	**Medium**

CO3	Constant Water Effluent	Concern with constant water effluent from upstream water treatment plant may affect current soil properties	Water effluent may create super-saturated sediment conditions in the excavation area. The sediment removal site may require additional time for drying-out before hauling off. Water effluent will continue to be discharged, but it is controlled by continual dewatering operations and diversion of water. Risk event is already accounted in the cost and schedule as removal of damp material. The PDT feels that additional risks associated with different soil properties are low.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
CO4	Soil Contaminants	Malibu Creek could be contaminated with trash and other pollutants	The effect of this impact is expected to be minor due to the proposed construction in the dry. BMPs will be in place to further reduce the risk of spills. Due diligence has been taken in determining field conditions. An upstream watershed survey was conducted for historic use/environmental contaminants risks and gave favorable results. Cost and Sch risks associated with soil contaminants are unlikely and negligible.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
CO5	Access Road Re-construction	Re-construction of slope may pose difficulties.	Slope stability during Access Road Construction may increase the costs and cause delays. After the 1st year, the current estimate assumes 25% of the initial volume is required to rebuild the ramps on sub-sequent years. Worst case scenario would represent rebuilding the complete ramp. Representing a cost increase of $1M per re-construction year.	Possible	Moderate	**Medium**	Unlikely	Negligible	**Low**
CO6	Variation in Quantities	Concern with sediment removal quantities accuracy and dam removal quantities.	There is inherent risk of under runs and overruns, but the quantities will most likely fall within the VEQ range. The PDT does not know the exact configuration of the buried canyon walls.	Very Likely	Moderate	**High**	Very Likely	Moderate	**High**

C07	Impact on Private Property	Concern from landslides	Outside of the footprint of the dam. If we have a landslide that occurs with the removal of the dam, it will impact private property. There is a landslide that is a mile long, private property 3 miles away, landslides can go up to the ridgeline. Issues of landslide remains. Risk is an existing condition but conditions might be worsened due to construction activities. We haven't done the mapping, it might be eliminated. We don't know the extent of landslides in the area. Purchase land would be cheap. This risk in already accounted under (TR2) Slope Stabilization / Landslides	Possible	Marginal	**Low**	Possible	Negligible	**Low**
C08	Claims/Modifications	This item captures the risk that post-award construction modifications or claims may cause a variance to project cost and schedule.	Possible claims and modifications may rise affecting the cost and/or causing schedule delays.	Very Likely	Moderate	**High**	Very Likely	Moderate	**High**
Estimate and Schedule Risks (ES)									
ES1	Upstream Barriers Costs	Concern on limited level of design	Cost relocations are representative of the limited level of design. The costs of the relocations could therefore change as the design changes.	Likely	Marginal	**Medium**	Unlikely	Negligible	**Low**
ES2	Diversion and Control of Water	Assumptions regarding amount of water to divert may change	Variations in flows are likely. Diversion and control of water cost are highly likely to be impacted. Estimate assumes an average discharge for the stream. Schedule impacts would be low.	Likely	Marginal	**Medium**	Likely	Negligible	**Low**

ES3	Dewatering	Dewatering design is typically left to the contractor.	Estimate was developed with assistance from a dewatering contractor. However, preliminary estimate is subject to change based on pump test results and yearly replacement of dewatering platforms and instrumentation. Cost and schedule are very likely to change.	Likely	Marginal	**Medium**	Likely	Marginal	**Medium**
ES4	Sediment Hauling	Areas can incur times of high traffic and congestion.	Estimates on hauling productivity are likely to change causing cost and schedule impacts.	Likely	Marginal	**Medium**	Likely	Significant	**High**

ES5	Additional Vegetation Clearing	Vegetation density will increase from current state.	In the last few years, vegetation in the area has significantly matured. By the time clearing and grubbing operations take place, vegetation density may double. Cost and schedule are likely impacted.	Likely	Significant	**High**	Likely	Significant	**High**
ES6	Disposal site changing	Concern of an alternative disposal site for the removed sediment.	Risk could present an opportunity if a closer or cheaper alternative disposal site is identified. Currently, the gravel-rich and clay/silt-rich sediment is disposed at the closest landfill -- the Calabasas Landfill. Disposal fees are high. Worst case scenario is for the landfill capacity to pose an issue. On the LPP Alt., the Ventura Harbor availability for sediment tranfer from truck to barge may pose a risk. Risk occurrence is unlikely, but cost impacts would be significant.	Unlikely	Significant	**Medium**	Unlikely	Significant	**Medium**

ES7	Soil Parameters	Uncertainty on actual soil properties (% swell).	Civil and geotechnical design assisted in the development of quantites. Geotech believes reasonable quantity estimates were developed. Geotechnical investigations and Soil Penetration Tests (SPT) were performed on the impounded sediment within the last few years. Blow count tests indicated soil properties with extremely low relative density. The PDT feels the impounded sediment is in its loose state and the baseline estimate was based on in-situ Loose Cubic Yards (LCY). But, there is a possibility for increased quantities based on potential swell factors. - PDT feels the quantities are appropriate and material swelling will not be an issue (Unlikely to happen), but if the material does swell it will add large costs (Significant impact) and delay the schedule.	Very Likely	Moderate	**High**	Very Likely	Moderate	**High**
ES8	Productivity Lessens as Mining Progresses	The surface area/work zone for mining sediment upstream of Rindge Dam will diminish as more of the canyon slopes are exposed. Space to divert/control water, have dewatering wells, mine sediment, etc… will affect daily and annual productivity.	The PDT has already considered diminishing productivity due to more limited work space in the schedule and cost estimates. Already accounted in the estimate and schedule by reducing productivity in the work zones, but productivity could still vary. Assume costs could be affected, but not the baseline schedule. Account for conservative assumptions, items that can be improved. Opportunities on improving production & construction efficiencies.	Likely	Marginal	**Medium**	Unlikely	Negligible	**Low**
ES9	PED and CM Cost Increase	Increase in PED and CM Costs (30 & 31 Accounts).	Project features are in the preliminary stages. This item captures the risk that the costs for PED and CM could increase from beyond the currently estimated cost.	Very Likely	Marginal	**Medium**	Likely	Marginal	**Medium**

External Risks (EX)									
EX1	Internal Low or not studied risks	This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule.	This item is added based on standard items noted as being required for all formal cost and schedule risk analyses, such as sufficient studies, based on forthcoming policy based on Agency Technical Review comment/resolution. This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule.	Likely	Marginal	**Medium**	Likely	Moderate	**Medium**
EX2	Tribal Politics	Tribal elections generally take place every 2-4 years depending on the Tribe. Changes in Tribal personnel may take place any time.	A change in Tribal politics may have an impact on external relations with USACE/CDPR and previously determined mitigation measures. Intertribal conflicts may have more of an impact. But, risk to the project cost and schedule are considered low.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
EX3	Political/Legal Opposition	There are locals opposed to certain aspects. They could potentially attempt to file a suit against the project.	There remains the possibility that political opposition/legal opposition could delay the project or any individual event. It could also create a delay in the activities as well (2+ years).	Possible	Marginal	**Low**	Possible	Critical	**High**

Malibu Ecosystem Restoration - LPP

Remove Rindge Dam concrete arch over 8 years concurrent with removal of impounded sediment, restoring aquatic habitat connectivity while minimizing downstream adverse impacts to habitat and flood risk. Remove the dam spillway to lessen potential habitat disturbance, improve safety, and for aesthetic purposes.

Remove Rindge Dam concrete arch and spillway over 8 years concurrent to removal of impounded sediment.
Truck sand sediment to Ventura Harbor and barge to Malibu for near-shore placement.

Estimated by	Juan Dominguez, PE, CCE
Designed by	Los Angeles District
Prepared by	Cost Engineering, Los Angeles District
Preparation Date	1/30/2020
Effective Date of Pricing	10/1/2019
Estimated Construction Time	Days

Designed by	Los Angeles District
Estimated by	Juan Dominguez, PE, CCE
Prepared by	Cost Engineering, Los Angeles District

Design Document	Feasibility
Document Date	4/26/2016
District	Los Angeles District
Contact	Juan Dominguez, x3737
Budget Year	2020
UOM System	Original

Direct Costs

LaborCost
EQCost
MatlCost
SubBidCost

Timeline/Currency

Preparation Date	1/30/2020
Escalation Date	10/1/2019
Eff. Pricing Date	10/1/2019
Estimated Duration	0 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB16EN: 2016 MII English Cost Book

Labor 01LA20: Riverside, San Bernardino, Los Angeles County

ates. Fringes paid to the laborers may be fully or partially taxable. In a NON-UNION job, all the fringe benefits are taxable. In a UNION job, the vacation pay fringes is taxable an

Labor Rates

LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP16R07: MII Equipment 2016 Region 07

07 WEST

Sales Tax	7.95
Working Hours per Year	1,630
Labor Adjustment Factor	1.13
Cost of Money	2.13
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.112
Gas	3.420
Diesel Off-Road	3.370
Diesel On-Road	3.870

Shipping Rates

Over 0 CWT	28.91
Over 240 CWT	21.98
Over 300 CWT	18.50
Over 400 CWT	16.24
Over 500 CWT	19.65
Over 700 CWT	18.73
Over 800 CWT	10.52

Date	Author	Note

Description	Quantity	UOM	BareCost	DirectCost	CostToPrime	ProjectCost
Project Summary Report Level 2			**93,027,199**	**96,833,987**	**50,679,457**	**119,025,978**
06 Rindge Dam Demolition and Sediment Removal	**1.00**	**LS**	**93,027,199**	**96,833,987**	**50,679,457**	**119,025,978**
			4,039,244.49	*4,241,303.76*	*3,322,883.84*	*5,709,607.09*
0601 General Requirements (LPP)	**8.00**	**YR**	**32,313,956**	**33,930,430**	**26,583,071**	**45,676,857**
			74.27	*76.66*	*24.93*	*86.48*
0602 Sediment Removal (LPP)	**770,000.00**	**LCY**	**57,184,696**	**59,024,541**	**19,198,744**	**66,590,482**
			588.09	*646.50*	*816.27*	*1,126.44*
0603 Rindge Dam Arc and Spillway Demolition	**6,000.00**	**CY**	**3,528,548**	**3,879,016**	**4,897,642**	**6,758,639**

Description	Quantity	UOM	BareCost	DirectCost	CostToPrime	ProjectCost
Project Summary Report Level 4			**93,027,199**	**96,833,987**	**50,679,457**	**119,025,978**
06 Rindge Dam Demolition and Sediment Removal	**1.00**	**LS**	**93,027,199**	**96,833,987**	**50,679,457**	**119,025,978**
			4,039,244.49	*4,241,303.76*	*3,322,883.84*	*5,709,607.09*
0601 General Requirements (LPP)	**8.00**	**YR**	**32,313,956**	**33,930,430**	**26,583,071**	**45,676,857**
			3,180,000.00	*3,180,000.00*	*0.00*	*3,180,000.00*
PED Phase -- Installation Geotechnical Instrumentation and Data Management	**1.00**	**EA**	**3,180,000**	**3,180,000**	**0**	**3,180,000**
			8,048,319.67	*8,499,956.53*	*7,541,868.55*	*11,770,813.80*
0601 First Contract -- Veg Clearing, Initial Road Establishment. Associated with Arc, Spillway and Gravel Layer Removal ~ Upper 22 lf	**1.00**	**EA**	**8,048,320**	**8,499,957**	**7,541,869**	**11,770,814**
			4,620,331.13	*4,880,615.83*	*4,404,944.08*	*6,760,326.58*
General Requirements for 1st year of construction	**1.00**	**YR**	**4,620,331**	**4,880,616**	**4,404,944**	**6,760,327**
			3,427,988.53	*3,619,340.70*	*3,136,924.47*	*5,010,487.22*
General Requirements for 2nd year of construction	**1.00**	**YR**	**3,427,989**	**3,619,341**	**3,136,924**	**5,010,487**
			10,283,965.60	*10,858,022.09*	*9,410,773.40*	*15,031,461.67*
0601 Second Contract -- Associated with Arc, Spillway and Sand Layer Removal ~ Mid 40 lf	**1.00**	**EA**	**10,283,966**	**10,858,022**	**9,410,773**	**15,031,462**
			3,427,988.53	*3,619,340.70*	*3,136,924.47*	*5,010,487.22*
General Requirements for 3rd year of construction	**1.00**	**YR**	**3,427,989**	**3,619,341**	**3,136,924**	**5,010,487**
			3,427,988.53	*3,619,340.70*	*3,136,924.47*	*5,010,487.22*
General Requirements for 4th year of construction	**1.00**	**YR**	**3,427,989**	**3,619,341**	**3,136,924**	**5,010,487**
			3,427,988.53	*3,619,340.70*	*3,136,924.47*	*5,010,487.22*
General Requirements for 5th year of construction	**1.00**	**YR**	**3,427,989**	**3,619,341**	**3,136,924**	**5,010,487**
			10,801,670.67	*11,392,451.42*	*9,630,428.77*	*15,694,581.28*
0601 Third Contract -- Associated with Arc/Foundation, Spillway and Silt/Clay Removal ~ Lower 40 lf	**1.00**	**EA**	**10,801,671**	**11,392,451**	**9,630,429**	**15,694,581**
			3,427,988.53	*3,619,340.70*	*3,136,924.47*	*5,010,487.22*
General Requirements for 6th year of construction	**1.00**	**YR**	**3,427,989**	**3,619,341**	**3,136,924**	**5,010,487**
			3,427,988.53	*3,619,340.70*	*3,136,924.47*	*5,010,487.22*
General Requirements for 7th year of construction	**1.00**	**YR**	**3,427,989**	**3,619,341**	**3,136,924**	**5,010,487**
			3,945,693.60	*4,153,770.03*	*3,356,579.84*	*5,673,606.83*
General Requirements for 8th year of construction	**1.00**	**YR**	**3,945,694**	**4,153,770**	**3,356,580**	**5,673,607**
			74.27	*76.66*	*24.93*	*86.48*
0602 Sediment Removal (LPP)	**770,000.00**	**LCY**	**57,184,696**	**59,024,541**	**19,198,744**	**66,590,482**

Description	Quantity	UOM	BareCost	DirectCost	CostToPrime	ProjectCost
			74.27	*76.66*	*24.93*	*86.48*
0601 LPP -- Haul / Barge Alternative - Haul to Ventura Harbor and Barge to Malibu for nearshore placement	**770,000.00**	**LCY**	**57,184,696**	**59,024,541**	**19,198,744**	**66,590,482**
			15,465,654.27	*15,646,604.39*	*1,967,199.00*	*16,394,097.03*
0601 First Contract -- Gravel Rich Material	**1.00**	**EA**	**15,465,654**	**15,646,604**	**1,967,199**	**16,394,097**
			10,561,830.53	*11,734,569.35*	*12,005,407.84*	*16,567,200.50*
0601 Second Contract - Sand Rich Material	**1.00**	**EA**	**10,561,831**	**11,734,569**	**12,005,408**	**16,567,200**
			31,157,210.79	*31,643,366.78*	*5,226,137.07*	*33,629,184.67*
0601 Third Contract - Clay/Silt Material	**1.00**	**EA**	**31,157,211**	**31,643,367**	**5,226,137**	**33,629,185**
			588.09	*646.50*	*816.27*	*1,126.44*
0603 Rindge Dam Arc and Spillway Demolition	**6,000.00**	**CY**	**3,528,548**	**3,879,016**	**4,897,642**	**6,758,639**
			887,430.67	*975,836.61*	*1,234,461.88*	*1,703,530.42*
0601 First Contract in concurrence with sediment removal - Arc and Spillway Demo	**1.00**	**EA**	**887,431**	**975,837**	**1,234,462**	**1,703,530**
			682.49	*752.74*	*955.78*	*1,318.96*
0601 Rindge Dam ARC Demolition	**800.00**	**CY**	**545,996**	**602,188**	**764,627**	**1,055,169**
			512.67	*561.03*	*705.46*	*973.52*
0601 Rindge Dam SPILLWAY Demolition (assume 1/3 of the total volume)	**666.00**	**CY**	**341,435**	**373,648**	**469,835**	**648,361**
			1,214,869.88	*1,337,302.23*	*1,690,773.54*	*2,333,230.54*
0601 Second Contract in concurrence with sediment removall - Arc and Spillway Demo	**1.00**	**EA**	**1,214,870**	**1,337,302**	**1,690,774**	**2,333,231**
			656.72	*724.55*	*918.00*	*1,266.82*
0601 Rindge Dam ARC Demolition	**1,330.00**	**CY**	**873,435**	**963,654**	**1,220,939**	**1,684,869**
			512.67	*561.03*	*705.46*	*973.52*
0601 Rindge Dam SPILLWAY Demolition (assume 1/3 of the total volume)	**666.00**	**CY**	**341,435**	**373,648**	**469,835**	**648,361**
			1,426,247.22	*1,565,877.62*	*1,972,406.95*	*2,721,878.49*
0601 Third Contract in concurrence with sediment removall - Arc, Foundation and Spillway Demo	**1.00**	**EA**	**1,426,247**	**1,565,878**	**1,972,407**	**2,721,878**
			636.79	*701.88*	*888.88*	*1,226.64*
0601 Rindge Dam ARC Demolition	**1,330.00**	**CY**	**846,937**	**933,504**	**1,182,214**	**1,631,429**
			440.51	*479.12*	*593.26*	*818.68*
0601 Concrete ARC FOUNDATION Demolition	**540.00**	**CY**	**237,875**	**258,726**	**320,358**	**442,088**
			512.67	*561.03*	*705.46*	*973.52*
0601 Rindge Dam SPILLWAY Demolition (assume 1/3 of the total volume)	**666.00**	**CY**	**341,435**	**373,648**	**469,835**	**648,361**

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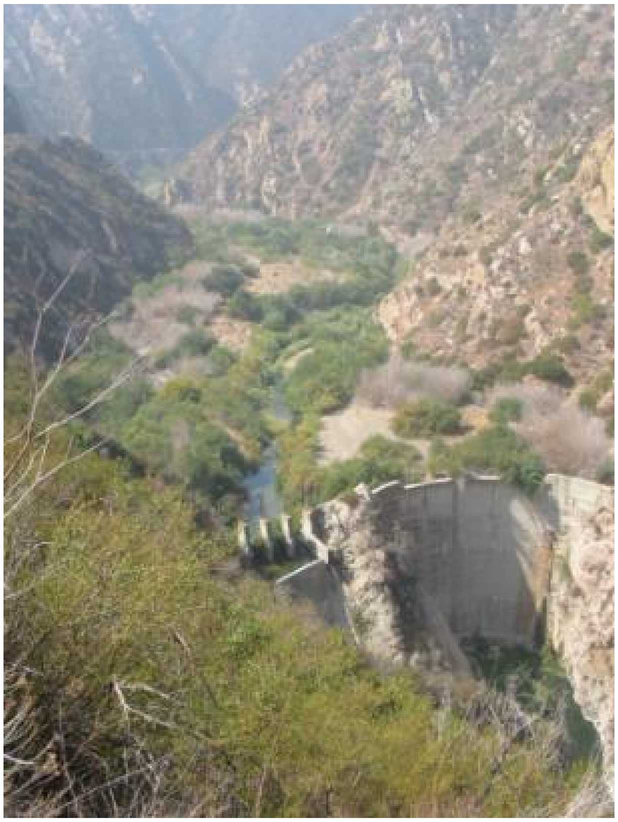
Malibu Creek Ecosystem Restoration Project

Los Angeles and Ventura Counties, California

NER

Cost Engineering



U.S. Army Corps of Engineers
Los Angeles District

November 2020

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1.0 INTRODUCTION

This Appendix presents the assumptions and construction methodologies used on the National Ecosystem Restoration (NER) alternative for the Malibu Creek Ecosystem Restoration Feasibility Study.

The NER alternative includes the demolition, removal, and disposal of the arch as well as removal for the sediment currently impounded by the Rindge Dam. Spillway demolition is not included in the scope of work. Additionally, the NER alternative considers the enhancement of seven (7) existing upstream barriers to allow passage of fish and other wildlife.

The study area is located about 30 miles (mi) west of the city of Los Angeles. Approximately 2/3 of the 109 sq. mi watershed is located in the northwest portion of the Los Angeles County area and the remaining 1/3 is in Ventura County. Malibu Creek Watershed is within the Santa Monica Mountains, in a mix of urban development and open space. Malibu Creek drains into Malibu Lagoon and Santa Monica Bay.

Malibu Creek drains 109 sq. mi of the Santa Monica Mountains, where the reach from Malibu Lagoon to Malibu Dam is 10 mi Rindge Dam, built in the 1920’s, is located about 2 mi upstream from the confluence with the Pacific Ocean. The dam is a concrete arch structure 108 feet (ft) in height with an arc length of 140 ft at its crest (excluding spillway & rock outcrop) and 80 ft at its base. The dam is 2 ft thick at the crest and 12 ft thick at the base. 60-lb steel railroad ties run horizontally and vertically throughout the dam and serve as reinforcement for the structure. The height from the top of the arch structure to bedrock is approximately 117 ft. The top of dam elevation is approximately 298 ft.

A gated spillway was built in a rock outcrop on the western side adjacent to the arch dam abutment. The spillway had four radial gates, each measuring 11 ft high by 8 ft wide.

Rindge Dam is the largest disruption to stream flow and aquatic and terrestrial habitat connectivity on Malibu Creek between Malibu Dam and the Pacific Ocean. The dam creates a barrier to the endangered steelhead trout's spawning ground upstream of Malibu Creek. Currently, the geotechnical assessment estimates that 780,000 cubic yards (cy) of sediment is impounded behind the dam. The impounded sediment is defined as three distinct layers. The extent of the impounded sediment area is presented in **Figure 1.1-1**. The uppermost layer (Unit 1) is composed of fluvial deposition, which contains sand, gravel, cobbles and larger rocks and is the layer that continues to erode and aggrade during storm events with overall increases in deposition occurring in the future. The sand-dominant (Unit 2) sediment, which underlies Unit 1, comprises nearly half the total volume of impounded sediment and contains about 73 % sand, 22% silt, and 5% gravel and rock. Unit 2 sediment is likely source of beach nourishment. Unit 2 is underlain by a silt-clay dominant layer (Unit 3).

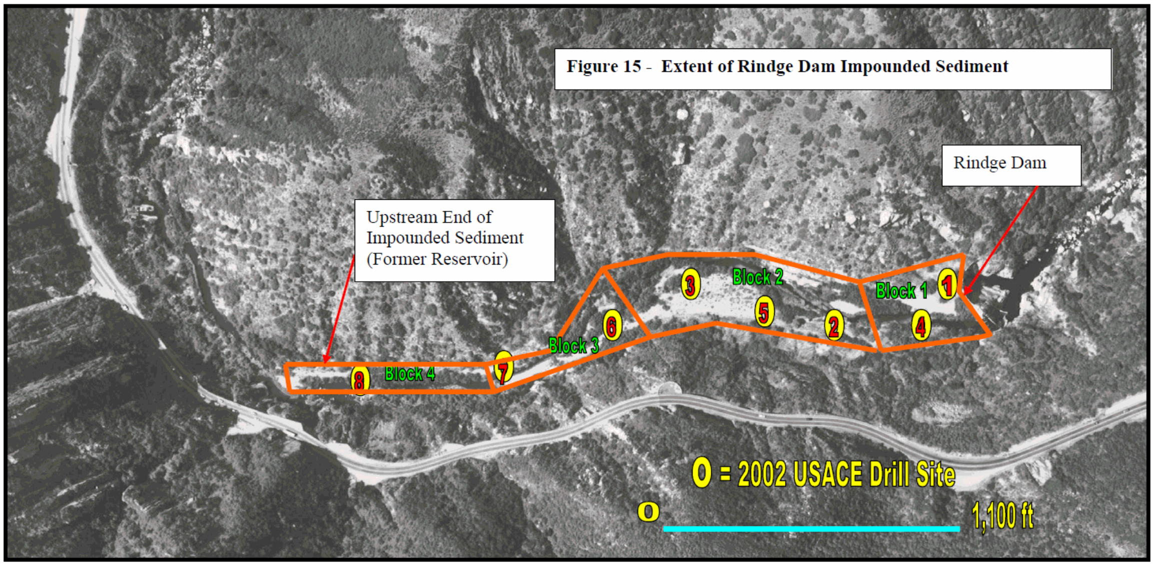

Figure 1.1-1 Extent of Rindge Dam Impounded Sediment

The study objectives are listed in the main report; please refer to the main report for information regarding study objectives.

The sediment behind the dam could be used to nourish downstream beaches in the City of Malibu and elsewhere in the Los Angeles (LA) County.

Most storms in the Southern California coastal area are of the general winter type, with hours of light to moderate steady precipitation, but with occasionally heavy showers or thunderstorms embedded. Local thunderstorms can occur in southern California at any time of the year, but are least common and least intense during the late spring. Most of the major flood events in the history of Southern California have been the result of general winter storms.

The study area of Malibu Creek is undeveloped through the canyon reaches, but the creek is narrow and steep. In the mountains, runoff concentrates quickly from the steep slopes; hydrographs show that the stream flow increases rapidly in response to effective rainfall. High rainfall rates, in combination with the effects of shallow surface soils, impervious bedrock, and fan shaped stream systems, steep gradients, and occasional denudation of the area by fire, result in intense debris-laden floods. Flows originating in the upper watershed flow through the lower canyon portion of the study area at high velocities, upstream and downstream of Rindge Dam. The bed slope decreases and the overbank area increases where Malibu Creek emerges from the canyon about a mile below Rindge Dam resulting in a reduction in flow velocities and a potential increase in sediment deposition.

1.1 NER Alternative (formerly Alternative 2d1): Dam Removal with Mechanical Transport (trucking transport)

This plan contributes to the primary study ecological restoration objective to restore the Malibu Creek ecosystem, (with some additional benefits to Las Virgenes Creek and Cold Creek), while maintaining downstream ecosystem and riparian management activities. This plan is expected to result in significant benefits to the ecosystem. The plan is to lower the dam height at the same rate as the impounded sediment is removed from behind the dam using mechanical means (excavators, bulldozers etc.) over a course of seven to seven (7) years, from April to October. During the remainder of the year, work on the project ceases due to city and environmental limitations.

The first year of the project is dedicated to site prep: clearing, dewatering and ramp construction. The dam and the sediment from behind the dam will be removed over a 6 year time span. Construction will be limited to outside the rainy season and the sediment removed from behind the dam will either go to down-coast of Malibu Pier or the Calabasas Landfill. Calabasas Landfill is open from 8 am – 5 pm Monday through Saturday and closed Sundays. All sediment will be removed with loaders and highway trucks. The last year the creek invert is stabilized and trimmed. Work will consist of rock placement and grading to create a series of pools and riffles to enhance the natural characteristic of the project area.

The sandy material may be used as beach nourishment material. Identified beach site is located down-coast of Malibu Pier. The sand is trucked from the Rindge Dam project site to the shoreline down-coast of Malibu Pier. Trucking includes use of temporary upland Site F and Malibu Pier parking area.

The Southern California Dredged Materials Management Team (SC-DMMT), which is the regulatory body that reviews and approves placement of dredged materials in ocean or on beaches, on February 27, 2013, agreed in concept to consider allowing both on-beach placement and near-shore placement of the impounds sand-rich layer, while recognizing that its 22% fines content is at the upper end of the maximum percentage of fines accepted for on-beach placement.

As per standard procedures, prior to any placement, transect sampling is required to verify gradation compatibility with both near-shore and on-shore placements; if sediment is shown to be compatible, regular, confirmatory gradation sampling of the material at the dam site also have to be done as the excavation proceeds, to assure the gradation remains within the tolerable range. In addition, any approved placement scenario will be subject to continued testing for unsuitable materials as excavation of the impound proceeds

Gravel and clay-silt layers have no interested end-users to date, and is modeled to be wasted in a landfill. It may be usable as a landfill daily cover, but there are no interested landfill managers within a reasonable hauling range.

2.0 RINDGE DAM AND SEDIMENT REMOVAL COST ESTIMATE BASIS

2.1 Unit Cost Basis

2.1.1 Direct Cost

Components of construction include the following five cost elements: labor, permanent materials, construction equipment, subcontracts, and contractor's expendable supplies. The key factors in determining the cost of each of these elements is the productivity of the work force and the construction equipment used to perform the various work activities. Productivity rates for the sediment excavation work were selected to reflect local weather, site conditions, work week hours, estimated volume, appropriate construction techniques, schedule sequencing, and experience gained on previous construction projects of similar nature.

Most costs were determined using databases for the individual components of labor, materials, and equipment. In some cases, costs from the bid tabulations of construction projects were selected to represent the actual cost of similar portions of this project. Where used, these historic values were escalated to dollar values and adjusted for economies of scale and other factors to provide an accurate reflection of the cost to do the work over the lifetime of the project. A third source of prices included commercially available construction cost data guides. Generally, costs were grouped for the most significant impact items, such as excavation, transportation of sediment, and concrete removal.

Labor rates used to develop the estimate were obtained from the latest Davis-Bacon Wage Rates for Los Angeles County, Heavy Construction.

Equipment rates are based on the Department of the Army EP 1110-1-8 “Construction Equipment Ownership and Expense Schedule”, Region 7.

Crews were developed for project specific applications and are listed in the crew database.

2.1.2 Quantity and Material Analysis

Sediment is assumed to be alluvial. The sediment is generally distributed in three layers. The upper layer predominantly consists of gravel, cobbles, and other rocks. The middle layer is predominantly sand. The bottom layer is mostly a combination of silt, sand and clay. The sediment distribution was simplified in the following breakdown show in **Table 2.1-1**.

Table 2.1-1 Sediment Distribution

Material Classification	Volumes
Rock/Gravel	200,000 CY
Sand	340,000 CY
Clay/Silt	230,000 CY
TOTAL	**770,000 CY**

Actual sediment volume available amounts to 780,000 CY. However, upstream 10,000 CY impounded material is narrow and thin; and it has no appreciable sand. This 10,000 CY is left in-place and eroded to grade naturally by the creek as recommended by the 2003 Geotechnical Impound investigation report. Therefore, the net sediment removal volume is 770,000 CY.

Based on consultation with USACE Geology, the impounded sediment will not swell upon excavation due extremely low relative density of the fine material, and the loose nature of the granular material. Geotechnical investigations and several Soil Penetration Tests

(SPT) performed upon the impounded sediment indicated deposit are very loose even at the deepest layers. All material is in Loose Cubic Yards (LCY).

2.1.3 Equipment Selection

Equipment selection and sizing were developed through cost engineer experience.

2.2 Real Estate

According to information provided by the Design Planning Report, the Calabasas Landfill can provide temporary storage for up to approximately 565,000 CY of roughly separated sand/cobble/gravel/boulder material for a ten-year period. The estimated time period is 2017-2027. Between 2017 and 2027, approximately 12 acres in stockpile area could be made available at the Calabasas Landfill for temporary storage. The site incurs costs associated with receiving this material, including dozer work associated with receiving the dirt, additional street sweeping and dust control.

2.3 Relocations

Relocations associated with the upstream barriers were estimated in detail by Cost Engineering.

2.4 Assumptions

2.4.1 Site Access/Preparation and Mobilization

The dam can be accessed through an existing, unpaved road off Malibu Canyon. Site access improvements are required for approximately 800 linear feet of temporary road for widening, as necessary, to accommodate construction traffic and for normal maintenance of the roadway surface and drainage culverts during the contract period. No other improvements are anticipated.

Temporary haul roads will be required to be established for excavation of the sediment material. Maximum grades should generally not exceed 15%. Mobilization and demobilization encompass the cost of transporting and setting up heavy pieces of equipment.

The current estimate considers constraints on construction activities for protection of threatened and endangered species.

Vegetation is cleared along the pioneer road, access maintenance road, and sediment removal area. Ground trees, trash, and areas difficult to access encompass 25% of the total area and they are manually cleared with brush-saws, track-hoes, and chippers. 75% of the total area is cleared with dozers and mulched.

The Sheriff’s Overlook is a small overlook area off the Malibu Canyon Road just south of the project site. During construction, Sheriff’s Overlook will be used as a staging and an oversight area for construction teams. A trailer for construction crews can be placed to provide optimal views of the dam deconstruction and truck and equipment routes to and from the construction site. Upon completion of construction activities, the trailer will be removed and any debris or equipment located at Sheriff's Overlook will be cleared from the area.

The cost estimate includes installation of guard rail fencing around the outlook and installing gravel for vehicles parking/roads.

Post construction, Sheriff's Overlook will remain a dirt turnout for vehicles driving along Malibu Canyon Road. Interruptive signs will be placed displaying images and facts about the history of the Rindge Dam.

The disposal site (Calabasas Landfill) is located 7.5 mi north of the project area. The LA County beach potentially receiving sand material from the project is approximately 5 miles from the dam.

Due to a lack of turnaround space available on the access road leading to the dam, two (2) ramps are constructed for truck traffic. One ramp will allow vehicles to travel northbound, towards the landfill, and the other allowing vehicles to travel southbound, towards the beach.

There is already an existing 12-ft wide ramp in the southbound direction, but it is in a state of disrepair. Repair of the existing ramp involves rebuilding the bottom area of the ramp (approximately 15,700 cy of fill) to a length of 1,000 ft. Additional work on the southbound ramp is required to allow for loaded truck traffic. The ramp is widened to 15 ft and reduced to a grade of 15%. Widening and re-grading the southbound ramp requires 55,000 cy of fill material.

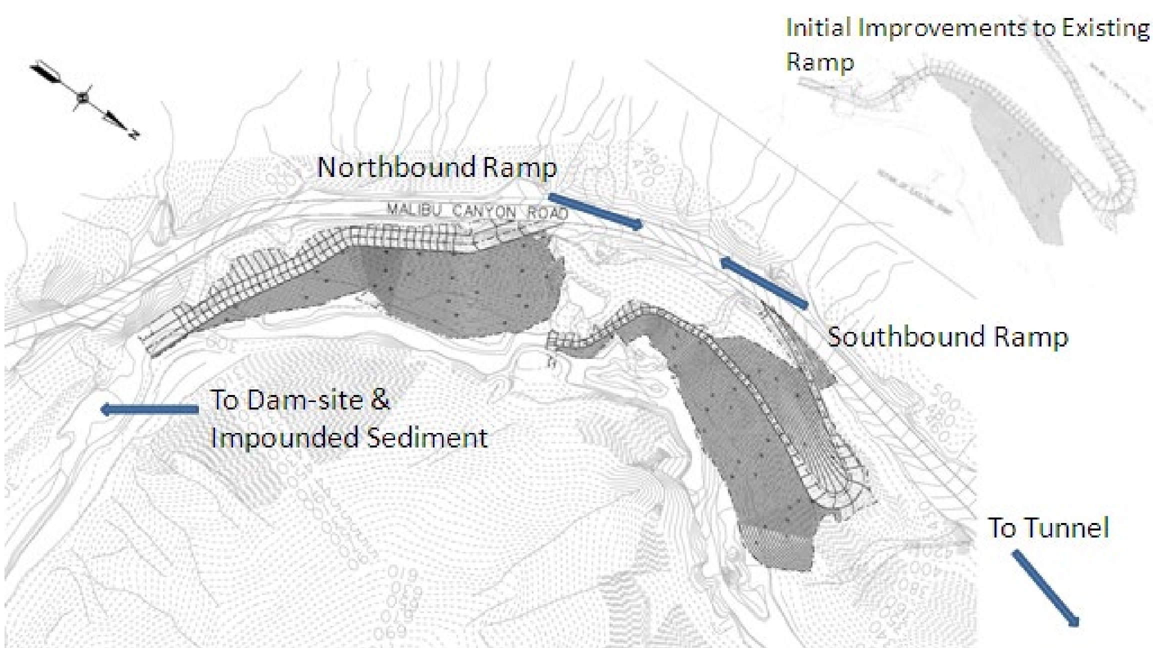

Figure 2.4-1 Northbound and Southbound Access Ramp Plans

2.4.2 Diversion and Control of Water

A cofferdam shall be used, upstream of the sediment removal area, for temporary control of water. The cofferdam permits construction and modification of the diversion channel as construction proceeds. The cofferdam will be constructed of compacted earthen fill material harnessed at the project site. The cofferdam will be approximately 30 ft long, 6 ft wide at the top (with 1:2 side slopes), and 6 ft high. Low flow water will travel from the cofferdam to the existing spillway via a 36-in diameter corrugated metal pipe (CMP) approximately 4,100 ft in length. It was decided to keep the pipeline above ground to allow for maximum flexibility during the removal of sediment material, concrete arc section, and spillway. The CMP will be anchored using 4 ft long metal stakes placed every 50 ft along both sides of the pipe. During the second year of construction, the CMP line is aligned such that all bypassed water is discharged from the Spillway.
At the end of each construction season, the CMP will be removed and transported to the contractor's yard for storage (i.e. to prevent damage during winter flows). The pipeline will then be reinstalled at the beginning of the next construction season. The cofferdam will also be demolished at the end of each construction season and re-constructed at the beginning of the next.

A total of 11 wells will be used to provide de-watering for the project site. These wells will be installed in the first year of the project and extend to the final project depth. The wells will be trimmed down to current invert level periodically throughout construction.

Since turbidity is a major environmental consideration during construction, the USACE validated the assumptions above relating to dewatering with a local dewatering contractor on February 1, 2013. The dewatering contractor suggested the use of de-silting tanks to treat the water before it's discharged into the CMP line, combined with other bypassed waters, and ultimately released downstream via the existing spillway. The dewatering contractor also reviewed sieve data collected out in the field by the USACE Geologist and provided a recommendation with regards to the design of the well screens which has proven effective with fine material 200 and smaller.

2.4.3 Rindge Dam Structural Demolition

For estimating purposes, the removal of the arch dam section is assumed to be performed using conventional high-impact breakers, blasting, and diamond-wire saw-cutting methods.

The diamond-wire system consists of a diamond-impregnated wire made to length for each cut and a hydraulically-powered drive system. Diamond wire is routed to envelope the area to be cut (requiring drilled holes), then guided into a drive wheel on the power unit. The drive wheel rotates and pulls the wire through the concrete. The diamond wire is best suited for cutting or notching composites of dissimilar materials. Since the Rindge Dam arch is a composite of concrete, rebar and railroad ties, the cutting action of the diamond wire conforms to the work. The gentle cutting action of the diamond wire does not smear one material into another and does not snag at the border between two materials. Diamond wire saw-cutting will provide smooth surfaces, facilitate excavation of notch portions of the arch dam section, improve control of the excavation grade, provide smooth working surfaces for excavation of each layer, and permit removal of the concrete in large blocks (rather than attempting to confine rubble to the working surface and removing the rubble by loaders). This demolition method allows for compliance with environmental requirements relating to turbidity and discharging waste material into Waters of the United States.

Vertical and angled drill holes were assumed to be required for production blasting of the dam foundation to the final excavation level.

All the debris from the dam arch removal will be taken to the Calabasas Landfill for disposal.

2.4.4 Waste Disposal

The Calabasas Landfill is located off of Lost Hills Road in Agoura, CA at the upper end of the watershed. The landfill is approximately 7.5 mi from Rindge Dam, mostly along Malibu Canyon Road, named Las Virgenes Road after crossing Mulholland Drive. All waste materials will be removed from the site and transported to the Calabasas landfill.

The cost estimate assumes that all waste concrete will be dumped at the Calabasas Landfill. An estimated 3,460 cy of concrete will be in large blocks, weighing approximately 19 tons each. An estimated 540 cy of concrete from the foundation demolition will be fractured and broken into manageable pieces before hauling and disposal. Additional costs required to crush all waste concrete for disposal (with any reinforcing steel removed) is assumed to take place at the disposal site and is included in the disposal cost.

Additional waste disposal will result from de-vegetation activity. The green waste associated with vegetation removal will also be sent to the Calabasas Landfill.

2.4.5 Hauling

Typical construction equipment used for hauling includes flatbed trucks, low boys, and dump trucks.

The arc foundation concrete requires removal of approximately 15 feet of concrete from the surface (base) of the dam to the bedrock. The arc foundation amounts to approximately 540 CY of concrete to be removed and hauled away.

Haul loads cannot exceed 80,000 pounds. The contractor may be required to make some repairs to the Malibu Canyon Road to allow for normal use after construction.

2.4.6 Road Improvement Plan

Heavy construction traffic associated with hauling materials from the dam site to designated disposal areas may cause damage to some of the existing roadways in the area. Malibu Canyon Road is designed and constructed to accept standard truck traffic. Two types of roadway repairs were considered; spot patching with resurfacing, or total replacement. The alternative for spot patching, as needed, is difficult to evaluate due to the inability to identify with any confidence the extent of potential damage and the amount of patching that may be required. It is anticipated that dips and ruts will be typical repair requirements, which could involve long sections of the road. The spot patching alternative also included resurfacing 0.5 miles of roadway with two layers of bituminous surface treatment. On March 20, 2013, the PDT recommended the total replacement alternative (i.e. 0.5 mi) to ensure that all potential deficiencies are addressed.

2.4.7 Site Clean-up

Final channel cleanup, including removal of any concrete rubble and boulders, may be performed during the low-flow period (April through October).

2.4.8 Site Restoration

A site restoration plan will be developed to provide natural-looking contours following removal of the sediment and dam. The river channel contains large boulders, which will be push aside as necessary for fish passage and potential recreational use of the river, if possible.

2.4.9 Monitoring & Adaptive Management

An environmental mitigation cost were developed with input from the environmental coordinator and biologist. Cost includes: seeding, weeding, maintenance for five years, and biological monitoring for five years.

2.4.10 Sand-rich Sediment Hauling

The SC-DMMT agreed in concept to consider allowing on-beach placement and near-shore placement of the sand-rich layer. The existing condition of the sand-rich material is 22% fines and 5% gravel with the remaining content being sand. Although this level of fines (silty material) is at the upper end of what is generally be accepted for on-beach placement, no amount of screening has been assumed at this time. The sand is trucked from the Rindge Dam project site to the shoreline down-coast of Malibu Pier.

2.5 Indirect Costs (Contractor Markups)

The contractors and subcontractors' field office overhead, home office overhead, and profit were established using historical rates for similarly size jobs and represent the contractor's cost of doing business and assuming the risks associated with construction work. A dewatering subcontractor, fencing subcontractor, drilling/blasting subcontractor, paving subcontractor, landscape subcontractor, demolition subcontractor, and environmental restoration subcontractor were included in the estimate.

For all the alternatives, disposal fees do not carry contractor’s markups. Disposal fees represent approximately 70% of the total sediment removal cost. Typically, disposal fees carry markups, but since the disposal fees represent such a large percentage of the estimate adding contractor’s markups would artificially inflate the estimate

2.6 Owner Cost

The following Owner Costs are applied to the CWE.

2.6.1 Planning Engineering and Design (PE&D) and Pre-construction Engineering and Design (PED)

Planning Engineering and Design (PE&D), including Engineering During Construction (EDC), and Preconstruction Engineering and Design were estimated per labor-hour for each discipline, broken out per phase and contract.

2.6.2 Construction Management or Supervision & Administration (S&A)

Construction Management was estimated as a percentage of the construction cost prior to addition of the applicable contingency.

2.7 Schedule of Work

Due to traffic conditions on Malibu Canyon/Las Virgenes Road, truck use for hauling on this road will be restricted to the hours of 9 AM to 3 PM daily. On school days, hauling is disallowed from 2:00 PM to 3:30 PM. Therefore, assume road use from 9 AM to 2 PM (5 work hours per day) while school is in session for any material hauled to the Calabasas landfill. On non-school days, the work day is 9 AM to 3 PM (6 hours).

During the summer, sand is not allowed to be hauled to the beach. Therefore, sediment is temporarily store at Site F. Site F is located outside the sediment impounded area near the dam. During the winter, sand is hauled from Site F to the beach.

After the addition of daily operational restrictions, the job requires one year of set up and site preparation, and 6 years of sediment hauling to complete the job. Construction schedule totals 7 years.

Truck hauling will occur 6 days a week. No hauling to the landfill will occur on Sundays or federal holidays. Estimated construction duration is approximately 7 years including rehabilitation of the highway and environmental mitigation work. The construction season is defined as 1-April to 15-October. During the winter period, no work will be done and no equipment will be on-site. During construction, the contractor will be responsible for checking the weather conditions every day and evacuating all personnel and equipment in the event inclement weather is forecasted. The existing cost estimate has accounted for contractor mobilization and de-mobilization during each year of construction.

3.0 UPSTREAM BARRIERS COST ESTIMATE BASIS

A list has been compiled of 7 high-priority man-made barriers upstream of the Rindge Dam that have been identified as additional blockages to the migration of local fish species. Barriers removal, modification or replacement can add migratory fish access to a large amount of additional habitat upstream of the dam for a relatively small incremental expense.

Man-made barriers are considered a limiting factor and are, therefore, the only barriers included in this assessment. During construction, it is necessary to demolish and rebuild only one lane at a time where there is a County road running above (if applicable). The contractor is required to block only one-half of the barrier/bridge at a time, and allow for staggered two-way passage on the other lane using flag-men or automated signals at night. Fire department access to any construction site and passage across the road above must be maintained at all times during construction.

CC5 (Cold Canyon Road Culvert) may have more than 6-inches of concrete on the invert, but from project photographs, the invert has eroded away with time. If more of the concrete is removed, there is a risk in exposing the corrugated metal pipe (CMP). Over time, the corrugated metal pipe will corrode and break down, and when this happens along the invert of a culvert it jeopardizes the structural integrity of the entire culvert. The concrete inverts of LV3 and LV4 also cannot be chipped away for similar reasons. From researching other projects plan sets, concrete inverts generally have about 4-inches of concrete placed over the reinforcing rebar, which is insufficient for a passage channel to be made. In addition, when concrete is removed from a box culvert, the structural characteristics of the culvert are changed and there is a risk of reducing the overall structural capacity.

In contrast to carving a channel in each invert, it was assumed that there would be a need to construct a channel along the inverts of CC5, LV3, and LV4. The construction at CC5 requires building a channel along the 130 ft-long invert of the culvert, and do limited work upstream and downstream of the culvert to ensure low flows still pass through the structure. For LV3 and LV4, it is necessary to modify the invert of the box culvert AND the entire concrete apron upstream and downstream of each structure. In addition to the concrete apron modification, there is a need to modify the stream bed enough to ensure low flows pass through LV3 and LV4 and modify the sill structures to ensure fish can overcome the vertical drop at each one.

3.1 <u>Upstream Barriers Plans</u>

USACE developed the following upstream barrier plans for the feasibility-level cost estimates. These plans are considered to be technically feasible, economical, and compatible with the project objectives.

3.1.1 Site Access/Preparation

The current estimate assumes no constraints on construction activities will be necessary for protection of threatened and endangered species.

Vegetation must be cleared in and around the project sites and access maintenance roads, as needed. For the majority of the upstream barrier sites, it is assumed that vegetation will have to be manually cleared with brush-saws, track-hoes, and chippers. Some barrier sites, where equipment access is not an issue, allow for clearing using small dozers. Disposal of materials using rental dumpsters was assumed.

3.1.2 Diversion and Control of Water

For most of the upstream barrier alternatives, it is assumed that a temporary cofferdam of varying heights per alternative is installed upstream of the construction area. Installation of a temporary 36-inch CMP allows for water conveyance through the construction site, enabling fish passage during construction.

For some of the upstream barrier alternatives, a lack of staging area and/or access issues requires that the temporary cofferdam be built using sandbags. These cofferdams require the construction of a trench/sump to pump the water downstream of the construction site using hosing.

3.1.3 Demolition of Upstream Barriers

The demolition for each of the upstream barriers varies based upon existing conditions (see **Figure 3.4-1** for a location of each barrier).

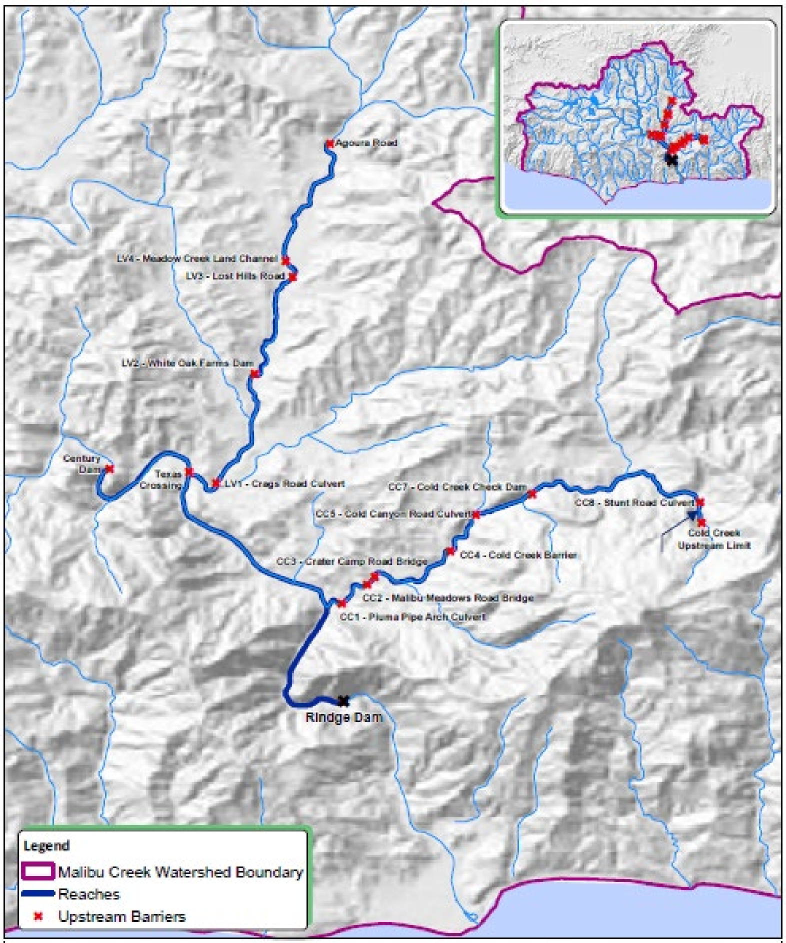

Figure 3.4-1 Locations of Upstream Barriers

The following descriptions highlight some of the differing site conditions at each site and identify what the planned method is for improving fish passage to meet the project objective:

LV1 - Crags Road Culvert Crossing

The existing concrete box culvert, the existing concrete abutments, and the existing concrete wing walls will be removed and replaced with a pre manufactured 75 ft long, 20 ft wide clear span bridge. This new bridge will span the entire creek and eliminate the current reduction in the creek cross section. The new bridge's deck elevation will match the top elevation of the existing structure.

The use of a pre-manufactured bridge will reduce construction time since the bridge will be delivered to the site and placed on the new abutments with a crane. Prior to installing the new bridge, the new wing walls and bridge abutments will have to be constructed on both banks of the creek. The creek bed will have to be re-graded to fill any voids left by the removal of the existing structures. Construction is estimated to take 45 days.

The creek flow will have to be diverted during removal of all the existing structures and construction of the new abutments and wing walls. Water diversion will also be necessary while any work is being performed within the creek. The creek will not need to be diverted while the pre manufactured bridge is being placed on the abutments. Dewatering will also be necessary during construction of the new bridge wing walls and the new bridge abutments.

De-vegetation will be required for the removal of the existing bridge wing walls and abutments along with construction of the new bridge wing walls and abutments. Additional clearing will be required at the designated staging area for the project. All areas that are cleared will be restored once construction is complete.

No traffic control measures will be required since this bridge is used for maintenance vehicle and fire truck access.

LV2 - White Oak Dam

The existing 6 ft dam will be removed in stages to minimize any erosion and scour problems. The creek will have to be diverted each year to protect any crews and equipment being used to remove the dam. However, work in the creek will be kept at a minimum since the dam will be removed by a backhoe stationed on the creek bank. Dewatering will not be required. Demolition is estimated to take 15 days each year. Clearing will be limited to a 40 ft by 40 ft area on either side of the cofferdam, which will ensure the backhoe, has adequate space to work. These areas will have to be cleared every year of dam removal. All areas that are cleared will be restored once the dam removal is completed. Once the dam is removed, no further work will be done to restore the creek.

LV3 - Lost Hills Road Culvert & LV4 - Meadow Creek Lane Crossing

Both LV3 and LV4 will have to be treated as a single project because fish have to pass through both barriers to reach the habitat areas upstream of LV4. These structures will not be removed; rather, a low flow channel will be constructed along the invert of each structure and along the portion of the stream between LV3 and LV4.

The low flow channel for LV3 will be built on top of the existing concrete invert. This channel will be 6 inches deep and start at the downstream end of the concrete apron, extend upstream through the culvert structure, and terminate at the end of the upstream concrete apron. This channel will be 3 feet wide and will ensure there is enough water traveling at low enough velocities for fish passage. The drop at the downstream end of the concrete invert will not be modified. The low flow channel for LV4 will be similar to the channel passing through LV3 and allow fish to travel upstream to the designated habitat areas. Construction is estimated to take 50 days.

The invert of the creek between LV3 and LV4 will have to be cleared and re-graded to provide a low flow channel that will connect the concrete channels along LV3 and LV4. This area will be restored once construction is complete.

The creek flow will have to be diverted during construction of both concrete low flow channels and while the creek invert between LV3 and LV4 is being re-graded. Limited dewatering will be necessary along the creek between LV3 and LV4 to ensure adequate working conditions for construction equipment.

Additional clearing will be required at the designated staging area for the project and along any invert access ramps. The staging area will be restored once construction is completed.

Some traffic control measures may be required during construction hours to facilitate the movement of equipment from the staging area to the construction site.

<u>CC1 - Piuma Culvert</u>

The existing CMP arch culvert, the concrete lining along the creek invert, and the stone head walls will be replaced by a 12 ft pre-cast arch culvert with new concrete footings and concrete head walls on both sides of the creek. The width and height of the new culvert will match the existing CMP culvert and the road elevations across the culvert will be the same as the existing roadway.

The existing metal arch culvert, stone wing walls, and concrete invert will be removed in two stages. The first stage will be from the upstream inlet to the centerline of the road, the second state will be from the centerline of the road to the downstream outlet. The culvert must be removed in two parts so the traffic along the road can be diverted into one lane across the bridge. Traffic control measures will be required during and after construction hours to ensure traffic can safely be reduced down to one lane across the creek.

The pre-cast culvert will reduce construction time since the culvert will be delivered to the site and placed on the footings with a crane. Prior to installing the new culvert sections, new headwalls and footings will have to be constructed. Construction is estimated to take 30 days.

The concrete invert of the creek will be replaced with a natural channel. The creek bed under the culvert will have to be re-graded to compensate for the small elevation drop at the end of the existing concrete invert.

Temporary shoring will be required to preserve the road while the existing metal culvert and stone wing walls are being removed. The temporary shoring will be placed perpendicular to the centerline of the road and run parallel to the existing CMP culvert for 46 ft. The temporary shoring will be required on the north and south sides of the existing structure and will be removed once the new bridge abutments and wing walls are completed.

The creek flow will have to be diverted during removal of all the existing structures and construction of the new footings and headwalls. The creek will also have to be diverted while any work is being performed within the creek bed. Dewatering will be necessary during construction of the new culvert footings and headwalls.

Clearing will be required for the removal of the existing culvert wing walls and abutments, along with construction of the new culvert footings and headwalls. Additional clearing will be required at the designated staging area for the project. All areas that are cleared will be restored once construction has been completed.

<u>CC2 - Malibu Meadows Road Crossing</u>

The existing structure is a wood deck, steel beam bridge with the concrete invert and CMU abutments and wing walls. This structure will be removed and replaced with a 70 ft long and 25 ft wide pre-manufactured bridge with concrete abutments and wing walls on both sides of the creek. The new bridge will have a longer span than the existing structure to help eliminate the reduction of the creek cross section, and the bridge deck elevation will match the existing bridge deck elevation.

The pre-manufactured bridge will reduce construction time since the bridge will be delivered to the site and placed on the new abutments with a crane. Prior to installing the new bridge, new wing walls and bridge abutments will have to be constructed on both banks of the creek. Construction is estimated to take 30 days.

The existing concrete invert will be removed and replaced with a modified stream bed. The stream bed improvements will have to be designed to compensate for a 5 ft drop at the end of the existing concrete invert while still allowing fish to swim upstream. The stream bed improvements will have to prevent head cutting upstream of the new bridge.

The creek flow will have to be diverted during removal of all the existing structures and construction of the new abutments and wing walls. The creek flows will also have to be diverted while any work is being performed within the creek bed. The creek will not need to be diverted while the pre-manufactured bridge is being installed. Dewatering will also be necessary during construction of the wing walls and abutments.
Clearing will be required for the removal of the existing wing walls and abutments along with construction of the new abutments and wing walls. Additional clearing will be required at the designated staging area for the project. All areas that are cleared will be restored once construction has been completed.

Traffic control measures will only be in place to warn drivers of a closed bridge. All traffic will be redirected through neighboring streets.

CC3-Crater Camp Road Crossing

This site is assumed to be the same as CC2, except there is no gas line running along the bridge. This structure will be replaced in like manner to CC2, with minor changes to specific lengths and measurements.

CC4 - Cold Creek Barrier (Dam)

Cold Creek Barrier (Dam) is excluded from the project.

CC5 - Cold Canyon Road Culvert

The existing 25 ft diameter concrete culvert cannot be removed so a low flow channel will be built along the culvert's invert to allow fish passage upstream. The channel will be 6 inches deep and 3 ft wide and will ensure flows are slow enough and deep enough for fish passage during low flow conditions. The downstream portion of the culvert will not be modified, because fish can use existing ponds to make their way into the low flow channel. The creek invert near the inlet of the culvert will have to be cleared and re-graded to ensure flows can enter the low flow channel.

Creek flows will need to be diverted during construction but no dewatering will be necessary. Construction is estimated to take 15 days. No traffic control will be necessary.

Construction Logic and duration

Activity durations were based on engineering judgment and experience. Construction durations vary per alternative from 15 days to 5 months.

3.1.4 Waste Disposal

The Calabasas Landfill is located at Lost Hills Road in Agoura, CA at the upper end of the watershed. For the 7 upstream barriers, it was assumed that waste disposal is carried on via rented waste dumpsters per the suggestion of the local sponsor. The cost estimate assumes waste will be dumped at the Calabasas Landfill without further handling.

3.1.5 Hauling

Typical construction equipment used for hauling includes flatbed trucks, low boys, and dump trucks. Hauling is performed 6 days per week during daylight hours.

3.1.6 Site Clean-up

Final channel cleanup, including removal of any concrete rubble and boulders, must be performed during the low-flow period (April through October). All upstream barrier alternatives are assumed to have varying rock landscaping requirements based upon the project site to help enhance migratory fish passage.

3.1.7 Monitoring & Adaptive Management

Environmental monitoring and adaptive management scope and costs were provided by the USACE LA Planning Division Environmental Resources representative with assistance from Cost Engineering.

4.0 SYNOPSIS

4.1.1 Synopsis

Feasibility-level designs and estimates have been prepared for the sediment removal and demolition of Rindge Dam arch as well as for the 7 upstream barrier alternatives. The current studies confirm that dam removal is technically feasible and can be safely performed in a manner compatible with sediment management requirements and project objectives. Dam removal activities will require a period of approximately 7 years.

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US Army Corps
of Engineers®

Malibu Creek Ecosystem Restoration Project

Los Angeles and Ventura Counties, California

National Economic Restoration (NER)

Project Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers,
Los Angeles District

Prepared by:

Los Angeles District, U.S. Army Corps of Engineers

November 2020

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EXECUTIVE SUMMARY

The US Army Corps of Engineers (USACE), Los Angeles District, presents this cost and schedule risk analysis (CSRA) report regarding the risk findings and recommended contingencies for the Malibu Creek Ecosystem Restoration Project. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated June 30, 2016, a formal risk analysis, *Monte-Carlo* based-study was conducted by the Project Development Team (PDT) on remaining costs. The purpose of this risk analysis study is to present the cost and schedule risks considered, those determined and respective project contingencies at a recommend 80% confidence level of successful execution to project completion.

This project contributes to the primary study ecological restoration objective to restore the Malibu Creek ecosystem, (with some additional benefits to Las Virgenes Creek and Cold Creek), while maintaining downstream ecosystem and riparian management activities. This plan is expected to result in significant benefits to the ecosystem.

The National Economic Restoration (NER) alternative includes the demolition, removal, and disposal of the arch as well as removal for the sediment currently impounded by the Rindge Dam. Spillway demolition is not included in the scope of work. Additionally, the NER alternative considers the enhancement of seven (7) existing upstream barriers to allow passage of fish and other wildlife.

The estimated project base cost for the NER alternative work approximates $179.5M. Based on the results of the risk analysis, Cost Engineering recommends a contingency value of $76.7M on the remaining work or approximately 43% of base project cost

Los Angeles District, Cost Engineering performed a risk analysis using the *Monte Carlo* technique for the estimated construction costs, supported by the district PDT input. The following table ES-1 portrays the development of the construction contingencies. The contingency is based on an 80% confidence level, as per USACE Civil Works guidance. Knowing that estimates can fluctuate to a certain degree over time with little to no change in risk, it is common to rely on the per cent of contingency applied against the costs under study. For example, the estimated project cost of $179.5M was the basis for the risk model. The current construction estimate may have changed to a minor degree with no change in risks.

Table ES-1. Construction Contingency Results

Baseline Estimate Cost	**$179,517,000**	
Confidence Level	**Project Cost ($) with Contingency**	**Contingency**
50%	$249,528,630	39%
80%	**$256,218,000**	**43%**
90%	$260,299,650	45%

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The PDT worked through the risk register on: November 30, 2017. Furthermore, Jacksonville District was interviewed on October 24, 2017 providing lessons learned and potential risks resulting from a similar Ecosystem Restoration Project. On February 10, 2020 the TPC was reprised and the CSRA updated. The key risk drivers identified through sensitivity analysis suggest a cost contingency of $50.3M and schedule risks adding another potential of $26.4M, both at an 80% confidence level.

Cost Risks: From the CSRA, the key or greater Cost Risk items include:

- TR-2: Slope Stabilization / Landslides - Concerns of landslides during and after excavation. Construction-related impacts to earth resources, through movement of earth by heavy equipment, would result in potential destabilization and erosion of soils in the vicinity of construction activities at and adjacent to Rindge Dam, in the area of accumulated sediment upstream of the Dam, and in constructed access roads and staging areas, and at the disposal sites. Destabilization effects to Malibu Canyon Road could expose people and structures to potential substantial adverse effects due to landslides and slope instability if not mitigated. Soil stabilization methods may be required on side slope below Malibu Canyon Road following excavation of sediment. Continuous monitoring/confirmatory test may be required.
  The costs associated with remediation of landslide concerns during construction are difficult to predict due to the limited understanding of the actual geologic conditions and the scope of necessary remediation. Some uncertainties/unknowns are better addressed during PED - field investigations. We will characterize the field conditions in the future during PED, but it does not reduce the risk. We are reducing the uncertainty by doing testing. The County commented about possible failure of the access ramps. The toe has been eroded by stream flow. The worst case scenario would be down into the sediment in the impound area and a landslide moves completely eliminating Malibu Canyon Road, cutting off access to the construction site; potentially killing or damaging equipment; creating an earthen dam in the canyon that would then have to be removed.
- ES-2: Diversion and Control of Water - Variations in flows are likely. Diversion and control of water costs are highly likely to be impacted.
- EX-1: Internal Low or not studied risks - This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule. This item is added based on standard items noted as being required for all formal cost and schedule risk analyses, such as sufficient studies, based on forthcoming policy based on Agency Technical Review comment/resolution.

This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule.

- CO-5: Access Road Re-Construction - Re-construction of slope may pose difficulties. Slope stability during Access Road Construction may increase the costs and cause delays. After the 1st year, the current estimate assumes 25% of the initial volume is required to rebuild the ramps on sub-sequent years. Worst case scenario would represent rebuilding the complete ramp. Representing a cost increase of $1M per re-construction year.
- ES-4: Sediment Hauling - Areas can incur times of high traffic and congestion. Estimates on hauling productivity are likely to change causing cost and schedule impacts.
- ES-7: Soil Parameters – Civil and Geotechnical Design assisted in the development of quantities. Geotech believes reasonable quantity estimates were developed. Geotechnical investigations and Soil Penetration Tests (SPT) were performed on the impounded sediment within the last few years. Blow count tests indicated soil properties with extremely low relative density. The PDT feels the impounded sediment is in its loose state and the baseline estimate was based on in-situ Loose Cubic Yards (LCY). But, there is a possibility for increased quantities based on potential swell factors. The PDT feels the quantities are appropriate and material swelling will not be an issue (Unlikely to happen), but if the material does swell it will add large costs (Significant impact) and delay the schedule.
- PM-1: Insufficient Funding - Project may be funded on some years, but we are not certain that the project will be funded the amount it is requesting or skip a year. Project may be terminated if it doesn't receive funding. Impact on project resourcing and sequencing. Required appropriations are large for each contract. Currently, the project is broken down into 3 contracts.
- ES-8: Productivity Lessens as Mining Progresses - The surface area/work zone for mining sediment upstream of Rindge Dam will diminish as more of the canyon slopes are exposed. Space to divert/control water, dewatering wells, and mined sediment will affect daily and annual productivity. The PDT has already considered diminishing productivity due to more limited work space in the schedule and cost estimates. Already accounted in the estimate and schedule by reducing productivity in the work zones, but productivity could still vary.

Schedule Risks: The schedule risk indicates some uncertainty of key risk items; time duration growth that can translate into added costs. Over time, risks increase on out-year contracts where there is greater potential for change in new scope requirements, uncertain market conditions, and unexpected high inflation. The key or greater Cost Risk items include:

- EX-3: Political/Legal Opposition – There are locals opposed to certain aspects. They could potentially attempt to file a suit against the project. There remains the possibility that political opposition/legal opposition could delay the project or any individual event. It could also create a delay in the activities as well.

- TR-2: Slope Stabilization / Landslides - Concerns of landslides during and after excavation. Construction-related impacts to earth resources, through movement of earth by heavy equipment, would result in potential destabilization and erosion of soils in the vicinity of construction activities at and adjacent to Rindge Dam, in the area of accumulated sediment upstream of the Dam, and in constructed access roads and staging areas, and at the disposal sites. Destabilization effects to Malibu Canyon Road could expose people and structures to potential substantial adverse effects due to landslides and slope instability if not mitigated. Soil stabilization methods may be required on side slope below Malibu Canyon Road following excavation of sediment. Continuous monitoring/confirmatory test may be required.
  The costs associated with remediation of landslide concerns during construction are difficult to predict due to the limited understanding of the actual geologic conditions and the scope of necessary remediation. Some uncertainties/unknowns are better addressed during PED - field investigations. We will characterize the field conditions in the future during PED, but it does not reduce the risk. We are reducing the uncertainty by doing testing. The County commented about possible failure of the access ramps. The toe has been eroded by stream flow. The worst case scenario would be down into the sediment in the impound area and a landslide moves completely eliminating Malibu Canyon Road, cutting off access to the construction site; potentially killing or damaging equipment; creating an earthen dam in the canyon that would then have to be removed.
- ES-7: Soil Parameters – Civil and Geotechnical Design assisted in the development of quantities. Geotech believes reasonable quantity estimates were developed. Geotechnical investigations and Soil Penetration Tests (SPT) were performed on the impounded sediment within the last few years. Blow count tests indicated soil properties with extremely low relative density. The PDT feels the impounded sediment is in its loose state and the baseline estimate was based on in-situ Loose Cubic Yards (LCY). But, there is a possibility for increased quantities based on potential swell factors. The PDT feels the quantities are appropriate and material swelling will not be an issue (Unlikely to happen), but if the material does swell it will add large costs (Significant impact) and delay the schedule.
- RG3: Wildlife/ESA - Concern of greater schedule delays associated with other species (IEPR concern). Red legged frogs, monitoring and relocation. Steel head relocations concerns are captured in the estimate. Some isolated areas in the construction zone, possible relocation outside the project footprint. This risk

affects mostly the Upstream Barriers (Red legged frogs). Worst case scenario involves finding an endangered species at the dam site, at the beginning of the season, pre-construction, or during construction and resulting delays. At the upstream barriers sites the weight of the risk is higher, but this work is not on the project critical path.

- ES-3: Dewatering - Preliminary estimate is subject to change based on pump test results and yearly replacement of dewatering platforms and instrumentation. Cost and schedule are very likely to change.
- ES-5: Additional Vegetation Clearing - Vegetation density will increase from current state. In the last few years, vegetation in the area has significantly matured. By the time clearing and grubbing operations take place, vegetation density may double. Cost and schedule are likely impacted.
- PM4: Inadequate Staffing - Resources in PM, Design, Geotechnical, Economics, and Construction are currently overloaded in terms of workload and priorities. The PDT has been performing well. However, there are many competing demands. The COE may reach out to AE firms to help out reducing the staffing risk, but the schedule may be affected by unavailability of key members.
- PM-1: Insufficient Funding - Project may be funded on some years, but we are not certain that the project will be funded the amount it is requesting or skip a year. Project may be terminated if it doesn't receive funding. Impact on project resourcing and sequencing. Required appropriations are large for each contract. Currently, the project is broken down into 3 contracts.

Recommendations: The PDT must include the recommended cost and schedule contingencies and incorporate risk monitoring and mitigation on those identified risks. Further iterative study and update of the risk analysis throughout the project life-cycle is important in support of the remaining project work within an approved budget and appropriation.

MAIN REPORT

1.0 PURPOSE

Under the auspices of the US Army Corps of Engineers (USACE), Los Angeles District, this report presents a recommendation for the total project cost and schedule contingencies for the Malibu Creek Ecosystem Restoration Project.

2.0 BACKGROUND

The National Ecosystem Restoration (NER) alternative includes the demolition, removal, and disposal of the arch as well as removal for the sediment currently impounded by the Rindge Dam. Spillway demolition is not included in the scope of work. Additionally, the NER alternative considers the enhancement of seven (7) existing upstream barriers to allow passage of fish and other wildlife.

The study area is located about 30 miles (mi) west of the city of Los Angeles. Approximately 2/3 of the 109 sq. mi watershed is located in the northwest portion of the Los Angeles County area and the remaining 1/3 is in Ventura County. Malibu Creek Watershed is within the Santa Monica Mountains, in a mix of urban development and open space. Malibu Creek drains into Malibu Lagoon and Santa Monica Bay.

Malibu Creek drains 109 sq. mi of the Santa Monica Mountains, where the reach from Malibu Lagoon to Malibu Dam is 10 mi Rindge Dam, built in the 1920's, is located about 2 mi upstream from the confluence with the Pacific Ocean. The dam is a concrete arch structure 108 feet (ft) in height with an arc length of 140 ft at its crest (excluding spillway & rock outcrop) and 80 ft at its base. The dam is 2 ft thick at the crest and 12 ft thick at the base. 60-lb steel railroad ties run horizontally and vertically throughout the dam and serve as reinforcement for the structure. The height from the top of the arch structure to bedrock is approximately 117 ft. The top of dam elevation is approximately 298 ft.

As a part of this effort, Los Angeles District requested that the USACE Cost Engineering Directory of Expertise for Civil Works (Cost Engineering MCX) provide an agency technical review (ATR) of the cost estimate, schedule and risk analysis for the National Ecosystem Restoration (NER) Plan.

3.0 REPORT SCOPE

The scope of the risk analysis report is to identify cost and schedule risks with a resulting recommendation for contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, and ER 1110-2-1302, Civil Works Cost Engineering. The report presents the contingency results for cost risks for construction features. The CSRA excludes Real Estate costs and does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the Micro Computer Aided Cost Estimating System (MCACES) cost estimate, project schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the Los Angeles District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of concerns, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering MCX. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering MCX.

- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated June 30, 2016.

4.0 METHODOLOGY / PROCESS

Cost Engineering performed the Cost and Schedule Risk Analysis, relying on local Los Angeles District staff to provide expertise and information gathering. The Los Angeles PDT conducted the initial risk identification workshop on November 30, 2017. The initial risk identification meeting also included qualitative analysis to produce a risk register that served as the draft framework for the risk analysis. Furthermore, Jacksonville District was interviewed on October 24, 2017 providing lessons learned and potential risks resulting from a similar Ecosystem Restoration Project.

Participants in the risk identification meeting of November 30, 2017 included:

Name	Office	Representing
Susan Ming	USACE - SPL	Project Manager
James Hutchison	USACE - SPL	Lead Planner
Lawrence Smith	USACE - SPL	Biologist
Moosub Eom	USACE - SPL	Hydraulics
Chris Spitzer	USACE - SPL	Geotechnical
Jesse Ray	USACE - SPL	Environmental Coordinator
Frank Mallette	USACE - SPL	Design
Ronald Spencer	USACE - SPL	Survey
Mark Chatman	USACE - SPL	Geology
Michael Hallisy	USACE - SPL	Economics
Matt Wesley	USACE - SPL	Coastal Engineering
Lisa Sandoval	USACE - SPL	Real Estate
Suzanne Goode	Cal Dept of Parks and Recreations	Liaison
Jamie King	Cal Dept of Parks and Recreations	Liaison
Meg McDonald	USACE - SPL	Cultural Resources
Juan Dominguez	USACE - SPL	Cost / Facilitator

Participants in sharing lessons learned from Jacksonville District on October 24, 2017 included:

Name	Office	Representing
Donna George	Jacksonville District	Interviewed on 10-24-17
Tiphanie Mattis	Jacksonville District	Interviewed on 10-24-17
Michael Dorg	Jacksonville District	Interviewed on 10-24-17

Participants in updating the risk analysis on February 10, 2020 included:

Name	Office	Representing
Susan Ming	USACE - SPL	Project Manager
James Hutchison	USACE - SPL	Lead Planner

The draft CSRA model was completed January 12, 2018 and submitted for recertification. On February 9, 2018, ATR comments were received and addressed. On February 23, 2018, the CSRA model was modified based on additional verbal ATR comments. On February 12, 2020, the TPC template was reprised to 2020 price levels and the CSRA was updated accordingly.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence. Per regulation and guidance, the P80 confidence level (80% confidence level) is the normal and accepted cost confidence level. District Management has the prerogative to select different confidence levels, pending approval from Headquarters, USACE.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost MCX guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

A formal PDT meeting was held for the purposes of identifying and assessing risk factors. The meeting (conducted on November 30, 2017) included capable and qualified representatives from multiple project team disciplines and functions, including project management, cost engineering, design, and the California Department of Parks and Recreation (CDPR).

The initial formal meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Additionally, numerous conference calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a larger portion of the project cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the Malibu Ecosystem Restoration project.

a. The Los Angeles District provided MII MCACES (Micro-Computer Aided Cost Estimating Software) files electronically. The MII and CWE files prepared on November 21, 2017 were the basis for the initial cost and schedule risk analyses. The MII and CWE files were updated on February 1, 2020.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the Feasibility Level.

c. The Cost Engineering MCX guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

d. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk “watch list”.

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Contingency and Sensitivity Analysis

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project cost at intervals of confidence (probability).

Table 1 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50, P80 and P90 confidence levels are also provided for illustrative purposes only.

Cost contingency for the Construction risks (including schedule impacts converted to dollars) was quantified as approximately $76.7 Million at the P80 confidence level (43% of the baseline construction cost estimate).

Table 1. Construction Cost Contingency Summary

Baseline Estimate Cost	**$179,517,000**	
Confidence Level	**Project Cost ($) with Contingency**	**Contingency**
50%	$249,528,630	39%
80%	**$256,218,000**	**43%**
90%	$260,299,650	45%

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

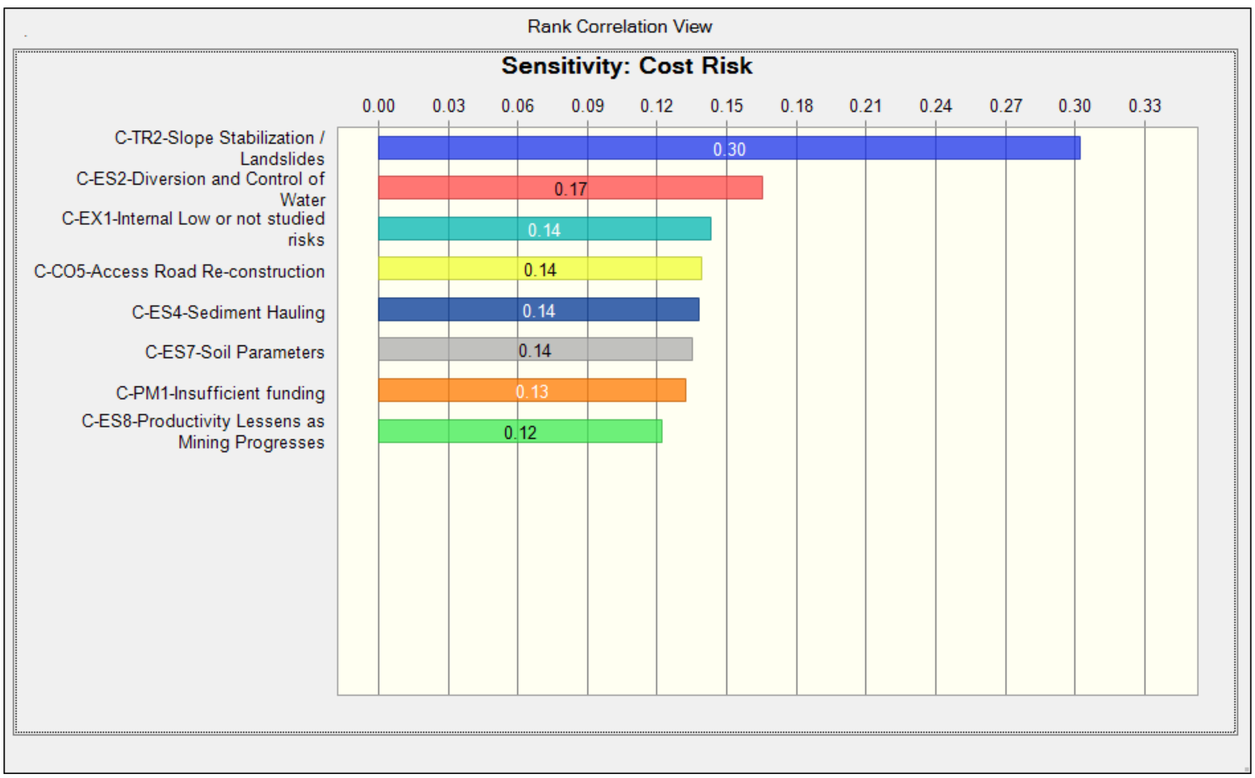
Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers and the respective value variance are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

Figure 1. Cost Sensitivity Analysis



6.3 Schedule and Contingency Risk Analysis

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project duration at intervals of confidence (probability).

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P90 confidence levels are also provided for illustrative purposes.

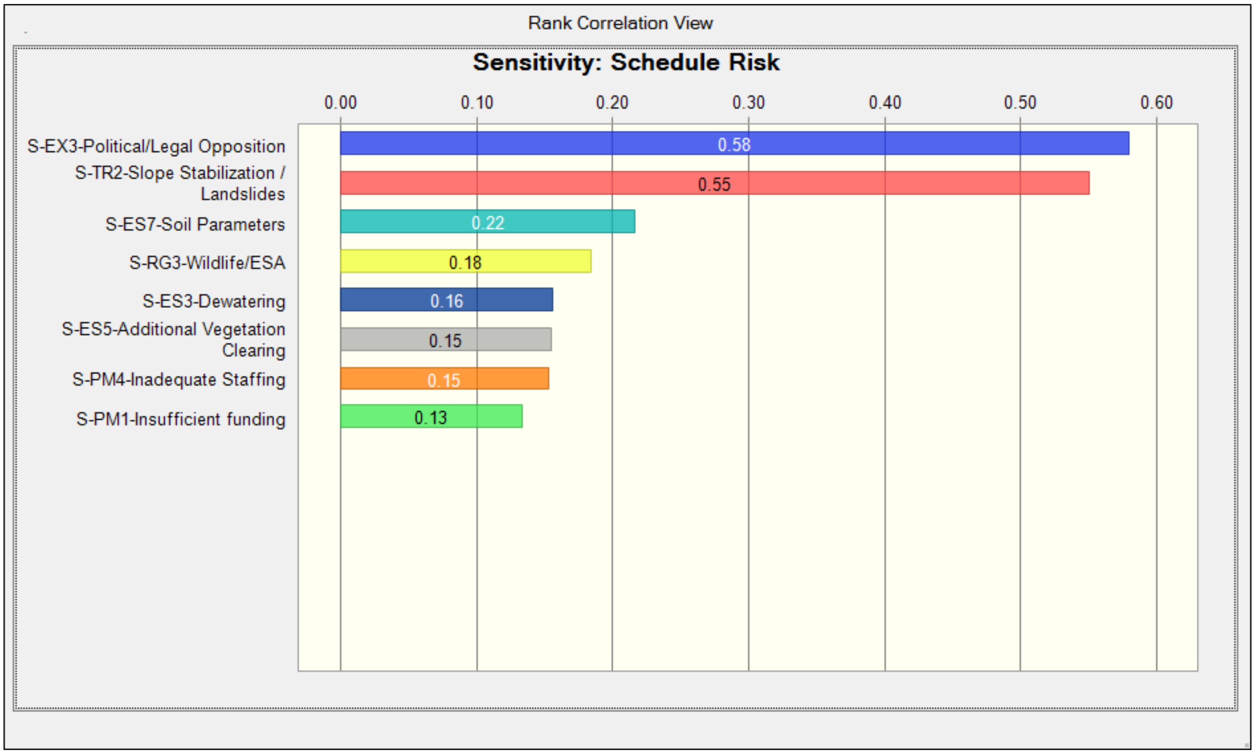
Schedule duration contingency was quantified as 87 months based on the P80 level of confidence. These contingencies were used to calculate the projected residual fixed cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected residual fixed costs.

Table 2. Schedule Duration Contingency Summary

Base Case Schedule	**12 months**	
Confidence Level	**Schedule Duration (Months) w/ Contingency**	**Contingency (months)**
50%	197 months	77 months
80%	207 months	87 months
90%	213 months	93 months

Figure 2. Schedule Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Project cost and schedule comparison summaries are provided in Table 3 and Table 4 respectively. Additional major findings and observations of the risk analysis are listed below.

Cost Risks: From the CSRA, the key or greater Cost Risk items of include:

- TR-2: Slope Stabilization / Landslides - Concerns of landslides during and after excavation. Construction-related impacts to earth resources, through movement of earth by heavy equipment, would result in potential destabilization and erosion of soils in the vicinity of construction activities at and adjacent to Rindge Dam, in the area of accumulated sediment upstream of the Dam, and in constructed access roads and staging areas, and at the disposal sites. Destabilization effects to Malibu Canyon Road could expose people and structures to potential substantial adverse effects due to landslides and slope instability if not mitigated. Soil stabilization methods may be required on side slope below Malibu Canyon Road following excavation of sediment. Continuous monitoring/confirmatory test may be required.
  The costs associated with remediation of landslide concerns during construction are difficult to predict due to the limited understanding of the actual geologic conditions and the scope of necessary remediation. Some uncertainties/unknowns are better addressed during PED - field investigations. We will characterize the field conditions in the future during PED, but it does not reduce the risk. We are reducing the uncertainty by doing testing. The County commented about possible failure of the access ramps. The toe has been eroded by stream flow. The worst case scenario would be down into the sediment in the impound area and a landslide moves completely eliminating Malibu Canyon Road, cutting off access to the construction site; potentially killing or damaging equipment; creating an earthen dam in the canyon that would then have to be removed.
- ES-2: Diversion and Control of Water - Variations in flows are likely. Diversion and control of water costs are highly likely to be impacted.

- EX-1: Internal Low or not studied risks - This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule. This item is added based on standard items noted as being required for all formal cost and schedule risk analyses, such as sufficient studies, based on forthcoming policy based on Agency Technical Review comment/resolution. This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule.
- CO-5: Access Road Re-Construction - Re-construction of slope may pose difficulties. Slope stability during Access Road Construction may increase the costs and cause delays. After the 1st year, the current estimate assumes 25% of the initial volume is required to rebuild the ramps on sub-sequent years. Worst case scenario would represent rebuilding the complete ramp. Representing a cost increase of $1M per re-construction year.
- ES-4: Sediment Hauling - Areas can incur times of high traffic and congestion. Estimates on hauling productivity are likely to change causing cost and schedule impacts.
- ES-7: Soil Parameters – Civil and Geotechnical Design assisted in the development of quantities. Geotech believes reasonable quantity estimates were developed. Geotechnical investigations and Soil Penetration Tests (SPT) were performed on the impounded sediment within the last few years. Blow count tests indicated soil properties with extremely low relative density. The PDT feels the impounded sediment is in its loose state and the baseline estimate was based on in-situ Loose Cubic Yards (LCY). But, there is a possibility for increased quantities based on potential swell factors. The PDT feels the quantities are appropriate and material swelling will not be an issue (Unlikely to happen), but if the material does swell it will add large costs (Significant impact) and delay the schedule.
- PM-1: Insufficient Funding - Project may be funded on some years, but we are not certain that the project will be funded the amount it is requesting or skip a year. Project may be terminated if it doesn't receive funding. Impact on project resourcing and sequencing. Required appropriations are large for each contract. Currently, the project is broken down into 3 contracts.
- ES-8: Productivity Lessens as Mining Progresses - The surface area/work zone for mining sediment upstream of Rindge Dam will diminish as more of the canyon slopes are exposed. Space to divert/control water, dewatering wells, and mined sediment will affect daily and annual productivity. The PDT has already considered diminishing productivity due to more limited work space in the schedule and cost estimates. Already accounted in the estimate and schedule by reducing productivity in the work zones, but productivity could still vary.

Schedule Risks: The high value of schedule risk indicates a significant uncertainty of key risk items, time duration growth that can translate into added costs. Over time, risks increase on those out-year contracts where there is greater potential for change in new scope requirements, uncertain market conditions, and unexpected high inflation. The key or greater Cost Risk items include:

- EX-3: Political/Legal Opposition – There are locals opposed to certain aspects. They could potentially attempt to file a suit against the project. There remains the possibility that political opposition/legal opposition could delay the project or any individual event. It could also create a delay in the activities as well.

- TR-2: Slope Stabilization / Landslides - Concerns of landslides during and after excavation. Construction-related impacts to earth resources, through movement of earth by heavy equipment, would result in potential destabilization and erosion of soils in the vicinity of construction activities at and adjacent to Rindge Dam, in the area of accumulated sediment upstream of the Dam, and in constructed access roads and staging areas, and at the disposal sites. Destabilization effects to Malibu Canyon Road could expose people and structures to potential substantial adverse effects due to landslides and slope instability if not mitigated. Soil stabilization methods may be required on side slope below Malibu Canyon Road following excavation of sediment. Continuous monitoring/confirmatory test may be required.
  The costs associated with remediation of landslide concerns during construction are difficult to predict due to the limited understanding of the actual geologic conditions and the scope of necessary remediation. Some uncertainties/unknowns are better addressed during PED - field investigations. We will characterize the field conditions in the future during PED, but it does not reduce the risk. We are reducing the uncertainty by doing testing. The County commented about possible failure of the access ramps. The toe has been eroded by stream flow. The worst case scenario would be down into the sediment in the impound area and a landslide moves completely eliminating Malibu Canyon Road, cutting off access to the construction site; potentially killing or damaging equipment; creating an earthen dam in the canyon that would then have to be removed.
- ES-7: Soil Parameters – Civil and Geotechnical Design assisted in the development of quantities. Geotech believes reasonable quantity estimates were developed. Geotechnical investigations and Soil Penetration Tests (SPT) were performed on the impounded sediment within the last few years. Blow count tests indicated soil properties with extremely low relative density. The PDT feels the impounded sediment is in its loose state and the baseline estimate was based on in-situ Loose Cubic Yards (LCY). But, there is a possibility for increased quantities based on potential swell factors. The PDT feels the quantities are appropriate and material swelling will not be an issue (Unlikely to happen), but if the material does swell it will add large costs (Significant impact) and delay the schedule.
- RG3: Wildlife/ESA - Concern of greater schedule delays associated with other species (IEPR concern). Red legged frogs, monitoring and relocation. Steel head relocations concerns are captured in the estimate. Some isolated areas in

the construction zone, possible relocation outside the project footprint. This risk affects mostly the Upstream Barriers (Red legged frogs). Worst case scenario involves finding an endangered species at the dam site, at the beginning of the season, pre-construction, or during construction and resulting delays. At the upstream barriers sites the weight of the risk is higher, but this work is not on the project critical path.

- ES-3: Dewatering - Preliminary estimate is subject to change based on pump test results and yearly replacement of dewatering platforms and instrumentation. Cost and schedule are very likely to change.
- ES-5: Additional Vegetation Clearing - Vegetation density will increase from current state. In the last few years, vegetation in the area has significantly matured. By the time clearing and grubbing operations take place, vegetation density may double. Cost and schedule are likely impacted.
- PM4: Inadequate Staffing - Resources in PM, Design, Geotechnical, Economics, and Construction are currently overloaded in terms of workload and priorities. The PDT has been performing well. However, there are many competing demands. The COE may reach out to AE firms to help out reducing the staffing risk, but the schedule may be affected by unavailability of key members.

PM-1: Insufficient Funding - Project may be funded on some years, but we are not certain that the project will be funded the amount it is requesting or skip a year. Project may be terminated if it doesn't receive funding. Impact on project resourcing and sequencing. Required appropriations are large for each contract. Currently, the project is broken down into 3 contracts.

Table 3. Construction Cost Comparison Summary (Uncertainty Analysis)

Most Likely Cost Estimate	**$179,517,000**		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	**$226,191,420**	**$46,674,420**	**26.00%**
10%	**$240,552,780**	**$61,035,780**	**34.00%**
20%	**$242,347,950**	**$62,830,950**	**35.00%**
30%	**$245,938,290**	**$66,421,290**	**37.00%**
40%	**$247,733,460**	**$68,216,460**	**38.00%**
50%	**$249,528,630**	**$70,011,630**	**39.00%**
60%	**$251,323,800**	**$71,806,800**	**40.00%**
70%	**$253,118,970**	**$73,601,970**	**41.00%**
80%	**$256,218,310**	**$76,692,310**	**43.00%**
90%	**$260,299,650**	**$80,782,650**	**45.00%**
100%	**$274,661,010**	**$95,144,010**	**53.00%**

Table 4. Construction Schedule Comparison Summary (Uncertainty Analysis)

Most Likely Schedule Duration	120.1 Months		
Confidence Level	**Project Duration**	**Contingency**	**Contingency %**
0%	**165.7 Months**	**45.6 Months**	**38.00%**
10%	**178.9 Months**	**58.8 Months**	**49.00%**
20%	**185.0 Months**	**64.9 Months**	**54.00%**
30%	**189.8 Months**	**69.7 Months**	**58.00%**
40%	**193.4 Months**	**73.3 Months**	**61.00%**
50%	**197.0 Months**	**76.9 Months**	**64.00%**
60%	**199.4 Months**	**79.3 Months**	**66.00%**
70%	**203.0 Months**	**82.9 Months**	**69.00%**
80%	**206.6 Months**	**86.5 Months**	**72.00%**
90%	**212.6 Months**	**92.5 Months**	**77.00%**
100%	**236.6 Months**	**116.5 Months**	**97.00%**

7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

The CSRA study serves as a "road map" towards project improvements and reduced risks over time. Timely coordination and risk resolution between the Sponsor and USACE is needed in areas of ROW, site access and staging, and funding needs and updates as applicable. The PDT must include the recommended cost and schedule contingencies and incorporate risk monitoring and mitigation on those identified risks. Further iterative study and update of the risk analysis throughout the project life-cycle is important in support of remaining within an approved budget and appropriation.

Risk Management: Project leadership should use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

				Project Cost			Project Schedule		
CREF	**Risk/Opportunity Event**	**Risk Event Description**	**PDT Discussions on Impact and Likelihood**	**Likelihood ©**	**Impact ©**	**Risk Level ©**	**Likelihood (S)**	**Impact (S)**	**Risk Level (S)**
Organizational and Project Management Risks (PM)									
PM1	Insufficient funding	Fed projects are subject to annual appropriations. Non-Federal Sponsor also has competing budgetary priorities.	Project may be funded on some years, but we are not certain that the project will be funded the amount it is requesting or skip a year. Project may be terminated if it doesn't receive funding. Impact on project resourcing and sequencing. Required appropriations are large for each contract. Currently, the project is broken down into 3 contracts; breaking out the project into 3 contracts lessens the impact. Federal Funding Issues. All Fed projects are subject to annual appropriations, which are a function of budget priorities. Currently, ecosystem restoration projects are considered a lower priority than flood and coastal storm risk management and deep draft navigation. The project must also compete with other ER projects nationwide for funding. Given these conditions, there is uncertainty regarding the potential annual funding that will be allocated for this project. Non-Federal Funding Issues. The NF Sponsor is responsible for providing all LERRD for the project as well as a significant cash contribution (estimated at over $57 million). Completion of the project will depend on the NF Sponsor providing their cash contributions in a timely manner to match the federal share and the provision of LERRD as necessary to maintain project schedules. The NF Sponsor has provided a Statement of Financial Capability, but also has competing budgetary priorities which may vary from year to year through completion of the Project. Risk carries significant impact on cost and schedule.	Likely	Significant	**High**	Likely	Significant	**High**

PM2	Internal Red Tape	New requirements for review (ATR, IEPR, etc.) may cause delays in the project schedule.	New guidance processes have been assimilated and policy is better understood and budgeted. Estimate accounts for additional review costs. Having to delay the project phases, potential new requirements (changes in process) may cause inefficiencies but impacts to cost and schedule are minimal.	Possible	Marginal	**Low**	Possible	Marginal	**Low**
PM3	Scope Confidence	Concern regarding adding additional features	From a civil perspective the PDT doesn't see a major change in scope. Scope changes may encompass: (1) a reduction in cost by having the U/S Barriers Lost Hills Rd Culvert (LV3) and Meadow Crk Lane Crossing (LV4) built by someone else; (2) an increase in cost due to night trucking could be a possibility, but it is unlikely because the owner of the road wants work to stop by 3 PM; (3) additional EIS requirement is very unlikely. A design change, such as night trucking allowance, could cause a variance to the contract cost and schedule.	Possible	Significant	**Medium**	Possible	Significant	**Medium**
PM4	Inadequate Staffing	Resources in PM, Design, Geotechnical, Economics, and Construction are currently overloaded in terms of workload and priorities.	The PDT has been performing well. However, there are many competing demands. The COE may reach out to AE firms to help out reducing the staffing risk, but the schedule may be affected by unavailability of key members.	Possible	Marginal	**Low**	Possible	Moderate	**Medium**
PM5	Continuing Contract Clause	If each multi-year construction contract is not fully funded, the Continuing Contract Clause will need to be exercised to make subsequent year's award.	A continuing contract permits USACE to obligate the government to the entire contract amount at award and fund the contract incrementally until completion. If the initial construction is not fully funded, the Continuing Contract Clause will need to be exercised to make a subsequent years awards. The Standard Continuing Contract Clause increases the risk of contractors increasing their prices.	Possible	Moderate	**Medium**	Unlikely	Marginal	**Low**

Contract Acquisition Risks (CA)									
CA1	Numerous Separate Contracts	If optimal funding was received, then there would be fewer contracts required. However, increasing the number of contracts may change conditions downstream of the dam.	Current estimate is based on three (3) fixed-price contracts. Number of contracts will impact cost and schedule. The current breakdown and estimate assumes a reasonable approach to the number of contracts. However, less than optimal funding would increase the number of contracts (possibly one contract per year) and change the conditions downstream of the dam. Resulting cost impacts involve additional Engineering and Design costs. Schedule risk are possible but marginal in magnitude.	Possible	Critical	**High**	Possible	Marginal	**Low**
CA2	Inefficient Contractor	There is a possibility that a new contractor obtains one of the contracts and is unable to perform the work.	The nature of this type of work makes this likely. However, there are a lot capable contractors in the area are experienced and the work is not complex. The Contractor has to coordinate with many different entities, captured in schedule. It is likely we will go open-bid because of the nature of the work. Construction entails traditional earth moving equipment, but it is tricky to work in constrained space at the bottom of the canyon. Worst case scenario: we get 1 bad contractor and have to add 1 new contract (1 year delay).	Likely	Marginal	**Medium**	Likely	Moderate	**Medium**
CA3	Hauling Contractors	Numerous hauling time restrictions	This may or may not come to play in this project. Reduced number of prospective bidders due to job time restrictions. Hauling restrictions such as limiting hauling time to 5-6 hours per day may affect/reduce the number of prospective bidders and/or inflate cost. The estimate accounts for hauling time restrictions, however, schedule costs can be impacted.	Possible	Marginal	**Low**	Possible	Moderate	**Medium**

General Technical Risks (TR)									
TR1	Piuma Bridge Weight Limitations	The local agencies have expressed concern regarding weight limitations on Piuma Bridge along Malibu Canyon Road.	The Malibu Canyon Rd Bridge does not have any weight restriction sign postings and based on our data from the Bridge Capacity System the bridge is rated as PPPPP which means that it is rated to withstand significant truck loads. Risk is not modeled for impact to this project in terms of cost and schedule. Emails from the Sponsor and the County indicate this risk is minimal.	Unlikely	Marginal	**Low**	Unlikely	Marginal	**Low**
TR2	Slope Stabilization / Landslides	Concerns of landslides during and after excavation. Construction-related impacts to earth resources, through movement of earth by heavy equipment, would result in potential destabilization and erosion of soils in the vicinity of construction activities at and adjacent to Rindge Dam, in the area of accumulated sediment upstream of the Dam, and in constructed access roads and staging areas, and at the disposal sites	Destabilization effects to Malibu Canyon Road could expose people and structures to potential substantial adverse effects due to landslides and slope instability if not mitigated. Soil stabilization methods may be required on side slope below Malibu Canyon Road following excavation of sediment. Continuous monitoring/confirmatory test may be required. The costs associated with remediation of landslide concerns during construction are difficult to predict due to the limited understanding of the actual geologic conditions and the scope of necessary remediation. Some uncertainties/unknowns better addressed during PED - field investigations. The question remains, how do we take into consideration field investigations moving forward during construction? We will characterize the field conditions in the future during PED, but it does not reduce the risk. We are reducing the uncertainty by doing testing. We might learn during after testing and investigation are conducted that cost and schedules will increase. The County commented about possible failure of the access ramps. The toe has been eroded by stream flow.	Possible	Critical	**High**	Possible	Critical	**High**

TR3	Beach Compatibility Not an issue for the LPP - only potential for the NER	Material distribution versus placement site may be altered. Sand-rich layer may be beach compatible or non-beach compatible.	Risk captures the uncertainty of the material going to where we are envisioning. In particular, the sand-rich layer. Worst case scenario would be for the sand sediment being non-beach compatible. Applicable to NER because of grain size, we did the field testing and had a prior consultant (Lou Crandle?) we have good characterization to give us confidence on what this material looks like, came out clean for multiple uses (on land and shoreline placement). There might be variation, gradation has been reviewed by SCDMMT and we're high and fine built not too fine, we can put it on the beach. If we place the material near shore, ocean currents will remove the fine grained fraction. Greater risk going with beach placement vs shoreline placement. LPP: unlikely & negligible NER (cost and schedule): possible & moderate (material sorting or diversion required). Risk is captured under Risk ES6 (Disposal Site Changing)	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
TR4	Roads Repair	In the vicinity of the ramps themselves, fully loaded trucks could induce wear and tear	Roadway repair is variable and has been considered. Other work such as flagging and dust control was estimated in accordance with time frames. Malibu Canyon Road and Pacific Coast Hwy trucking is a small percentage of the overall traffic. The risk of causing any damage is small (LA County). We will develop a road repair plan for the disturbed areas. Impacted areas will be the site ingress and egress points.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
Lands and Damages (LD)									
LD1	Utility Impacts	Investigations have identified a high pressure gas line, overhead power line, and a water line which are public utilities. However, one water line which was identified as needing to be relocated is owned by the homeowner's association. Currently it is anticipated the sponsor will coordinate with the homeowner's association to address the waterline as part of the relocation of the affected bridge.	This would not have a cost impact, but historically has impacted the schedule. This risk is associated with the U/S Barriers relocations.	Unlikely	Negligible	**Low**	Likely	Marginal	**Medium**

LD2	LERRDS Acquisition	Schedule delays relating to LERRDS acquisition with upstream barriers.	Cold creek, homeowners association, CC2 and CC3 uncertainties on community reaction (potentially litigious). Potential delays in acquiring easements. Depending on the inconvenience of construction, potential delay in schedule. We have some room to absorb impacts and delays because this is not on the critical path. Homeowner association likely favors bridge replacement but legal issues/challenges still possible.	Possible	Moderate	**Medium**	Possible	Negligible	**Low**
LD3	State Land Permits -Site F Not an issue for the LPP OR NER	Not a risk because sponsor owns real estate for Site F. Exclude from the risk analysis.	Do not model in the risk analysis.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
LD4	Ventura Harbor Permit LPP - only	In the LPP, it describes trucking sediment to barges at Ventura Harbor for beach placement by Malibu pier. These effort need to be coordinated with Ventura Port District	This may not have an impact to costs, but unforeseen circumstances may impact the schedule.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
Regulatory Environmental Risks (RG)									
RG1	Traffic Impacts Not an issue for the LPP - only potential for the NER Risk is captured by ES4	Work in this area will be lengthy and extensive, so this will result possible impacts and aggravation due to congestion. DOT involvement will be important is moving forward.	The PDT feels that the costs associated with this issue has been adequately captured in the cost estimate. May have to conduct a traffic plan that requires review (may require a traffic engineer). Exiting the site into traffic will affect (NER: Malibu Canyon & PCH). Cost and Schedule impacts will be resolved during PED. We will develop a traffic plan.	Possible	Moderate	**Medium**	Possible	Marginal	**Low**
RG2	Nesting Birds	Concern of greater cost buffer associated with the nesting bird item (IEPR concern).	Based on recent surveys of the entire work area there is suitable nesting habitat on a lot of the canyon slopes. Thus, there is some likelihood that a nest may come into play in an adjacent un-grubbed area that we need to buffer away from. We always commit to come in before nesting season and remove nests. Minor costs and schedule delays are expected.	Very Likely	Negligible	**Low**	Very Likely	Negligible	**Low**

RG3	Wildlife/ESA	Concern of greater schedule delays associated with other species (IEPR concern).	Red legged frogs, monitoring and relocation. Steel head relocations concerns are captured in the estimate. Some isolated areas in the construction zone, possible relocation outside the project footprint. This risk affects mostly the Upstream Barriers (Red legged frogs). Worst case scenario involves finding an endangered specie at the dam site, at the beginning of the season, pre-construction, or during construction and resulting in a 6 month delay. At the upstream barriers sites the weight of the risk is higher, but this work is not on the project critical path.	Possible	Negligible	**Low**	Possible	Significant	**Medium**
RG4	Water Turbidity	Potential for increased turbidity during the winter season during and immediately after the construction season due to sediment at cleared excavation areas not being vegetated and being exposed to flow of water.	Permit requires project life water turbidity monitoring; not just during active construction. There is a potential of increased turbidity if there is a long lapse between one contract to the next. Runoff and construction dust will also increase turbidity (surface water). Water Board Permit is required. There is weekly testing of water quality to account for increase in turbidity. Extended time between contracts and during high flow events the BMPs will need to be updated. Increased turbidity would be similar to turbidity levels under larger storm events. These impacts are adverse but will be temporary, seasonal and limited in duration. The PDT feels that water turbidity risks increase at the dam site, but costs will be negligible. The schedule is not impacted.	Likely	Negligible	**Low**	Unlikely	Negligible	**Low**
RG5	Increased run-off during construction seasons	Additional sediment from the site may be transported downstream. One or several storms require rapid (and partial) demobilization from the Dam area. Established access ramps and diversion/control of water may be impacted.	Damage not likely to be significant during construction cycles, but storm runoff can possibly wash away temporary infrastructure for access and affect establishment of dewatering wells, Cost and schedule may increase to conduct repairs. If there is a delay in award of the next construction contract, risks of this scenario occurring increase. Downstream impacts to the environment include sediment deposition and additional water turbidity.	Possible	Significant	**Medium**	Possible	Significant	**Medium**

RG6	Post-Review Discoveries (Cultural Artifacts/Human Remains)	The Santa Monica and Malibu coastal areas represent one of the most intensely studied archeological regions in the state of California. Cultural artifacts may be found during excavation requiring mining/other construction activities to be temporarily suspended.	Finding cultural artifacts during excavation may delay the construction schedule while appropriate consultation measures and removal of artifacts occur. Greater chance of finding artifacts or human remains at upland barriers and temporary stockpile areas. Cost impacts are low. In a worst case scenario, construction work could stop up to 30 days around a specified buffer zone, but remaining areas will stay open for the contractor to continue working. Overall schedule delays are negligible.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
Construction Risks (CO)									
CO1	Dam Arch Stability	Arch safety risk during demolition	Arch demolition occurs together with the sediment removal operations. The number, size, and locations of arch cut-off notches coincide with the sediment removal; as the sediment is removed the arch demolition proceeds. We reduce the risk because we are keeping the static load behind the arch constant; a dynamic load is not imparted on the arch.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
CO2	Debris Flow Risk	During construction a natural plateau or bench will temporarily exist during excavation. The debris plateau refers to the difference in height of remaining impounded sediment vs. remaining dam arch. This is not "debris" in terms of trash, but all impounded material trapped behind the arch.	Sediment volume calculations/quantities are likely to change due to the intermittent nature of the construction sequence. Sediment removal is not continuous. Sediment removal cost and schedules are possibly impacted. During the construction scenario, we get the dam cut down first (in stages) ahead of sediment removal. Possibility, not covered. Risk could occur. Rain event could create ponding behind the dam, becomes a jurisdictional condition (DSOD). However, construction is taking place outside the raining season. Removing the arch and mining the sediment in the same time frame is staged, but leaves the possibility of "debris flow" for that exposed volume of sediment. Risk may have downstream effects (turbidity, swamp road crossings, consultation with ESA) because it's an uncontrolled release of flow. Risk may result in emergency actions, but no project shutdown (maybe up to $3M & 1 year delay).	Possible	Moderate	**Medium**	Possible	Moderate	**Medium**

CO3	Constant Water Effluent	Concern with constant water effluent from upstream water treatment plant may affect current soil properties	Water effluent may create super-saturated sediment conditions in the excavation area. The sediment removal site may require additional time for drying-out before hauling off. Water effluent will continue to be discharged, but it is controlled by continual dewatering operations and diversion of water. Risk event is already accounted in the cost and schedule as removal of damp material. The PDT feels that additional risks associated with different soil properties are low.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
CO4	Soil Contaminants	Malibu Creek could be contaminated with trash and other pollutants	The effect of this impact is expected to be minor due to the proposed construction in the dry. BMPs will be in place to further reduce the risk of spills. Due diligence has been taken in determining field conditions. An upstream watershed survey was conducted for historic use/environmental contaminant risks and gave favorable results. Cost and Sch risks associated with soil contaminants are unlikely and negligible.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
CO5	Access Road Re-construction	Re-construction of slope may pose difficulties.	Slope stability during Access Road Construction may increase the costs and cause delays. After the 1st year, the current estimate assumes 25% of the initial volume is required to rebuild the ramps on sub-sequent years. Worst case scenario would represent rebuilding the complete ramp. Representing a cost increase of $1M per re-construction year.	Possible	Moderate	**Medium**	Unlikely	Negligible	**Low**
CO6	Variation in Quantities	Concern with sediment removal quantities accuracy and dam removal quantities.	There is inherent risk of under runs and overruns, but the quantities will most likely fall within the VEQ range. The PDT does not the exact configuration of the buried canyon walls.	Very Likely	Moderate	**High**	Very Likely	Moderate	**High**

C07	Impact on Private Property	Concern for landslides	Outside of the footprint of the dam. If we have a landslide that occurs with the removal of the dam, it will impact private property. There is a landslide that is a mile long, private property 3 miles away, landslides can go up to the ridgeline. Issues of landslide remains. Risk is an existing condition but conditions might be worsened due to construction activities. We haven't done the mapping, it might be eliminated. We don't know the extent of landslides in the area. Purchase land would be cheap. This risk in already accounted under (TR2) Slope Stabilization / Landslides	Possible	Marginal	**Low**	Possible	Negligible	**Low**
C08	Claims/Modifications	This item captures the risk that post-award construction modifications or claims may cause a variance to project cost and schedule.	Possible claims and modifications may rise affecting the cost and/or causing schedule delays.	Very Likely	Moderate	**High**	Very Likely	Moderate	**High**
Estimate and Schedule Risks (ES)									
ES1	Upstream Barriers Costs	Concern on limited level of design	Cost relocations are representative of the limited level of design. The costs of the relocations could therefore change as the design changes.	Likely	Marginal	**Medium**	Unlikely	Negligible	**Low**
ES2	Diversion and Control of Water	Assumptions regarding amount of water to divert may change	Variations in flows are likely. Diversion and control of water cost are highly likely to be impacted. Estimate assumes an average discharge for the stream. Schedule impacts would be low.	Likely	Marginal	**Medium**	Likely	Negligible	**Low**

ES3	Dewatering	Dewatering design is typically left to the contractor.	Estimate was developed with assistance from a dewatering contractor. However, preliminary estimate is subject to change based on pump test results and yearly replacement of dewatering platforms and instrumentation. Cost and schedule are very likely to change.	Likely	Marginal	**Medium**	Likely	Marginal	**Medium**
ES4	Sediment Hauling	Areas can incur times of high traffic and congestion.	Estimates on hauling productivity are likely to change causing cost and schedule impacts.	Likely	Marginal	**Medium**	Likely	Significant	**High**

ES5	Additional Vegetation Clearing	Vegetation density will increase from current state.	In the last few years, vegetation in the area has significantly matured. By the time clearing and grubbing operations take place, vegetation density may double. Cost and schedule are likely impacted.	Likely	Significant	**High**	Likely	Significant	**High**
ES6	Disposal site changing	Concern of an alternative disposal site for the removed sediment.	Risk could present an opportunity if a closer or cheaper alternative disposal site is identified. Currently, the gravel-rich and clay/silt-rich sediment is disposed at the closest landfill -- the Calabasas Landfill. Disposal fees are high. Worst case scenario is for the landfill capacity to pose an issue. Risk occurrence is unlikely, but cost impacts would be significant.	Unlikely	Significant	**Medium**	Unlikely	Significant	**Medium**

ES7	Soil Parameters	Uncertainty on actual soil properties (% swell).	Civil and geotechnical design assisted in the development of quantities. Geotech believes reasonable quantity estimates were developed. Geotechnical investigations and Soil Penetration Tests (SPT) were performed on the impounded sediment within the last few years. Blow count tests indicated soil properties with extremely low relative density. The PDT feels the impounded sediment is in its loose state and the baseline estimate was based on in-situ Loose Cubic Yards (LCY). But, there is a possibility for increased quantities based on potential swell factors. - PDT feels the quantities are appropriate and material swelling will not be an issue (Unlikely to happen), but if the material does swell it will add large costs (Significant impact) and delay the schedule.	Very Likely	Moderate	**High**	Very Likely	Moderate	**High**
ES8	Productivity Lessens as Mining Progresses	The surface area/work zone for mining sediment upstream of Rindge Dam will diminish as more of the canyon slopes are exposed. Space to divert/control water, have dewatering wells, mine sediment, etc… will affect daily and annual productivity.	The PDT has already considered diminishing productivity due to more limited work space in the schedule and cost estimates. Already accounted in the estimate and schedule by reducing productivity in the work zones, but productivity could still vary. Assume costs could be affected, but not the baseline schedule. Account for conservative assumptions, items that can be improved. Opportunities on improving production & construction efficiencies.	Likely	Marginal	**Medium**	Unlikely	Negligible	**Low**
ES9	PED and CM Cost Increase	Increase in PED and CM Costs (30 & 31 Accounts).	Project features are in the preliminary stages. This item captures the risk that the costs for PED and CM could increase from beyond the currently estimated.	Very Likely	Marginal	**Medium**	Likely	Marginal	**Medium**

External Risks (EX)									
EX1	Internal Low or not studied risks	This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule.	This item is added based on standard items noted as being required for all formal cost and schedule risk analyses, such as sufficient studies, based on forthcoming policy based on Agency Technical Review comment/resolution. This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule.	Likely	Marginal	**Medium**	Likely	Moderate	**Medium**
EX2	Tribal Politics	Tribal elections generally take place every 2-4 years depending on the Tribe. Changes in Tribal personnel may take place any time.	A change in Tribal politics may have an impact on external relations with USACE/CDPR and previously determined mitigation measures. Intertribal conflicts may have more of an impact. But, risk to the project cost and executions ares considered low.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
EX3	Political/Legal Opposition	There are locals opposed to certain aspects. They could potentially attempt to file a suit against the project.	There remains the possibility that political opposition/legal opposition could delay the project or any individual event. It could also create a delay in the activities as well (2+ years).	Possible	Marginal	**Low**	Possible	Critical	**High**
EX4	Inflation Volatility	Extreme volatility and inflation on (WBS 06) Fish and Wildlife Facilities projects are captured by CWICCS tables.	CWCCIS tables show ~4% per year on average (years 2000 thru 2017). Undersigned feels that the CWCCIS inflation factors are reasonable and that the rate of increase will not be much higher than the inflation factors captured in the CWCCIS tables.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
EX5	Bidding Climate	The conditions are currently favorable. (Yr 2017).	There is a healthy amount of development taking place in the LA County area. Expect the current trend to continue. There is a healthy competitive bidding climate in LA.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
EX6	Brush Fires	There have historically been brush fires that can impact construction projects.	The project is in an area prone to fires, but cost and schedule should only be marginally affected. Impact on duration is minimal.	Possible	Marginal	**Low**	Possible	Negligible	**Low**

Malibu Ecosystem Restoration - NER

Remove Rindge Dam concrete arch (not the spillway) over 7 years concurrent with removal of impounded sediment.
Truck Sand layer to the shoreline downcoast of Malibu Pier. Truck Gravel and Clay/silt layers to Calabasas Landfill.
Impounded sediment (sand) trucked for shoreline placement downcoast of Malibu Pier includes use of temp upland Site F and Malibu pier parking area.

Estimated by	Juan Dominguez, PE, CCE
Designed by	Los Angeles District
Prepared by	Cost Engineering, Los Angeles District
Preparation Date	1/30/2020
Effective Date of Pricing	10/1/2019
Estimated Construction Time	Days

Designed by	
Los Angeles District	
Estimated by	
Juan Dominguez, PE, CCE	
Prepared by	
Cost Engineering, Los Angeles District	

Design Document	Feasibility
Document Date	4/26/2016
District	Los Angeles District
Contact	Juan Dominguez, x3737
Budget Year	2020
UOM System	Original

Direct Costs

LaborCost
EQCost
MatlCost
SubBidCost

Timeline/Currency

Preparation Date	1/30/2020
Escalation Date	10/1/2019
Eff. Pricing Date	10/1/2019
Estimated Duration	0 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB16EN: 2016 MII English Cost Book

Labor 01LA20: Riverside, San Bernardino, Los Angeles County

ates. Fringes paid to the laborers may be fully or partially taxable. In a NON-UNION job, all the fringe benefits are taxable. In a UNION job, the vacation pay fringes is taxable an

Labor Rates

LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP16R07: MII Equipment 2016 Region 07

07 WEST

Sales Tax	7.95
Working Hours per Year	1,630
Labor Adjustment Factor	1.13
Cost of Money	2.13
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.112
Gas	3.420
Diesel Off-Road	3.370
Diesel On-Road	3.870

Shipping Rates

Over 0 CWT	28.91
Over 240 CWT	21.98
Over 300 CWT	18.50
Over 400 CWT	16.24
Over 500 CWT	19.65
Over 700 CWT	18.73
Over 800 CWT	10.52

Date	Author	Note

Description	Quantity	UOM	BareCost	DirectCost	CostToPrime	ProjectCost
Project Summary Report Level 2			**88,464,487**	**91,922,922**	**45,984,969**	**111,875,592**
06 Rindge Dam Demolition and Sediment Removal	**1.00**	**LS**	**88,464,487**	**91,922,922**	**45,984,969**	**111,875,592**
			4,467,281.40	*4,706,431.34*	*3,769,019.73*	*6,388,479.16*
0601 General Requirements (NER)	**7.00**	**YR**	**31,270,970**	**32,945,019**	**26,383,138**	**44,719,354**
			71.03	*73.01*	*20.93*	*80.96*
0602 Sediment Removal (NER)	**770,000.00**	**LCY**	**54,689,275**	**56,219,831**	**16,113,693**	**62,342,683**
			417.37	*459.68*	*581.36*	*802.26*
0603 Rindge Dam Arc Demolition - NO Spillway Demolition	**6,000.00**	**CY**	**2,504,243**	**2,758,072**	**3,488,139**	**4,813,555**

Description	Quantity	UOM	BareCost	DirectCost	CostToPrime	ProjectCost
Project Summary Report Level 4			**88,464,487**	**91,922,922**	**45,984,969**	**111,875,592**
06 Rindge Dam Demolition and Sediment Removal	**1.00**	**LS**	**88,464,487**	**91,922,922**	**45,984,969**	**111,875,592**
			4,467,281.40	*4,706,431.34*	*3,769,019.73*	*6,388,479.16*
0601 General Requirements (NER)	**7.00**	**YR**	**31,270,970**	**32,945,019**	**26,383,138**	**44,719,354**
			3,180,000.00	*3,180,000.00*	*0.00*	*3,180,000.00*
PED Phase -- Installation Geotechnical Instrumentation and Data Management	**1.00**	**EA**	**3,180,000**	**3,180,000**	**0**	**3,180,000**
			8,729,653.61	*9,252,412.63*	*8,380,891.22*	*12,928,646.76*
0601 First Contract -- Veg Clearing, Initial Road Establishment. Associated with Arc and Gravel Layer Removal ~ Upper 22 lf	**1.00**	**EA**	**8,729,654**	**9,252,413**	**8,380,891**	**12,928,647**
			4,960,931.37	*5,256,777.16*	*4,824,372.91*	*7,339,129.21*
General Requirements for 1st year of construction	**1.00**	**YR**	**4,960,931**	**5,256,777**	**4,824,373**	**7,339,129**
			3,768,722.23	*3,995,635.48*	*3,556,518.31*	*5,589,517.55*
General Requirements for 2nd year of construction	**1.00**	**YR**	**3,768,722**	**3,995,635**	**3,556,518**	**5,589,518**
			7,537,444.46	*7,991,270.96*	*7,113,036.61*	*11,179,035.11*
0601 Second Contract -- Associated with Arc and Sand Layer Removal ~ Mid 40 lf	**1.00**	**EA**	**7,537,444**	**7,991,271**	**7,113,037**	**11,179,035**
			3,768,722.23	*3,995,635.48*	*3,556,518.31*	*5,589,517.55*
General Requirements for 3rd year of construction	**1.00**	**YR**	**3,768,722**	**3,995,635**	**3,556,518**	**5,589,518**
			3,768,722.23	*3,995,635.48*	*3,556,518.31*	*5,589,517.55*
General Requirements for 4th year of construction	**1.00**	**YR**	**3,768,722**	**3,995,635**	**3,556,518**	**5,589,518**
			11,823,871.76	*12,521,335.77*	*10,889,210.29*	*17,431,672.27*
0601 Third Contract -- Associated with Arc/Foundation, and Silt/Clay Removal ~ Lower 40 lf	**1.00**	**EA**	**11,823,872**	**12,521,336**	**10,889,210**	**17,431,672**
			3,768,722.23	*3,995,635.48*	*3,556,518.31*	*5,589,517.55*
General Requirements for 5th year of construction	**1.00**	**YR**	**3,768,722**	**3,995,635**	**3,556,518**	**5,589,518**
			3,768,722.23	*3,995,635.48*	*3,556,518.31*	*5,589,517.55*
General Requirements for 6th year of construction	**1.00**	**YR**	**3,768,722**	**3,995,635**	**3,556,518**	**5,589,518**
			4,286,427.29	*4,530,064.81*	*3,776,173.67*	*6,252,637.16*
General Requirements for 7th year of construction	**1.00**	**YR**	**4,286,427**	**4,530,065**	**3,776,174**	**6,252,637**
			71.03	*73.01*	*20.93*	*80.96*
0602 Sediment Removal (NER)	**770,000.00**	**LCY**	**54,689,275**	**56,219,831**	**16,113,693**	**62,342,683**
			71.03	*73.01*	*20.93*	*80.96*
0601 NER -- Haul Alternative - Haul to Landfill, Temporary Site F and Downcoast of Malibu Pier	**770,000.00**	**LCY**	**54,689,275**	**56,219,831**	**16,113,693**	**62,342,683**

Description	Quantity	UOM	BareCost	DirectCost	CostToPrime	ProjectCost
			17,165,507.70	*17,533,212.45*	*3,917,245.19*	*19,021,680.03*
First Contract -- Gravel Rich Material and Sand Rich Material	**1.00**	**EA**	**17,165,508**	**17,533,212**	**3,917,245**	**19,021,680**
			11,759,600.20	*12,477,928.54*	*7,432,282.18*	*15,302,033.38*
Second Contract -- Sand Rich Material and Silt/Clay Material	**1.00**	**EA**	**11,759,600**	**12,477,929**	**7,432,282**	**15,302,033**
			25,764,167.15	*26,208,690.37*	*4,764,165.36*	*28,018,969.11*
Third Contract -- Clay/Silt Material	**1.00**	**EA**	**25,764,167**	**26,208,690**	**4,764,165**	**28,018,969**
			417.37	*459.68*	*581.36*	*802.26*
0603 Rindge Dam Arc Demolition - NO Spillway Demolition	**6,000.00**	**CY**	**2,504,243**	**2,758,072**	**3,488,139**	**4,813,555**
			545,995.62	*602,188.35*	*764,627.28*	*1,055,168.94*
0601 First Contract in concurrence with sediment removal - Arc Demo	**1.00**	**EA**	**545,996**	**602,188**	**764,627**	**1,055,169**
			682.49	*752.74*	*955.78*	*1,318.96*
0601 Rindge Dam ARC Demolition	**800.00**	**CY**	**545,996**	**602,188**	**764,627**	**1,055,169**
			873,434.83	*963,653.96*	*1,220,938.94*	*1,684,869.05*
0601 Second Contract in concurrence with sediment removall - Arc Demo	**1.00**	**EA**	**873,435**	**963,654**	**1,220,939**	**1,684,869**
			656.72	*724.55*	*918.00*	*1,266.82*
0601 Rindge Dam ARC Demolition	**1,330.00**	**CY**	**873,435**	**963,654**	**1,220,939**	**1,684,869**
			1,084,812.17	*1,192,229.36*	*1,502,572.35*	*2,073,517.01*
0601 Third Contract in concurrence with sediment removall - Arc, Foundation Demo	**1.00**	**EA**	**1,084,812**	**1,192,229**	**1,502,572**	**2,073,517**
			636.79	*701.88*	*888.88*	*1,226.64*
0601 Rindge Dam ARC Demolition	**1,330.00**	**CY**	**846,937**	**933,504**	**1,182,214**	**1,631,429**
			440.51	*479.12*	*593.26*	*818.68*
0601 Concrete ARC FOUNDATION Demolition	**540.00**	**CY**	**237,875**	**258,726**	**320,358**	**442,088**

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