Los Angeles River Ecosystem Restoration Integrated Feasibility Report

FINAL Feasibility Report and Environmental Impact Statement/Environmental Impact Report

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B: Economics
C: Cost
D: Geotechnical

Los Angeles County, California

September 2015

US Army Corps of Engineers®
Los Angeles District

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Los Angeles River Ecosystem Restoration Feasibility Study

Final
Design Appendix

September 2015

LOS ANGELES RIVER ECOSYSTEM RESTORATION FEASIBILITY STUDY
DESIGN APPENDIX

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1. INTRODUCTION

The Los Angeles River Ecosystem Restoration Feasibility Study is evaluating ecosystem restoration opportunities on an 11.5-mile long reach of the Los Angeles River (River) located in southern California. This reach, named the Los Angeles River ARBOR (Area with Restoration Benefits and Opportunities for Revitalization) extends from the Headworks area[1] downstream to First Street in downtown Los Angeles. The ARBOR reach includes the Glendale Narrows—one of the few sections of the study area that does not have a hardened river bed—and contains several distinctive sites and connections including the Headworks, Pollywog Park, Bette Davis Park, the Burbank-Western Channel and Glendale River Walk, Griffith Park, Ferraro Fields, Verdugo Wash, Atwater Village, Taylor Yard and the Rio de Los Angeles State Park, the "Cornfields" (Los Angeles State Historic Park), Arroyo Seco, Elysian Park, "LATC" (also known as the "Los Angeles Transportation Center" as well as "Mission Yard"), and downtown Los Angeles.

This appendix documents the preliminary array of conceptual alternatives based on plan formulation efforts through 2013 and includes: reach alignments and geometries (Section 2), a summary of ecosystem restoration measures and alternatives (Section 3), review of preliminary design features (Section 4), the final array of alternative plans (Section 5), and utilities potentially affecting future implementation of the project features (Section 6).

The conceptual drawings presented in this appendix are adapted from the as-built design drawings. All elevations are based on the National Geodetic Vertical Datum (NGVD) of 1929, unless otherwise noted. Updated survey information will be required for the detailed design to be completed during the PED. Horizontal and vertical datum will be compliant with current Corps requirements for survey data.

[1] The "Headworks" is a site owned by the LA Department of Water and Power that was formerly used for groundwater infiltration using Los Angeles River water. The facility includes water diversion appurtenances, including a rubber dam that is no longer operated for diversion.

2. REACH ALIGNMENTS AND GEOMETRIES

The 11.5-mile study area ARBOR reach has been divided into eight distinct reaches, or sub-reaches. This section reviews the alignment and geometry for each of the eight sub-reaches within the project bounds. Alignment describes the length and location in relation to known landmarks/roads, and geometry describes the channel shape/geomorphology of each sub-reach. The eight sub-reaches are outlined on Figure 4.1, "Preliminary Design Cross-Section Locations by Sub-reach."

1. Pollywog Park/Headworks to the downstream edge of the concrete bed at the midpoint of Bette Davis Park (BDP)
2. Midpoint BDP to the upstream edge of Ferraro Fields
3. Ferraro Fields to Brazil Street
4. Brazil Street to Los Feliz Boulevard
5. Los Feliz Boulevard to the Glendale Freeway
6. Glendale Freeway to Interstate 5
7. Interstate 5 to Main Street
8. Main Street to 1st Street

2.1 Sub-Reaches

2.1.1 Pollywog Park/Headworks to the Downstream Edge of the Concrete Bed at the Midpoint of Bette Davis Park (BDP)

This sub-reach is approximately 1.5 miles in length and is located at the upstream boundary of the ARBOR reach. This reach connects the Headworks Ecosystem Restoration study area[2] with the area adjacent to Disney Studios in Burbank. Channel geometry in this reach is a rectangular reinforced concrete channel with dimensions typically 18 feet high and 130 feet wide. The Burbank-Western Channel enters the River just downstream of the Los Angeles Equestrian Center, at an approximate 45 degree angle. The geometry of the Burbank-Western Channel near the confluence is rectangular reinforced concrete with dimensions of 60 feet wide by 18 feet high.

[2] The Headworks Ecosystem Restoration Study is a separate, ongoing study being conducted in partnership with the Corps and the City of Los Angeles. It is authorized through utilization of the Los Angeles County Drainage Area (LACDA) Review flood control study, Senate Resolution approved 25 June 1969, as referenced in the Los Angeles River Watercourse Improvement, California, Reconnaissance Study, January 1993.

2.1.2 Midpoint BDP to Upstream Edge of Ferraro Fields

This sub-reach is approximately ¾ miles in length and extends from the midpoint of Bette Davis Park to the upstream location of Ferraro Fields just downstream the bridge crossing for Interstate 5. The channel geometry in this reach is a rectangular reinforced concrete channel with dimensions typically 18 feet high and 175 feet wide and is trapezoidal with a cobble bed and Derrick stone banks. The banks are toed-down with sheet pile and quarry run stone.

2.1.3 Ferraro Fields to Brazil Street

This sub-reach is approximately 1 mile in length and extends from the upstream edge of Ferraro Soccer Fields downstream to Brazil Street. The channel geometry is concrete rectangular reinforced channel 18 to 23 feet high and 180 to 380 feet wide. The Verdugo Wash confluences with the River on the left bank; the geometry of the confluence is a rectangular reinforced concrete channel. The Verdugo Wash channel bed contains deposits of sediment stabilized by vegetative growth, which spans 1,000 feet upstream of San Fernando Road.

2.1.4 Brazil Street to Los Feliz Boulevard

This sub-reach is approximately 1.75 miles in length and flows southerly from Brazil Street to the Los Feliz Boulevard Bridge. The channel geometry transitions from a rectangular reinforced concrete channel upstream of Brazil Street to an 18-foot high and 130- to 160-foot-wide trapezoidal channel with a cobble bed and grouted Derrick stone banks. The banks are toed-down with sheet pile and quarry run stone. The channel transitions back to a rectangular reinforced concrete channel at the downstream extent of the Los Feliz Boulevard Bridge. This section of the River has experienced sediment deposition which has subsequently formed bars and islands due to stabilization provided by tree/shrub root and vegetative cover establishment.

2.1.5 Los Feliz Boulevard to Glendale Freeway

This sub-reach is approximately 1.55 miles in length starting at the Los Feliz Boulevard Bridge and ending at the Glendale Freeway. A total of five bridges cross the channel within this sub-reach, as follows (in upstream to downstream order): Los Feliz Boulevard Bridge, Sunnynook pedestrian bridge, Hyperion Avenue Bridge, Fletcher Drive Bridge, and the Glendale Freeway (Hwy 2) Bridge. In general, the geometry of the channel between each bridge is trapezoidal and 18 feet high with a 130- to 160-foot-wide cobble bed. The channel banks are grouted riprap from Los Feliz Boulevard to Fletcher Drive, and transition to reinforced concrete from Fletcher Drive to the Glendale Freeway. The banks are toed-down with sheet pile quarry run stone. At each bridge crossing, the channel transitions to a downwardly-sloped concrete apron to create more advantageous flow conditions and to provide erosion protection. This section of the River has experienced sediment deposition which has subsequently formed bars and islands due to stabilization provided by tree/shrub root and vegetative cover establishment.

2.1.6 Glendale Freeway to I-5

This sub-reach is approximately 2.34 miles in length and extends from the Glendale Freeway Bridge to upstream of the crossing of the Interstate 5 Freeway. The geometry of the channel in between each bridge is trapezoidal with a cobble soft bottom and Derrick stone banks, and is 30 feet high and 190 to 215 feet wide. The banks are toed-down with sheet pile quarry run stone. This section of the river has experienced sediment deposition which has subsequently formed bars and islands due to stabilization provided by tree/shrub root and vegetative cover establishment. At each bridge crossing, the channel transitions to downwardly-sloped concrete apron to create more advantageous flow conditions and to provide erosion protection. The downstream geometry of the reach as it approaches the Interstate 5 Freeway transitions to a 170-foot-wide rectangular reinforced concrete channel. A 20-foot-wide low-flow channel begins within this transition and continues downstream.

2.1.7 I-5 to Main

This sub-reach is approximately one mile in length and begins at the Interstate 5 Bridge and ends downstream at the Main Street Bridge. The channel geometry is rectangular reinforced concrete channel that is 30 feet high and 150 to 190 feet wide with a 20-foot-wide low-flow channel in the bed. The Arroyo Seco confluences with the River at an approximate 60 degree angle on the left bank downstream of Highway 110. The geometry of the Arroyo Seco at the confluence is rectangular reinforced concrete channel 16 feet high and 66 feet wide, which transitions to trapezoidal reinforced concrete channel upstream. From upstream to downstream order, North Figueroa Street, Arroyo Seco Parkway, railway line, North Broadway, and North Spring Street all cross the channel within this reach.

2.1.8 Main to 1st Street

This sub-reach is approximately one mile in length and extends from the Main Street Bridge downstream to the First Street Bridge. The channel geometry is a trapezoidal reinforced concrete channel, 30 feet high and 170 to 200 feet wide. The bed has a low-flow channel throughout the reach.

3. ECOSYSTEM RESTORATION MEASURES AND PRELIMINARY ALTERNATIVES

Ecosystem restoration[3] measures were developed to meet the study objectives. The development and evaluation of measures and alternatives is described in the main report and is not repeated herein. A measure is "a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives."[4] Alternatives are defined in the main report to be "a set of one or more management measures functioning together to address one or more planning objectives." The measures described below were first developed in a planning charette and further expanded and defined by the project team.

A matrix of alternatives and associated measures is provided as Attachment 1 to this document and is repeated in the Cost Appendix. This matrix includes these 19 preliminary alternatives across the top and the eight sub-reaches down the left. Measures and sub-measures that make up each of the alternatives, by reach, are shown within the matrix itself. Correlation of measures and the alternatives are designated with an "X." The measures listed on the matrix should be referred to in conjunction with Sections 3.1 and 3.2 below.

3.1 Ecosystem Restoration Measures

The ecosystem restoration measures identified consist of one or more actions or features in a particular location that are intended to solve specific problems or help achieve particular planning objectives. Measures are broken-out into six major categories as discussed in the six sub-headings immediately below. Under each of the six major categories are associated sub-measures; potential design components are described under each measure.

3.1.1 Adjacent or Off-Channel Modifications

Adjacent and off-channel modifications include restoration measures both immediately adjacent to and separated from the main river channel. Potential sub-measures include the following. *Note that the numbering is not sequential* because screening of the sub-measures has occurred, as explained in Chapter 3, "Formulation of Alternative Plans," of Volume 1 of the Integrated Feasibility Report.

(2) Restore riparian and marsh habitat by daylighting streams: Storm drains leading into the River would be modified with a transition structure that would divert low flows into a daylighted natural stream or wetland area where possible, especially where the rights-of -way are sufficient to do so. The wetlands or ponds created within the drainage area would provide habitat and water quality treatment. Existing storm drains would remain in place after modification to convey peak

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[3] Within this appendix, references to restoration, creation, or improvement of "hydrology" and "geomorphology" are intended to refer to restoration, creation, or improvement of a more natural hydrologic regime and a more natural geomorphic character.

[4] USACE, 1996. IWR Report 96-R-21, Planning Manual.

storm flows. Design of the outlet and adjacent wetland is site-specific and depends on sizing, discharge, and available right-of-way.

Figure 3.1, displays the conceptual design of this sub-measure:

1. A low-flow diversion/high-flow bypass
2. A pipe diverting low flows from the splitter box to the wetland
3. A benched wetland area built into the wall or overbank area of the channel providing treatment capacity and added habitat value to the river corridor
4. A drainage pipe to be constructed from the base of the wetland to the channel wall
5. Existing storm drain line feeding into the low-flow splitter box up-gradient of the existing channel wall storm drain outlet

The low-flow diversion/high-flow bypass would allow the existing storm drain's nuisance flow and first flush pollutants to be diverted from the storm drain line to the wetland area for treatment and infiltration, and then returned back into the River. Contech's proprietary "StormGate Vault" or other approved, equivalent vault is recommended for the low-flow diversion/high-flow bypass as shown in Figure 3.2. A pipe with an approximate measurement of 24 inches would be used to divert low flows from the splitter box down-gradient to the wetland area. The wetland bench would be lined with a rock/soil filter for infiltration and then drained back through the sideslope of the channel. On top of the rock filter substrate would be additional topsoil and wetland vegetation planted according to the project biologist's recommendations, consistent with the plant palette seen in Table 3-1.

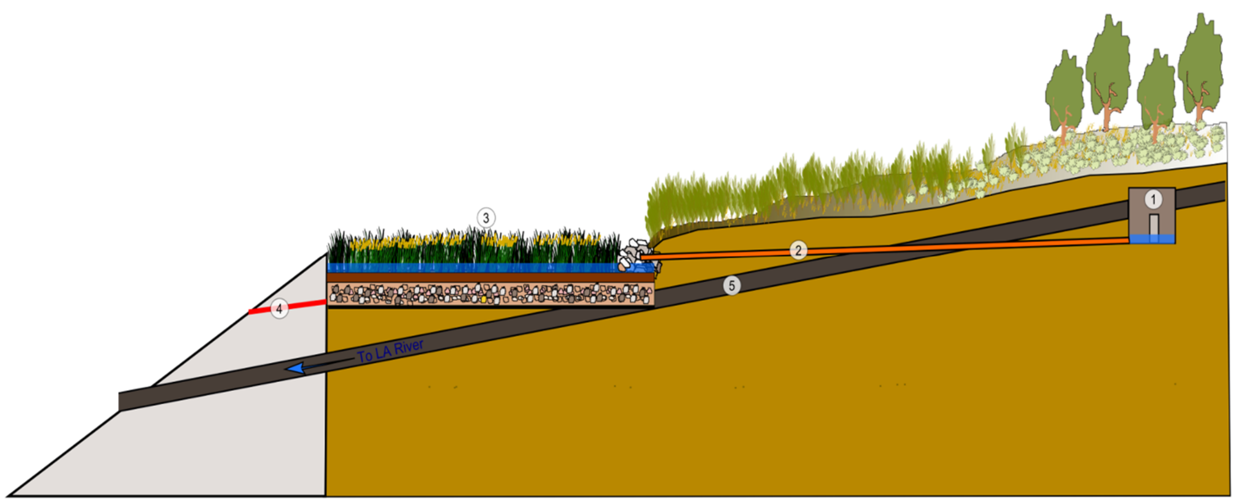
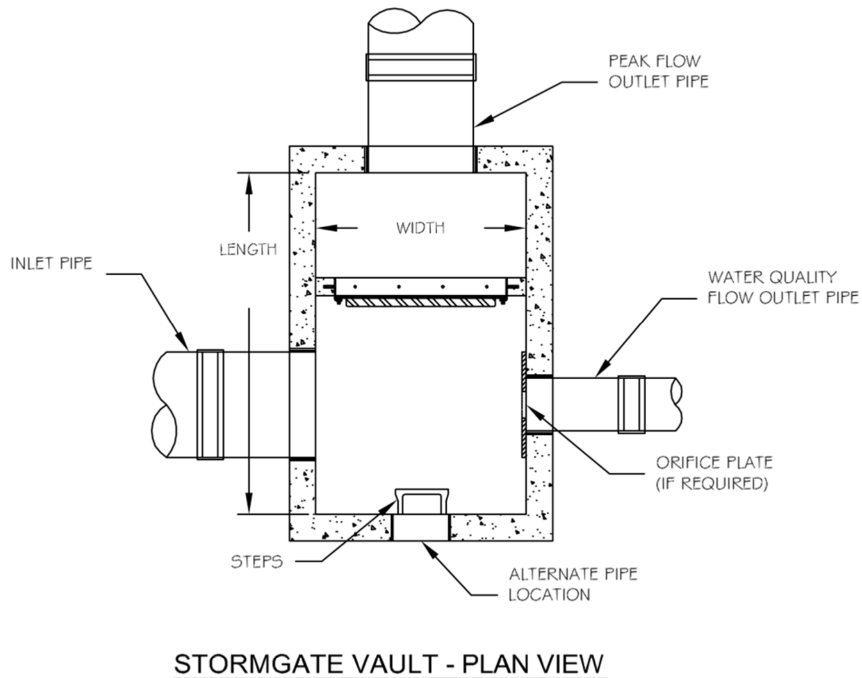


Figure 3.1 Daylight Streams



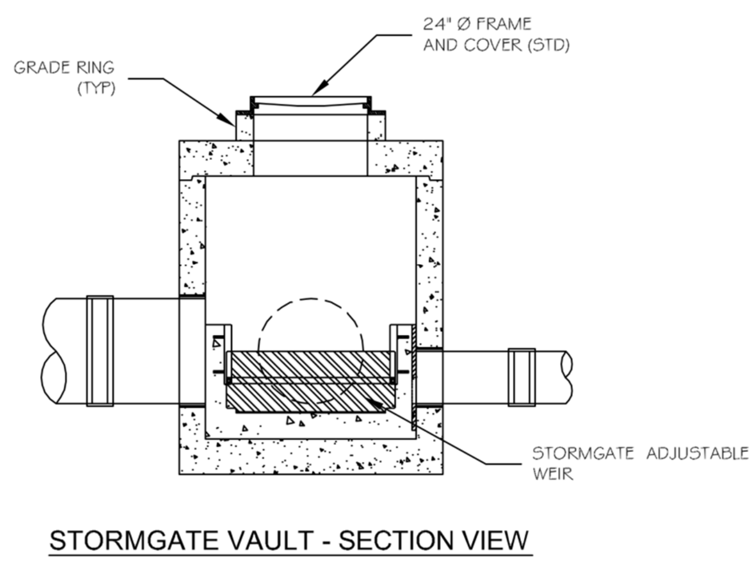


Figure 3.2 Storm Gate Vault High Flow Bypass

***(3) Create geomorphology and plant for freshwater marsh in adjacent channel*:** This includes modification of the existing concrete channel to allow suitable conditions for restoration of freshwater marsh. Shallow water (< 6 feet) would be required for freshwater marsh, which would be interspersed with open water and riparian vegetation. Modifications to the channel include removal of concrete, excavation to create uneven bottom with pools and shallow zones, stabilization of the channel with boulders or weirs, and installation of wetland and riparian vegetation. The plant palette shown in Table 3-1, "Wetland Plant Palette," will be used to vegetate wetland restoration areas.

Existing reaches that include wetlands and pools/riffles will be prototypes for what can be created in remaining river reaches. Several variables including flow velocities and sheer stress will be used to help define areas within the project area that are suitable for freshwater marsh and riparian habitat restoration.

For this sub-measure, a series of grade control structures made of grouted stone are proposed. When more detailed hydraulic design occurs, modification to the preliminary design will take place to create site-specific pool/riffle and weir configurations.

Table 3-1 Wetland Plant Palette

Carex praegracilis	clustered field sedge
Cyperus odoratus	fragrant flatsedge
Eleocharis parishii	Parish's spikerush
Juncus effusus	common rush
Mimulus cardinalus	scarlet monkeyflower
Schoenoplectus californicus (Scirpus californicus)	California bulrush
Typha angustifolia	narrow leaved cattail
Typha latifolia	common cattail

(4) Grade adjacent areas to lower elevation for habitat, floodplain reconnection, and offline retention: This sub-measure includes the lowering of specific sites adjacent to the channel to allow for retention of water and habitat creation. It would include excavation to create basins or terraces that tie into the channel and adjacent topography. Identified sites would be terraced with a 3H:1V or more gradual slope, and be planted with emergent and riparian vegetation.

(5) Create geomorphology for open water adjacent to the channel: This sub-measure is similar to sub-measure 3 but will include deeper water or open-water deeper than 6 feet, which would be absent of vegetation growth. Modifications to the channel would include the removal of concrete and excavation as needed for channel bed equilibrium. To achieve this sub-measure, the channel bottom would include boulders to stabilize bed material and weirs to slow in-stream velocities.

(6) Rebuild geomorphology for historic wash: This sub-measure includes the restoration of the LATC (sub-reach 8) historic wash through the implementation of grading and excavation activities. Implementation of this sub-measure would require the removal of the existing industrial/railroad land use and associated contaminants.

Rebuilding the geomorphology of the historic wash would include creating channel banks with gradual (3H:1V or milder) slopes. Reshaping of the LATC area would incorporate the reshaping of the historic wash itself along with adjacent areas supportive of habitat restoration. Terraces for the planting and establishment of riparian and buffer vegetation would occur towards the perimeter of the site. A list of recommended riparian and buffer vegetation can be found in Table 3-2, "Riparian and Buffer/Transitional Plant Palette." Reshaping activities would extend from the River eastward to Interstate 5. Detailed site designs would be further developed during the final design phase of the study based upon more detailed hydraulic analysis.

Table 3-2 Riparian and Buffer/Transitional Plant Palette

Riparian	
Ambrosia psilostachya	western ragweed
Artemisia douglasiana	Mugwort
Baccharis salicifolia	Mulefat
Mimulus cardinalis	scarlet monkeyflower
Platanus racemosa	western sycamore
Populus fremontii	Fremont's cottonwood
Salix laevigata	red willow
Salix lasiolepis	Arroyo willow
Buffer/Transitional (minimal acreage)	
Artemisia californica	California sagebrush
Eriogonum fasciculatum	California buckwheat
Eschscholzia californica	California poppy
Helianthus annuus	Sunflower
Leymus condensatus	giant wild rye
Lotus scoparius	Deerweed
Malacothamnus fasciculatus	chaparral mallow
Malosma laurina	laurel sumac
Rhus integrifolia	lemonade berry
Salvia apiana	white sage

3.1.2 Attenuation

These measures include capture of flows from both the main channel and tributaries into surface and subsurface basins or channels. Potential sub-measures include the following:

(7) Create underground basins for attenuation of flood flows: This sub-measure consists of the construction of underground basins for attenuation of floodwaters and to provide temporary water supply for restoration. Six proposed locations include: Los Angeles Equestrian Center, Betty Davis Park, Ferraro Fields, Griffith Park, Bowtie Parcel, and LATC. Preliminary design considerations for this feature include potential use of Contech's Stormtank® (or approved equivalent) water storage modules developed for sub-surface storm water detention and infiltration systems. It was estimated that up to 3,100 acre feet of storage could be created with implementing all sites.

Installation would require excavation of the site followed by covering with geotextile and filling with crushed stone. Existing land uses would be returned to the site after construction. The system is design to exceed HS-25 weight-loading criteria, and could be utilized under parking lots, athletic fields, parks, etc. The estimated depth of the storage modules would be 10 to 12 feet.

An analysis of the basin's ability to store floodwaters was conducted based on frequency hydrographs found in the 1992 LACDA Study. The analysis showed that the storage capacity of the basins would only provide a minor amount of peak flow reduction before the storage volume is completely utilized. In addition, water stored in underground basins would be difficult to off-load for water conservation activities due to the associated piping requirements and the existing high depth of groundwater in the channel area. The estimated preliminary cost of implementing this measure is $1.3 billion or $4.7 million per acre. Due to the low effectiveness and high cost of this sub-measure, it was dropped from further consideration.

(8) Creation of attenuation basin with wetlands: This sub-measure includes slowing input of storm flows and restoration of wetlands by creating storage at appropriate confluences with the River. Wetland attenuation basins would be sized to capture runoff from the local area (not the main channel) and would include a basin surrounded by terraced slopes. The basin would slow down flows before entering the main stem of the river system and would provide seasonal wetland habitat. Preliminary design includes excavation of a basin that would have an impermeable layer of either geotextile or fine materials installed. The basin would then be planted with wetland vegetation. Average depth of the basin is assumed to be 3 feet with depths ranging to 10 feet.

(9) Diversion tunnels: This sub-measure consists of the construction of a culvert (tunnel) beginning at the Headworks and extending downstream to LATC to divert a minimum of 40,000 cfs from the channel during peak flow. The culvert would need to be designed to accommodate increasing flows from tributaries as it continues downstream. Preliminary costs were investigated for drilling four 24-foot-diameter tunnels to convey the discharge.

(10) Divert river and tributary flow into channels: This sub-measure includes diversion of either tributary or River flows into created channel or off-channel sites. Under this sub-measure, the installation of diversion structures and the grading and revegetation of the tributary or channel would be implemented. Further investigation would be required to design the site-specific diversions of water from the main channel at these sites.

This measure is currently proposed at seven sites within sub-reaches 1, 2, 3, 4, and 8. These include:

- Headworks area extending into Pollywog Park adjacent to the Burbank-Western Channel (1 site)
- Adjacent to Zoo Drive (2 sites)
- Adjacent to Ferraro Fields (1 site)
- Under the freeway and adjacent to the Wilson and Harding golf course (2 sites)
- LATC (1 site)

3.1.3 Wildlife Access

These measures provide access and crossings for wildlife between the River and adjacent landscape. They include bridges, under-crossings, and tunnels.

(12) Bridge undercrossings for wildlife: Under this sub-measure, bridge under-crossings would be modified by installing corridors, which would allow wildlife crossing.

(13) Wildlife bridges: Under this sub-measure, vegetated wildlife bridges would be installed at identified sites to allow wildlife to pass across the channel or other impediments.

(14) Wildlife access from river to bank: Under this sub-measure, the slopes of channels would be re-graded to 3H:1V or milder to improve the ability of wildlife to ingress/egress along channel slopes.

(15) Wildlife passage into river: Under this sub-measure, modifications to storm drains and culverts would be implemented to allow wildlife passage. Activities under this sub-measure would include the widening and daylighting of tunnels and culverts where possible.

3.1.4 Planting

These measures would restore vegetation at various locations throughout the study area through revegetation of wetland, riparian, and buffer zones including bioengineering of channel walls and plantings within the channel bed wherever possible.

(16) Restructure/vegetate concrete channel walls: This sub-measure includes modification of the channel walls to allow the growth of vegetation. It could be accomplished through notching or inclusion of other structural changes such as terracing to allow vegetation growth. Plantings in or at the tops of channel walls would require, at a minimum, temporary irrigation during habitat establishment.

In order to stabilize planting and reduce erosion potential, turf reinforcement mats (TRM) or an acceptable geotextile fabric is proposed for the design of this measure. The fabric is reported to withstand velocities of up to 20 feet/second and shear stress of up to 15 pounds/square foot and can be planted with vegetation (grasses and low shrubs). These are the current manufacturer's claims, and further analysis during detailed design as well as potential physical modeling would need to take place. To that end, the product and others that are similar are being tested by the Corps' Engineer Research and Development Center (ERDC).

Detailed analyses of the Selected Plan will take place during final design phase (PED). Channel protection products will be evaluated to ensure they meet Corps specifications and surpass all hydraulic, geotechnical, and structural criteria. For the plans, Taylor Yard offers the only opportunity within the existing channel to employ High-Performance Turf Reinforcement Mats (HPTRMs), or alternate channel protection products. HPTRMs present higher uncertainties with respect to maintenance, repair, and/or replacement and may need to be augmented by more traditional channel protection measures. Features of the plans located adjacent or outside the existing channel offer greater opportunities for HPTRMs. We will follow Corps guidance and regulations and utilize existing information including any available testing results.

The plans call for the use of HPTRMs to resist the effect of erosion. This soft approach is highly compatible with the ecosystem restoration concept, but its inability to resist erosion in the same manner as a hard protection system such as concrete or grouted rock is obvious. At some level, a soft armored slope bank, which may be compatible with ecosystem restoration, will not be effective in resisting erosion. The ability of HPTRMs or other soft methods to resist erosion will need to be fully evaluated before they are incorporated in a final design. It is anticipated that site-specific data that includes results of subsurface investigation and engineering analysis will be necessary to complete this evaluation. As such, this work is anticipated to be completed during PED.

During PED, if it is determined that HPTRMs alone will not meet the Corps requirements, additional measures will be evaluated. These additional structural elements are likely to consist of hardened elements such as riprap, soil cement, sheet pile walls, secant walls, stone or other slope protection materials buried behind a soil slope that is soft armored with HPTRMs or other soft erosion protection methods. The remedial methods utilized must be integrated with the minimal grades and channel configurations required for hydraulic capacity.

(17) Habitat corridors/Riparian planting: Under this sub-measure, the creation of habitat corridors would include riparian vegetation planting on the riverbank and transitional vegetation on the overbank. Grading and modification of the top of the bank to tie created habitat into the adjacent river channel and proposed revegetation would occur. A list of recommended vegetation types for riparian and transitional zones can be found in Table 3-2.

(18) Establish/improve open water habitat over concrete areas: Currently, open water exists intermittently throughout the ARBOR reach albeit shallow with little habitat value. Using implementation actions included under sub-measures 3 and 5, modifications to create and/or improve open water conditions would include the restoration of freshwater marsh (sub-measure 3), the removal of channel bottom concrete (sub-measures 3 and 5), excavation of the channel bottom and placement of boulders for channel bed stabilization and the creation of pool and riffle zone habitat (sub-measure 5), and the construction of weirs to slow in-stream velocities (sub-measure 5).

(19) Terrace concrete banks/planting built into channel walls: This would include modifications to the channel walls to allow growth of vegetation. Concrete walls would be modified to add structures able to support vegetation. This could include constructed terraced habitat or openings in the concrete where vegetation is installed. Terraced banks are proposed where channel walls are sloped and have suitable space. Dimensions of the planters would be approximately 12 feet wide and 3 to 4 feet deep, and would be filled with soil for planting vegetation.

3.1.5 Remove Concrete

Concrete removal measures include modification of the channel by removal of concrete and/or grouted stone. It implies that erosion control would take place with any concrete removal that occurs due to modifications to the channel bed, terracing of the banks, etc.

(21/22) Lower channel banks and widen: This sub-measure includes lowering the channel banks and providing setback levees to provide more capacity for habitat. The widened area would only convey peak flows when the water surface exceeded the elevation of the lowered channel banks. Sub-measures 21 and 22 were originally two separate measures but were combined during alternative formulation due to their similarity.

(23) Channel bed deepening: This sub-measure would consist of excavation of the channel bed to create more capacity for habitat. It would require the removal of the concrete invert and subsequent excavation of the channel bed and creation of a soft-bottom regime. The resulting channel would need to be stabilized either through the reduction of flow or reduction of the channel grade. This sub-measure is combined with sub-measure 3 in most cases, which includes modification of the channel to provide suitable conditions for freshwater marsh habitat.

(26) Terraces with earthen banks: This sub-measure consists of terracing the channel banks to provide step-like structures in place of current slopes. The terraced configuration would consist of planter-box type structures filled with soil to allow habitat planting. Terraces and the soil would need to be stabilized for flood flows and safety.

3.1.6 Reshape Channel

This measure is proposed in several sub-reaches of the study area. Reshaping of the channel would increase channel capacity and create geomorphic features that would support riverine habitat. This measure includes modification of the trapezoidal channel to vertical sides to increase channel capacity and cantilevering the top-of-bank surface over the channel walls to provide additional channel capacity.

(27) Modify trapezoidal channel to vertical, widening the channel: This sub-measure would remove the existing trapezoidal channel walls and widen the channel by constructing vertical walls. To implement this measure, demolition and excavation of the existing trapezoidal channel banks would occur, and vertical walls with footings and toe protection would be constructed.

(28) Cantilever channel bank: This sub-measure includes the widening of the channel and construction of an overhanging, cantilevered top-of-bank section. Demolition and rebuilding of the channel and adjacent infrastructure would occur. The cantilevered bank sections would include overhanging walkways or promenades tied to hiking trails and adjacent streets while providing additional channel capacity underneath the overbank.

3.2 Preliminary Ecosystem Restoration Alternatives

The above measures and sub-measures, and a set of initial alternatives, were developed during charette workshops held December 2-4, 2009. Alternatives were subsequently evaluated and additional alternatives developed for a total of 19 preliminary alternatives, as shown in Table 3-3. Measures that make up each of the 19 alternatives are displayed in Attachment 3. This set of 19 alternatives was evaluated and different combinations of alternatives and reaches derived to develop the final array of alternatives described later in Section 5. Alternative formulation and evaluation is described in Section 4 of the IFR, and not repeated here.

It should be noted that implementation of some alternatives would be dependent on the diversion of flood flows from this reach of the river. That analysis is described in the main report and the descriptions in Section 4 assume that diversion would be in place, if required. However, the diversion tunnel and alternatives dependent on it were not cost effective and, therefore, none of the final alternatives found in Section 5 require a tunnel.

Table 3-3 Preliminary Array of 19 Alternatives

No.	Alternative	Description
0	No Action	Future Without-Project Conditions
1	Comprehensive A	Includes development of freshwater marsh, open water ponds, fish refugia, and riparian corridors, exposing storm drain outlets and converting to natural stream confluences, diversion of flow into side channels lined with habitat, underground basins and culverts to attenuate flow, bioengineering of channel walls, channel modification to increase width by terracing, channel widening, and/or modification of channel walls, connections to green streets, modification along tributary confluences to more natural habitat, and wildlife crossings.
2	Atwater to Cornfields (Developed by City)	Implements all of the above within the Atwater to Cornfields part of the reach.
3	Banks & Tributaries Only	Leaves the flood control channel bed primarily "as is" and restores floodplain by creating side channels in open areas along the river with freshwater marsh and riparian corridors and restoring tributary confluences. Includes modification of storm drain outlets and bank terracing.
4	Comprehensive B (developed based on measures with objectives scores over 3)	Includes most of measures included in Alt 1 Comprehensive A with fewer locations, less terracing and side channels, and omits elevating railroads on trestles, bioengineering walls, open water, and modifying trap channel to vertical.

No.	Alternative	Description
5	Los Feliz to Arroyo Seco (Developed by City)	Implements all measures within Los Feliz to Arroyo Seco reach.
6	Comprehensive C (developed by USACE)	Includes most of measures included in Alt 1 Comprehensive A with fewer locations and omits railroad elevation, bioengineering walls, open water, and modifying trap channel to vertical. Includes more terracing and storm drain modifications and different locations for wildlife crossings than Alt 4 Comprehensive B.
7	Channel Reshaping A (developed based on measures with objectives scoring over 5)	Focus is on channel reshaping and attenuation of flow – detention, bypass and widening. Using culverts and underground basins to attenuate flows, the channel is geomorphically changed to a wider, softer channel, naturalized storm drain outlets, and some restored riparian corridors.
8	Habitat Variation (Derived from Charette Team 1)	Maximizing habitat restoration for a species diversity, including fish, motivated formulation of alternative. Attenuation or reduction in flow is included in each reach as well as freshwater marsh, riparian and aquatic habitat measures.
9	Soft Bottom Channel & Associated Banks	This alternative focuses restoration in reaches that already have a soft riverbed. Where open areas are adjacent to the river, the river will be widened rather than terraced. Storm drains are converted to natural stream confluences and restored with vegetation. Habitats include aquatic, freshwater marsh and riparian areas.
10	Channel Modifications with least structural and engineering impacts and public acceptability (based on scores for each measure under this criteria)	This alternative implements measures in locations with the least impact to infrastructure and engineering challenges, while still including measures in all reaches to attenuate flow, restore riparian and freshwater marsh habitat and tributary confluence restoration.
11	Habitat Connectivity (Derived from Charette Team 4)	This alternative focuses on bank to bank and upstream to downstream connections for wildlife, linkages to wildlife areas, channel widening and terracing.
12	Hydrologic Connection Improvements (Derived from Charette Team 3)	This alternative focuses on lowering grade for adjacent large open areas, improved hydrologic connections between the banks, storm drains and the river. It also intends to increase wildlife movement between the river and adjacent open areas.
13	Channel Reshaping B (Derived from Charette Team 6)	Using culverts to attenuate flows, the channel is geomorphically changed to a wider, softer channel, naturalized storm drain outlets, and restored riparian corridors. Includes bioengineering of channel walls, side channels and has more riparian and freshwater marsh replanting than Channel Reshaping A.
14	Channel Widening(Derived from Charette Team 5)	This alternative focuses on widening the channel. Attenuation is accomplished with culvert bypasses. Includes planting of freshwater marsh and riparian corridors.
15	Bypass with Bank and Tributary Confluence Restoration (Derived from Charette Team 2)	Reduces flow using culvert bypass to allow for terracing and channel bank softening. Improves freshwater marsh habitat in soft bottom area and adds riparian habitat to downstream locations on the river overbank. Emphasizes widening and restoration at tributary confluences.
16	Side Channels Only	Leaves the flood control channel bed and banks primarily “as is,” and restores floodplain by creating side channels in open areas along the river with freshwater marsh and riparian corridors and restoring tributary confluences.
17	Opportunity area restoration with channel widening at tributaries (Derived from Charette Team 7)	Restores wetlands on the overbank and major tributaries at River Glen - Verdugo Wash confluence, Griffith Park, Bowtie/Taylor Yard, Arroyo Seco confluence, Burbank Western Channel, Cornfields (Los Angeles Historical Park) and the LATC (Mission

No.	Alternative	Description
		Yard). Widens the river at Verdugo, Arroyo Seco and Burbank Western Channel.
18	Opportunity area restoration to large open areas	Leaves flood control channel bed and banks "as is" and restores wetlands on the overbank and major tributaries at River Glen - Verdugo Wash confluence, Bowtie/Taylor Yard, Arroyo Seco confluence, and Cornfields (Los Angeles Historic Park).
19	Taylor Yard	Restores wetlands on the overbank and widens the river at this single key location on the river (includes the Bowtie parcel).

4. PRELIMINARY FEASIBILITY DESIGNS

Conceptual designs were developed for the measures described in Section 3 for the purpose of developing quantities and costs and comparing alternatives. They are not intended to be final designs, and only typical cross-sections were developed for this effort. Typical cross-sections were developed for each of the study sub-reaches; cross-section locations throughout the study area are shown in Figure 4.1. These cross-sections include major features found in each of the sections noted and include multiple measures, which may not be present in each alternative. Detailed design drawings were not developed for each project feature; rather, typical cross sections are included as well as mapping that is found in Attachment 3. Descriptions below include reference to the right and left bank. That reference assumes one is looking downstream.

During the formulation and analysis of alternatives it was assumed that the implementation of several of these would require tunnels to divert flood flows. The description of those alternatives and reaches that are assumed to require tunnels for implementation is described in the plan formulation section of the main feasibility report.

4.1 Assumptions and Limitations

Designs are based on preliminary, planning-level conceptual designs, and common engineering practices. The development of the preliminary designs took place prior to hydraulic and geotechnical design information. Design parameters for such things as velocities, shear stress, erosiveness, etc., were not provided at the time the preliminary designs were developed. Future design phases would be more integrated with the hydraulic analysis, geotechnical analysis, and vegetation requirements such that the concepts shown and discussed herein may be modified if necessary.

Several assumptions were developed during the preliminary design in order to complete the design and cost estimate. The riprap was conceptually sized in accordance with USACE's methodology and the TRM in accordance with the manufacturer's recommendation. Because of a lack of clear design parameters including the aforementioned hydraulic and geotechnical analyses, the designs and dimensions shown below are approximate in nature and are subject to reanalysis during the final design phase.

Turf Replacement Matting and Riprap Protection – The existing bank grouted rock or concrete slope protection would be removed and replaced by a 3H:1V combination of high performance TRM, or acceptable geotextile, and riprap system. A riprap layer was provided at the bottom river bank for higher flow velocity protection. In addition, the riprap extends an assumed 10 feet below the river invert for scour protection. This assumption was conservatively based on the existing toe protection, which in most cases is a 3-5 foot deep grouted section and sometimes includes a 10-15 foot deep sheet pile. Above the riprap, the river bank is lined with a high performance TRM to protect against erosion potential and to allow for acceptable vegetation growth.

Reinforced Concrete Retaining Wall – The existing bank grouted rock or concrete slope protection would be removed and replaced by a reinforced concrete retaining wall system. The 22-foot-high reinforced concrete wall was conceptually sized per the California Department of

Transportation's (Caltrans) Type 1 Retaining Wall specifications, having a 13-foot-wide footing. A horizontal layer of riprap with a 10-foot toe-down was assumed to provide erosion protection.

Terraced Banks and Riprap Protection – The existing bank grouted rock or concrete slope protection would be removed and replaced by a 3H:1V combination of terraces and riprap system. A riprap layer was provided at the bottom river bank for higher flow velocity protection. In addition, the riprap extends an assumed 10 feet below the river invert for scour protection. Above the riprap, the river bank would be protected by four reinforced concrete terraces anchored to the channel slope. The terraces would provide additional bank substrate for acceptable vegetation planting/establishment and would protect against potential erosion.

4.2 Cross-Sections

This section describes each cross-section illustrated in the preliminary design array. Typical cross-sections for measures included in the preliminary alternatives were developed to:

- Determine the feasibility of preliminary design measures
- Provide depictions of preliminary design measures
- Facilitate quantity and cost estimation

In addition, cross-sections representing revisions to the preliminary design array that were developed as part of the final array of alternatives described in Section 6, below, may be found in Attachment 4.

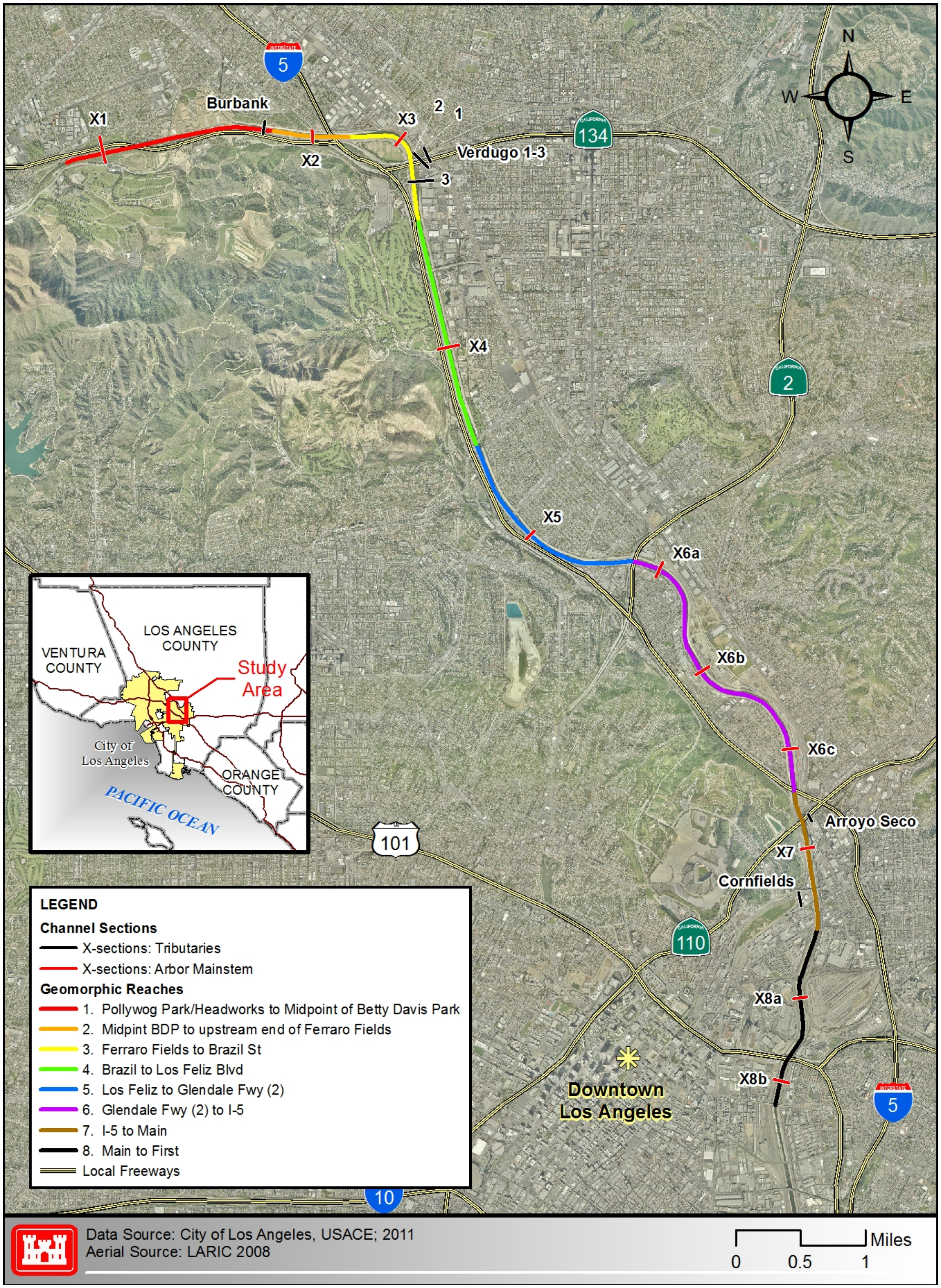


Figure 4.1 Preliminary Design Cross-Section Locations by Sub-reach

4.2.1 Cross-Section 1, Sub-Reach 1 - Pollywog Park/Headworks to Midpoint of Betty Davis Park

Existing Channel Features – The existing rectangular reinforced concrete channel is 130 feet wide and 18 feet high from the invert, with subdrain systems underneath the invert slab.

Preliminary Channel Design – As seen in Figure 4.2, "Cross-Section 1, Pollywog Park/Headworks to Midpoint of Betty Davis Park," the proposed design would widen the channel by 51 feet by replacing the existing vertical concrete retaining wall and footing with a combination of TRM and riprap on 3H:1V slopes on the left/north bank of the channel. The upper 3 feet of the right/south bank would be sloped 3H:1V, with the remaining portion of the wall and foundation protected in place. The existing concrete channel bottom would be replaced by a soft, "natural" substrate. A toedown structure with added bank protection would be constructed at the toe of the proposed left/north bank. Grade control structures would be constructed to reduce in-stream velocities and secure natural bed materials for meander and vegetation development. Impacts to the subdrain system and their mitigation will depend on additional modeling during detailed design, but it is likely that any concrete invert that is removed and replaced by an infiltrating substrate will no longer need the existing subdrain system.

Demolition and Excavation – Several areas of the reach would undergo demolition and excavation to implement the proposed design. The concrete channel bottom, the top 3 feet of the left/north bank retaining wall, and the right/south bank concrete retaining wall would be demolished. The remainder of the left/north bank retaining wall would be protected in place. Excavation of earthen material would occur behind the removed left/north bank retaining wall and behind the removed upper portion of the right/south bank retaining wall. In areas where grade control structures would be implemented, an additional 10 to 15 feet of earthen material would be excavated from the channel bed to accommodate construction of grouted riprap toedowns. Excavation at a depth of 3 to10 feet and a width of 20 feet would be conducted for the left/north bank toedown.

Compacted Fill and Maintenance Road – Compacted fill would be used to fill behind the left/north and right/south channel top of banks. The compacted fill would be used to create a 16-foot wide maintenance road. The maintenance road would be paved with asphalt-concrete that would meet the proposed channel's TRM and vegetated 3H:1V slope on the river, and compacted fill on the 3H:1V slope landward. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Erosion Control – Erosion control matting, TRM, or approved equivalent geotextile mats would be used to stabilize, prevent channel scour, and to promote vegetation establishment on channel slopes.

Topsoil and Vegetation – Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the slopes of the maintenance road compacted fill and along the channel's 3H:1V slopes after TRM matting has been installed. Topsoil areas would be seeded and planted with native riparian vegetation as listed in Table 3-2.

Grade Control Structure – Grouted riprap grade control structures would be constructed every 500 feet along this reach of the channel. Grade control structures would reduce in-stream flow velocities and stabilize the channel's slope and earthen bed material. Grade control structures would be constructed in the channel bottom at a depth of 10 or 15 feet, have a 2H:1V slope on the upstream end and a 4H:1V slope on the downstream end, be 5 feet in width on top, and have a 2-foot-deep and 20-foot-wide low-flow centerline notch.

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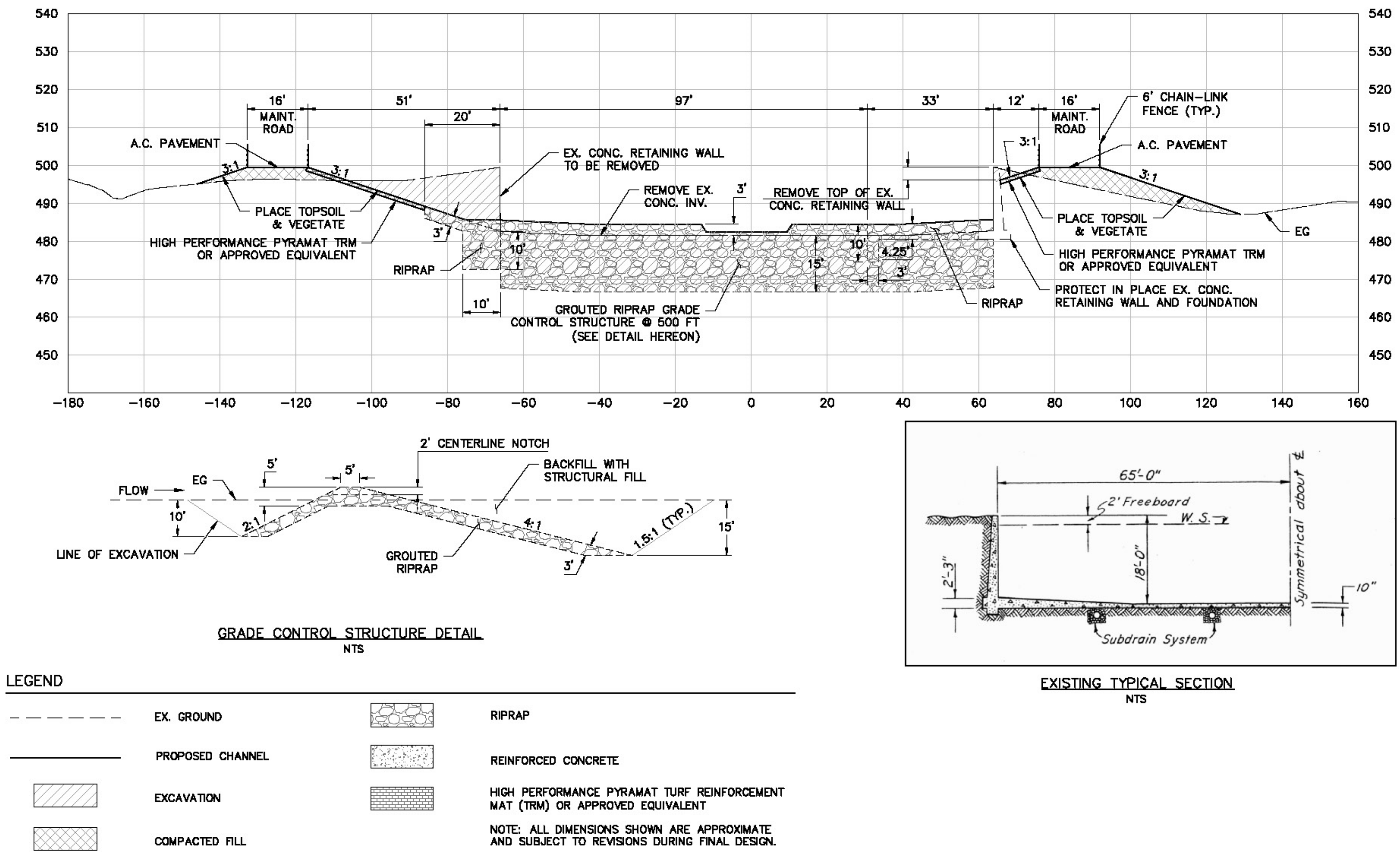


Figure 4.2 Cross-Section 1, Pollywog Park/Headworks to Midpoint of Betty Davis Park

4.2.2 Burbank-Western Channel Cross-Section, Sub-Reach 1 - Confluence at the Los Angeles River

Existing Channel Features – The existing rectangular reinforced concrete channel is 60 feet wide and 18 feet high from the invert.

Preliminary Channel Design – As seen in Figure 4.3, "Burbank-Western Channel Cross-Section," the proposed design would widen the left/north top of bank of the channel by 188 feet by removing the side channel tributary's right/south retaining wall. The proposed left/north bank would have an 8H:1V vegetated slope. A soft-bottom vegetated wetland would be constructed in the widened portion of the channel bottom. Two riprap toedowns would be constructed below the channel bottom and banks. The first riprap toedown would be located at the in-channel edge of the proposed wetland at a depth and width of 10 feet. The second riprap toedown, with additional bank protection, would extend landward from the toe of the proposed left/north bank at a depth of 3 to 10 feet and a width of 20 feet. A 16-foot-wide asphalt concrete maintenance road would be constructed on the proposed left/north top of bank.

Demolition and Excavation – The left/north concrete retaining wall would be demolished. The channel bottom would be excavated to a width of 60 feet; an 8H:1V channel bank would be excavated for an additional 88 feet to meet the existing ground above.

Compacted Fill and Maintenance Road – The existing ground at the left/north top of bank would be used as the base of the proposed 16-foot-wide asphalt concrete maintenance road. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Wetlands – The wetlands would extend for a distance of 188 feet from the edge of the concrete channel bottom (where the retaining wall is to be removed) to the proposed right/west bank toe. The wetland area would spread channel flows and slow in-stream flow velocities, assist in treating pollutants, and create riverine wetland habitat for wildlife and aesthetics.

Erosion Control – Erosion control matting, such as TRM, would be used to stabilize, prevent channel scour, and to promote vegetation establishment on the left/north channel slope.

Topsoil and Vegetation – Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the left/north bank slope after TRM matting is installed. Topsoil would also be placed in the wetlands area. Topsoil areas would be seeded and planted with riparian vegetation on the banks and wetland vegetation in-channel per recommendations of the project biologist.

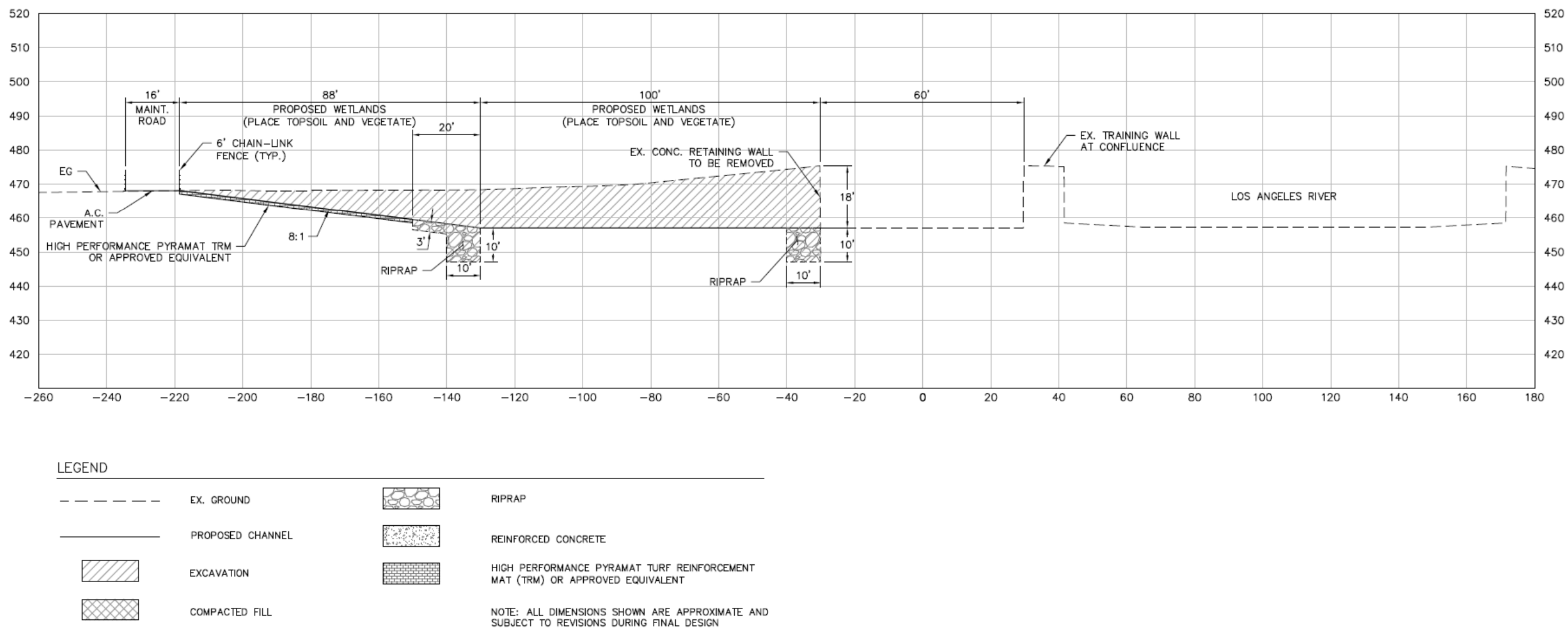


Figure 4.3 Burbank-Western Channel Cross-Section

4.2.3 Cross-Section 2, Sub-Reach 2 - Midpoint of Betty Davis Park to Upstream End of Ferraro Fields

***Existing Channel Features* –** The existing trapezoidal reinforced concrete/grouted rock channel with cobblestone soft bottom is 300 feet wide from the top of bank and 16 feet above the invert.

***Preliminary Channel Design* –** As seen in Figure 4.4, "Cross-Section 2, Midpoint Bette Davis Park to Upstream of Ferraro Fields," the proposed design would remove the existing grouted rock or concrete slope protection on both banks. The left/north bank would have a 3H:1V slope stabilized by erosion control matting and vegetation, and the top of bank would be widened by 10 feet. A toedown structure with added bank protection would be constructed at the toe of the proposed left/north bank. The toe of the right/south bank would be widened by 60 feet, where a 22-foot-high vertical retaining wall with subdrainage system would be constructed. The existing cobble bottom would be protected in place. Grade control structures would be constructed to reduce in-stream velocities and secure natural bed materials for meander and vegetation development.

***Demolition and Excavation* –** Several areas of the reach would undergo excavation to implement the proposed design. The left/north bank's existing grouted riprap or concrete slope protection would be excavated to widen the channel by 10 feet. The right/south bank's existing grouted riprap or concrete slope protection would be excavated to widen the channel by 60 feet. Additional excavation would occur behind the proposed retaining wall, and would have a temporary slope of 1.5H:1V to meet the existing ground; excavation would allow temporary access for construction of the retaining wall. In areas where grade control structures would be implemented, an additional 10 to 15 feet of channel bottom would be excavated to accommodate construction of grouted riprap toedowns and retaining wall footings.

***Compacted Fill and Maintenance Road* –** After construction of the retaining wall, compacted fill would be placed and compacted behind the right/south channel top of bank to create a 16-foot-wide paved asphalt-concrete maintenance road. Compacted fill would also be placed on the land of the maintenance road and sloped 3H:1V to meet the existing ground. The left/north top of bank maintenance road would use the existing ground as a base. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

***Erosion Control* –** Erosion control matting, such as TRM, would be used to stabilize, prevent channel scour, and to promote vegetation establishment on channel slopes.

***Topsoil and Vegetation* –** Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed over TRM on the right/south bank channel slope and the left/north bank maintenance road slope. Topsoil areas would be seeded and planted with native riparian vegetation per the project biologist's recommendations.

Grade Control Structure – Grouted riprap grade control structures would be placed every 500 feet along this reach of the channel. Grade control structures would reduce in-stream flow velocities and stabilize the channel's slope and earthen bed material. Grade control structures would be constructed in the channel bottom at a depth of 10 or 15 feet, have a 2H:1V slope on the upstream end and a 4H:1V slope on the downstream end, be 5 feet in width on top, and have a 2-foot-deep and 20-foot-wide low-flow centerline notch.

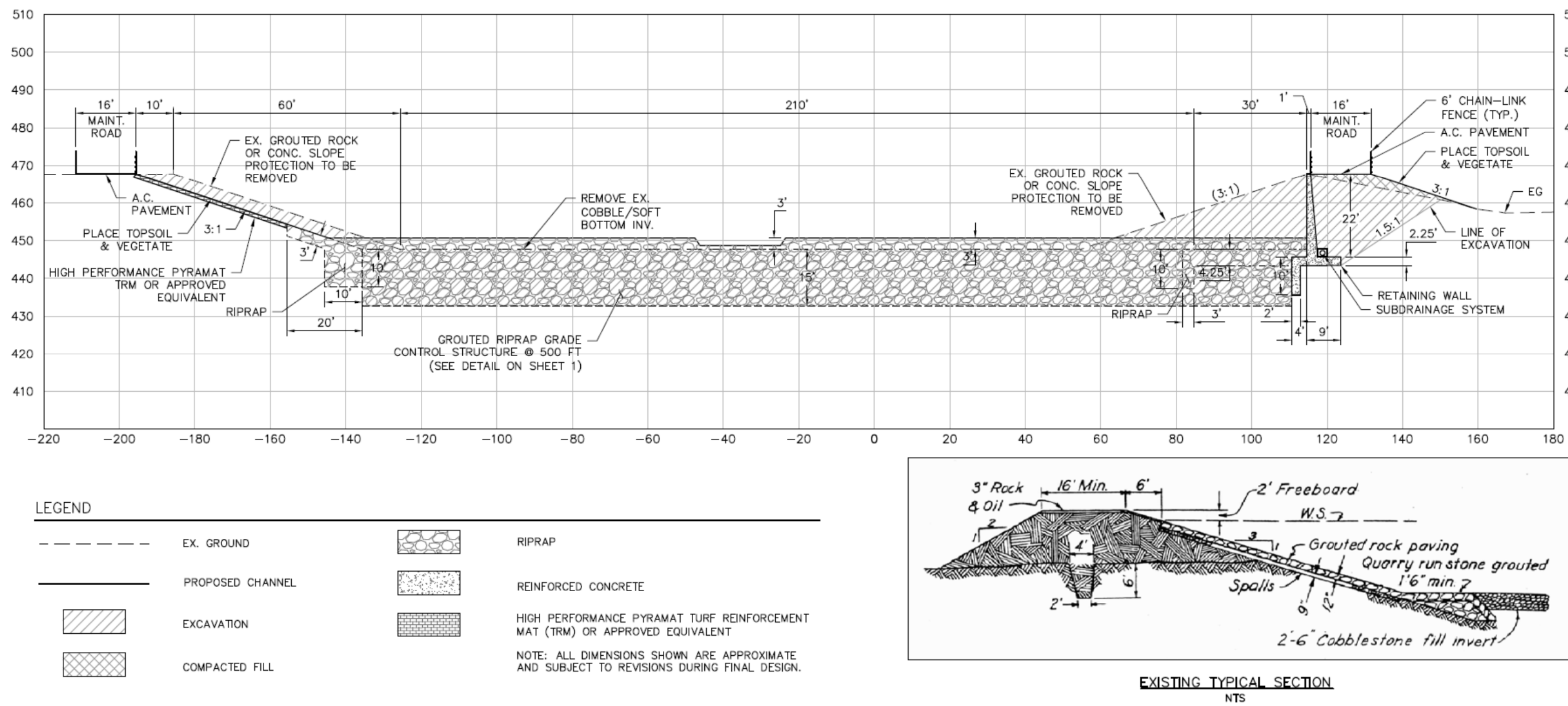


Figure 4.4 Cross-Section 2, Midpoint Bette Davis Park to Upstream of Ferraro Fields

4.2.4 Cross-Section 3, Sub-Reach 3 - Ferraro Fields to Brazil Street

Existing Channel Features – The existing trapezoidal reinforced concrete/grouted rock paving channel with concrete bottom, and 3H:1V slopes, is 280 feet wide from the top of bank, and approximately 21 feet high from the invert.

Preliminary Channel Design – As seen in Figure 4.5, "Cross-Section 3, Ferraro Fields to Brazil Street," the proposed design would construct two 23-foot-high retaining walls associated subdrain systems on the left/east and right/west banks of the channel. Riprap toedowns would be placed at the toe of the retaining walls. Two concrete reinforced planter boxes (naturalized channel) on the left/north and right/south banks would be constructed at the edge of the toedown and extend 50 feet towards the centerline of the channel. Two 16-foot-wide asphalt concrete maintenance roads would be constructed on the top of the channel's banks. The existing low-flow channel and concrete bottom would be protected in place except where removal is needed for construction of the walls and concrete planter boxes.

Demolition and Excavation **–** Several areas of the reach would undergo demolition and excavation to implement the proposed design. The right/west bank and the left/east bank existing trapezoidal grouted riprap or concrete paved slope protection would be demolished; 74 feet of the concrete channel bottom would be demolished for construction of the naturalized channel. Excavation would widen the channel bottom by 48 feet on both banks and would occur behind the proposed location of the retaining walls and would have a temporary slope of 1.5H:1V to meet the existing ground; excavation would allow temporary access for construction of the walls. The proposed toedown locations would be excavated to a depth of 4.25 to 10 feet and a width of 30 and 33 feet at the toe of the left/east and right/west retaining walls respectively. The naturalized channel and concrete footing locations would be excavated to a depth of 12 feet and a width of 50 feet at the edge of the toedowns towards the center of the channel.

Compacted Fill and Maintenance Road **–** After construction of the retaining walls, compacted fill would be placed and compacted behind the left/north and right/south channel's retaining walls. The fill would be placed to accommodate a 16-foot-wide paved asphalt-concrete maintenance road on both banks. The land compacted fill on the right/south bank maintenance road would be sloped 3H:1V to meet the existing ground. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Planter Boxes (Naturalized Channel) – Naturalized channel would be constructed at the edge of the retaining wall toedowns and would extend 50 feet into the center of the channel at a depth of 12 feet. The surface of the naturalized channel would be flush to the existing channel concrete bottom. The bottom 6 feet of the naturalized channel would be filled with riprap. The top 6 feet of the planter boxes would be filled with soil and secured with concrete baffles at 20-foot intervals to prevent scour/erosion. They would also include drainage holes to help route drainage water from upper boxes to lower boxes.

Topsoil and Vegetation – Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the right/south bank of the maintenance road and the two sections of naturalized channel. Topsoil areas would be seeded and planted with transitional zone vegetation on the top of the maintenance road and riparian/wetland vegetation in the channel as recommended by the project biologist.

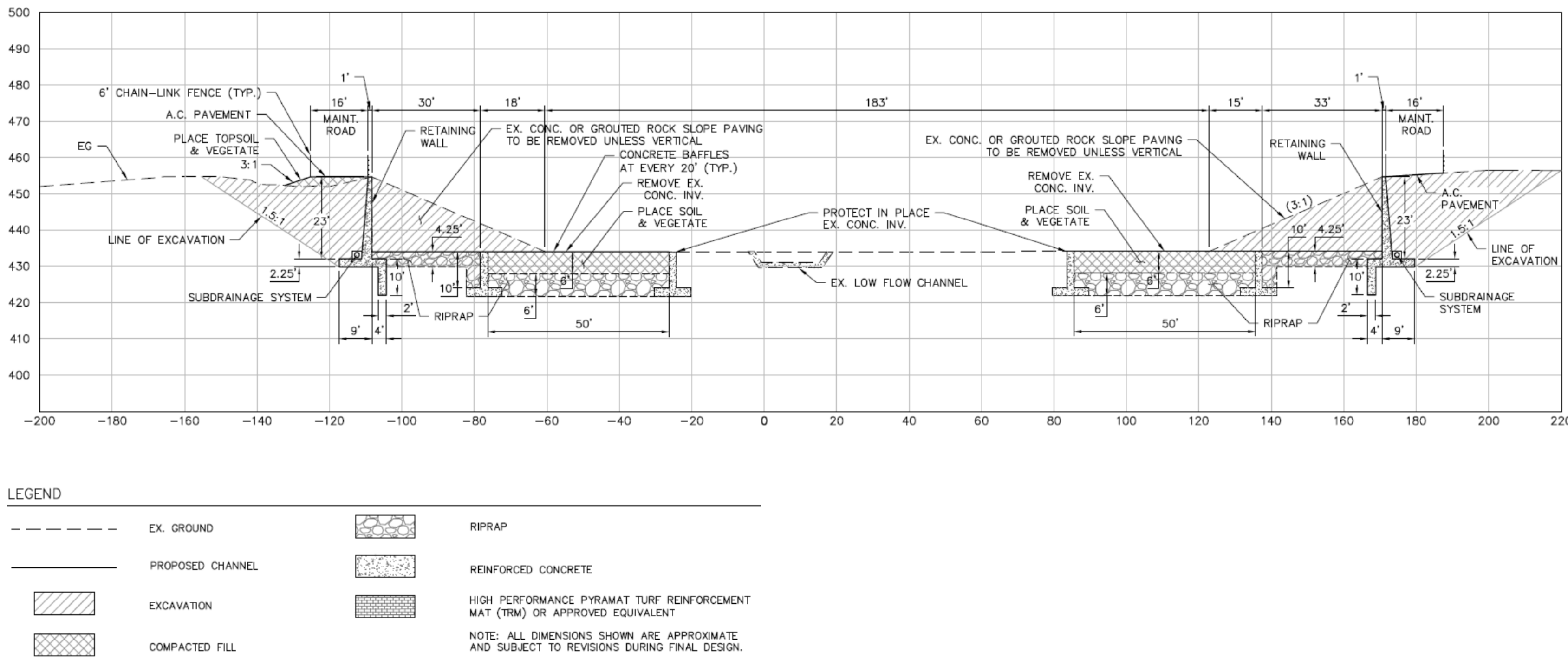


Figure 4.5 Cross-Section 3, Ferraro Fields to Brazil Street

4.2.5 Verdugo Wash Cross-Section 1, Sub-Reach 3 - Upstream of the Los Angeles River Confluence

Existing Channel Features – The existing rectangular reinforced concrete channel is 110 feet wide and 28 feet high from the invert.

Preliminary Channel Design – As seen in Figure 4.6, "Verdugo Wash Cross-Section 1, Upstream of Los Angeles River Confluence," the proposed design would widen the left/south top of bank of the channel by 389 feet, and construct a 119-foot-wide 3H:1V benched/terraced vegetated slope. The benching/terracing would provide access for maintenance of the vegetated slope as well as break up the flow path downslope by providing cross drainage. The proposed widened section of the channel would be soft bottom. Two riprap toedowns would be constructed below the channel bottom at the respective banks. The first riprap toedown would be located at the edge of the proposed widened portion of the channel at a depth and width of 10 feet. The second riprap toedown, which would include bank protection along the base of the proposed left/east bank, would be at a depth of 3 to 10 feet and a width of 20 feet. A 16-foot-wide asphalt concrete maintenance road would be constructed on the proposed left/east top of bank.

Demolition and Excavation – The left/south concrete retaining wall would be demolished. The channel bottom would be excavated to a width of 270 feet; a 3H:1V terraced/benched channel bank would be excavated for an additional 135 feet to meet the existing ground above. Excavation for riprap toedowns would occur at the toe of the proposed left/south bank and at the edge of where the widened and existing concrete channel bottoms would meet, at a depth of 3 to 10 feet.

Compacted Fill and Maintenance Road – The existing ground at the left/east top of bank would be used for the base of the proposed 16-foot-wide asphalt concrete maintenance road. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Erosion Control – Erosion control matting, such as TRM, or approved equivalent, would be used to stabilize, prevent channel scour, and to promote vegetation establishment on the left/south channel slope.

Topsoil and Vegetation – Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the left/south bank and after TRM matting is installed. Topsoil areas would be seeded and planted with recommended vegetation.

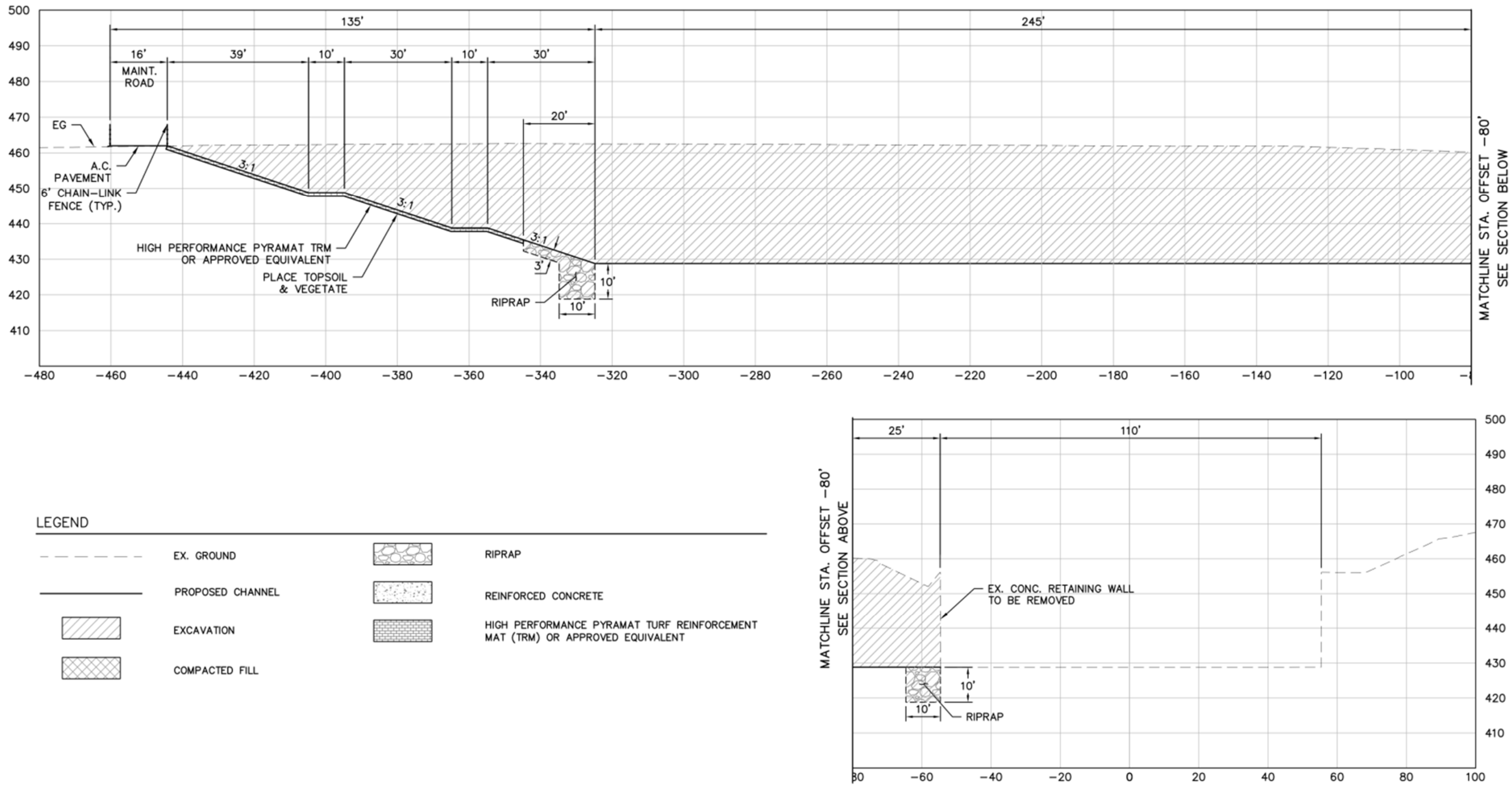


Figure 4.6 Verdugo Wash Cross-Section 1, Upstream of Los Angeles River Confluence

4.2.6 Verdugo Wash Cross-Section 2, Sub-Reach 3 - Upstream of Los Angeles River Confluence

Existing Channel Features – The existing rectangular reinforced concrete channel is 90 feet wide and 24 feet high from the invert.

Preliminary Channel Design – As seen in Figure 4.7 and Figure 4.8, "Verdugo Wash Cross-Section 2, Upstream of Los Angeles River Confluence," the proposed design would widen the left/south top of bank of the channel by 647 feet, and construct a 129-foot-wide 3H:1V benched/terraced vegetated slope. Benching on the slope would be 10 feet wide and occur at 30 and 70 feet from the toe. The benching/terracing would provide access for maintenance of the vegetated slope as well as break up the flow path downslope by providing cross drainage. The proposed widened section of the channel would be soft bottom. Two riprap toedowns would be constructed below the channel bottom at the respective banks. The first riprap toedown would be located at the edge of the proposed widened portion of the channel at a depth and width of 10 feet. The second riprap toedown, which would include bank protection along the base of the proposed left/south bank, would be at a depth of 3 to 10 feet and a width of 20 feet. A 16-foot-wide asphalt concrete maintenance road would be constructed on the proposed left/east top of bank.

Demolition and Excavation **–** The left/east concrete retaining wall would be demolished. The channel bottom would be excavated to a width of 534 feet; a 3H:1V terraced/benched channel bank would be excavated for an additional 113 feet to meet the existing ground above. Excavation for riprap toedowns would occur at the toe of the proposed left/east bank and at the edge of where the widened and existing concrete channel bottoms would meet, at a depth of 3 to 10 feet.

Compacted Fill and Maintenance Road **–** The existing ground at the left/south top of bank would be used as the base of the proposed 16-foot-wide asphalt concrete maintenance road. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Erosion Control **–** Erosion control matting, such as TRM, or approved equivalent, would be used to stabilize, prevent channel scour, and to promote vegetation establishment on the left/south channel slope.

Topsoil and Vegetation **–** Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the left/south bank after TRM matting is installed. Topsoil areas would be seeded and planted with riparian vegetation per recommendation of the project biologist.

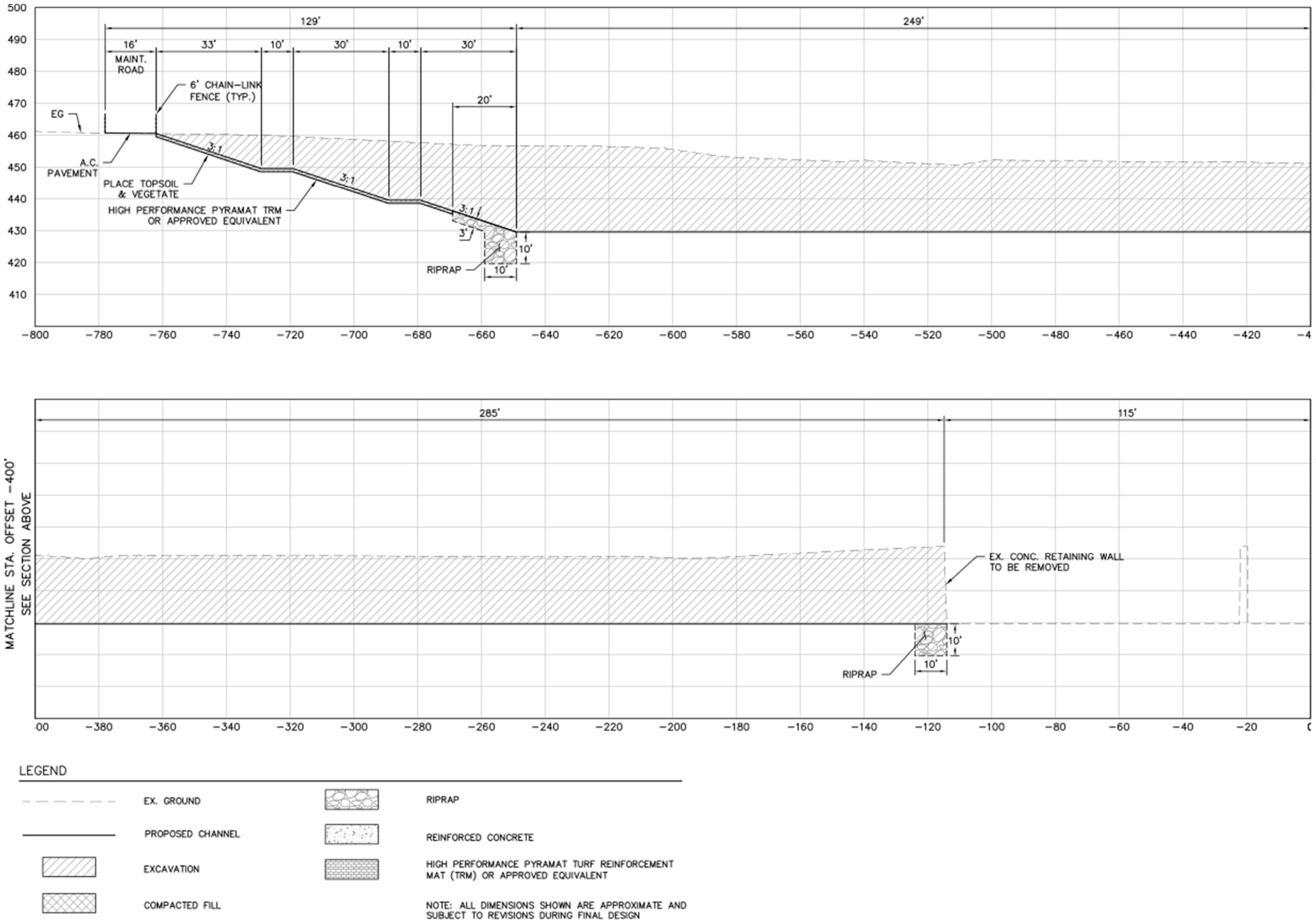


Figure 4.7 Verdugo Wash Cross-Section 2, Upstream of Los Angeles River Confluence

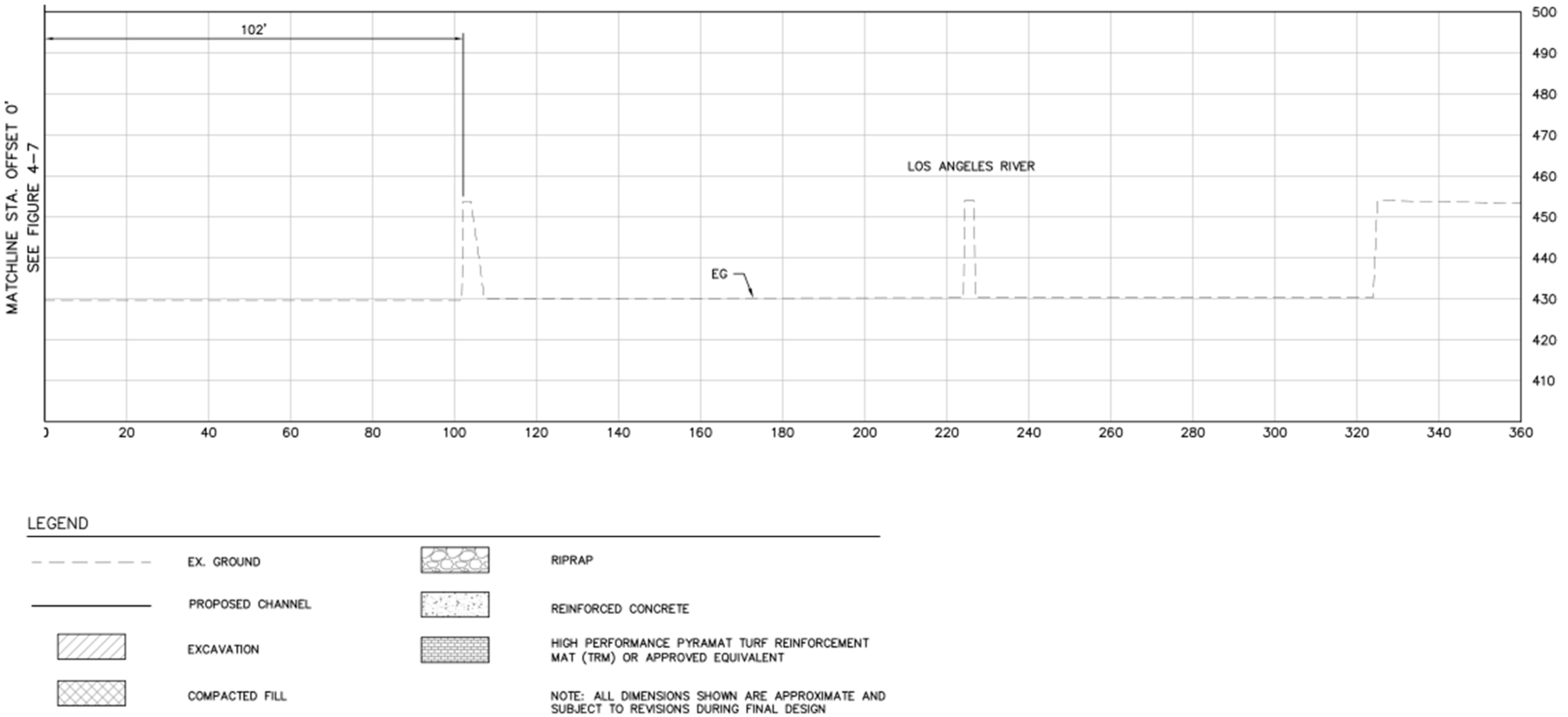


Figure 4.8 Verdugo Was Cross-Section 2 (cont'd), Upstream of Los Angeles River Confluence

4.2.7 Verdugo Wash Cross-Section 3, Sub-Reach 3 - Los Angeles River Confluence

Existing Channel Features – The existing rectangular reinforced concrete channel is at the confluence of Verdugo Wash and the Los Angeles River. The width of the existing channel is 389 feet wide and 25 feet high from the invert.

Preliminary Channel Design – As seen in Figure 4.9 and Figure 4.10, "Verdugo Wash Cross-Section 3, Upstream of Los Angeles River Confluence," the proposed design would widen the left/east top of bank of the channel confluence by 628 feet, and construct a 113-foot-wide 3H:1V benched/terraced vegetated slope. Benching on the slope would be 10 feet wide and occur at 30 and 70 feet from the toe. The benching/terracing would provide access for maintenance of the vegetated slope as well as break up the flow path downslope by providing cross drainage. The proposed widened section of the channel would be soft bottom. Two riprap toedowns would be constructed below the channel bottom respective banks. The first riprap toedown would be located at the edge of the proposed widened portion of the channel at a depth and width of 10 feet. The second riprap toedown, which would include bank protection along the base of the proposed left/east bank, would be at a depth of 3 to 10 feet and a width of 20 feet. A 16-foot-wide asphalt concrete maintenance road would be constructed on the proposed left/east top of bank.

Demolition and Excavation – The left/east concrete retaining wall would be demolished. The channel bottom would be excavated to a width of 515 feet; a 3H:1V terraced/benched channel bank would be excavated for an additional 103 feet to meet the existing ground above. Excavation for riprap toedowns would occur at the toe of the proposed left/east bank and at the edge of where the widened and existing concrete channel bottoms would meet, at a depth of 3 to 10 feet.

Compacted Fill and Maintenance Road – The existing ground at the left/east top of bank would be used as the base of the proposed 16-foot-wide asphalt concrete maintenance road. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Erosion Control – Erosion control matting, such as TRM would be used to stabilize, prevent channel scour, and to promote vegetation establishment on the left/east channel slope.

Topsoil and Vegetation – Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the left/east bank after TRM matting is installed. Topsoil areas would be seeded and planted with riparian vegetation per recommendation of the project biologist.

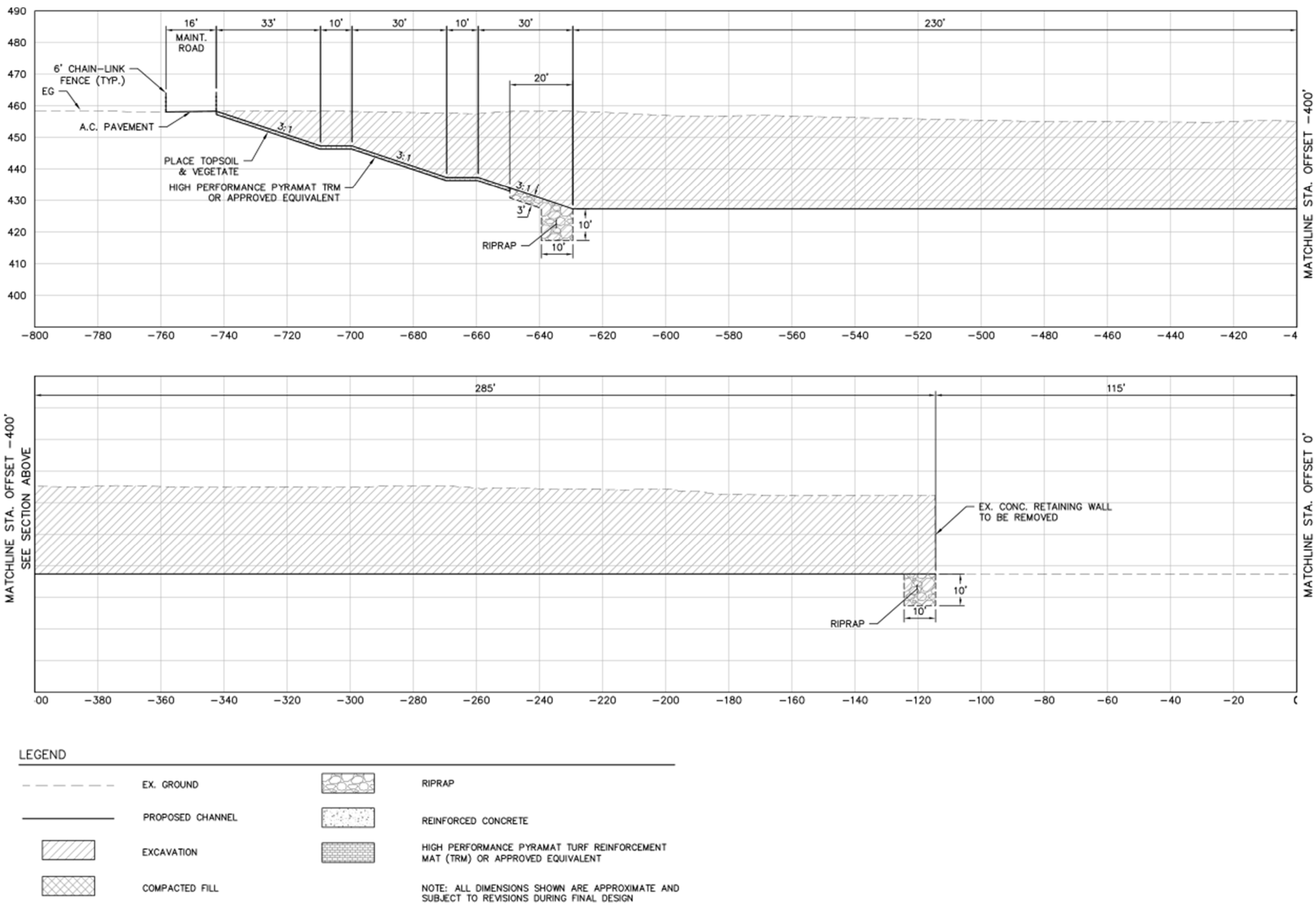


Figure 4.9 Verdugo Wash Cross-Section 3, Upstream of Los Angeles River Confluence

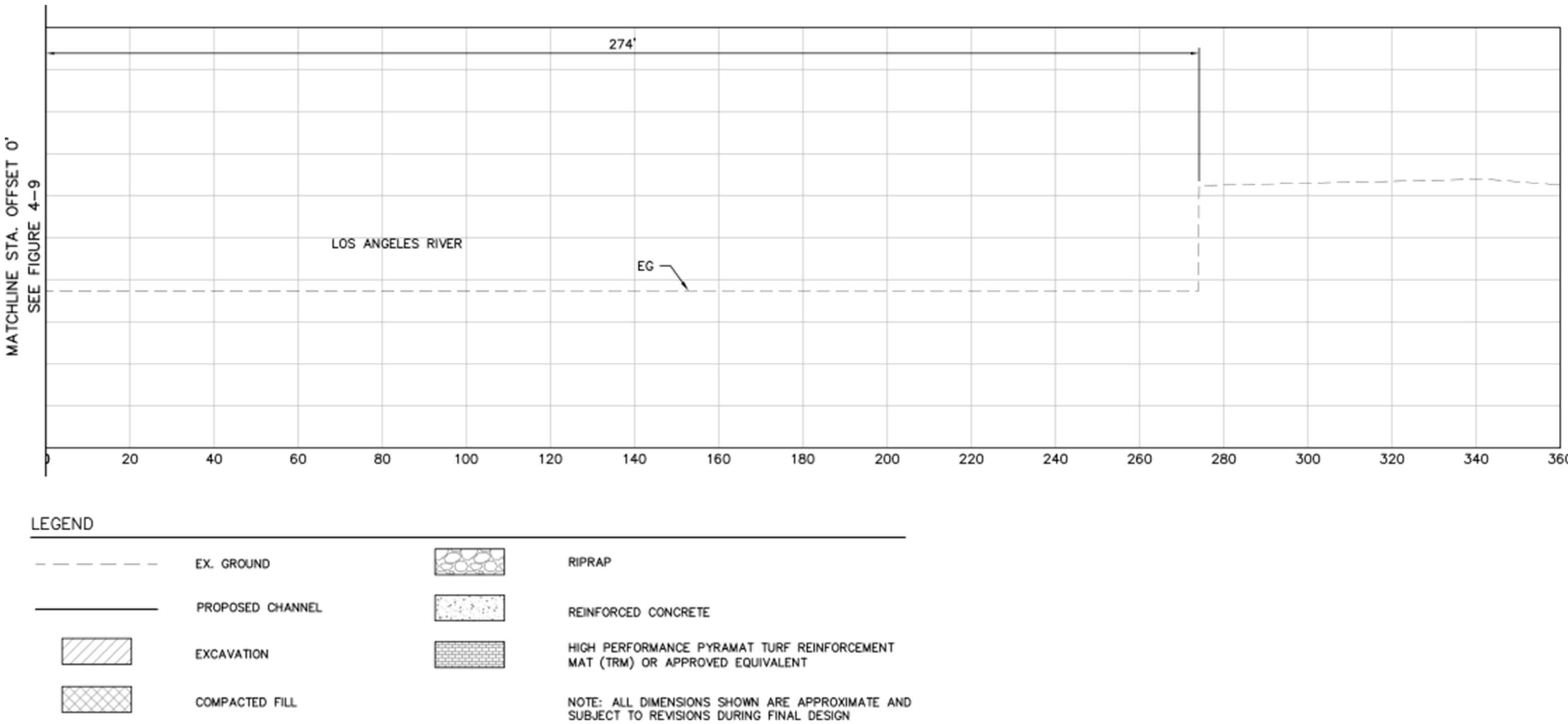


Figure 4.10 Verdugo Wash Cross-Section 3 (cont'd), Upstream of Los Angeles River Confluence

4.2.8 Cross-Section 4, Sub-Reach 4 - Brazil to Los Feliz Boulevard

Existing Channel Features – The existing trapezoidal channel within the sub-reach varies from grouted rock to concrete paved channel, is 324 feet wide from the top of bank, and 22 feet high from the invert.

Preliminary Channel Design – As seen in Figure 4.11, "Cross-Section 4, Brazil to Los Feliz," the proposed design would construct four concrete terraced planters in the left/east and right/west banks of the channel. Toedowns with bank protection would be constructed at the toe of the proposed channel banks. A 16-foot-wide asphalt concrete maintenance road would be constructed on both sides of the channel. Grade control structures would be constructed to reduce in-stream velocities and secure natural bed materials for meander and vegetation development.

Demolition and Excavation – Several areas of the reach would undergo demolition and excavation to implement the proposed design. The left/east and right/west banks' grouted rock or slope paving would be demolished. Excavation of earthen material for four concrete terraced planters at a depth of 4 to 8.75 feet and a width of 12.5 feet would occur on the channel slopes. Excavation would also occur at a depth of 3 to 10 feet at the toe of both banks for proposed toedowns with bank protection. In areas where grade control structures would be implemented, 10 to 15 feet of earthen material would be excavated from the channel bed to accommodate construction of grouted riprap toedowns.

Compacted Fill and Maintenance Road – Compacted fill would be placed behind the right/west and left/east channel top of banks to create 16-foot wide maintenance roads on both sides of the channel. The asphalt concrete maintenance roads would meet the proposed channel's top of bank on the river and would have a slope of 3H:1V on the landward. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Terraced Vegetated Planters – After demolition and excavation, terraced planters would be constructed in the slopes of the existing channel. Planter dimensions would be 4 to 8.75 feet in height and 12.5 feet in width. The terraces would be spaced along the channel wall so that the top of the lowest meets the bottom of the next. The bottom would be flush with the top of the highest point of the grade control structure. Each planter would have a 1-foot-thick concrete bottom and 1.5-foot-thick concrete walls. Concrete baffles would be placed every 20 feet along the terraces to prevent erosion/scour. Terraces would be seeded and planted with native riparian vegetation per the project biologist's recommendation. The planter boxes would also include drainage holes to help route drainage water from upper boxes to lower boxes.

Topsoil and Vegetation – Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the slopes of the maintenance road compacted fill and in the concrete terraced planters. Topsoil areas would be seeded and planted with native riparian vegetation per the project biologist's recommendations.

Grade Control Structure – Grouted riprap grade control structures would be placed every 500 feet along this reach of the channel. Grade control structures would reduce in-stream flow velocities and stabilize the channel's slope and earthen bed material. Grade control structures would be constructed in the channel bottom at a depth of 10 or 15 feet, have a 2H:1V slope on the upstream end and a 4H:1V slope on the downstream end, be 5 feet in width on top, and have a 2-foot-deep and 20-foot-wide low-flow centerline notch.

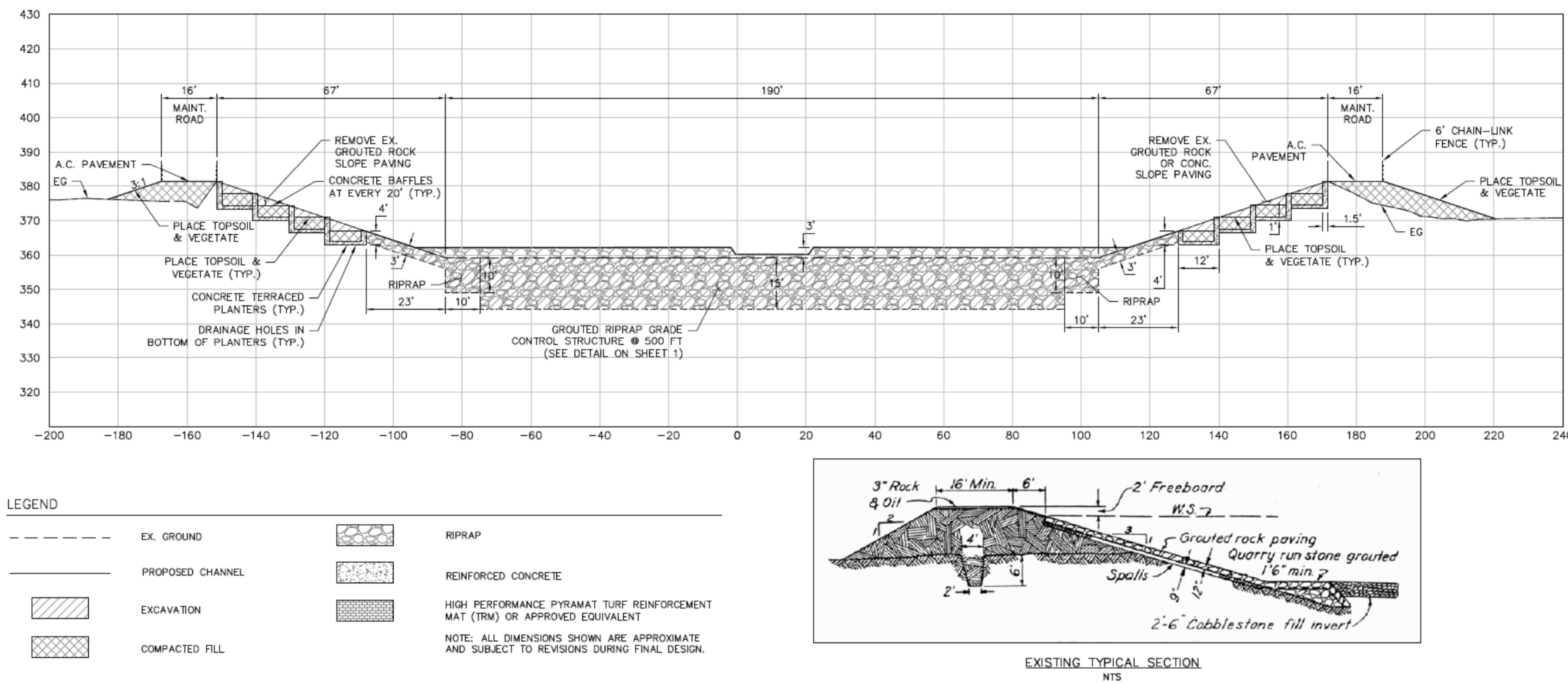


Figure 4.11 Cross-Section 4, Brazil to Los Feliz

4.2.9 Cross-Section 5, Sub-Reach 5 - Los Feliz Boulevard to Glendale Freeway

Existing Channel Features – The existing trapezoidal channel within the sub-reach varies from grouted rock to concrete paved channel, is 310 feet wide from the top of bank and 20 feet high from the invert.

Preliminary Channel Design – As seen in Figure 4.12, " Cross-Section 5, Los Feliz Boulevard to Glendale Freeway," the proposed design would construct four concrete terraced planters in the left/east bank of the channel slope. The right/west bank of the trapezoidal bank would be replaced by a 22-foot-high vertical retaining wall with subdrainage under the footing, which would meet the existing top of bank. Two riprap toedowns would be constructed below the channel bottom and bank. The first riprap toedown would be constructed on the right/west bank and the second that would include bank protection, would be located on the left/east bank. Two 16-foot-wide asphalt concrete maintenance roads would be constructed on the land of the retaining walls on the top of bank. The existing cobble/soft bottom would be protected in place and expanded 27 feet towards the proposed right/west bank of the channel.

Demolition and Excavation – Several areas of the reach would undergo demolition and excavation to implement the proposed design. The left/east and right/west banks' grouted rock or slope paving would be demolished. Excavation of earthen material for four concrete terraced planters with dimensions of 4 to 8.75 feet deep and 12.5 feet wide would occur along the left/east bank. Excavation on the right/west bank would widen the channel by 60 feet. Toedown excavation would occur at a depth of 3 to 10 feet and 27 and 33 feet wide at the toe of the left/east bank, which would include bank protection at the base of the channel, and right/west bank, respectively. Excavation for the footing of the retaining wall would range from 4 to 12 feet deep and be 13 feet wide. Excavation would also occur behind the location of the proposed retaining wall, and would have a temporary slope of 1.5H:1V to meet the existing ground; excavation would allow temporary access for construction of the walls.

Compacted Fill and Maintenance Road – Compacted fill would be placed behind the left/east and right/west channel top of banks. The compacted fill would be used to create a 16-foot-wide asphalt concrete maintenance road on both sides of the channel, which would meet the proposed channel's top of bank on the river, and would have a slope of 3H:1V on the landward. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Terraced Vegetated Planters – After demolition and excavation, terraced planters would be constructed in the slopes of the existing channel. Planter dimensions would be 4 to 8.75 feet in height and 12.5 feet in width. The terraces would be spaced along the channel wall so that the top of the lowest meets the bottom of the next. The bottom would be flush with the top of the highest point of the grade control structure. Each planter would have a 1-foot-thick concrete bottom and 1.5-foot-thick concrete walls. Concrete baffles would be placed every 20 feet along the terraces to prevent erosion/scour. The planter boxes would also include drainage holes to help route drainage water from upper boxes to lower boxes. Terraces would be seeded and planted with native riparian vegetation per the project biologist's recommendation.

***Topsoil and Vegetation* –** Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the slopes of the maintenance road's compacted fill 3H:1V slopes and in the concrete terraced planters on the left/east bank. Topsoil areas would be seeded and planted with native riparian vegetation per the project biologist's recommendations.

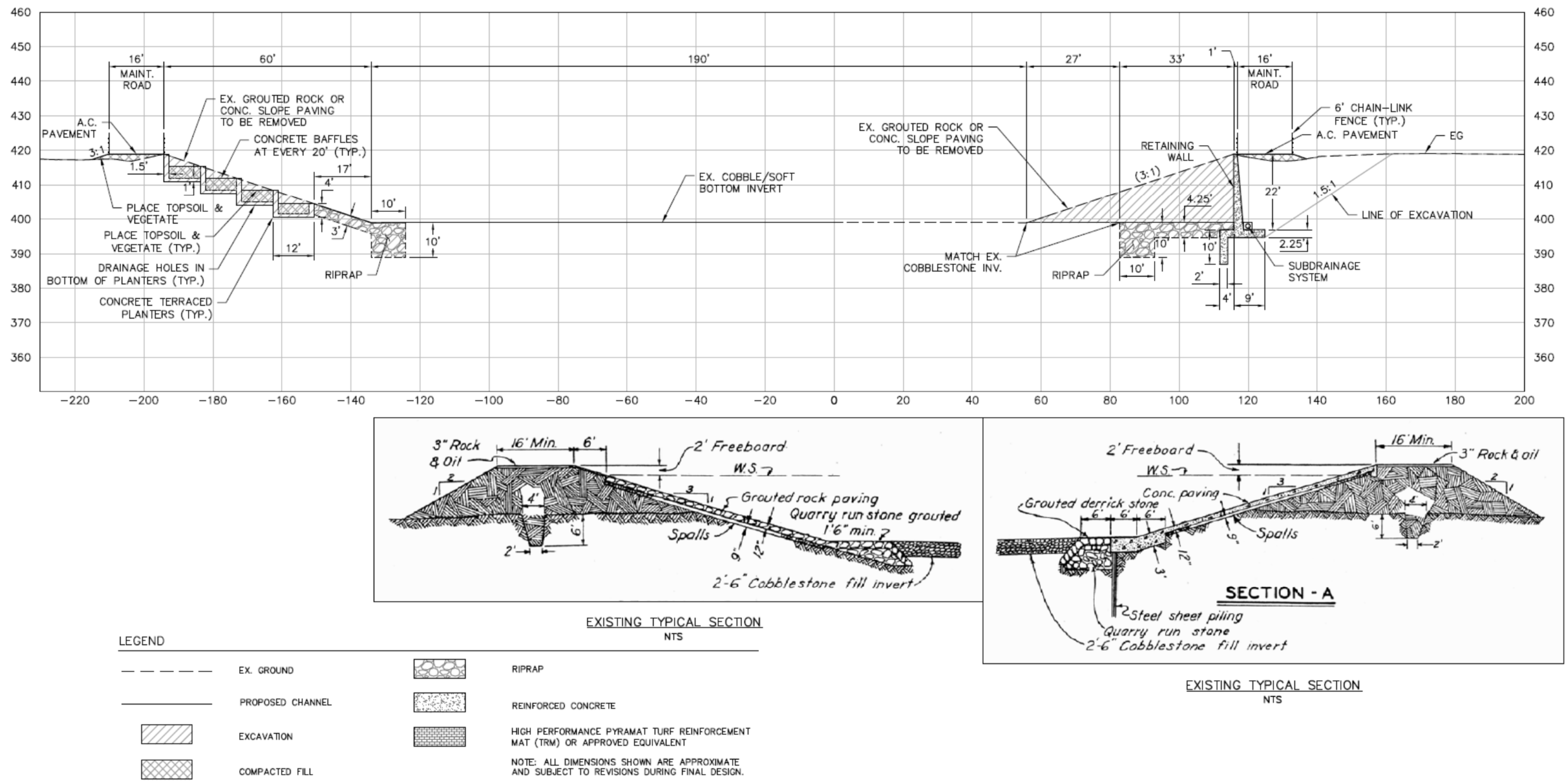


Figure 4.12 Cross-Section 5, Los Feliz Boulevard to Glendale Freeway

4.2.10 Cross-Section 6a, Sub-Reach 6 - Glendale Freeway to Interstate 5

Existing Channel Features – The existing trapezoidal channel within the sub-reach varies from grouted rock to concrete paved, is 365 feet wide from the top of bank, and approximately 22 feet high from the invert.

Preliminary Channel Design – As seen in Figure 4.13, "Cross-Section 6a, Glendale Freeway to Interstate 5," the proposed design would replace the existing trapezoidal channel's grouted rock or concrete paved 3H:1V slopes with TRM, topsoil, and vegetation on the left/east bank and right/west bank. Riprap toedowns with bank protection would be placed at the toe of both banks of the channel. Two 16-foot-wide asphalt concrete maintenance roads would be constructed on the channel's left/east and right/west top of banks. The existing cobble/soft bottom would be protected in place.

Demolition and Excavation – The left/east bank and the right/west bank grouted rock or slope paving would be demolished. Excavation for the left/east bank and the right/west bank toedowns and bank protection would start at the channel toe, and extend 20 feet towards the landward at a depth of 3 to 10 feet below the existing cobble/soft bottom and channel banks.

Compacted Fill and Maintenance Road – Compacted fill would be used to fill behind the left/east and right/west channel top of banks to form the subsurface of the proposed 16-foot-wide maintenance road. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Erosion Control – Erosion control matting, such as TRM, would be used to stabilize, prevent channel scour, and to promote vegetation establishment on channel slopes.

Topsoil and Vegetation – Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the 3H:1V channel slopes after TRM matting has been installed. Topsoil areas would be seeded and planted with native riparian vegetation per the project biologist's recommendations.

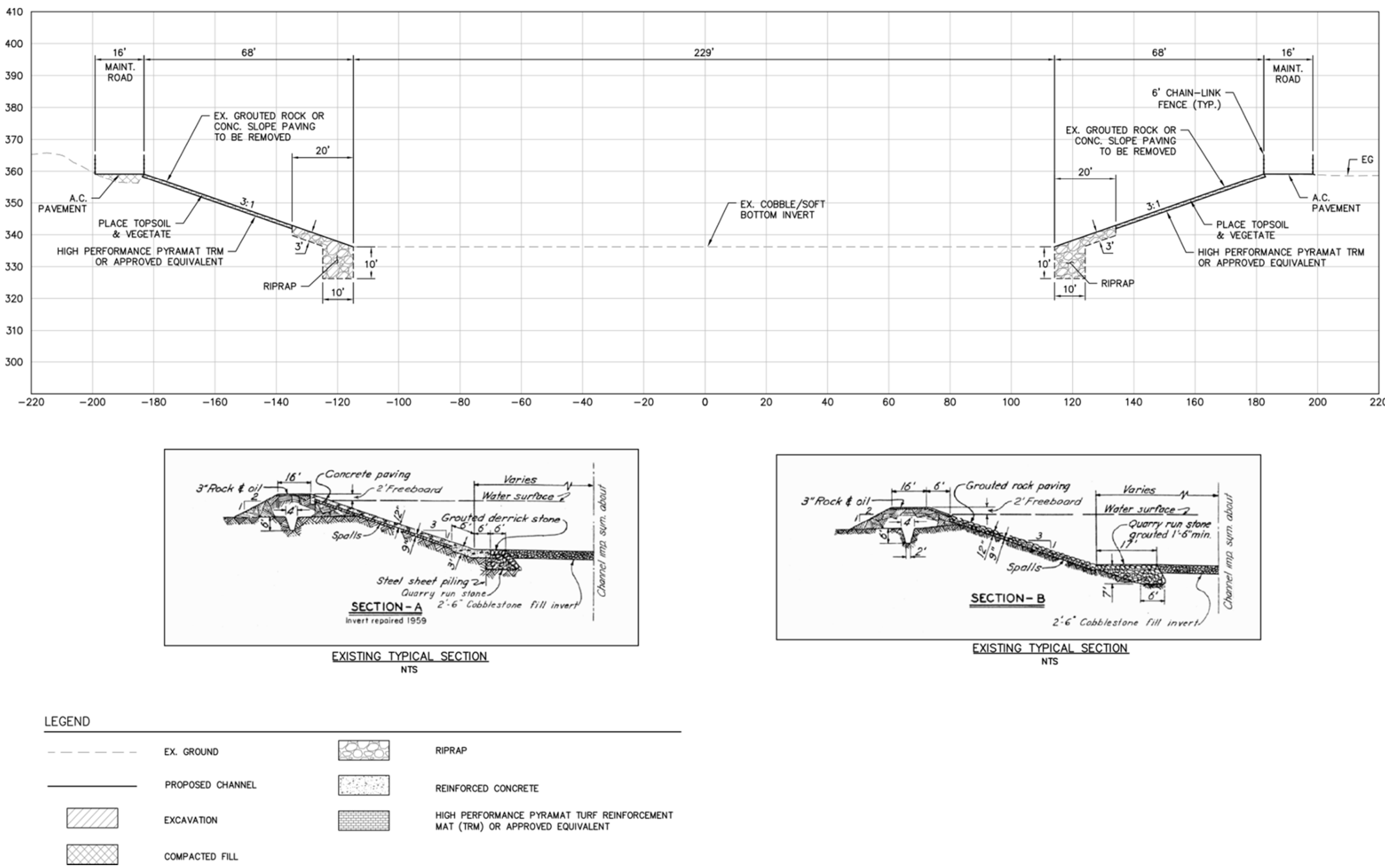


Figure 4.13 Cross-Section 6a, Glendale Freeway to Interstate 5

4.2.11 Cross-Section 6b, Sub-Reach 6 - Glendale Freeway to Interstate 5

Existing Channel Features – The existing trapezoidal channel within the sub-reach varies from grouted rock to concrete paved channel, is 365 feet wide from the top of bank, and approximately 22 feet high from the invert. The existing channel bottom is cobble/soft bottom.

Preliminary Channel Design **–** As seen in Figure 4.14, “Cross-Section 6b, Glendale Freeway to Interstate 5,” the proposed design would replace the existing channel’s grouted rock or concrete paved 3H:1V slopes with TRM, topsoil, and vegetation on the left/east bank and the widened right/west bank. The left/east top of bank would be widened by approximately 316 feet to create acreage for the construction of wetlands. Three riprap toedowns with slope protection would be constructed: one at the toe of the right/west bank, one at the toe of the proposed wetlands (existing left/east bank), and the third at the toe of the widened left/east bank. Maintenance roads would be constructed on both sides of the channel’s top of banks. The existing cobble/soft bottom would be protected in place.

Demolition and Excavation **–** The right/west bank and left/east bank grouted rock or slope paving would be demolished. Excavation would also occur as needed to widen the left/east overbank area by approximately 316 feet and to an elevation of approximately 6 feet above the existing channel invert. The new left/east bank would be excavated at a 3H:1V slope and meet the existing ground at the top of bank. Excavation for the three toedowns would be approximately 20 feet wide and at a depth of 3 to 10 feet below the adjacent ground surface elevation.

Compacted Fill and Maintenance Road **–** Two 16-foot-wide asphalt concrete maintenance roads would be constructed on the left/east and right/west channel top of banks. Compacted fill would be used to fill behind the right/west channel top of bank to form the subsurface for the road. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Wetlands **–** The construction of wetlands would start 20 feet landward from the existing channel left/east bank toe, terraced to an elevation of 6 feet above the invert. The wetlands would extend for a distance of approximately 316 feet to the proposed left/east bank toe. The 6-foot-high terraced wetland area would receive channel flow conveyed throughout the site that would assist in treating pollutants and creating riverine wetland habitat.

Erosion Control **–** Erosion control matting, such as TRM, would be used to stabilize, prevent channel scour, and to promote vegetation establishment on channel slopes.

Topsoil and Vegetation **–** Topsoil would aid in the recruitment and establishment of vegetation along the channel’s riparian zone. Topsoil would be placed on the right/west bank and the left/east bank’s 3H:1V channel slopes after TRM matting is installed. Topsoil would also be placed in the proposed wetlands area. Topsoil areas would be seeded and planted with native riparian vegetation per the project biologist’s recommendations.

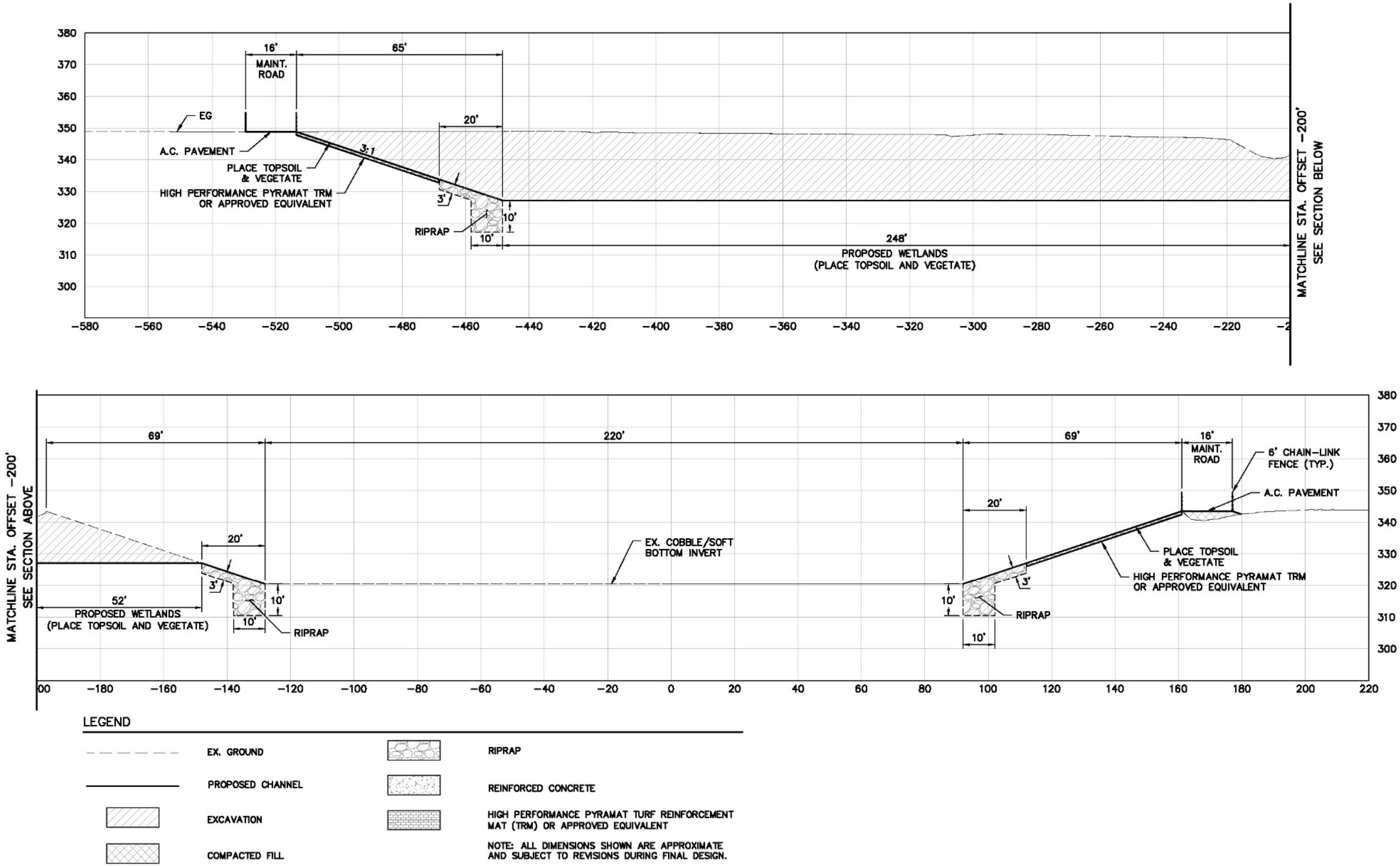


Figure 4.14 Cross-Section 6b, Glendale Freeway to Interstate 5

4.2.12 Cross-Section 6c, Sub-Reach 6 - Glendale Freeway to Interstate 5

Existing Channel Features – The existing trapezoidal channel within the sub-reach varies from grouted rock to concrete paved channel, is 380 feet wide from the top of bank and approximately 26 feet high from the invert. The existing channel bottom is cobble/soft bottom.

Preliminary Channel Design – As seen in Figure 4.15, "Cross-Section 6c, Glendale Freeway to Interstate 5," the proposed design would replace the existing trapezoidal channel's grouted rock or concrete paved 3H:1V slopes with erosion control matting and vegetation on the left/east bank and right/west bank. Riprap toedowns with bank protection would be placed at the toe of both banks in the channel, and extend 20 feet landward. Asphalt concrete maintenance roads would be constructed on both sides of the channel at the top of bank. The existing cobble/soft bottom would be protected in place.

Demolition and Excavation – The left/east bank and right/west bank grouted rock or slope paving would be demolished. Excavation for the left/east bank and the right/west bank toedowns would start at the channel toe and extend 20 feet landward, at a depth of 3 to 10 feet below the existing cobble/soft bottom and the channel banks.

Compacted Fill and Maintenance Road – Compacted fill would be used to fill behind the left/east and right/west channel top of banks to form the subsurface of the proposed 16-foot-wide maintenance roads. The fill would meet the top of bank on the river, and have a slope of 3H:1V to meet the existing ground. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Erosion Control – Erosion control matting, such as TRM, would be used to stabilize, prevent channel scour, and to promote vegetation establishment on the channel's 3H:1V slopes.

Topsoil and Vegetation – Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the left/east and right/west banks' 3H:1V channel slopes after TRM matting is installed. Topsoil without TRM matting would be placed on the 3H:1V maintenance road slopes. Topsoil areas would be seeded and planted with vegetation per the project biologist's recommendations.

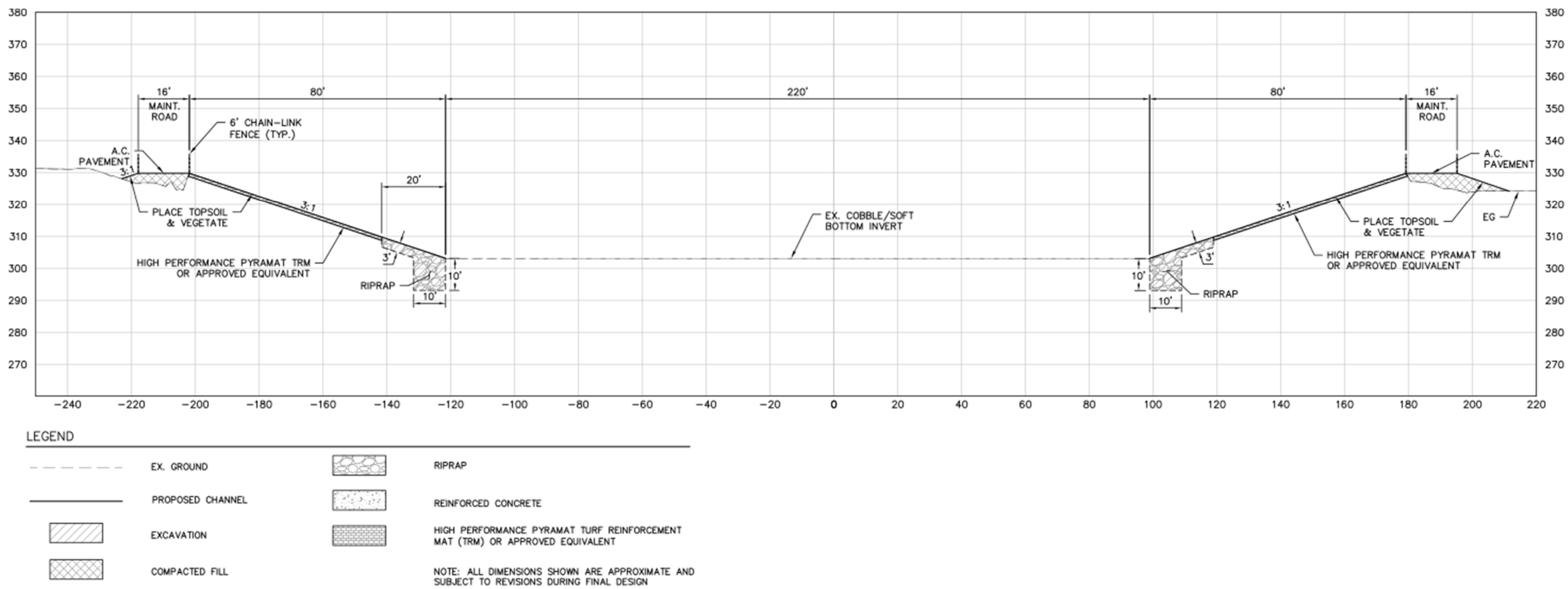


Figure 4.15 Cross-Section 6c, Glendale Freeway to Interstate 5

4.2.13 Cross-Section 7, Sub-Reach 7 - Interstate 5 to Main

Existing Channel Features – The existing trapezoidal reinforced concrete channel with concrete bottom is 264 feet wide from the top of bank and approximately 26 feet high from the invert.

Preliminary Channel Design – As seen in Figure 4.16, "Cross-Section 7, Interstate 5 to Main Street," the proposed design would widen the bottom of the channel by 52 feet and construct a 29-foot-high retaining wall with subdrainage at the footings and invert slab on the left/east and right/west banks. Reinforced cantilevered platforms would be constructed on the top of the proposed retaining walls and would extend 25 feet over the channel. Reinforced concrete piers would be located on the in-channel edge of the platform and spaced 25 feet apart for support. Concrete-reinforced, naturalized planter boxes that would replace portions of the concrete invert would be constructed adjacent to the footings at both banks and extend 50 feet towards the center of the channel. A 16-foot-wide asphalt concrete maintenance road would be constructed on the retaining wall and on the top of both banks. The low-flow channel and portion of the concrete-lined invert that would remain following construction would be protected in place.

Demolition and Excavation – Several areas of the reach would undergo demolition and excavation to implement the proposed design. The left/east and right/west banks' existing concrete slope protection would be demolished. A 31-foot stretch of reinforced concrete channel bottom starting at the existing toe and extending towards the channel centerline would be demolished. Excavation would widen the channel bottom by 52 feet on both banks, changing the channel wall morphology from trapezoidal to vertical. Retaining wall and pier footing locations at depths of 4.25 to 10 feet and a width of 42 feet would be excavated. Naturalized channel locations would be excavated at a depth of 12 feet and width of 50 feet towards the channel centerline. Excavation would occur behind the locations of the proposed retaining walls and would have a temporary slope of 1.5H:1V to meet the existing ground. Excavation would allow temporary access for construction of the retaining walls.

Compacted Fill and Maintenance Road – After construction of the retaining walls, compacted fill would be placed behind the left/east and right/west channels' retaining walls. The fill would be placed to accommodate a 16-foot-wide paved asphalt-concrete maintenance road on both banks. The river side elevation of the maintenance roads would meet the top of the proposed retaining walls on both banks. The land side of the left/east bank maintenance road would be sloped 3H:1V to meet the existing ground using compacted fill. Fencing would be constructed to separate areas of access from the maintenance road and the platform on both the potentially private right-of-way and the river.

Planter Boxes (Naturalized Channel) – Naturalized channel would be constructed at the edge of the retaining wall toedowns, and would extend 50 feet towards the center of the channel at a depth of 12 feet. The surface of the naturalized channel would be flush with the invert. The bottom 6 feet of the channel would be filled with riprap and the top 6 feet with soil. The soil would be secured with concrete baffles spaced 20 feet apart to help prevent scour/erosion. The naturalized channel would be seeded and planted with native riparian vegetation per the project biologist's recommendation.

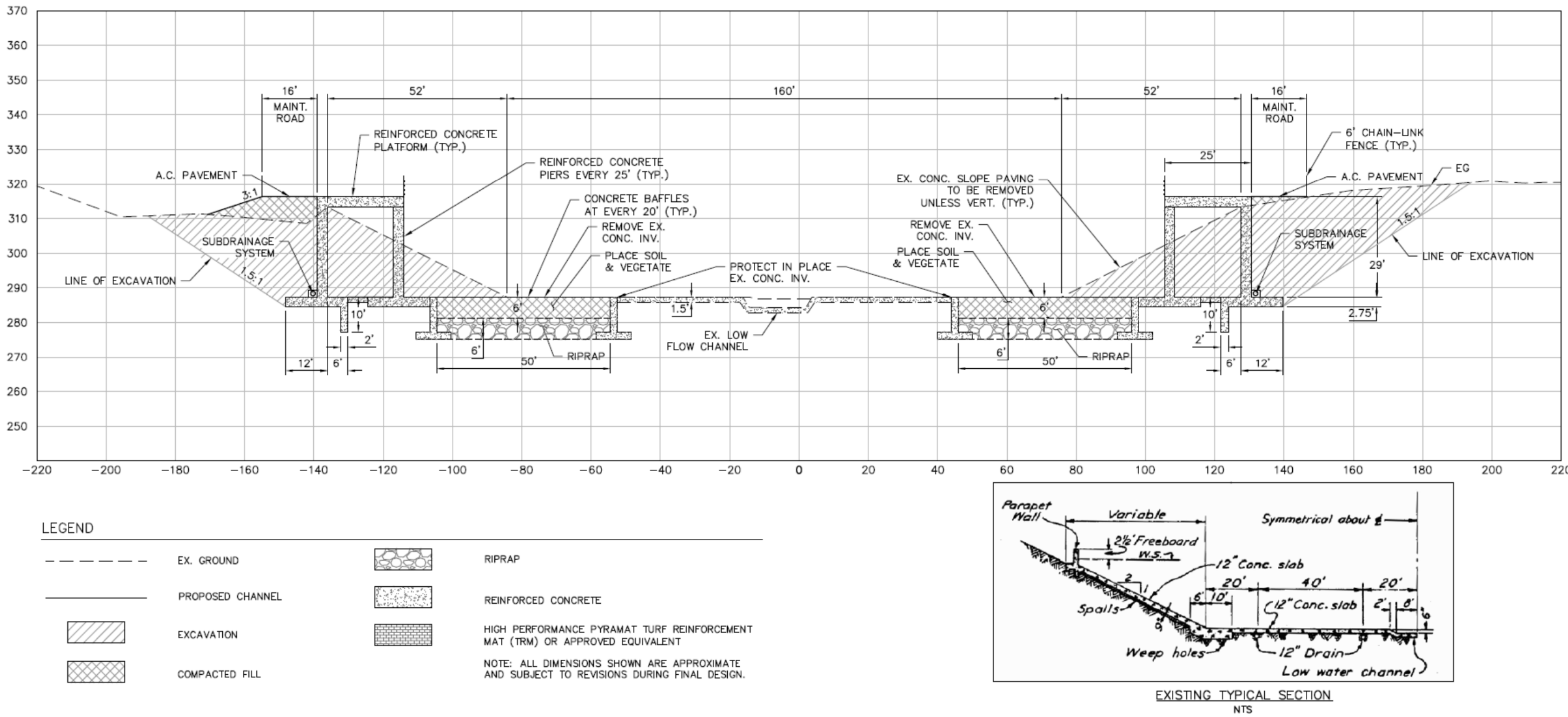


Figure 4.16 Cross-Section 7, Interstate 5 to Main Street

4.2.14 Arroyo Seco Cross-Section, Sub-Reach 7 – Arroyo Seco Confluence

Existing Channel Features – The existing rectangular reinforced concrete channel with concrete bottom is 66 feet wide from the top of bank and approximately 24 feet high from the invert.

Preliminary Channel Design – As seen in Figure 4.17, "Arroyo Seco Cross-Section," the proposed design would remove 4 feet and 24 feet off the top of the existing left/south and right/north retaining walls respectively. The channel bottom would be widened by 10 feet on both banks. Both sides of the channel would be additionally widened to accommodate 3H:1V vegetated banks; the left/south bank would be widened by 60 feet, 12 feet above the invert, and the right/north bank widened by 62 feet, 6 feet above the invert. The existing concrete bottom would be protected in place. An asphalt concrete maintenance road would be constructed on both sides of the channel top of bank. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Demolition and Excavation – Demolition of the tops of the retaining walls would occur on both sides of the channel; the top 4 feet of the left/south retaining wall and the top 24 feet of the right/north retaining wall would be demolished. From the new height of the retaining walls, both sides of the channel would be excavated and benched 10 feet landward; trapezoidal banks with a slope of 3H:1V would be excavated and extend from the benches for 60 feet on the left/south bank and 62 feet on the right/north bank. In addition, the left/south bank would be excavated and leveled for the construction of a 16-foot-wide asphalt concrete maintenance road.

Maintenance Road – The proposed channel design would construct two 16-foot-wide asphalt concrete maintenance roads on the left/south and the right/north banks of the channel. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Erosion Control – Erosion control matting, such as TRM, or approved equivalent, would be used to stabilize, prevent channel scour, and to promote vegetation establishment on channel's 3H:1V slopes.

Topsoil and Vegetation – Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the left/south and right/north banks' 3H:1V channel slopes, after TRM matting is installed. Topsoil areas would be seeded and planted with native riparian vegetation per the project biologist's recommendations.

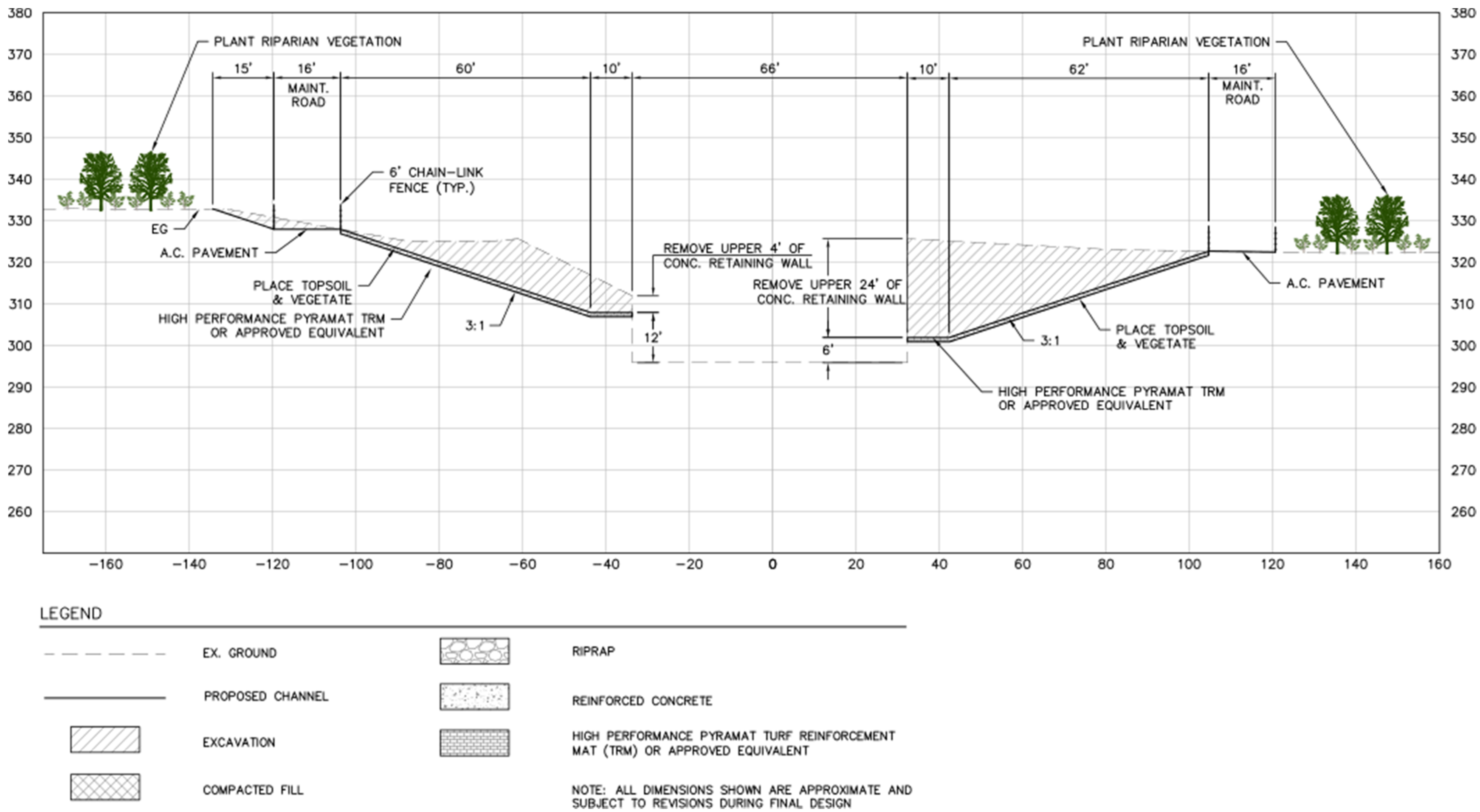


Figure 4.17 Arroyo Seco Cross-Section

4.2.15 Cornfields Cross-Section, Sub-Reach 7, Cornfields Hydrologic Connection

Existing Channel Features – The preliminary design is proposing to hydrologically connect the upstream portion of the Cornfields site with the Los Angeles River; currently, there is no existing channel at the site.

Preliminary Channel Design – As seen in Figure 4.18, "Cornfields Cross-Section," the proposed design would create a 379-foot-wide channel with a 51-foot-wide low-flow channel near center. The left/north and right/south banks of the channel would have 3H:1V slopes with a benched point on either bank. The channel bottom and slopes would be covered with an impermeable liner and vegetated. An asphalt concrete maintenance road would be constructed on both sides of the channel top of bank. A 6-foot chain link fence would be constructed on both shoulders of the maintenance road to seclude trespassers from the road and the channel.

Demolition and Excavation – No major demolition would occur in the proposed channel area. Excavation in the main channel would occur at an average depth of 7 to 8 feet and a width of 325 feet. Within the main channel, excavation of the 51-foot-wide proposed low-flow channel would occur at a depth of 14 feet and width of 15 feet, with 18-foot-wide 3H:1V slopes on either. Excavation of the left/north bank would be 25 feet wide and right/south bank 29 feet wide; approximately halfway up the banks 3H:1V slopes, a 10-foot-wide terraced/benched area would be excavated.

Maintenance Road – The proposed channel design would construct two 16-foot-wide asphalt concrete maintenance roads on the right/south and the left/north banks of the channel. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Impermeable Liner and Vegetation – Depending on the level of residual contamination of the soil, an impermeable liner would be used to cover the surface of the channel bottom and slopes. The impermeable liner would prevent the interaction between surface and groundwater and the potential for contamination. Impermeable liners would be seeded and planted with native riparian vegetation and wetland vegetation per the project biologist's recommendations. (Costs for the liner have been included in the subsequent cost estimate.)

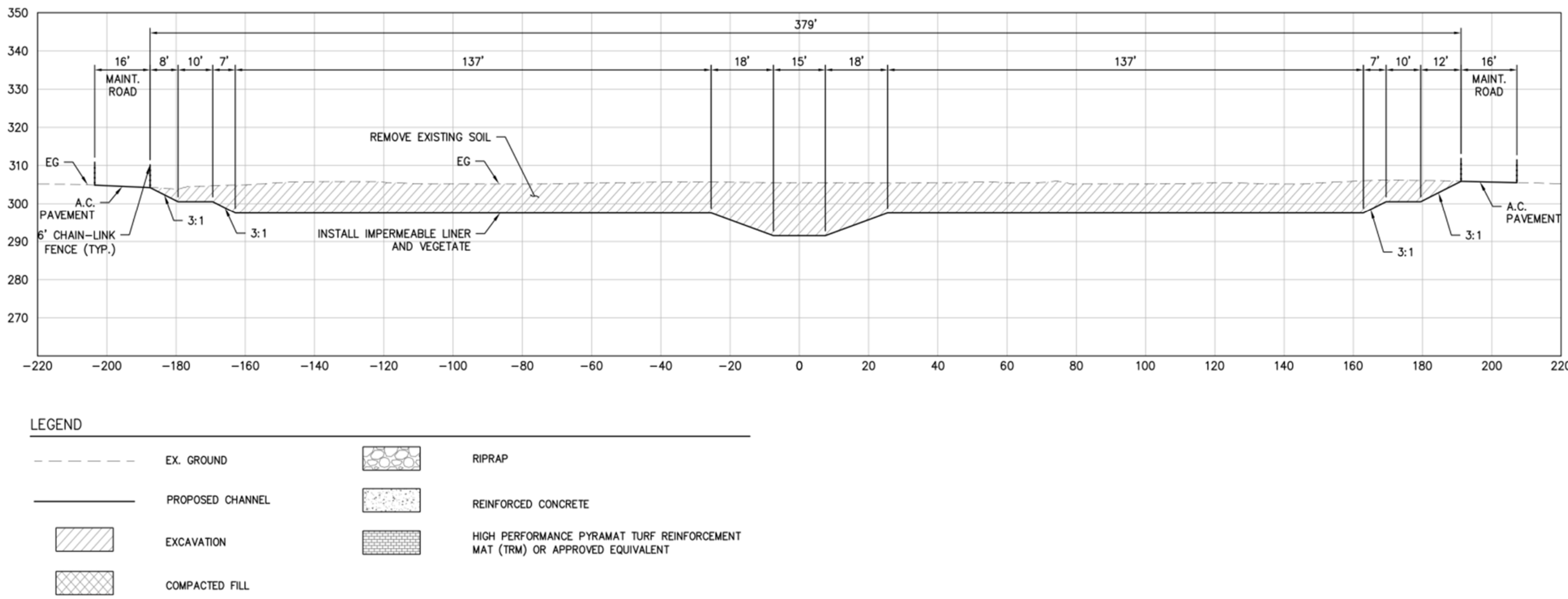


Figure 4.18 Cornfields Cross-Section

4.2.16 Cross-Section 8a, Sub-Reach 8 - Main to First

Existing Channel Features – The existing trapezoidal reinforced concrete channel is 237 feet wide from the top of bank and approximately 22 feet high from the invert. The existing channel bottom is cobble/soft bottom.

Preliminary Channel Design – As seen in Figure 4.19, "Cross-Section 8a, Main to First Street," the proposed design would widen the left/east overbank area by298 feet to create acreage for the construction of wetlands. Due to the widening of the left/east bank and channel bottom, the existing railroad would be impacted; the railroad would need to be elevated on a trestle above the proposed wetland area. Construction of the trestle would avoid realignment of the current railway and would provide hydrologic connection and flow supportive of wetland habitat proposed to the west and east of the railway line. The existing channel's right/west bank concrete paved 3H:1V slopes would be replaced with three concrete terraced planters with riprap toedowns for bank protection. A 16-foot-wide asphalt concrete maintenance road would be constructed at the top of both the right/west and left/east banks. The existing concrete channel bottom would be replaced by soft "natural" substrate. Grade control structures would be constructed to reduce in-stream velocities and secure natural bed materials for meander and vegetation development.

Demolition and Excavation – The right/west bank and left/east bank slope paving would be demolished. Demolition would also occur as needed to widen the left/east top of bank by approximately 200 feet. The existing left/east bank would be excavated to a height of 2 feet above the existing invert for 200 feet landward. At 200 feet, the toe of the new right/west bank would begin with a 3H:1V slope to the top of bank and existing ground. Excavation on the right/west top of bank would be conducted to shape and level the area for the proposed maintenance road. Riprap toedowns with bank protection at the channel toes would be excavated to a depth of 3 to 10 feet below the channel bottom and banks, and a width of 20 feet on the left/east bank to 30 feet on the right/west bank. Excavation on the east of the grade control structure at a depth of 10 feet and width of 10 feet would be used for a grade control structure toedown.

Compacted Fill and Maintenance Road – A 16-foot-wide asphalt concrete maintenance road is proposed to be constructed on the left/east and right/west channel top of bank. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Wetlands – The construction of wetlands would start on the eastern edge and top of the proposed grade control structure, 2 feet above the invert. The wetlands would extend for a distance of 200 feet landward to the proposed left/east bank toedown. The wetland area would receive channel flow conveyed throughout the site that would assist in treating pollutants and creating riverine wetland habitat.

Erosion Control – Erosion control matting, such as TRM, would be used to stabilize, prevent channel scour, and to promote vegetation establishment on channel slopes above the proposed riprap toedown bank protection structures.

Topsoil and Vegetation – Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone. Topsoil would be placed on the left/east bank and the right/west bank 3H:1V channel slopes after TRM matting is installed. Topsoil without TRM matting would be placed in the wetlands area. Topsoil areas would be seeded and planted with native riparian vegetation and wetland vegetation per the project biologist's recommendations.

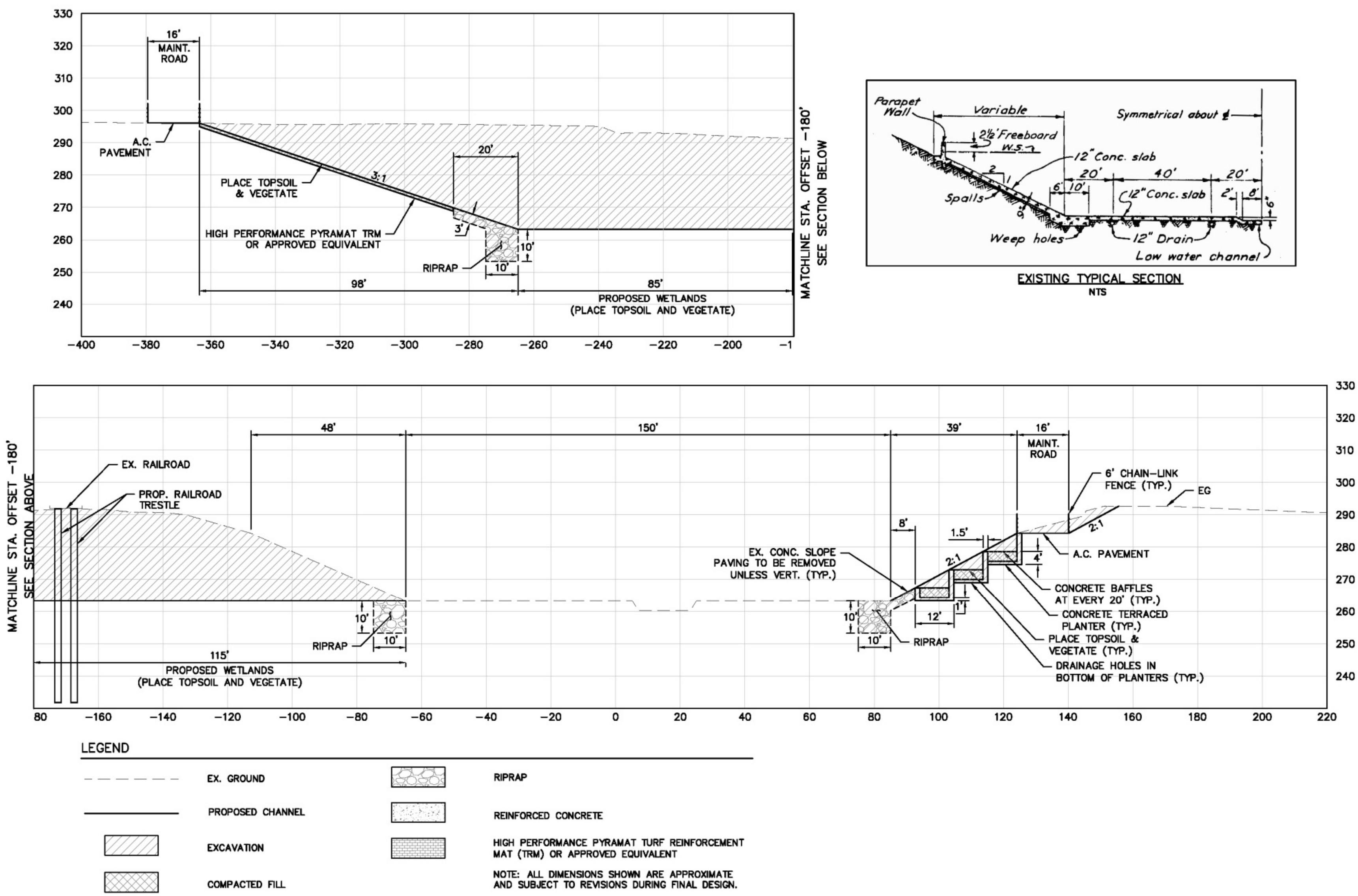


Figure 4.19 Cross-Section 8a, Main to First Street

4.2.17 Cross-Section 8b, Sub-Reach 8 - Main to First

Existing Channel Features – The existing trapezoidal channel within the sub-reach varies from grouted rock to concrete paved channel, is 264 feet wide from the top of bank, and 26 feet high from the invert.

Preliminary Channel Design – As seen in Figure 4.20, "Cross-Section 8b, Main to First Street," the proposed design would construct four concrete terraced planters in the 3H:1V left/east bank. The right/west channel bottom would be widened by 52 feet. A 29-foot-high retaining wall with a subdrain system at the footings and invert slab would be constructed at the new toe. Reinforced cantilevered platforms would be constructed on the top of the proposed retaining wall and would extend 25 feet over the channel. Reinforced concrete piers located on the in-channel edge of the platforms would be spaced 25 feet apart for platform support. Two concrete-reinforced, naturalized planter boxes that would replace portions of the concrete invert sections of would be constructed in the channel bottom on the left/east and right/west banks of the channel. A riprap toedown with bank protection would be constructed at the toe of the left/east bank. A 16-foot-wide asphalt concrete maintenance road would be constructed on both sides of the channel's top of bank. After construction of project features, the remaining existing low-flow channel and concrete bottom would be protected in place.

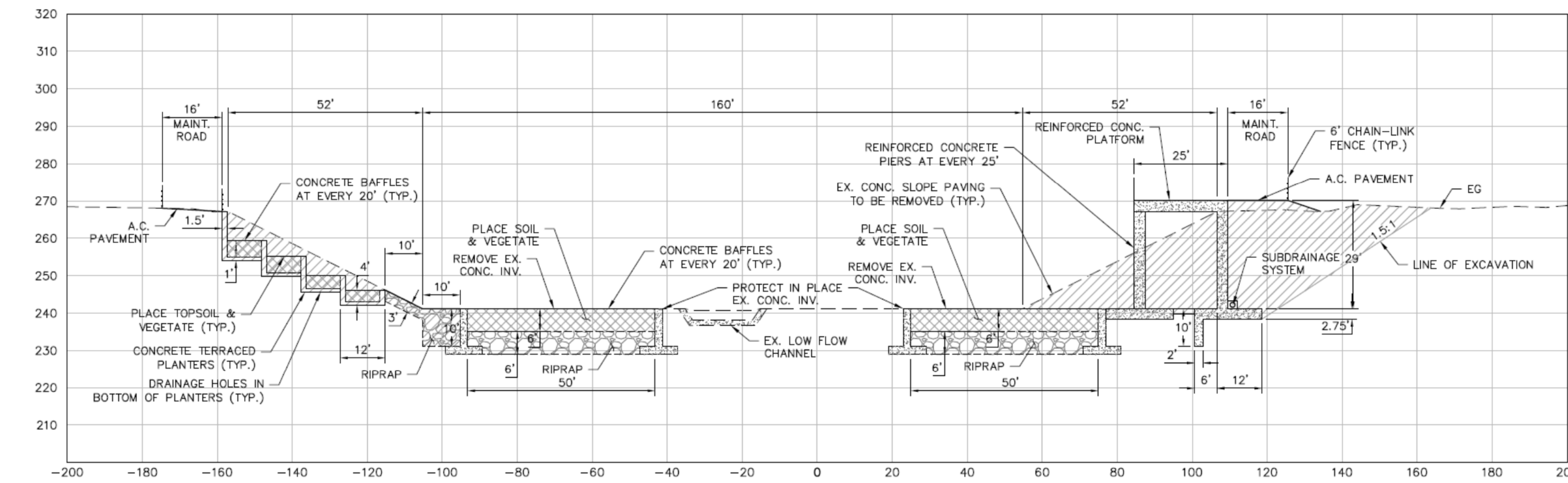
Demolition and Excavation – Several areas of the reach would undergo demolition and excavation to implement the proposed design. The left/east and right/west bank slope paving and approximately 100 feet of the channel bottom would be demolished. Excavation of earthen material for four concrete terraced planters at a depth of 4 to 8.75 feet and a width of 12.5 feet would occur in the channel's left/east bank slope. Excavation on the right/west bank would widen the channel bottom by 52 feet, changing the channel morphology from trapezoidal to vertical. Excavation to construct retaining wall and pier footings would be at a depth of 2.75 to 10 feet and a width of 42 feet. Excavation to construct naturalized planter boxes at the edge of right/west bank pier support footings and the left/east bank toedown would be 12 feet deep and extend 50 feet towards the channel centerline. Excavation would also occur behind the proposed retaining wall, and would have a temporary slope of 1.5H:1V to meet the existing ground; excavation would allow temporary access for construction of the retaining wall.

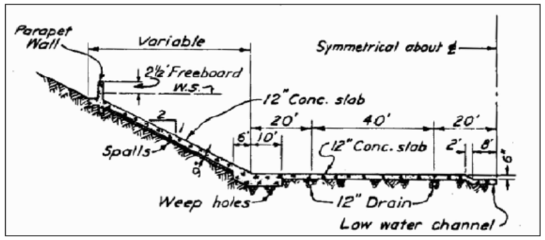
Maintenance Road – The asphalt concrete maintenance roads would meet the proposed channel's top of bank on the river and would have a slope of 3H:1V on the landward. Fencing would be constructed to separate areas of access from the maintenance road, on both the potentially private right-of-way, and the river.

Terraced Vegetated Planters – After demolition and excavation, terraced planters would be constructed in the slopes of the existing channel. Planter dimensions would be 4 to 8.75 feet in height and 12.5 feet in width. The terraces would be spaced along the channel wall so that the top of the lowest meets the bottom of the next. The bottom would be flush with the top of the highest point of the grade control structure. Each planter would have a 1-foot-thick concrete bottom and 1.5-foot-thick concrete walls. Concrete baffles would be placed every 20 feet along the terraces to prevent erosion/scour. Terraces would be seeded and planted with native riparian vegetation per the project biologist's recommendation.

Planter Boxes (Naturalized Channel) – Naturalized channel would be constructed at the edge of the retaining wall toedown on the right/west bank and on the left/east bank, extending 50 feet into the center of the channel at a depth of 12 feet. The surface of the boxes would be flush to the invert. The bottom 6 feet of the channel would be filled with riprap, and the top 6 feet with soil. The soil would be secured with concrete baffles spaced 20 feet apart to prevent scour/erosion.

***Topsoil and Vegetation* –** Topsoil would aid in the recruitment and establishment of vegetation along the channel's riparian zone and bottom. Topsoil would be placed in the concrete terraced planters and the naturalized channel. Topsoil areas would be seeded and planted with native wetland/riparian vegetation per the project biologist's recommendations.





EXISTING TYPICAL SECTION
NTS

Figure 4.20 Cross-Section 8b, Main to First Street

5. FINAL ARRAY OF ALTERNATIVES

Five alternatives were selected for further analysis. These include: 10-ARBOR Riparian Transitions, 13-ARBOR Corridor Extension, 16-ARBOR Narrows to Downtown, and 20-ARBOR Riparian Integration via Varied Ecological Reintroduction. These are also referred to by the following acronyms:

- Alternative 10-ART
- Alternative 13-ACE
- Alternative 13v
- Alternative 16-AND
- Alternative 20-RIVER

The final array of alternatives was developed by combining separate, independent sub-reaches from the preliminary 19 alternatives that optimized habitat benefits compared to costs. Table 5-1, below, includes an overview of each. The right hand column indicates which reaches from the preliminary 19 alternatives make up each of the final four alternatives. So, for example, Alternative 10-ART represents the design configuration of Reaches 1 and 2 from Preliminary Alternative 11, the design configuration of Reach 3 from Alternative 17, the design configuration of Reaches 4 and 5 from Alternative 16, and so on.

Formulation and analysis of the alternatives is described in the main report and not repeated herein.

5.1 Maps and Revised Cross-Sections

Mapping and revised cross-sections are provided in Attachments 3 and 4 in order to depict the final array of alternatives. Mapping includes the aerial extent of each project feature with the study area displayed on four 11”x17” maps from upstream to downstream.

The preliminary set of typical cross-sections was developed to aid in development of quantities and costs and, therefore, include more features than are included in the final array. Consequently, several modified cross-sections included in Attachment 4 depict only the structural measures that make up the final array. All are subject to additional modifications based on further analysis that could change the dimensions of foundations and retaining walls, for example, during detailed design. Typical cross-sections focus on the main river channel and do not generally include features beyond the main channel such as riparian corridors or channels.

Table 5-1 Final Array of Alternatives Summarized

Name	Description	Reaches (R) & Alternatives (A)
10 ARBOR Riparian Transitions (ART)	Focuses on areas upstream and downstream of existing soft-bottomed Glendale Narrows; includes all sub-reaches but limited restoration in sub-reaches 3, 4 and 5.	R1A11 R2A11 R3A17 R4 A16 R5A16 R6A14 R7A09 R8A15
13 ARBOR Corridor Extension (ACE)	Includes all 8 river sub-reaches, with channels in key locations and treatments into Downtown LA, but not at the Cornfield/LA State Historic Park	R1A11 R2A11 R3A16 R4A16 R5A16 R6A13 R7A12 R8A15
13v	Includes all 8 river sub-reaches. It includes the same reach sub-plans as Alternative 13 except in Reach 7, where it includes the sub-plan from Alternative 20.	R1A11 R2A11 R3A16 R4A16 R5A16 R6A13 R7A16 R8A15
16 ARBOR Narrows to Downtown (AND)	Includes all river sub-reaches and sub-reaches 1-4 are similar to the smaller two alternatives. Sub-reach 5 includes channel widening and terracing, includes restoration of Arroyo Seco and LATC.	R1A11 R2A11 R3A16 R4A16 R5A5 R6A13 R7A12 R8A3
20 ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER)	Most extensive, includes measures in all 8 sub-reaches with channel widening at Verdugo Wash, Arroyo Seco, Cornfield/LA State Historic Park, and LATC	R1A11 R2A13 R3A18 R4A16 R5A5 R6A13 R7A16 R8A3

5.2 Alternative Reach Descriptions

A summary of restoration activities for Alternatives 10, 13, 16, and 20 is listed below by sub-reach.

5.2.1 Alternative 10 ARBOR Riparian Transitions (ART)

In the ARBOR Riparian Transitions or ART plan, reaches would be restored to increase connections between upstream and downstream riparian areas and restore lost riparian strands on the overbank. This alternative restores a total of 528 acres, and each reach is described below. In addition to removal of invasives species throughout the ARBOR reach, this alternative includes the following specific restoration features.

Reach 1 Pollywog Park Area of Griffith Park

The Reach 1 sub-plan for all alternatives in the final array would implement a habitat corridor with riparian planting on the overbanks of both sides of the River and other nearby locations. Overbanks are those areas adjacent to the river where overland flow in flood events could occur in a natural river environment. Areas of restoration include the left overbank across the River from the Headworks Study Site, the Pollywog Park area of Griffith Park, the open area directly downstream of Headworks on the right overbank, and the left overbank of Burbank Western Channel (tributary from the north/west).

Riparian corridor restoration would involve planting a riparian community of cottonwood/willow, sycamore, mugwort, mulefat, and scarlet monkeyflower with a buffer of sagebrush, buckwheat, and native herbaceous plants. It would include irrigation for establishment and water harvesting features to sustain plants, including micro-grading and/or swales to capture and infiltrate water. Water sources could include reclaimed water, harvesting of stormwater and street runoff (with small wetland features at the end of adjacent streets), and/or highway runoff. Where stormwater or street runoff is excessive during storm events, a connection to the River would allow it to overflow into the channel. Establishment and drought management for this vegetation would utilize irrigation, either through flood irrigation (simulating a natural riparian regime) or drip irrigation, dependent upon the availability of water. In Pollywog Park, the water from an existing storm drain will spread/meander into the park, and during big storms may then flow back into the river at the downstream end through an existing culvert. There would be no substantial channel modifications within this reach. While there is a levee at the downstream end of this reach, any planting in that area would comply with all levee regulations.

Reach 2 Bette Davis Park Area of Griffith Park

This reach sub-plan continues establishment of habitat corridors/riparian planting along the overbanks of both sides of the River. This includes restoration of riparian habitat in the Bette Davis Park area of Griffith Park on the left bank and the area between Zoo Drive and SR-134, with connections under the highway to a restored linear riparian planting along the River extending into Reach 3. There would be no channel modifications within this reach. Modifications to levees would comply with levee regulations.

Reach 3 Ferraro Fields/Verdugo Wash Area of Griffith Park

This reach sub-plan continues establishment of the riparian corridor along Zoo Drive on the right side of the River. It also daylights a stream currently confined in a large culvert just downstream of Ferraro Fields on the right bank in the Zoo Drive area and daylights two smaller streams on the left bank. Depending upon the length of the daylighted stream, it would be planted with riparian vegetation and end at the confluence with the River in a small freshwater marsh. If it is not possible to design an efficient confluence, the connection to the River would remain gated. Freshwater marsh vegetation would include clustered field sedge, fragrant flatsedge, Parish's spikerush and common rush, scarlet monkey flower, California bulrush, narrow leaved cattail, and common cattail. There would be no modifications to the channel itself. Levee protection would remain.

Reach 4 Griffith Park

This reach sub-plan would restore approximately riparian and wetland habitat by establishing a riparian corridor on the left overbank of the River, daylighting eight streams, creating a side channel diverting river flows through the Griffith Park (Harding) Golf Course on the right bank, and lowering the Los Feliz Golf Course on the left bank to allow seasonal flooding through existing culverts.

The riparian corridor on the left overbank would be implemented as continuously as possible within the requirements of levee regulations. There would be no channel modifications within this reach. The side stream through Griffith Park would enter the park from the River under the I-5 Freeway (or farther upstream if necessary) and exit the park to reenter the River downstream under the I-5 as well. A riparian fringe of trees and marsh vegetation would line the new side channel. The Los Feliz Golf Course would be lowered, rebuilt, and allowed to seasonally flood (with no changes to the River channel walls) in order to establish a riparian habitat interspersed with the golf course greens.

The eight streams currently encased in culverts would be opened and naturalized as tributaries as far upstream as possible (at a minimum opening up the stream within the River right-of-way). Depending upon the length of the daylighted stream, it would be planted with riparian vegetation and end at the confluence with the River in a small freshwater marsh. If it is not possible to design an efficient confluence, the connection to the River would remain gated.

Reach 5 Riverside Drive

This reach sub-plan would continue implementation of the habitat corridor restoration in a narrow strip along the left overbank to avoid interference with the existing levee system (in compliance with current USACE guidance for vegetation on levees) and would daylight and restore one stream currently encased in a culvert with a riparian fringe and freshwater marsh. The stream would be opened and naturalized as far upstream as possible (at a minimum, this would open up a confluence within the River right-of-way). Depending upon the length of the daylighted stream, it would be planted with riparian vegetation and end at the confluence with the River in a small freshwater marsh. If it is not possible to design an efficient confluence due to the levee, the connection to the river would remain gated. Examples can be found in Los Angeles at North Atwater Park.

Reach 6 Taylor Yard

Restoration measures in this reach sub-plan include increasing riparian habitat within the Bowtie site and at Taylor Yard. This would include widening the channel bed on the left side of the River by a minimum of 80 feet and connecting this new channel bed to the existing level of the overbank with a sloped bank vegetated with riparian plants. The length of this widening would extend through the beginning of the bend in the Bowtie site downstream for 700 feet through the G-2 Taylor Yard parcel and beyond, for a maximum of about 1,000 feet. Widening would include removal of concrete and excavation followed by reconstruction of the channel structure to stabilize the bank using grade control, rock walls with toe-ins (an extension of the wall below the bed), and/or geotextiles, and would provide for a gradual, undulating four-to-one (4:1) slope up to current grade. There is limited terracing at the downstream end of the Bowtie site as it transitions into the widened Taylor Yard. In the widened area, the riparian area on the overbank would be similar to that described for Reach 1 and the bank would be vegetated with plants that would survive seasonal inundation and would lay down in flood events.

At the upstream end of the Bowtie site, the channel banks would be lowered in an approximate 100-foot-wide by 600-foot-long riparian area by creating a setback in the channel wall with a terrace planted with riparian and marsh habitat. The terrace would be 10 feet above the channel invert transitioning from upstream and downstream ends. The left overbank along the Bowtie site would be planted with a riparian corridor, irrigated for establishment, and water harvested from stormwater drainages.

Reach 7 Arroyo Seco/Los Angeles State Historic Park

This reach sub-plan would daylight three streams currently confined in storm drains/culverts. One is just upstream of Arroyo Seco on the opposite bank (right bank), and the others are downstream of Arroyo Seco. The second is on the right bank upstream of Los Angeles State Historic Park, and the third is on the left bank. Both streams on the right bank connect to the hills in Elysian Park. A freshwater marsh would be located in the daylighted area outside of the mainstem of the River channel. The streams would be opened and naturalized as tributaries as far upstream as possible (at a minimum opening up the stream within the River right-of-way). Depending on the length of the daylighted stream, it would be planted with riparian vegetation and end at the confluence with the River in a small freshwater marsh. If it is not possible to design an efficient confluence, the connection to the River would remain gated. There would be no modifications to the channel itself.

Reach 8 LATC

In this Reach 8 sub-plan, the LATC site would be restored with riparian habitat. Micro-grading would slope the site to restore the historical wash that once ran through this area. The restored historical wash would meander through the property and would be connected to the existing River channel through a wide culvert or designed confluence, if possible. The wash location would be determined by the USACE's hydrology and hydraulic analysis and would be located in the most appropriate place. This reach sub-plan also establishes riparian habitat within the site.

There would be no channel modifications within this reach as water entering the River from the historical wash would be routed through existing storm drains in the channel wall.

5.2.2 Alternative 13 ARBOR Corridor Extension (ACE)

ARBOR Corridor Extension (ACE) Alternative 13 restores a total of 588 acres.

Reach 1 Pollywog Park Area of Griffith Park

This reach sub-plan is the same as described for Alternative 10.

Reach 2 Bette Davis Park Area of Griffith Park

This reach sub-plan is the same as described for Alternative 10.

Reach 3 Ferraro Fields/Verdugo Wash area of Griffith Park

This reach sub-plan includes the three daylighted streams from the reach sub-plan for Alternative 10. In addition, using water diverted from the River, it creates a side channel that would flow along the west side of Ferraro Fields and reenter the River through the daylighted stream on the right bank. The side channel would support a riparian fringe, and open water and freshwater marsh would be located in the daylighted area outside of the mainstem of the River channel. This reach sub-plan continues and expands the riparian corridor from the reach plan for Alternative 10. Riparian areas would be located on the right overbank along Zoo Drive, along the River's edge at Ferraro Fields, and between the daylighted streams on the left overbank. There would be no modifications to the channel itself. Levee protection would remain and levee vegetation policy would be followed.

Reach 4 Griffith Park

This reach sub-plan is the same as described for Alternative 10.

Reach 5 Riverside Drive

This reach sub-plan is the same as described for Alternative 10.

Reach 6 Taylor Yard

The Reach 6 sub-plan in Alternative 13 restores riparian corridors and widens the soft bottom bed of the River by over 300 feet with additional slope back to the overbank elevation along the reach for a length of approximately 1,000 feet. At the upstream end of the reach, a back water wetland would be developed at river level, and there would be a small terraced area at the downstream end of the Bowtie parcel to facilitate the transition into the widened area at Taylor Yard. Aquatic riverine habitats including freshwater marsh would dominate the new river bed. The banks of the River, upstream of the Bowtie backwater wetland and downstream of Taylor

Yard on the left bank and the entirety of the right bank, would be restructured to support overhanging vines and other vegetation.

Reach 7 Arroyo Seco/Los Angeles River State Historic Park

In this Reach 7 sub-plan, the Arroyo Seco tributary would be restored with riparian habitat. This stream would have its banks and bed softened by removing concrete for approximately one-half mile upstream and planting riparian vegetation on its banks. It would be stabilized with erosion control elements to maintain the existing protection. At the confluence on the upstream edge of the River, a backwater riparian wetland would be established. Within the River channel itself, the banks would be restructured to support vegetation on the banks.

Reach 8 LATC

This reach sub-plan is the same as for Alternative 10.

5.2.3 Alternative 13v

Alternative 13v restores a total of 598 acres and is a variation of Alternative 13. It includes the same reach sub-plans as Alternative 13 except in Reach 7, where it includes the sub-plan from Alternative 20.

Reach 1 Pollywog Park Area of Griffith Park

This reach sub-plan is the same as described for Alternative 10..

Reach 2 Bette Davis Park Area of Griffith Park

This reach sub-plan is the same as described for Alternative 10.

Reach 3 Ferraro Fields/Verdugo Wash area of Griffith Park

This reach sub-plan is the same as described for Alternative 13.

Reach 4 Griffith Park

This reach sub-plan is the same as described for Alternative 10.

Reach 5 Riverside Drive

This reach sub-plan is the same as described for Alternative 10.

Reach 6 Taylor Yard

This reach sub-plan is the same as described for Alternative 13.

Reach 7 Arroyo Seco/Los Angeles River State Historic Park

This Reach 7 sub-plan includes the three daylighted streams restored in the Alternative 10 sub-plan and the restoration of the Arroyo Seco tributary included in the Alternative 13 sub-plan. In addition, this Reach 7 sub-plan restores freshwater marsh at the Los Angeles State Historic Park and terraces the adjacent right River bank to include riparian vegetation and connect the marsh area to the river. To facilitate the terracing, the existing rail road track would be trestled at grade. This reach sub-plan is the same as for Alternative 20.

Reach 8 LATC

This reach sub-plan is the same as for Alternative 10.

5.2.4 Alternative 16 ARBOR Narrows to Downtown (AND)

ARBOR Narrows to Downtown Alternative 16 (AND), would include restoration of a total of 659 acres. Specific restoration features in each reach are described below.

Reach 1 Pollywog Park Area of Griffith Park

This reach sub-plan is the same as described for Alternative 10.

Reach 2 Bette Davis Park Area of Griffith Park

This reach sub-plan is the same as described for Alternative 10.

Reach 3 Ferraro Fields/Verdugo Wash Area of Griffith Park

This reach sub-plan is the same as described for Alternative 13.

Reach 4 Griffith Park

This reach sub-plan is the same as described for Alternative 10.

Reach 5 Riverside Drive

In Reach 5, the right bank would be modified from a trapezoidal bank to a vertical bank. This would increase the width of the soft bottom bed of the River by over 100 feet. The top of the bank would be notched and planted with overhanging vines. The left bank would be modified from trapezoidal to terraced and planted with riparian herbaceous vegetation and would include any necessary erosion measures, which would consist of concrete-lined beds. The land side of the bank would be planted with riparian herbaceous vegetation. At the downstream end of this reach, the River will also be widened on the left bank with appropriate erosion control measures in place. This would further increase the natural river bottom area. The daylighed stream in the sub-plan for Alternatives 10 and 13 is also included in this reach sub-plan. All of these measures would comply with levee vegetation regulations.

Reach 6 Taylor Yard

This reach sub-plan is the same as for Alternative 13.

Reach 7 Arroyo Seco/Los Angeles River State Historic Park

This reach sub-plan is the same as for Alternative 13. However, after more detailed cost analysis, it was concluded that this reach sub-plan was not cost effective compared to the sub-plan in Alternatives 13v and 20.

Reach 8 LATC

In this sub-plan, Reach 8 would be modified with terracing on the right bank upstream of LATC and on the left bank downstream of LATC. This terracing would be planted with riparian vegetation. The channel would be modified from concrete to soft bottom to support aquatic habitat including freshwater marsh, and the reach would be widened. The marsh would extend into the LATC site 500 feet, with riparian area extending another 1,000 feet into the LATC site, gradually sloping up to existing bank elevations. The historic wash would be restored through the property with a riparian fringe as well as other side channels, and flows would be diverted out of the River into the LATC site, creating a large wetland area. A railroad trestle would be included with this alternative to allow the connection of the River channel and the adjacent restored areas.

5.2.5 Alternative 20 ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER)

Riparian Integration via Varied Ecological Reintroduction (RIVER) Alternative 20 would include restoration of a total of 719 acres. Restoration features within each reach are described below.

Reach 1 Pollywog Park Area of Griffith Park

This reach sub-plan is the same as described for Alternative 10.

Reach 2 Bette Davis Park Area of Griffith Park

The reach sub-plan for this alternative includes the habitat corridors/riparian planting included in the reach sub-plan for Alternative 10. In addition, this alternative modifies the right bank of the channel from trapezoidal to a vertical bank with overhanging vines, creating 80 feet of additional soft bottom width in the channel.

Reach 3 Ferraro Fields/Verdugo Wash area of Griffith Park

This reach sub-plan would include the riparian corridor along the right bank, the side channel and one of the daylighted streams included in the reach sub-plan for Alternative 13, and it would also restore the Verdugo Wash confluence. The side channel would be established on the west side (right bank) at Ferraro Fields with water diverted from the River. The stream currently confined in a large culvert just downstream of Ferraro Fields in the Zoo Drive area would be daylighted. The side channel would support a riparian fringe. The daylighted stream would include a riparian fringe with freshwater marsh at the confluence. Riparian areas are located on the right bank along Zoo Drive and on the River's edge at Ferraro Fields. These features would not modify the channel. In the Verdugo Wash confluence, the channel mouth will be widened, and the left bank of the wash would be sloped back to the existing overbank elevation. One potential design would use riparian vegetation to stabilize the south bank and a combined riparian and marsh community in the widened channel. Riparian habitat will be planted along the overbank of the widened Verdugo Wash. Levee protection would be tied in to the bank, and other levee protection will remain. Levee vegetation policy will be followed. Details for the confluence area will be determined during the detailed design phase.

Reach 4 Griffith Park

This reach sub-plan is the same as described for Alternative 10, 13, 13v, and 16.

Reach 5 Riverside Drive

This reach sub-plan is the same as described for Alternative 16.

Reach 6 Taylor Yard

This reach sub-plan is the same as described for Alternative 13, 13v, and 16.

Reach 7 Arroyo Seco/Los Angeles State Historic Park

This reach sub-plan is the same as described for Alternative 13v.

Reach 8 LATC

This reach sub-plan is the same as for Alternative 16.

5.3 Policy Issues, Risks and Constraints

During plan formulation, each measure and alternative was formulated to avoid constraints and minimize risk as much as was possible. However, several policy issues, risks, and constraints apply to all of the alternatives and will require further consideration during design. Each are summarized below and also included in the main feasibility report and relevant technical appendices.

5.3.1 Flood Risk Management

A key constraint of the study was that existing levels of flood risk management will be maintained.

The study area includes a portion of the Los Angeles River that was altered and engineered as part of the LACDA Project. Any restoration alternatives had to take into account the continued functioning of the flood risk management system and avoid induced flooding. The existing river channel in this reach does not provide a high level of protection (with or without existing vegetation). The existing channel provides less than a 1 percent annual chance exceedance (ACE) (100-year) level of protection for most of the ARBOR reach. For this reason, an alternative located solely within the existing LACDA project right of way was infeasible, as it would be likely to reduce conveyance capacity and/or be unsustainable and unable to meet restoration objectives given the high velocity flows carried by the system during storm events. Widening the channel at opportunity areas is thus critical to provide restoration benefits while maintaining existing levels of flood risk management. The inclusion of the Taylor Yard and LATC properties provided the only opportunities in the study area to substantially widen the channel and increase channel vegetation.

The addition of Taylor Yard, LA River State Historic Park (Cornfields), Verdugo Wash, Arroyo Seco, and LATC do not provide any additional flood risk reduction for larger floods, but may have an ecologically beneficial effect on the small to moderate size events that are contained within the channel. Unlike conventional hydraulics for the larger events where discharge is the dominant channel-forming parameter, vegetation dictates the channel forms during the small to moderate size events. Vegetation influences flow patterns and sediment settling on floodplains (Darby 1999, Larsen et al. 2007) as well as bedform changes, largely due to its effect on velocity.

The study analyzed impacts to the flood risk management function by looking at potential water surface elevation change. The study screened out any alternatives that adversely impacted the water surface elevation in a way that could not be addressed through design. Appendix E, Hydrology and Hydraulics, describes the hydraulic analyses conducted on the final array of alternatives. That analysis focused on changes to maximum velocity and associated changes to maximum water surface elevation. The alternatives were analyzed as compared to the existing conditions to determine the impacts on the flood risk management function of the channel. The results in the H&H Appendix are based on the limited hydraulic modeling that shows the alternatives are feasible without inducing flooding. Any minor increases in water surface elevations will be eliminated in the detailed design phase. These design refinements will not increase the costs of the recommended plan. If the water surface elevation for the with-project condition was significantly greater than that for the existing condition, then that restoration scenario was removed from further consideration.

All of the final alternatives can work hydraulically without inducing increased flooding. While the initial assessment identified that an increase in water surface elevation could occur at transition areas if no design refinements were made, the detailed design will ensure the maximum water surface elevations will not increase when compared to the existing conditions. Any change in water surface in the transition areas can and will be avoided through design refinements to the modifications to channel geometry and/or avoidance of introduction of vegetation and enforcing existing O&M requirements limiting vegetation growth in those areas. Characteristics of transition areas are either geometric (transitioning from trapezoidal to rectangular or from a widened section to a narrow section) or construction material (transitioning between soft-bottom and concrete). The exact refinements for avoidance will be further determined during the detailed design phase. The costs of these minor alterations have been included in the cost estimate for the project.

Under the analysis conducted during feasibility, the Engineering team also analyzed average velocities to determine channel function with respect to scour and sustainability of constructed restoration features. For widened areas, the flows need to be slowed sufficiently or sufficient protection need to be included to ensure channel erosion does not occur. Several areas exhibit average velocities in excess of 12 ft/s. In those areas, planting of vegetation as part of the restoration project is not recommended because vegetation may not withstand high velocities. For those areas with velocities greater than 8 ft/s, appropriate protection is included to avoid effects of scour and ensure channel function.

During the detailed design phase, 2D unsteady flow numeric models, and possibly physical modeling, will be required to more accurately simulate the flow hydraulics for the project. This may result in adjustments to plan features, but should not change the overall habitat benefits and will not induce damages from the flood risk perspective.

5.3.2 Existing Levee Systems

There are five existing levee systems that are within the study area. These levees are part of the existing LACDA project and are maintained by the Corps. The levees are identified based on their initials for the river name, Los Angeles River (LAR), and numbered. They are LAR-2, LAR-3, LAR-5, LAR-6, and LAR-7. Management of the vegetation on these levee systems, and any proposals for ecosystem restoration affecting these levee systems, must be compatible with the Corps vegetation management guidelines. There are several areas along these levee systems where the area directly behind the levee embankment has been filled in over time. For these areas, channel capacity is the main concern related to vegetation management. Appendix D (Geotechnical) contains information on the current condition of these levee systems as well as their location.

Corps vegetation management practices emphasize that levee embankments must be accessible for inspection, maintenance, and emergency activities. In addition, for any vegetation that is proposed or retained, it must be demonstrated that the vegetation does not pose an unacceptable risk. Restoration features in the final array of alternatives have been planned to be compatible with the Corps vegetation management guidelines allowing for forbs (native perennial grasses) grown on the levee embankment and other vegetation to be planted farther from the levee embankment. The riparian forbs on the levees are expected to occur in a relatively narrow band and be surrounded by more structurally diverse riparian vegetation in adjacent areas. Forbs provide habitat for small mammals, reptiles, birds and insects, and are an important part of the riparian community. Levees in each alternative that may be affected by alternative measures along with the proposed vegetation that would be further assessed are indicated in the bulleted list below,

- **Alternative 10**: In Reaches 1 and 2, the proposed riparian corridor along the left and right overbanks includes riparian vegetation on or along the existing levee (LAR-7 and LAR-3). The proposed riparian corridors along the left bank of Reaches 4 and 5 include riparian vegetation on the existing levee berm and crown (LAR-6).

- **Alternative 13**: In Reaches 1 and 2, the proposed riparian corridor along the left and right overbanks includes riparian vegetation on or along the existing levee (LAR-7 and LAR-3). In Reach 3, the proposed riparian corridor along the left and right overbanks includes riparian vegetation on or along the existing levee (LAR-7 and LAR-6 on left, LAR-3 on right). The proposed riparian corridors along the left overbank of Reaches 4 and 5 include riparian vegetation on the existing levee berm and crown (LAR-6). The Reach 7 features include banks restructured to support vegetation on both sides of the channel (LAR-2 and LAR-5).

- **Alternative 13v**: In Reaches 1 and 2, the proposed riparian corridor along the left and right overbanks includes riparian vegetation on or along the existing levee (LAR-7 and LAR-3). In Reach 3, the proposed riparian corridor along the left and right overbanks includes riparian vegetation on or along the existing levee (LAR-7 and LAR-6 on left, LAR-3 on right). The proposed riparian corridors along the left overbank of Reaches 4 and 5 include riparian vegetation on the existing levee berm and crown (LAR-6).

- **Alternative 16**: In Reaches 1 and 2, the proposed riparian corridor along the left and right overbanks includes riparian vegetation on or along the existing levee (LAR-7 and LAR-3). In Reach 3, the proposed riparian corridor along the left and right overbanks includes riparian vegetation on or along the existing levee (LAR-7 and LAR-6 on left, LAR-3 on right).The proposed riparian corridors along the left overbank of Reaches 4 and 5 include riparian vegetation on the existing levee berm and crown (LAR-6). The Reach 5 features also include planted terracing on the left bank (with concrete erosion control) and overhanging vegetation on a vertical wall on the right bank (LAR-6). The Reach 7 features include banks restructured to support vegetation on both sides of the channel (LAR-2 and LAR-5). In Reach 8, the features include planted terracing on the right bank (LAR-2) and channel expansion and terracing on the left bank (LAR-5).

- **Alternative 20**: In Reaches 1 and 2, the proposed riparian corridor along the left and right overbanks includes riparian vegetation on or along the existing levee (LAR-7 and LAR-3). The Reach 2 proposed features also involve channel modifications that would include overhanging vegetation on a vertical wall on the right bank (LAR-3). The Reach 3 features include the widening of Verdugo Wash and planting on the left bank (LAR-7 and LAR-6) and planting of a riparian corridor along the right overbank, on or along the existing levee (LAR-3). The proposed riparian corridors along the left overbank of Reaches 4 and 5 include riparian vegetation on the existing levee berm and crown (LAR-

6). The Reach 5 plan also calls for planted terracing on the left bank (with concrete erosion control) and overhanging vegetation on a vertical wall on the right bank (LAR-6). In Reach 8, the features include planted terracing on the right bank (LAR-2) and channel expansion and terracing on the left bank (LAR-5).

Wildlife is still expected to use the levee plantings as a movement corridor between the more diverse riparian habitat areas, which will provide habitat for small mammals, reptiles, and birds. By substituting riparian vegetation with riparian forbs on the levees, CHAP values in the final array would decrease slightly for those areas. However the overall CHAP values and the ranking of the final array would not be significantly impacted as the decrease would be relative across all alternatives in the final array.

Construction of restoration features that modify levees would necessitate removal of existing vegetation on and adjacent to the existing levees being modified. Where vegetation removal on and adjacent to levees is necessary to accommodate construction, no additional engineering analysis of the existing vegetation is needed to confirm vegetation removal. Removal of invasive species will be undertaken to accomplish the ecosystem restoration project purpose. Where vegetation removal is not necessary to accommodate feature construction but vegetation may have a detrimental effect on safety, structural integrity, or accessibility of the constructed/modified levee features, an engineering analysis will be undertaken to determine whether the vegetation poses an unacceptable risk. Based on the engineering analysis, vegetation determined to pose an unacceptable risk to the constructed features shall be removed as part of project construction. Vegetation on or adjacent to levees modified by the restoration project that is not determined to pose a safety, structural integrity, or accessibility risk will be documented in a vegetation variance. Any required analysis will be accomplished during PED.

For levee embankments within the ARBOR reach, which is the project reach, that would not be modified as part of the ecosystem restoration project, these portions will continue to be operated and maintained as part of the LACDA project by the Corps.

5.3.3 HTRW

A study constraint was to avoid sites contaminated with HTRW to the extent practicable. If sites cannot be avoided, the cost of HTRW investigations is cost-shared, but the non-Federal sponsor has responsibility at 100 percent non-project cost for undertaking or otherwise ensuring remediation of any known or unknown HTRW to provide sites compatible with the land use necessary for the restoration project. As described in this report and Appendix K HTRW Survey Report Appendix, there are known contaminated sites within the study area that cannot be avoided by the project. These include the San Fernando Valley Superfund Site, and Taylor Yard G1 and G2, which are considered high impact sites. In addition, contamination is possible at the LATC site based on historical uses, posing a potentially high impact to the project since the extent of this potential contamination is unknown. Localized groundwater contamination may also be encountered during construction. Under all alternatives the non-Federal sponsor would remediate or ensure the remediation of soil contamination to the standard required for the restoration project prior to construction of restoration features at the affected sites. Because it is infeasible to remediate groundwater contamination prior to construction, the sponsor would be responsible at 100 percent non-project cost for addressing contaminated groundwater including treatment and disposal during dewatering activities. The sponsor understands its responsibility and has directly committed to undertaking or ensuring the necessary HTRW remediation to facilitate the project, including providing sites to be cleaned to be compatible with the restoration land use necessary and addressing groundwater contamination during dewatering activities.

5.4 Modified NER Plan

Following public review, further analysis was performed that included a more detailed cost analysis using Mii software, real estate cost updates, and further modified contingencies based upon a full cost risk summary analysis. This analysis identified a more cost effective variation on Alternative 13 (referred to throughout the IFR and Appendices as "Alternative 13v") that is identical to Alternative 13 except for Reach 7, where it includes the reach plan included in Alternative 20 that provides 10 acres of marsh and a connection to the Los Angeles State Historic Park. As described in the IFR, the previously identified NER plan has been modified to include the substitution of the Reach 7 plan on the basis of the analysis referenced above; Alternative 13v is the NER plan. Because the analysis in this Appendix included analysis of all of the components of Alternative 13v, no separate or additional analysis is necessary. For the assessment of Alternative 13v for Reaches 1-6 and 8, see the Alternative 13 analysis included in this Appendix. For the assessment of Alternative 13v for Reach 7, see the Alternative 20 analysis included in this Appendix.

Alternative 20 is the Recommended Plan in the IFR.

6. UTILITIES

The main Integrated Feasibility Report describes the identification of the NER Plan and Locally Preferred Plan. That plan identification is not being repeated here. For purposes of evaluating potential utility relocation needs the NER and LPP were reviewed. Alternative 13v is the NER Plan and Alternative 20 the Locally Preferred Plan.

A desktop survey was conducted comparing the footprint of the NER and LPP with known utilities to inform relocation cost estimates. This included review of data available on the City of Los Angeles Department of Public Works, "Navigate LA" GIS website http://navigatela.lacity.org/index01.cfm. It should be recognized that the data base utilized may not contain all existing utilities and their locations. However, it is assumed that the data utilized is adequate for the current level of study. Unless otherwise noted the assumptions apply to both the NER and LPP. All water, sewer and power lines referenced below are indicated in the available information to be owned and operated by LADWP.

Reach 1 - Pollywog Park/Headworks to Midpoint of Bette Davis Park

Reaches 1 and 2 are comprised entirely of riparian corridors. It is assumed that riparian corridors will not affect utilities, and potential impacts can be avoided and designed around during PED.

Reach 2- Midpoint Bette Davis Park to Upstream end Ferraro Fields

The right bank of the channel is being converted from trapezoid to vertical in Alternative 20. There are power lines along the top of bank and storm water outfalls along the bank. It is assumed that the power lines do not require relocation and can be worked around (protect in place). Storm water outfalls will be modified with the channel, but may require relocations.

Reach 3- Ferraro Fields- to Brazil Street

There is a 48" concrete sewer line that bisecting the area where a side channel is proposed along the right bank in Ferraro Fields. The nearest manhole indicates that this is only 9ft below ground where the two intersect. Recommend that the side channel design will protect this in place, as designed during PED.

Reach 3- Verdugo Wash. Two sewer lines are indicated as crossing the under the river channel in siphons. One is a 21" VCP and the other 48" concrete pipe. Both appear to be 20' below the channel and deep enough to protect in place. There are also several lines in the areas to be widened that appear to service that area. These would need to be removed for construction and abandoned as the buildings that they service would be removed. These are local service lines to structures, not public utility lines, and no relocation has been identified. (This only applies to Alternative 20.)

Reach 4- Brazil Street to Los Feliz Boulevard

There is a 10" VCP indicated within Griffith Park Golf Course near the planned side channel. This could be designed around and avoided during construction.

Reach 5- Los Feliz Boulevard to Glendale Freeway

Immediately upstream of Glendale Freeway there are an abandoned 48" concrete pipe, and a 36" VCP in a siphon. Manhole data indicates that the siphon is between 22-37 feet deep as is crosses the channel. Modifications to the bank line should be able to avoid these, and protect in place if necessary. The river channel is not being excavated in this reach.

Reach 6- Glendale Freeway to I-5 Freeway

There are 2 lines crossing the channel near the north end of Taylor Yard. One is listed as a 24" CIP (abandoned), and a 15" VCP marked as inactive. Should be able to protect both in place.

Upstream of I-5 there is a 48" RCP crossing under the river in a siphon, nearest manholes indicate a depth of 22+ feet. No impact.

Power Lines- Lines that cross Taylor Yard will be relocated to the perimeter to avoid impacts.

Reach 7- I-5 Freeway to Main Street

Arroyo Seco- Sewer and water lines cross the channel at the San Fernando Road Bridge. These can be avoided and protected in place.

Railroad- The rail line on the right bank of the river channel near the Los Angeles State Historic Park (Cornfields) will be placed upon a trestle. It is assumed that the construction will be conducted in a manner to minimize closure or delays.

Power Lines- There are power lines along the right bank and two towers in the section proposed for terraces and trestle. These will be moved for construction.

There are several utilites along Baker Street that would require relocation if the street is removed for restoration. However based on USACE response to Metro the street will remain in place so that they can access the Gold Line maintenance facility. In addition the proposed waterwheel will likely be constructed in the next two years. Refinements are being made to the design to avoid impacting the street or waterwheel, utilities impacts will also be avoided.

Reach 8- Main Street to First Street (Alternative 20 only)

LATC

Two sewer lines including a 24" VCP (West alignment) and a 54" concrete pipe (East alignment) cross LATC parallel to the existing railroad tracks. On average, the West Alignment is 16.5 feet above the invert of the LAR and 202 feet from the centerline. The West alignment varies from 8 feet to 42 feet away from the centerline of the UPRR. In some locations, the West alignment intersects the alignment of the UPRR. On average, the East Alignment is 6.2 feet above the invert of the LAR and 312 feet from the centerline. The East Alignment varies from 65 feet to 198 feet away from the centerline of the UPRR. In some locations, the East Alignment intersects the alignment of the UPRR.

Sewer- Both sewer lines will be relocated across the river in a siphon, extended downstream along the right bank, then cross back under the channel in a siphon to their original alignment.

Electric towers- There are 3 electrical towers along the east bank (approximately 2,100 ft). To allow for channel modifications it is assumed that these lines will be moved to the west side of the river.

Railroad - Railroad lines running parallel to left bank of the channel will be placed upon trestles for implementation of the project. It is assumed that the construction will be conducted in a manner to minimize closure or delays.

6.1 Summary of Utility Relocation Assumptions

The table below summarizes the assumed relocations that will be required for implementation of the project. Other known utilities will not be impacted or will be protected in place.

Table 6-1. Summary of Utility Relocation Assumptions

NER (ALT 13v)	LPP (ALT 20)
Reach 6- LADWP Power lines, ~4,800 feet and 6 towers relocated around the Taylor Yard parcel being restored.	Reach 6- LADWP Power lines, ~4,800 feet (6 towers) relocated around the Taylor Yard parcel being restored.
Reach 7- Railroad, approximately 500 ft placed on trestle.	Reach 7- Railroad, approximately 500 ft placed on trestle.
Reach 7- LADWP Power lines, ~500 feet (2 towers) relocated to allow construction on the right bank.	Reach 7- LADWP Power lines, ~500 feet (2 towers) relocated to allow construction on the right bank.
	Reach 8- Relocate two LADWP sewer lines (24”VCP and 54” Concrete) sewer lines crossing LATC. Each approximately 2,200 ft length.
	Reach 8- LADWP power lines, ~2,100 ft. (5 towers) on the left bank at LATC, relocate across river.
	Reach 8- Railroad, approximately 1,500 ft placed on trestle.

US Army Corps of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration

Feasibility Study

Attachment 1 – Alternatives Matrix

September 2014

LOS ANGELES RIVER COST ESTIMATE
ALTERNATIVES MATRIX

Reach	Measure Type	Submeasure	1 Comprehensive	2 City: Atwater to Cornfields	3 Banks & Tribs Only	4 Highest Scoring Objectives (over 3)	5 City: Los Feliz to Arroyo Seco	6 Corps Team	7 highest objectives (over 5)	8 Charette Team 1	9 Soft Bottom & Channl associated banks	10 Highest Other Criteria (over 11)	11 Charette Team 4	12 Charette Team 3	13 Charette Team 6	14 Charette Team 5	15 Charette Team 2	16 Side Channels Only	17 Charette Team 7	18 Comprehensive Pockets	19 Taylor Yard
1. Pollywog Park/Headworks to Midpoint of Betty Davis Park	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x		x	x					x	x				x	x	x	x		
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x		x			x			x	x				x		x			
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat)	x		x			x		x	x	x						x			
		7. Create underground basin for attenuation at equestrian center - continue current use	y		y			y			y					y		y		y	
		9. culverts & or underground basins to divert flood flows	y		y	y		y	y	y	y						y		y		
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x							x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x		x	x				x	x	x	x	x	x	x	x	x	x	x	
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	21/22. channel banks mainstem/widen channel (implies erosion control)	x													x					
		23. channel bed (implies deepening or attenuation)	x			x		x		x	x	x		x		x					
		25. tributary channels/widen channel (implies erosion control)	x		x			x			x										
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x		x			x		x	x	x		x	x	x			x		
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x			x			x						x						
		Construction	71,138,775	-	50,790,568	22,707,817	-	63,895,827	936,944	59,532,012	67,498,547	60,731,449	1,460,173	39,056,801	25,989,049	42,959,521	5,062,893	23,134,820	25,951,542	1,460,173	-
		Mobilization (7.5%)	5,335,408	-	3,809,293	1,703,086	-	4,792,187	70,271	4,464,901	5,062,391	4,554,859	109,513	2,929,260	1,949,179	3,221,964	379,717	1,735,112	1,946,366	109,513	-
		Construction Subtotal	76,474,183	-	54,599,860	24,410,903	-	68,688,014	1,007,215	63,996,913	72,560,938	65,286,307	1,569,686	41,986,061	27,938,228	46,181,485	5,442,610	24,869,932	27,897,907	1,569,686	-
		Contingency (25%)	19,118,546	-	13,649,965	6,102,726	-	17,172,004	251,804	15,999,228	18,140,235	16,321,577	392,421	10,496,515	6,984,557	11,545,371	1,360,653	6,217,483	6,974,477	392,421	-
		PED/EDC (11%)	8,412,160	-	6,005,985	2,685,199	-	7,555,682	110,794	7,039,660	7,981,703	7,181,494	172,665	4,618,467	3,073,205	5,079,963	598,687	2,735,693	3,068,770	172,665	-
		S&A (6.5%)	4,970,822	-	3,548,991	1,586,709	-	4,464,721	65,469	4,159,799	4,716,461	4,243,610	102,030	2,729,094	1,815,985	3,001,797	353,770	1,616,546	1,813,364	102,030	-
		Construction Period (Months)	32	-	24	16	-	26	9	22	27	23	8	16	15	21	11	16	15	9	-
		IDC	5,532,329	-	2,931,039	875,221	-	3,983,847	20,568	3,243,568	4,510,035	3,334,547	27,908	1,484,615	950,985	2,225,551	133,558	895,086	949,278	32,312	-
		LERRDS	5,449,862	-	5,443,610	5,315,390	-	5,443,610	8,813	5,440,071	4,921,692	5,443,610	4,784,304	5,440,071	5,448,854	5,443,610	5,306,609	4,788,223	5,440,071	4,784,304	-
		Total Cost Subtotal	119,957,902	-	86,179,450	40,976,148	-	107,307,878	1,464,662	99,879,239	112,831,065	101,811,145	7,049,014	66,754,823	46,211,814	73,477,778	13,195,886	41,122,963	46,143,867	7,053,419	-
		Annualized Construction Costs	5,347,030	-	3,841,382	1,826,480	-	4,783,165	65,286	4,452,039	5,029,357	4,538,152	314,204	2,975,544	2,059,855	3,275,215	588,196	1,833,024	2,056,827	314,401	-
		Annualized O&M Costs	410,062	-	369,512	92,889	-	339,033	163,400	348,864	369,512	341,794	62,410	199,535	240,085	233,014	92,889	204,669	230,014	62,410	-
		Total Annualized Costs	5,757,091	-	4,210,894	1,919,369	-	5,122,198	228,686	4,800,903	5,398,869	4,879,946	376,615	3,175,079	2,299,940	3,508,229	681,086	2,037,693	2,286,841	376,811	-
2. Midpoint Betty Davis Park to upstream end of Ferraro Fields	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x		x	x					x	x				x	x	x	x		
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x		x			x			x	x						x			
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat)	x		x			x		x	x	x						x			
		9. culverts & or underground basins to divert flood flows	y		y	y		y	y	y	y						y		y		
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x							x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x		x	x		x	x	x	x	x	x	x	x	x	x	x			
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	23. channel bed (implies deepening or attenuation)				x			x												
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x					x		x	x	x		x							
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x			x			x						x						
		Construction	37,354,526	-	7,633,672	28,184,790	-	9,657,836	24,852,325	10,293,099	12,990,301	12,990,301	41,962	5,398,591	24,406,187	3,374,427	3,374,427	7,633,672	3,332,465	-	-
		Mobilization (7.5%)	2,801,589	-	572,525	2,113,859	-	724,338	1,863,924	771,982	974,273	974,273	3,147	404,894	1,830,464	253,082	253,082	572,525	249,935	-	-
		Construction Subtotal	40,156,115	-	8,206,198	30,298,649	-	10,382,173	26,716,249	11,065,081	13,964,573	13,964,573	45,109	5,803,485	26,236,651	3,627,509	3,627,509	8,206,198	3,582,400	-	-
		Contingency (25%)	10,039,029	-	2,051,549	7,574,662	-	2,595,543	6,679,062	2,766,270	3,491,143	3,491,143	11,277	1,450,871	6,559,163	906,877	906,877	2,051,549	895,600	-	-
		PED/EDC (11%)	4,417,173	-	902,682	3,332,851	-	1,142,039	2,938,787	1,217,159	1,536,103	1,536,103	4,962	638,383	2,886,032	399,026	399,026	902,682	394,064	-	-
		S&A (6.5%)	2,610,147	-	533,403	1,969,412	-	674,841	1,736,556	719,230	907,697	907,697	2,932	377,227	1,705,382	235,788	235,788	533,403	232,856	-	-
		Construction Period (Months)	18	-	10	13	-	11	12	11	12	11	4	6	10	6	7	9	6	-	-
		IDC	1,650,016	-	189,053	895,239	-	245,812	685,316	264,200	384,884	345,329	428	80,831	595,199	48,238	58,354	165,950	47,591	-	-
		LERRDS	2,257,456	-	2,093,163	2,230,703	-	2,116,844	2,230,703	2,254,384	2,119,884	2,116,844	2,091,559	2,112,199	2,257,423	2,088,519	2,091,559	2,093,163	-	-	-
		Total Cost Subtotal	61,129,936	-	13,976,048	46,301,517	-	17,157,253	40,986,674	18,286,325	22,404,286	22,361,690	2,156,267	10,462,996	40,239,850	7,305,958	7,319,113	13,952,945	5,152,511	-	-
		Annualized Construction Costs	2,724,819	-	622,971	2,063,854	-	764,771	1,826,949	815,099	998,654	996,755	96,114	466,380	1,793,660	325,657	326,244	621,942	229,669	-	-
		Annualized O&M Costs	215,441	-	114,267	175,662	-	87,201	147,892	87,409	114,970	114,970	50,629	51,333	151,100	78,399	78,399	114,267	77,769	-	-
		Total Annualized Costs	2,940,260	-	737,238	2,239,516	-	851,972	1,974,841	902,507	1,113,624	1,111,725	146,743	517,713	1,944,760	404,056	404,643	736,209	307,439	-	-
3. Ferraro Fields to Brazil St	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x		x	x					x	x			x	x		x		x	
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x	x	x			x		x	x							x	x		
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat) ro recreate channel braiding	x		x	x				x	x	x	x	x				x		x	
		9. culverts & or underground basins to divert flood flows	y	y	y	y		y	y	y	y				y		y		y		
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x	x						x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x	x	x	x		x	x	x	x	x	x	x	x	x		x		x	
		18. open water	x								x								x		
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	21/22 widenchannel, provide erosion control may lower channel banks and provide setback levees or vegetated berms			x						x		x		x					x	
		23. channel bed (implies deepening or attenuation)		x		x			x												
		25. tributary channels/widen channel (implies erosion control)	x					x		x	x		x	x	x	x	x			x	
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x		x			x			x		x		x						
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x	x		x			x					x	x						
		Construction	133,829,933	78,314,553	15,005,741	91,985,315	-	48,319,416	77,714,553	54,559,229	62,590,178	14,405,741	53,959,229	125,198,984	126,990,121	55,750,366	47,584,437	15,005,741	600,000	61,990,178	-
		Mobilization (7.5%)	10,037,245	5,873,591	1,125,431	6,898,899	-	3,623,956	5,828,591	4,091,942	4,694,263	1,080,431	4,046,942	9,389,924	9,524,259	4,181,277	3,568,833	1,125,431	45,000	4,649,263	-
		Construction Subtotal	143,867,178	84,188,144	16,131,171	98,884,213	-	51,943,372	83,543,144	58,651,171	67,284,442	15,486,171	58,006,171	134,588,908	136,514,380	59,931,643	51,153,270	16,131,171	645,000	66,639,442	-
		Contingency (25%)	35,966,795	21,047,036	4,032,793	24,721,053	-	12,985,843	20,885,786	14,662,793	16,821,110	3,871,543	14,501,543	33,647,227	34,128,595	14,982,911	12,788,318	4,032,793	161,250	16,659,860	-
		PED/EDC (11%)	15,825,390	9,260,696	1,774,429	10,877,263	-	5,713,771	9,189,746	6,451,629	7,401,289	1,703,479	6,380,679	14,804,780	15,016,582	6,592,481	5,626,860	1,774,429	70,950	7,330,339	-
		S&A (6.5%)	9,351,367	5,472,229	1,048,526	6,427,474	-	3,376,319	5,430,304	3,812,326	4,373,489	1,006,601	3,770,401	8,748,279	8,873,435	3,895,557	3,324,963	1,048,526	41,925	4,331,564	-
		Construction Period (Months)	34	23	14	23	-	17	20	19	23	9	18	27	31	14	13	10	8	18	-
		IDC	11,321,958	4,314,733	496,838	5,221,108	-	2,005,347	3,777,896	2,552,033	3,496,115	298,837	2,344,885	8,183,631	9,604,241	1,940,841	1,523,395	359,688	11,464	2,674,234	-
		LERRDS	12,244,960	12,015,063	108,626,715	1,748,027	-	11,948,150	1,343,274	11,026,690	107,384,686	1,696,095	107,368,440	10,950,933	108,448,474	10,721,071	10,449,278	502,284	174,856	107,366,428	-
		Total Cost Subtotal	228,577,647	136,297,902	132,110,473	147,879,138	-	87,972,803	124,170,150	97,156,641	206,761,130	24,062,726	192,372,119	210,923,757	312,585,706	98,064,504	84,866,083	23,848,891	1,105,445	205,001,867	-
		Annualized Construction Costs	10,188,670	6,075,372	5,888,721	6,591,597	-	3,921,319	5,534,787	4,330,681	9,216,216	1,072,577	8,574,837	9,401,762	13,933,264	4,371,149	3,782,839	1,063,046	49,274	9,137,798	-
		Annualized O&M Costs	430,160	251,093	237,092	366,896	-	115,289	245,093	103,064	237,092	173,827	154,329	290,133	379,121	128,788	50,000	179,827	56,000	173,827	-
		Total Annualized Costs	10,618,830	6,326,466	6,125,813	6,958,493	-	4,036,608	5,779,881	4,433,746	9,453,308	1,246,405	8,729,166	9,691,894	14,312,384	4,499,936	3,832,839	1,242,873	105,274	9,311,625	-

X: Indicates that the measure is included in the alternative.

y: Prelminary array included culverts or basins.

LOS ANGELES RIVER COST ESTIMATE
ALTERNATIVES MATRIX

Reach	Measure Type	Submeasure	1 Comprehensive	2 City: Atwater to Cornfields	3 Banks & Tribs Only	4 Highest Scoring Objectives (over 3)	5 City: Los Feliz to Arroyo Seco	6 Corps Team	7 highest objectives (over 5)	8 Charette Team 1	9 Soft Bottom & Channl associated banks	10 Highest Other Criteria (over 11)	11 Charette Team 4	12 Charette Team 3	13 Charette Team 6	14 Charette Team 5	15 Charette Team 2	16 Side Channels Only	17 Charette Team 7	18 Comprehensive Pockets	19 Taylor Yard
4. Brazil to Los Feliz Blvd	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x	x	x	x			x	x		x						x	x		
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x	x	x	x	x	x	x	x	x	x		x			x	x	x		
		4. grade adjacent areas to a lower elevation for habitat & offline retention	x	x	x	x		x	x			x		x				x			
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat)	x	x	x	x	x	x	x	x		x			x			x			
		7. Create underground basins for attenuation - continue current use	y		y					y				y	y			y			
		9. culverts & or underground basins to divert flood flows	y	y	y	y	y	y	y	y	y						y		y		
	III. Wildlife Access (formerly other)	12. bridge undercrossings for wildlife	x	x													x				
		15. wildlife passage/tunnels	x	x	x			x							x		x				
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x	x			x			x					x		x				
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x	x		x	x	x	x	x			x	x	x			x			
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	21/22 widenchannel, provide erosion control may lower channel banks and provide setback levees or vegetated berms	x	x		x		x	x					x		x					
		23. channel bed (implies deepening or attenuation)		x		x	x		x												
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x	x	x	x		x	x	x	x	x	x		x	x					
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x	x		x	x		x						x						
		Construction	137,219,364	138,376,364	127,488,009	137,874,958	7,848,819	131,040,351	137,874,958	126,011,065	114,541,639	127,488,009	113,641,639	12,108,299	119,433,459	122,871,588	900,000	13,846,370	6,577,607	-	-
		Mobilization (7.5%)	10,291,452	10,378,227	9,561,601	10,340,622	588,661	9,828,026	10,340,622	9,450,830	8,590,623	9,561,601	8,523,123	908,122	8,957,509	9,215,369	67,500	1,038,478	493,321	-	-
		Construction Subtotal	147,510,816	148,754,591	137,049,610	148,215,580	8,437,481	140,868,377	148,215,580	135,461,895	123,132,262	137,049,610	122,164,762	13,016,421	128,390,968	132,086,957	967,500	14,884,848	7,070,927	-	-
		Contingency (25%)	36,877,704	37,188,648	34,262,402	37,053,895	2,109,370	35,217,094	37,053,895	33,865,474	30,783,066	34,262,402	30,541,191	3,254,105	32,097,742	33,021,739	241,875	3,721,212	1,767,732	-	-
		PED/EDC (11%)	16,226,190	16,363,005	15,075,457	16,303,714	928,123	15,495,522	16,303,714	14,900,808	13,544,549	15,075,457	13,438,124	1,431,806	14,123,006	14,529,565	106,425	1,637,333	777,802	-	-
		S&A (6.5%)	9,588,203	9,669,048	8,908,225	9,634,013	548,436	9,156,445	9,634,013	8,805,023	8,003,597	8,908,225	7,940,710	846,067	8,345,413	8,585,652	62,888	967,515	459,610	-	-
		Construction Period (Months)	43	43	35	39	17	36	39	35	27	32	26	15	33	27	13	17	12	-	-
		IDC	14,782,451	14,967,077	11,163,895	13,508,715	328,001	11,645,434	13,508,715	10,966,480	7,642,732	9,919,258	7,184,143	449,021	9,718,354	8,171,589	27,158	564,516	191,153	-	-
		LERRDS	19,830,552	19,830,552	19,001,697	19,792,938	19,756,075	19,820,195	19,792,938	18,802,694	17,300,599	18,974,422	17,578,612	17,548,694	18,353,356	16,799,997	634,224	17,993,208	562,014	-	-
		Total Cost Subtotal	244,815,916	246,772,921	225,461,286	244,508,854	32,107,486	232,203,067	244,508,854	222,802,375	200,406,804	224,189,374	198,847,541	36,546,115	211,028,839	213,195,499	2,040,069	39,768,632	10,829,238	-	-
		Annualized Construction Costs	10,912,478	10,999,710	10,049,761	10,898,791	1,431,166	10,350,270	10,898,791	9,931,242	8,932,977	9,993,066	8,863,474	1,629,015	9,406,446	9,503,023	90,935	1,772,656	482,705	-	-
		Annualized O&M Costs	554,898	554,898	545,049	547,377	102,772	500,101	547,377	552,570	461,521	545,049	452,521	61,329	496,293	454,849	59,000	142,528	106,277	-	-
		Total Annualized Costs	11,467,377	11,554,609	10,594,809	11,446,168	1,533,939	10,850,371	11,446,168	10,483,811	9,394,497	10,538,115	9,315,994	1,690,343	9,902,739	9,957,872	149,935	1,915,184	588,982	-	-
5. Los Feliz to Glendale Fwy (2)	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x	x	x		x			x		x	x		x						
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x	x			x	x			x							x			
	II. Attenuation	9. culverts & or underground basins to divert flood flows	y	y	y	y	y	y	y	y	y						y		y		
	III. Wildlife Access (formerly other)	14. wildlife access from river to bank (in daylighted storm drain)	x	x			x	x		x		x					x				
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x	x			x			x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x	x		x	x	x	x	x			x		x			x			
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	23. channel bed (implies deepening or attenuation)		x		x	x		x												
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x	x	x		x						x								
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x	x		x	x		x						x						
		Construction	87,401,820	87,401,820	31,784,946	55,367,624	87,401,820	100,000	55,367,624	149,250	100,000	-	31,784,946	-	55,516,874	-	-	100,000	-	-	-
		Mobilization (7.5%)	6,555,137	6,555,137	2,383,871	4,152,572	6,555,137	7,500	4,152,572	11,194	7,500	-	2,383,871	-	4,163,766	-	-	7,500	-	-	-
		Construction Subtotal	93,956,957	93,956,957	34,168,817	59,520,196	93,956,957	107,500	59,520,196	160,444	107,500	-	34,168,817	-	59,680,640	-	-	107,500	-	-	-
		Contingency (25%)	23,489,239	23,489,239	8,542,204	14,880,049	23,489,239	26,875	14,880,049	40,111	26,875	-	8,542,204	-	14,920,160	-	-	26,875	-	-	-
		PED/EDC (11%)	10,335,265	10,335,265	3,758,570	6,547,222	10,335,265	11,825	6,547,222	17,649	11,825	-	3,758,570	-	6,564,870	-	-	11,825	-	-	-
		S&A (6.5%)	6,107,202	6,107,202	2,220,973	3,868,813	6,107,202	6,988	3,868,813	10,429	6,988	-	2,220,973	-	3,879,242	-	-	6,988	-	-	-
		Construction Period (Months)	29	30	15	20	30	12	20	13	10	-	15	-	20	-	-	10	-	-	-
		IDC	6,278,039	6,559,371	1,161,876	2,647,887	6,559,371	2,877	2,647,887	4,752	2,270	-	1,161,876	-	2,657,915	-	-	2,270	-	-	-
		LERRDS	1,755,929	1,755,929	1,569,855	1,353,694	1,755,929	1,330,646	1,353,694	1,741,935	59,726	-	1,562,483	-	1,686,421	-	-	59,726	-	-	-
		Total Cost Subtotal	141,922,632	142,203,963	51,422,296	88,817,861	142,203,963	1,486,711	88,817,861	1,975,319	215,183	-	51,414,923	-	89,389,248	-	-	215,183	-	-	-
		Annualized Construction Costs	6,326,090	6,338,631	2,292,109	3,958,987	6,338,631	66,269	3,958,987	88,048	9,592	-	2,291,780	-	3,984,456	-	-	9,592	-	-	-
		Annualized O&M Costs	532,619	532,619	320,008	259,372	532,619	51,000	259,372	52,239	51,000	-	320,008	-	261,611	-	-	51,000	-	-	-
		Total Annualized Costs	6,858,709	6,871,249	2,612,116	4,218,359	6,871,249	117,269	4,218,359	140,287	60,592	-	2,611,788	-	4,246,067	-	-	60,592	-	-	-
6. Glendale Fwy (2) to I-5	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x	x	x	x	x	x			x	x		x	x	x	x	x	x	x	x
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x	x	x	x	x	x			x							x		x	x
		4. grade adjacent areas to a lower elevation for habitat & offline retention	x	x	x	x	x	x	x		x			x				x			x
	II. Attenuation	9. culverts & or underground basins to divert flood flows	y	y	y	y	y	y	y	y	y						y		y		
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x	x			x			x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x	x	x	x	x	x	x	x	x		x	x	x	x	x			x	x
		19. Planting built into channel walls (reshape concrete walls to accommodate vegetation or add hanging boxes (native vines, small shrubs, etc)	x	x	x		x					x	x	x	x					x	
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	20. bring concrete down to channel level; reconfigure as soft bottom channel	x	x	x	x	x	x			x				x	x	x			x	x
		21/22 widenchannel, provide erosion control may lower channel banks and provide setback levees or vegetated berms	x	x	x	x	x	x	x		x		x	x	x	x	x		x	x	x
		23. channel bed (implies deepening or attenuation)		x		x	x		x												
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x	x	x		x	x		x	x	x	x	x			x		x	x	x
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x	x		x	x		x						x						
		Construction	87,357,210	87,357,210	79,398,773	35,964,291	87,357,210	77,497,106	35,864,291	50,416,020	77,497,106	44,359,249	51,974,577	79,298,773	18,400,200	8,540,096	50,072,911	27,424,195	49,148,143	52,074,577	77,497,106
		Mobilization (7.5%)	6,551,791	6,551,791	5,954,908	2,697,322	6,551,791	5,812,283	2,689,822	3,781,201	5,812,283	3,326,944	3,898,093	5,947,408	1,380,015	640,507	3,755,468	2,056,815	3,686,111	3,905,593	5,812,283
		Construction Subtotal	93,909,001	93,909,001	85,353,680	38,661,613	93,909,001	83,309,389	38,554,113	54,197,221	83,309,389	47,686,193	55,872,671	85,246,180	19,780,215	9,180,603	53,828,379	29,481,010	52,834,254	55,980,171	83,309,389
		Contingency (25%)	23,477,250	23,477,250	21,338,420	9,665,403	23,477,250	20,827,347	9,638,528	13,549,305	20,827,347	11,921,548	13,968,168	21,311,545	4,945,054	2,295,151	13,457,095	7,370,252	13,208,563	13,995,043	20,827,347
		PED/EDC (11%)	10,329,990	10,329,990	9,388,905	4,252,777	10,329,990	9,164,033	4,240,952	5,961,694	9,164,033	5,245,481	6,145,994	9,377,080	2,175,824	1,009,866	5,921,122	3,242,911	5,811,768	6,157,819	9,164,033
		S&A (6.5%)	6,104,085	6,104,085	5,547,989	2,513,005	6,104,085	5,415,110	2,506,017	3,522,819	5,415,110	3,099,603	3,631,724	5,541,002	1,285,714	596,739	3,498,845	1,916,266	3,434,226	3,638,711	5,415,110
		Construction Period (Months)	36	37	33	26	37	31	23	22	31	21	22	29	22	16	25	18	22	26	30
		IDC	7,849,100	8,136,336	6,385,208	2,330,657	8,136,336	5,927,984	1,982,117	2,727,153	5,927,984	2,305,189	2,839,949	5,606,629	961,836	337,351	3,018,641	1,177,639	2,636,668	3,341,702	5,678,106
		LERRDS	109,570,708	109,570,708	109,570,708	87,070,619	109,570,708	87,123,187	87,026,198	109,537,664	87,123,522	109,562,270	109,562,270	109,562,270	109,561,619	87,061,796	87,114,364	30,788,481	29,722,759	109,570,373	87,123,522
		Total Cost Subtotal	251,240,133	251,527,370	237,584,910	144,494,074	251,527,370	211,767,050	143,947,927	189,495,858	211,767,386	179,820,284	192,020,775	236,644,707	138,710,261	100,481,506	166,838,445	73,976,559	107,648,239	192,683,818	211,517,507
		Annualized Construction Costs	11,198,833	11,211,636	10,590,162	6,440,710	11,211,636	9,439,351	6,416,366	8,446,630	9,439,366	8,015,349	8,559,176	10,548,253	6,182,901	4,478,885	7,436,693	3,297,447	4,798,336	8,588,731	9,428,228
		Annualized O&M Costs	797,650	797,650	674,616	420,437	797,650	646,091	419,437	412,559	646,091	318,050	332,361	673,616	229,742	78,183	303,836	392,255	289,965	333,361	646,091
		Total Annualized Costs	11,996,483	12,009,286	11,264,778	6,861,148	12,009,286	10,085,442	6,835,804	8,859,189	10,085,457	8,333,399	8,891,537	11,221,869	6,412,643	4,557,067	7,740,529	3,689,702	5,088,301	8,922,092	10,074,318

X: Indicates that the measure is included in the alternative.

y: Prelminary array included culverts or basins.

LOS ANGELES RIVER COST ESTIMATE
ALTERNATIVES MATRIX

Reach	Measure Type	Submeasure	1 Comprehensive	2 City: Atwater to Cornfields	3 Banks & Tribs Only	4 Highest Scoring Objectives (over 3)	5 City: Los Feliz to Arroyo Seco	6 Corps Team	7 highest objectives (over 5)	8 Charette Team 1	9 Soft Bottom & Channl associated banks	10 Highest Other Criteria (over 11)	11 Charette Team 4	12 Charette Team 3	13 Charette Team 6	14 Charette Team 5	15 Charette Team 2	16 Side Channels Only	17 Charette Team 7	18 Comprehensive Pockets	19 Taylor Yard
7. I-5 to Main	I. Adjacent or off channel modifications	1. elevate railroads on trestles (consider other locations when necessary - is this an "all alts" measure?)	x	x	x	x		x		x		x	x		x			x	x	x	
		2. expose existing storm drains & gravity flow through DWP to LAR with terracing into the river	x	x	x			x		x		x	x				x			x	
		3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x	x	x	x	x	x		x		x	x		x		x	x	x		
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x	x			x	x			x							x			
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat)	x	x	x										x			x			
		8. creation of wetlands flood control basin (assumes culvert under Baker St)	x	x	x			x					x							x	
		9. culverts & or underground basins to divert flood flows	y	y	y	y	y	y	y	y	y						y		y		
	III. Wildlife Access (formerly other)	15. wildlife passage/tunnels	x	x				x									x				
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x	x			x			x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x		x	
		19. Planting built into channel walls (reshape concrete walls to accommodate vegetation or add hanging boxes (native vines, small shrubs, etc)	x	x	x		x					x	x	x	x					x	
		21/22 widenchannel, provide erosion control may lower channel banks and provide setback levees or vegetated berms	x	x	x	x	x	x				x	x	x	x	x	x		x	x	
		23. channel bed (implies deepening or attenuation)	x	x		x	x		x			x	x		x	x				x	
		25. tributary channels/widen channel (implies erosion control)		x	x	x	x	x	x	x		x	x				x				
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x	x	x		x	x		x		x	x		x						
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x	x		x	x		x						x						
		Construction	79,429,472	79,429,472	72,919,284	75,353,714	70,653,714	72,919,284	6,704,487	48,176,162	300,000	72,993,007	76,768,766	21,161,663	75,353,714	25,011,145	64,143,526	48,176,162	68,649,227	34,086,903	-
		Mobilization (7.5%)	5,957,210	5,957,210	5,468,946	5,651,529	5,299,029	5,468,946	502,837	3,613,212	22,500	5,474,476	5,757,657	1,587,125	5,651,529	1,875,836	4,810,764	3,613,212	5,148,692	2,556,518	-
		Construction Subtotal	85,386,683	85,386,683	78,388,231	81,005,242	75,952,742	78,388,231	7,207,324	51,789,374	322,500	78,467,483	82,526,423	22,748,788	81,005,242	26,886,980	68,954,290	51,789,374	73,797,919	36,643,421	-
		Contingency (25%)	21,346,671	21,346,671	19,597,058	20,251,311	18,988,186	19,597,058	1,801,831	12,947,343	80,625	19,616,871	20,631,606	5,687,197	20,251,311	6,721,745	17,238,573	12,947,343	18,449,480	9,160,855	-
		PED/EDC (11%)	9,392,535	9,392,535	8,622,705	8,910,577	8,354,802	8,622,705	792,806	5,696,831	35,475	8,631,423	9,077,907	2,502,367	8,910,577	2,957,568	7,584,972	5,696,831	8,117,771	4,030,776	-
		S&A (6.5%)	5,550,134	5,550,134	5,095,235	5,265,341	4,936,928	5,095,235	468,476	3,366,309	20,963	5,100,386	5,364,218	1,478,671	5,265,341	1,747,654	4,482,029	3,366,309	4,796,865	2,381,822	-
		Construction Period (Months)	33	35	27	24	27	27	11	20	6	25	27	10	27	11	21	17	18	17	-
		IDC	6,558,718	6,817,666	4,909,491	4,419,999	4,699,799	4,909,491	171,517	2,365,663	4,315	4,451,664	5,029,087	516,740	4,898,390	643,390	3,307,376	1,916,525	3,005,039	1,400,811	-
		LERRDS	47,061,897	47,061,897	31,372,890	31,282,450	22,658,568	47,057,422	5,869,762	45,153,206	2,324,206	31,372,890	31,372,890	5,749,795	45,237,420	5,653,606	25,045,660	33,285,601	25,628,633	31,372,890	-
		Total Cost Subtotal	175,296,639	175,555,587	147,985,610	151,134,919	135,591,024	163,670,142	16,311,716	121,318,726	2,788,084	147,640,717	154,002,130	38,683,557	165,568,280	44,610,943	126,612,900	109,001,984	133,795,707	84,990,576	-
		Annualized Construction Costs	7,813,711	7,825,253	6,596,343	6,736,721	6,043,864	7,295,469	727,082	5,407,687	124,277	6,580,970	6,864,525	1,724,289	7,380,077	1,988,498	5,643,671	4,858,678	5,963,839	3,788,388	-
		Annualized O&M Costs	277,496	277,496	263,119	320,002	267,002	263,119	120,291	237,622	53,000	255,626	263,119	70,918	267,002	70,918	255,626	234,622	249,711	81,412	-
		Total Annualized Costs	8,091,207	8,102,749	6,859,462	7,056,723	6,310,866	7,558,588	847,373	5,645,310	177,277	6,836,595	7,127,644	1,795,207	7,647,079	2,059,416	5,899,297	5,093,300	6,213,550	3,869,800	-
8. Main to First	I. Adjacent or off channel modifications	1. elevate railroads on trestles (consider other locations when necessary - is this an "all alts" measure?)	x		x	x		x	x	x		x	x	x		x		x	x		
		3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x		x	x		x		x		x				x		x			
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x					x			x							x			
		6. rebuild geomorphology for historic wash	x		x	x				x			x				x				
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat) to recreate channel braiding	x		x	x		x							x			x	x		
		9. culverts & or underground basins to divert flood flows	y		y	y		y	y	y	y						y		y		
	III. Wildlife Access (formerly other)	15. wildlife passage/tunnels	x		x			x					x				x				
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x							x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x		x	x		x	x	x		x	x	x	x	x	x	x			
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	21/22 widenchannel, provide erosion control may lower channel banks and provide setback levees or vegetated berms	x		x			x					x	x		x					
		23. channel bed (implies deepening or attenuation)	x			x			x			x	x			x					
		26. terrace banks (check for connectivity vs too small once mapping is completed)			x			x					x								
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x			x			x						x						
		Construction	141,779,824	-	109,533,381	90,353,761	-	98,659,287	53,192,364	57,775,550	200,000	50,858,186	99,560,232	64,496,286	40,570,055	90,126,824	12,271,741	51,514,951	40,600,920	-	-
		Mobilization (7.5%)	10,633,487	-	8,215,004	6,776,532	-	7,399,447	3,989,427	4,333,166	15,000	3,814,364	7,467,017	4,837,221	3,042,754	6,759,512	920,381	3,863,621	3,045,069	-	-
		Construction Subtotal	152,413,311	-	117,748,384	97,130,293	-	106,058,734	57,181,791	62,108,716	215,000	54,672,550	107,027,249	69,333,507	43,612,809	96,886,335	13,192,122	55,378,573	43,645,989	-	-
		Contingency (25%)	38,103,328	-	29,437,096	24,282,573	-	26,514,683	14,295,448	15,527,179	53,750	13,668,137	26,756,812	17,333,377	10,903,202	24,221,584	3,298,030	13,844,643	10,911,497	-	-
		PED/EDC (11%)	16,765,464	-	12,952,322	10,684,332	-	11,666,461	6,289,997	6,831,959	23,650	6,013,980	11,772,997	7,626,686	4,797,409	10,657,497	1,451,133	6,091,643	4,801,059	-	-
		S&A (6.5%)	9,906,865	-	7,653,645	6,313,469	-	6,893,818	3,716,816	4,037,067	13,975	3,553,716	6,956,771	4,506,678	2,834,833	6,297,612	857,488	3,599,607	2,836,989	-	-
		Construction Period (Months)	41	-	33	29	-	31	20	22	9	18	29	19	17	25	13	19	15	-	-
		IDC	14,501,299	-	8,824,577	6,362,679	-	7,560,057	2,541,787	3,034,250	4,081	2,230,617	7,020,346	2,933,981	1,634,792	5,477,239	375,186	2,431,497	1,511,180	-	-
		LERRDS	237,461,453	-	240,495,921	236,884,419	-	231,497,843	207,951,590	221,139,121	873,030	207,420,256	225,903,761	207,420,256	77,997,019	207,420,256	178,965,949	226,609,830	61,310,966	-	-
		Total Cost Subtotal	469,151,720	-	417,111,945	381,657,765	-	390,191,596	291,977,430	312,678,291	1,183,487	287,559,255	385,437,938	309,154,484	141,780,064	350,960,522	198,139,908	307,955,793	125,017,681	-	-
		Annualized Construction Costs	20,912,071	-	18,592,439	17,012,097	-	17,392,485	13,014,666	13,937,390	52,753	12,817,729	17,180,595	13,780,320	6,319,736	15,643,791	8,831,932	13,726,889	5,572,565	-	-
		Annualized O&M Costs	860,700	-	805,724	552,159	-	775,200	181,136	235,166	52,000	136,509	467,224	293,275	502,127	376,916	85,391	393,367	304,858	-	-
		Total Annualized Costs	21,772,771	-	19,398,163	17,564,255	-	18,167,686	13,195,801	14,172,556	104,753	12,954,238	17,647,819	14,073,594	6,821,863	16,020,707	8,917,322	14,120,256	5,877,423	-	-
Alternative Totals		Construction	775,510,925	470,879,419	494,554,373	537,792,269	253,261,563	502,089,107	392,507,546	406,912,386	335,717,771	383,825,941	429,191,524	346,719,395	486,659,658	348,633,966	183,409,935	186,835,912	194,859,903	149,611,832	77,497,106
		Mobilization (7.5%)	58,163,319	35,315,956	37,091,578	40,334,420	18,994,617	37,656,683	29,438,066	30,518,429	25,178,833	28,786,946	32,189,364	26,003,955	36,499,474	26,147,547	13,755,745	14,012,693	14,614,493	11,220,887	5,812,283
		Tunneling Costs	1,524,019,200	1,524,019,200	-	1,524,019,200	1,524,019,200	1,524,019,200	1,524,019,200	1,524,019,200	-	1,524,019,200	-	-	1,524,019,200	1,524,019,200	1,524,019,200	-	-	-	-
		Construction Subtotal	2,357,693,444	2,030,214,576	531,645,951	2,102,145,890	1,796,275,381	2,063,764,991	1,945,964,812	1,961,450,015	360,896,604	1,936,632,087	461,380,888	372,723,350	2,047,178,333	1,898,800,713	1,721,184,880	200,848,605	209,474,396	160,832,719	83,309,389
		Contingency (25%)	589,423,361	507,553,644	132,911,488	525,536,472	449,068,845	515,941,248	486,491,203	490,362,504	90,224,151	484,158,022	115,345,222	93,180,837	511,794,583	474,700,178	430,296,220	50,212,151	52,368,599	40,208,180	20,827,347
		PED/EDC (11%)	259,346,279	223,323,603	58,481,055	231,236,048	197,590,292	227,014,149	214,056,129	215,759,502	39,698,626	213,029,530	50,751,898	40,999,568	225,189,617	208,868,078	189,330,337	22,093,347	23,042,184	17,691,599	9,164,033
		S&A (6.5%)	153,250,074	131,963,947	34,556,987	136,639,483	116,757,900	134,144,724	126,487,713	127,494,251	23,458,279	125,881,086	29,989,758	24,227,018	133,066,592	123,422,046	111,877,017	13,055,159	13,615,836	10,454,127	5,415,110
		IDC	68,473,911	40,795,183	36,061,977	36,261,503	19,723,507	36,280,851	25,335,802	25,158,099	21,972,417	22,885,440	25,608,622	19,255,448	31,021,711	18,844,199	8,443,668	7,513,171	8,352,374	7,449,059	5,678,106
		LERRDS	435,632,817	190,234,150	518,174,560	385,678,240	153,741,279	406,337,897	325,576,973	415,095,764	222,107,346	376,586,386	500,224,319	358,784,218	368,990,587	335,188,854	309,607,642	316,120,517	122,839,298	253,093,996	87,123,522
		Total Cost Subtotal	3,863,819,886	3,124,085,103	1,311,832,017	1,245,770,276	561,429,843	1,211,756,500	952,185,273	1,063,592,774	758,357,424	987,445,190	1,183,300,707	909,170,440	1,145,514,062	888,096,709	599,012,404	609,842,950	429,692,687	489,729,679	211,517,507
		Annualized Construction Costs	179,861,590	145,426,788	61,066,043	57,990,856	26,134,672	56,407,508	44,324,415	49,510,457	35,301,690	45,965,772	55,082,885	42,322,066	53,323,909	41,341,080	27,884,147	28,388,312	20,002,281	22,797,015	9,846,182
		Annualized O&M Costs	4,079,026	2,413,757	3,329,386	2,734,795	1,700,044	2,777,035	2,084,000	2,029,493	1,985,186	1,885,825	2,102,601	1,640,138	2,527,081	1,421,067	925,140	1,712,535	1,314,594	651,010	646,091
		Total Annualized Costs	183,940,616	147,840,544	64,395,430	60,725,651	27,834,715	59,184,543	46,408,415	51,539,950	37,286,876	47,851,596	57,185,486	43,962,204	55,850,991	42,762,147	28,809,288	30,100,847	21,316,875	23,448,025	10,492,273

X: Indicates that the measure is included in the alternative.

y: Prelminary array included culverts or basins.

US Army Corps
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Los Angeles District

Los Angeles River Ecosystem Restoration

Feasibility Study

Attachment 2 - Utilities

Internal Use Only

August 2013

US Army Corps
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Los Angeles District

Los Angeles River Ecosystem Restoration

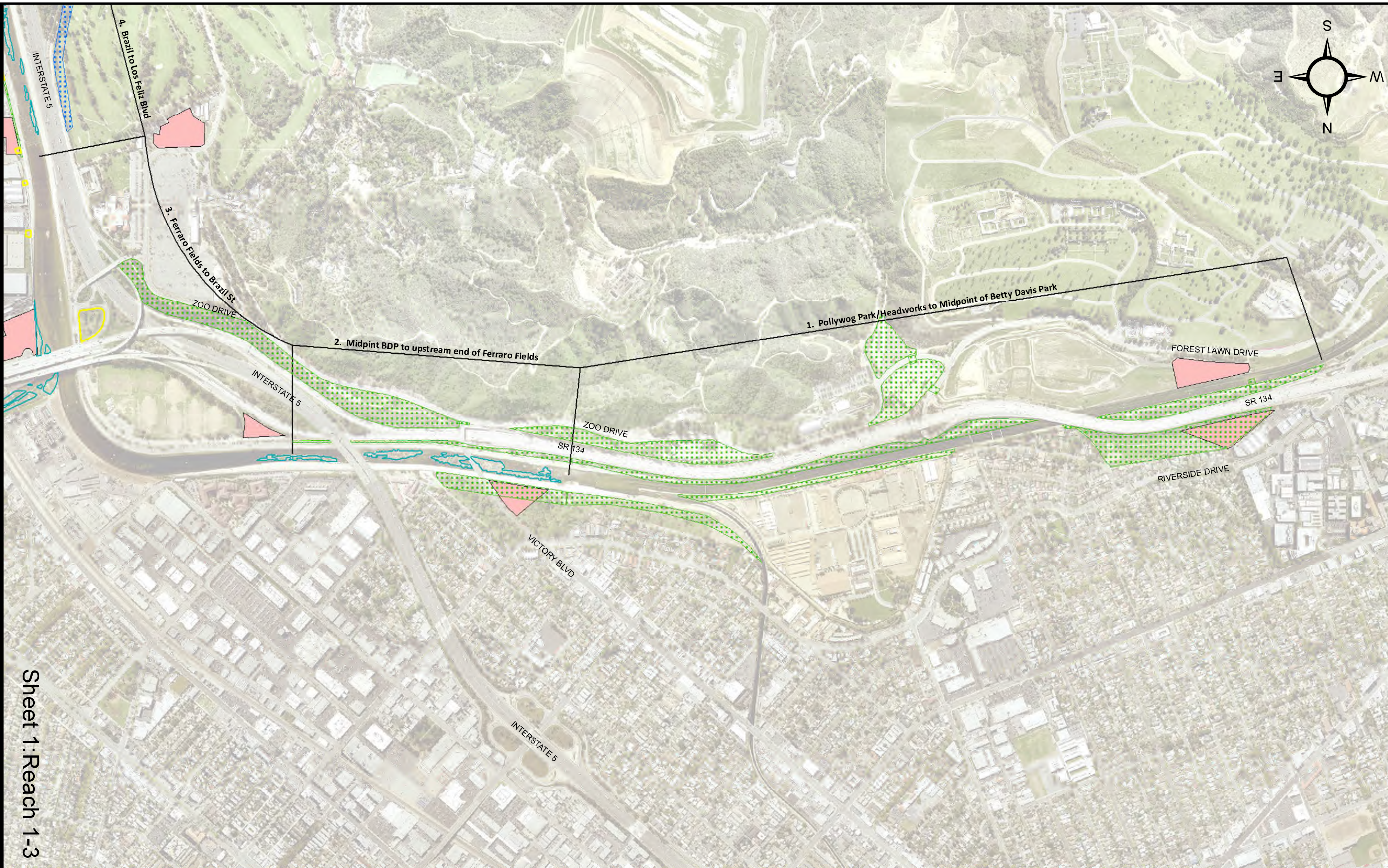
Feasibility Study

Attachment 3 – Final Array Maps

September 2014

Alternative 10, ARBOR Riparian Transitions (ART)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008



Sheet 1: Reach 1-3

0 0.2 0.4 Miles

LEGEND
Sub-Measures

- 2. Expose stormdrain outlets; convert to natural stream confluence
- 10. Divert tributary & river flow into side channels
- 17. Habitat corridors/riparian planting on banks
- 29. Invasive management
- Potential Temporary Construction Staging Areas

Alternative 10, ARBOR Riparian Transitions (ART)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008

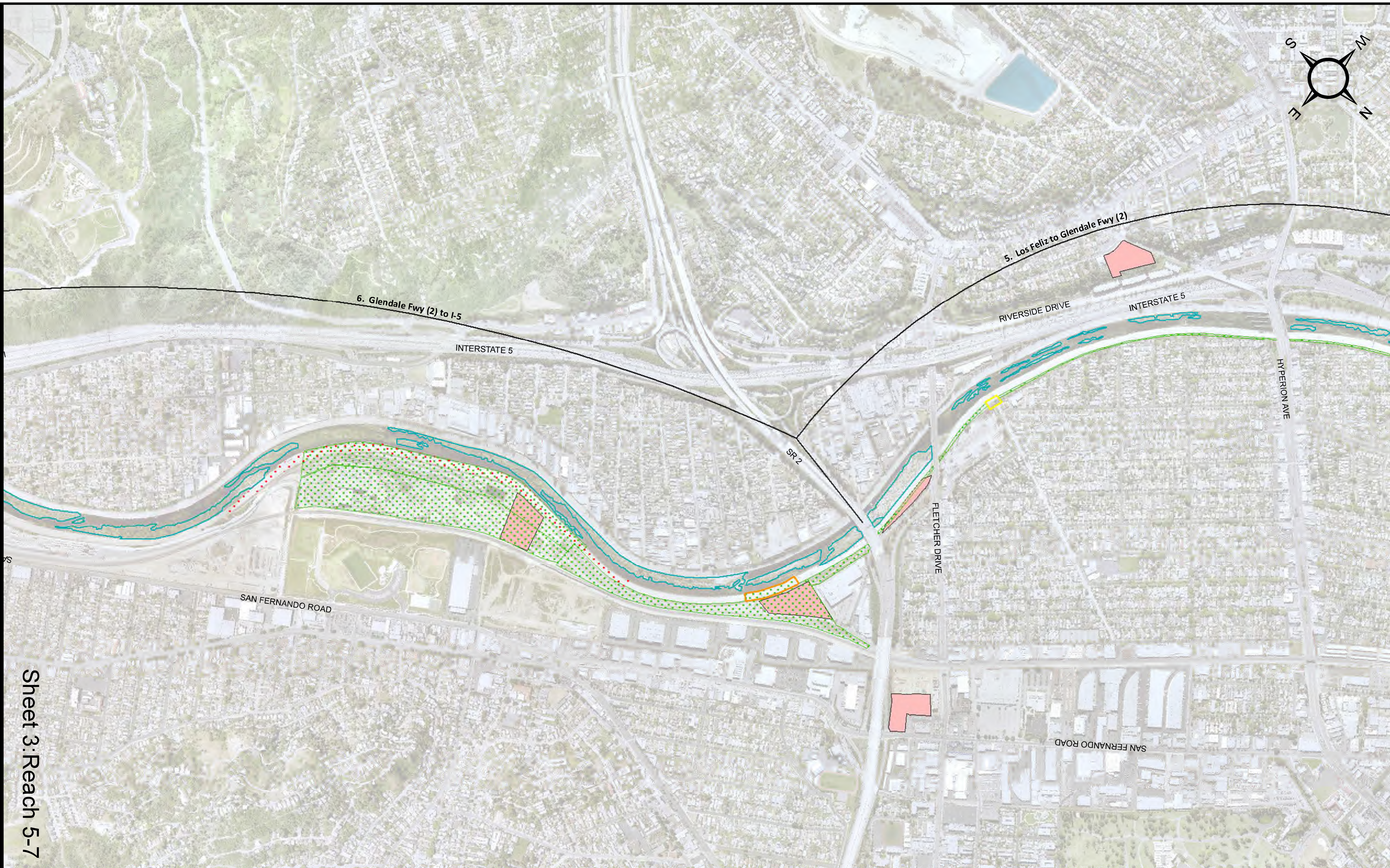
0 0.2 0.4 Miles

LEGEND
Sub-Measures

- 2. Expose stormdrain outlets; convert to natural stream confluence
- 10. Divert tributary & river flow into side channels
- 17. Habitat corridors/riparian planting on banks
- 29. Invasive management
- Potential Temporary Construction Staging Areas

Alternative 10, ARBOR Riparian Transitions (ART)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008



0 0.2 0.4 Miles

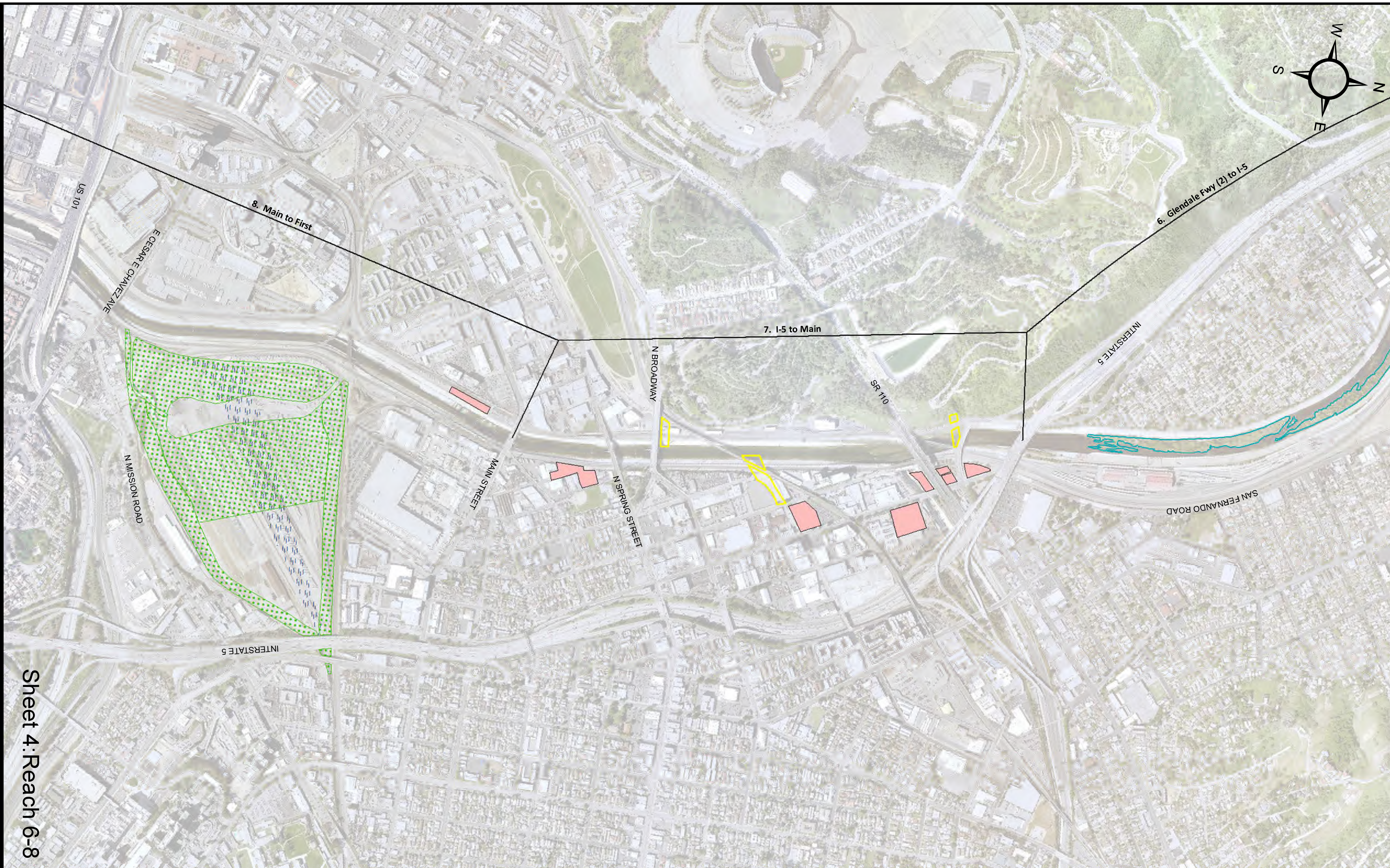
LEGEND
Sub-Measures

2. Expose stormdrain outlets; convert to natural stream confluence
17. Habitat corridors/riparian planting on banks
21. Lower channel banks and provide setback levees or vegetated berms
22. Channel banks mainstem/widen channel with concrete removal
29. Invasive management
Potential Temporary Construction Staging Areas

Alternative 10, ARBOR Riparian Transitions (ART)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008

0 0.2 0.4 Miles



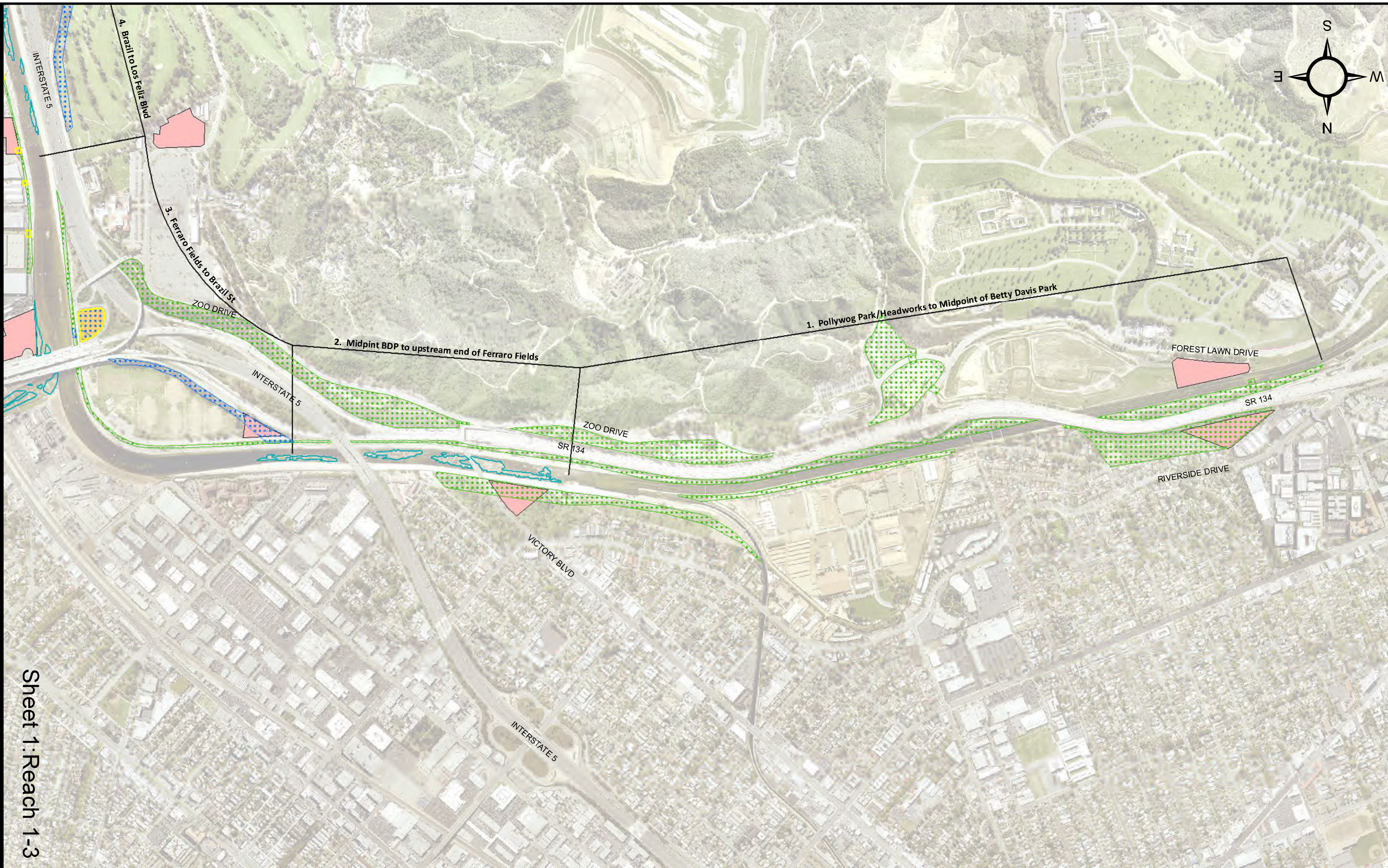
LEGEND
Sub-Measures

- 2. Expose stormdrain outlets; convert to natural stream confluence
- 6. Rebuild geomorphology for historic wash
- 17. Habitat corridors/riparian planting on banks
- 29. Invasive management
- Potential Temporary Construction Staging Areas

Alternative 13, ARBOR Corridor Extension (ACE)

Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008



0 0.2 0.4 Miles

LEGEND
Sub-Measures

- 2. Expose stormdrain outlets; convert to natural stream confluence
- 3/5. Create geomorphology and plant for freshwater marsh
- 10. Divert tributary & river flow into side channels
- 17. Habitat corridors/riparian planting on banks
- 29. Invasive management
- Potential Temporary Construction Staging Areas

Alternative 13, ARBOR Corridor Extension (ACE)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008

0
0.2
0.4
Miles

LEGEND
Sub-Measures

- 2. Expose stormdrain outlets; convert to natural stream confluence
- 3/5. Create geomorphology and plant for freshwater marsh
- 10. Divert tributary & river flow into side channels
- 17. Habitat corridors/riparian planting on banks
- 29. Invasive management
- Potential Temporary Construction Staging Areas

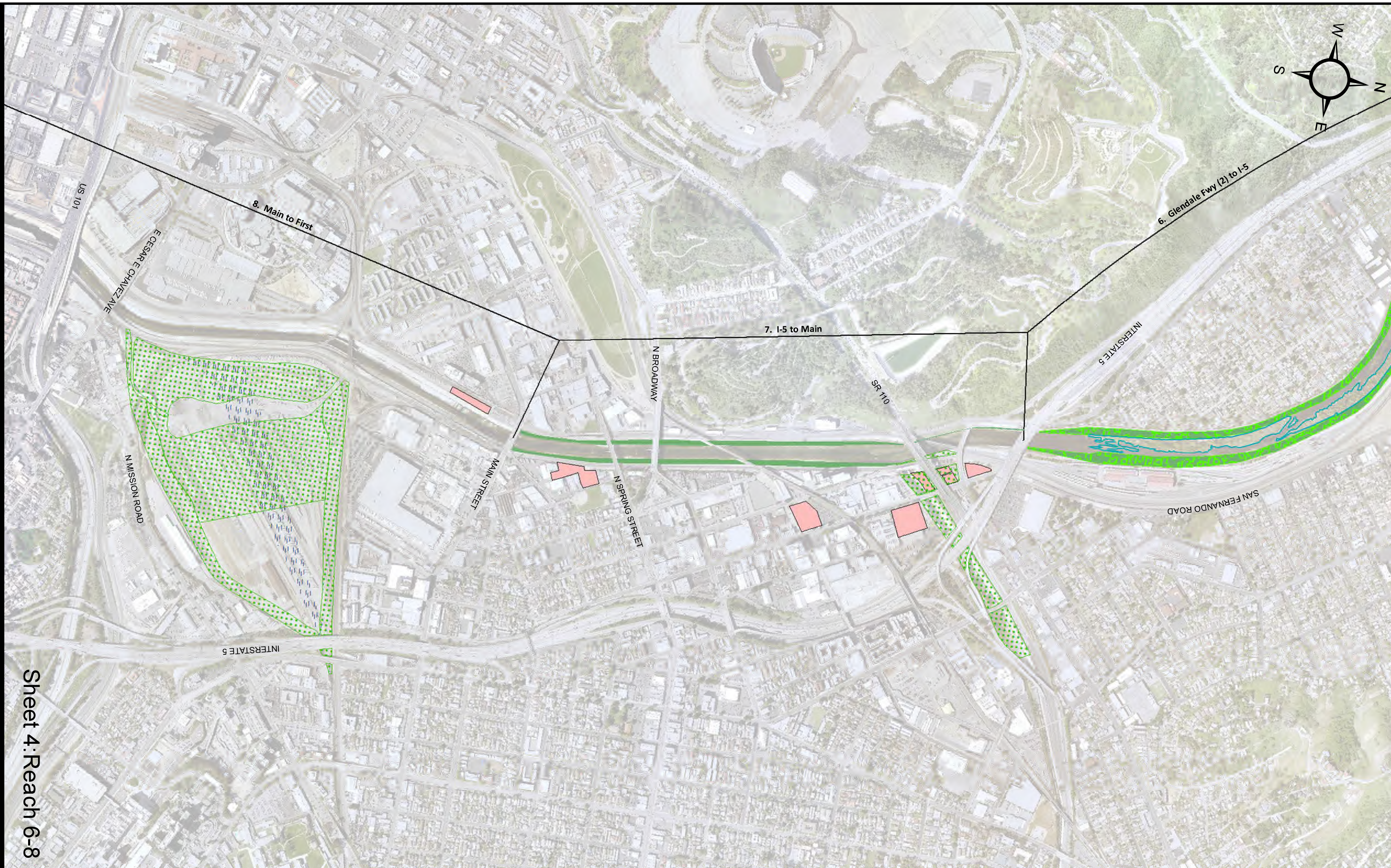
Alternative 13, ARBOR Corridor Extension (ACE)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008

0 0.2 0.4 Miles

LEGEND
Sub-Measures

- 2. Expose stormdrain outlets; convert to natural stream confluence
- 3/5. Create geomorphology and plant for freshwater marsh
- 16. Bioengineer channel walls
- 17. Habitat corridors/riparian planting on banks
- 19. Planting built into channel walls
- 22. Channel banks mainstem/widen channel with concrete removal
- 29. Invasive management
- Potential Temporary Construction Staging Areas



LEGEND
Sub-Measures

- 6. Rebuild geomorphology for historic wash
- 16. Bioengineer channel walls
- 17. Habitat corridors/riparian planting on banks
- 19. Planting built into channel walls
- 29. Invasive management
- Potential Temporary Construction Staging Areas

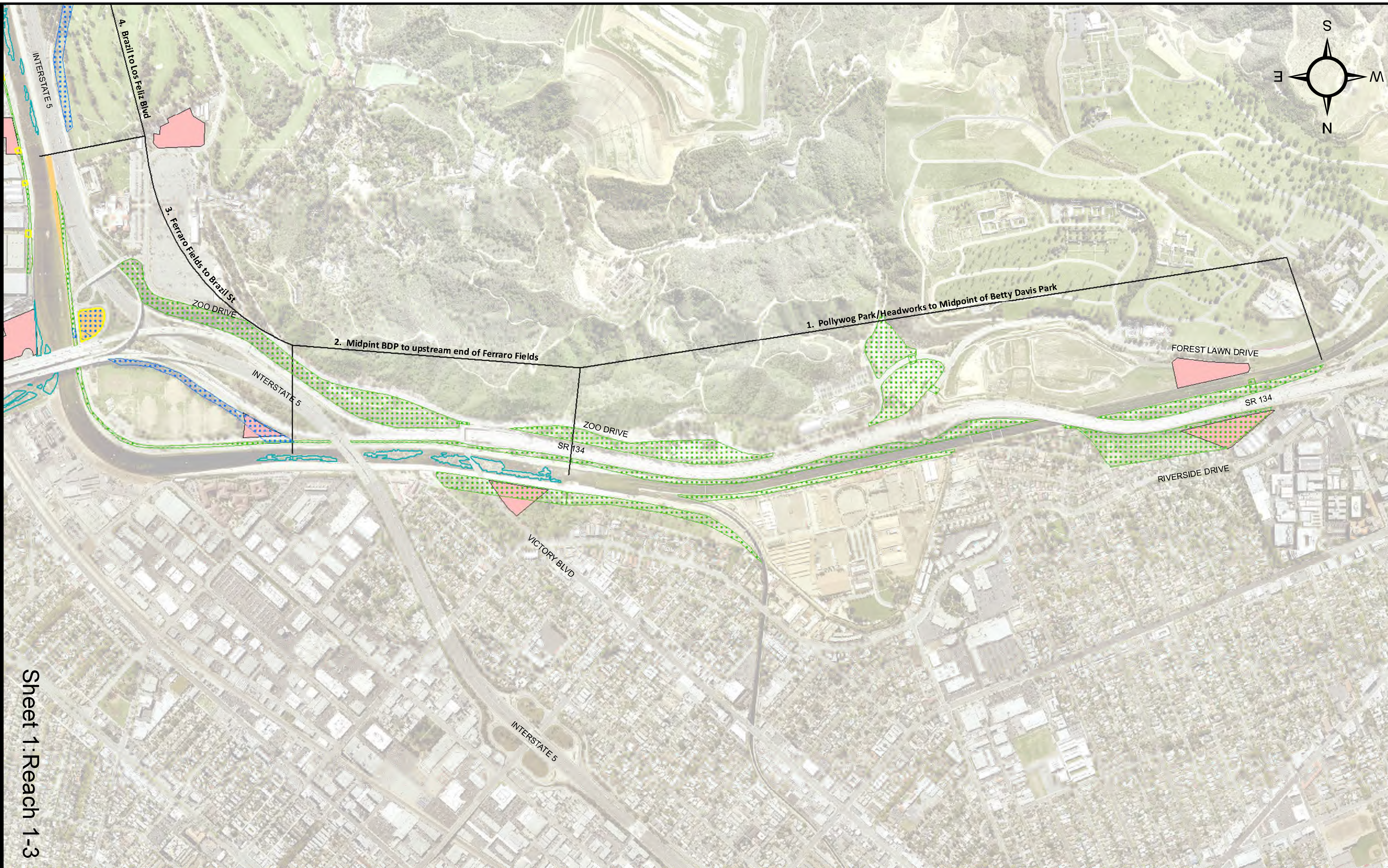
Alternative 13, ARBOR Corridor Extension (ACE)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008

0 0.2 0.4 Miles

Alternative 16, ARBOR Narrows to Downtown (AND)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008



LEGEND
Sub-Measures

- 2. Expose stormdrain outlets; convert to natural stream confluence
- 3/5. Create geomorphology and plant for freshwater marsh
- 10. Divert tributary & river flow into side channels
- 17. Habitat corridors/riparian planting on banks
- 29. Invasive management
- Potential Temporary Construction Staging Areas

Alternative 16, ARBOR Narrows to Downtown (AND)
Los Angeles River Ecosystem Restoration (Feb, 2013)

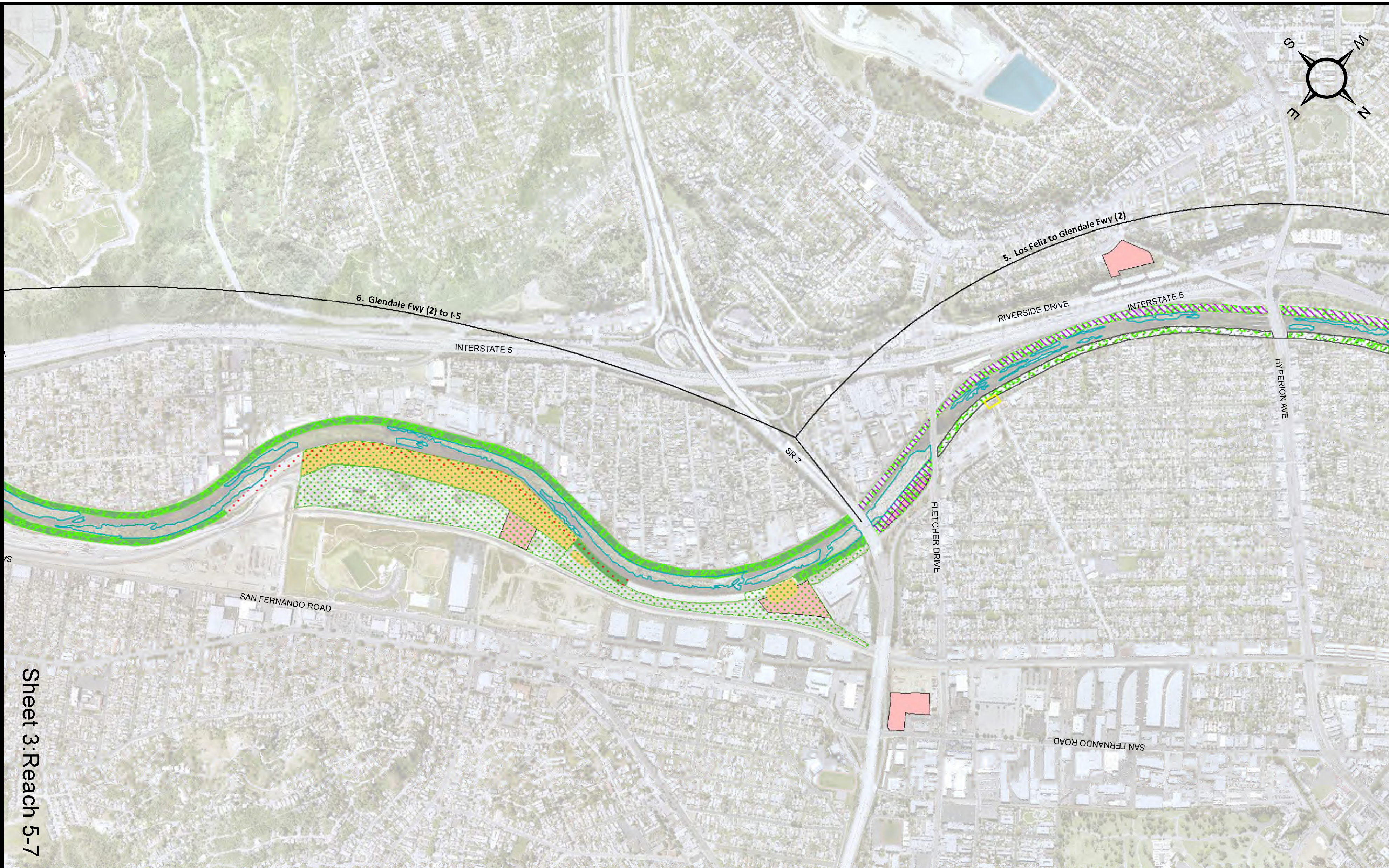
Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008

LEGEND
Sub-Measures

- 2. Expose stormdrain outlets; convert to natural stream confluence
- 3/5. Create geomorphology and plant for freshwater marsh
- 10. Divert tributary & river flow into side channels
- 16. Bioengineer channel walls
- 17. Habitat corridors/riparian planting on banks
- 26. Terrace banks
- 27. Modify trap channel to vertical sides
- 29. Invasive management
- Potential Temporary Construction Staging Areas

Alternative 16, ARBOR Narrows to Downtown (AND)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008



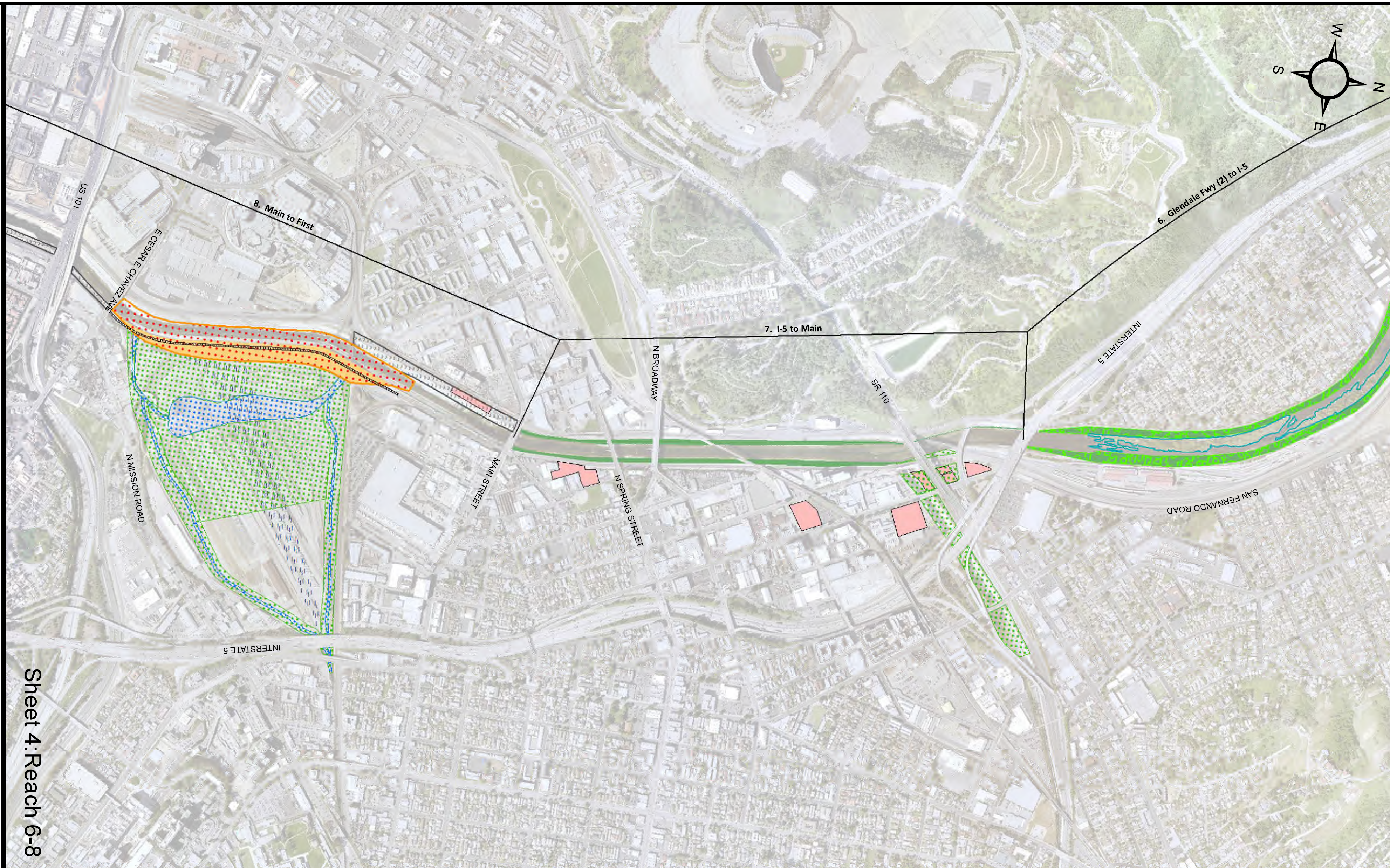
0 0.2 0.4 Miles

LEGEND
Sub-Measures

- 2. Expose stormdrain outlets; convert to natural stream confluence
- 3/5. Create geomorphology and plant for freshwater marsh
- 16. Bioengineer channel walls
- 17. Habitat corridors/riparian planting on banks
- 19. Planting built into channel walls
- 22. Channel banks mainstem/widen channel with concrete removal
- 26. Terrace banks
- 27. Modify trap channel to vertical sides
- 29. Invasive management
- Potential Temporary Construction Staging Areas

Alternative 16, ARBOR Narrows to Downtown (AND)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008



0 0.2 0.4 Miles

LEGEND
Sub-Measures

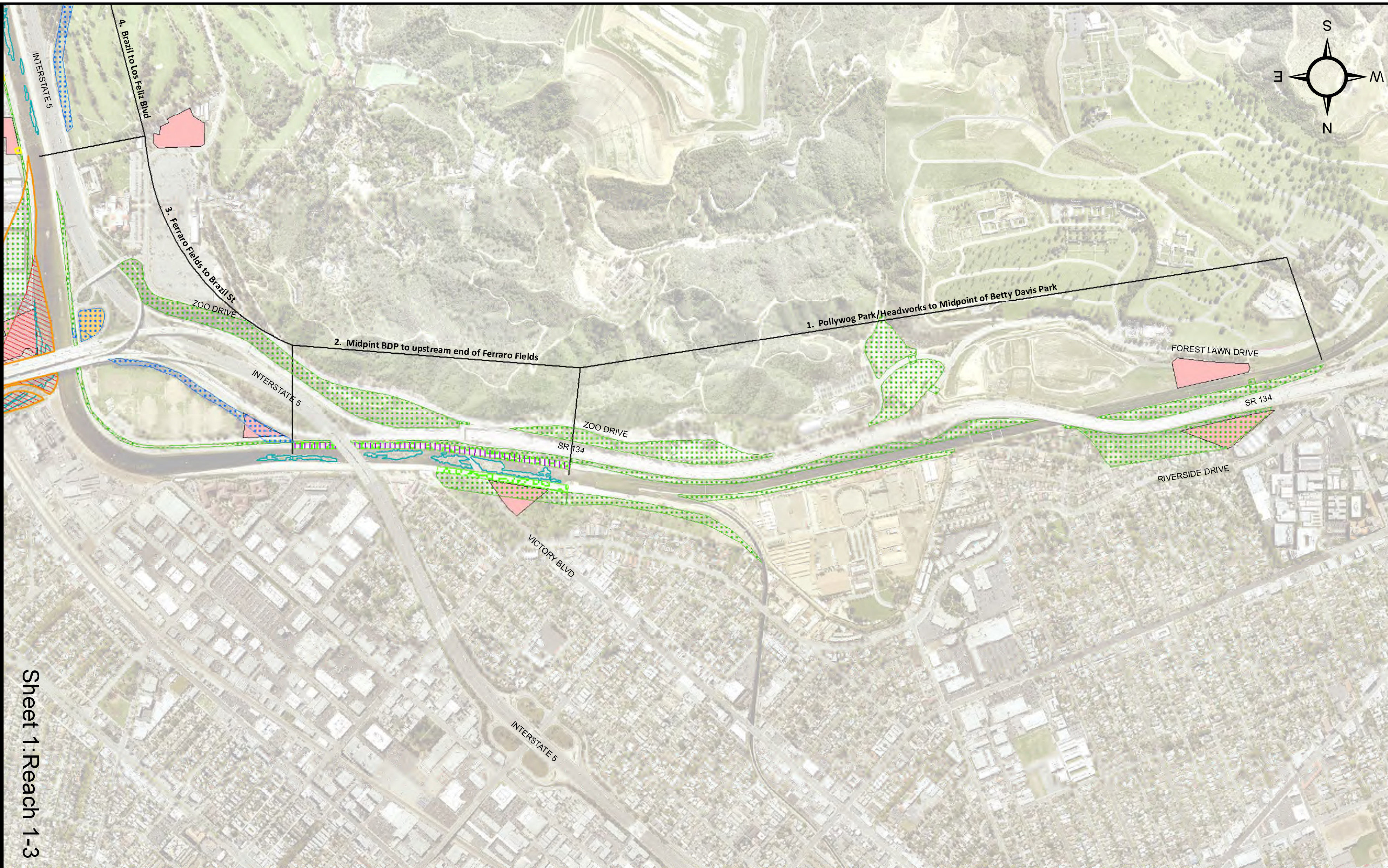
1. Elevate railroads on trestles
3/5. Create geomorphology and plant for freshwater marsh
6. Rebuild geomorphology for historic wash
10. Divert tributary & river flow into side channels
16. Bioengineer channel walls
17. Habitat corridors/riparian planting on banks
19. Planting built into channel walls
21. Lower channel banks and provide setback levees or vegetated berms
22. Channel banks mainstem/widen channel with concrete removal
26. Terrace banks
29. Invasive management
Potential Temporary Construction Staging Areas

Los Angeles River Ecosystem Restoration (Feb, 2013)

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008

0 0.2 0.4 Miles



LEGEND
Sub-Measures

- 2. Expose stormdrain outlets; convert to natural stream confluence
- 3/5. Create geomorphology and plant for freshwater marsh
- 10. Divert tributary & river flow into side channels
- 16. Bioengineer channel walls
- 17. Habitat corridors/riparian planting on banks
- 21. Lower channel banks and provide setback levees or vegetated berms
- 25. Tributary channels/widen channel with concrete removal
- 27. Modify trap channel to vertical sides
- 29. Invasive management
- Potential Temporary Construction Staging Areas

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)

Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008

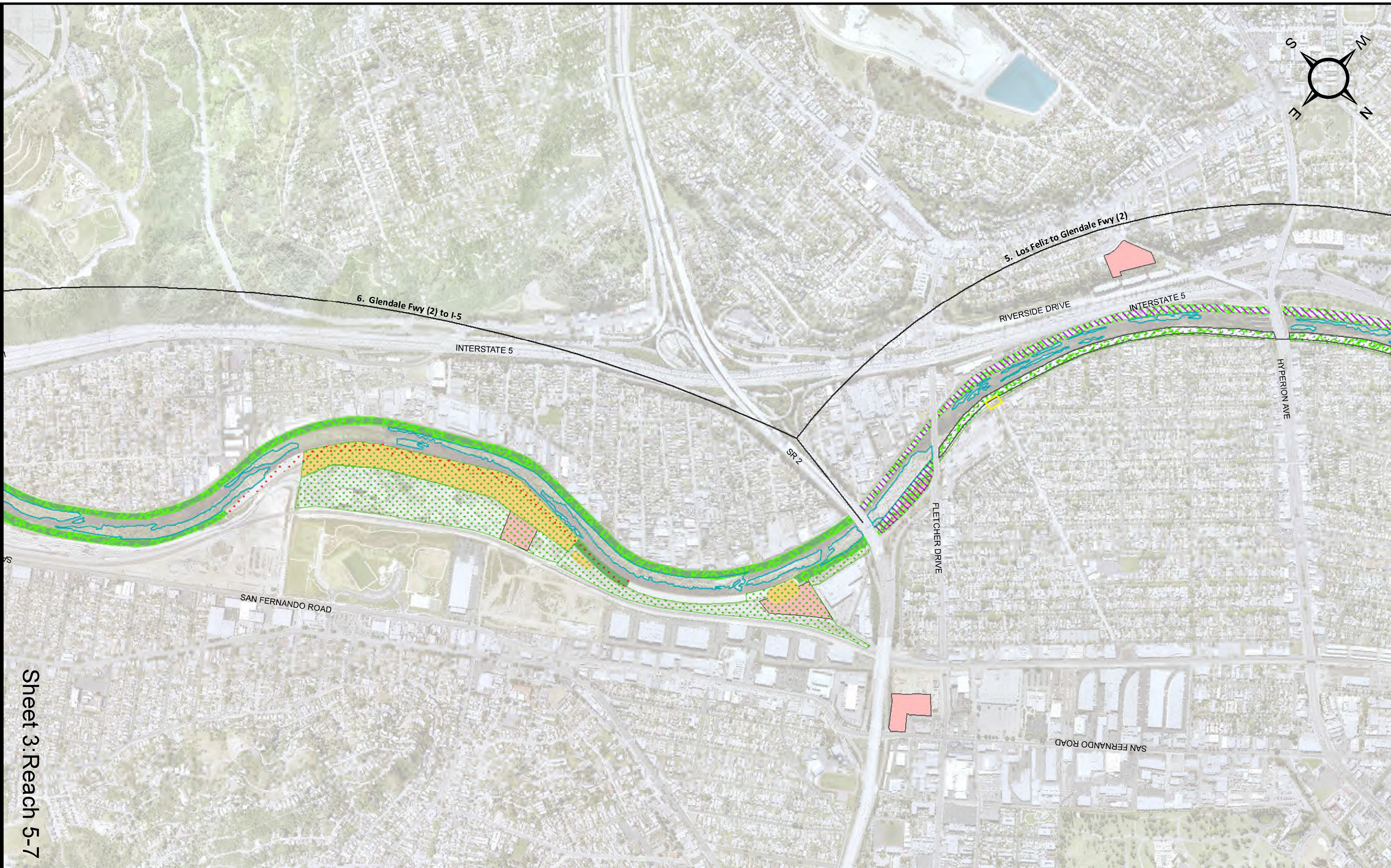
LEGEND
Sub-Measures

2. Expose stormdrain outlets; convert to natural stream confluence
3/5. Create geomorphology and plant for freshwater marsh
10. Divert tributary & river flow into side channels
16. Bioengineer channel walls
17. Habitat corridors/riparian planting on banks
21. Lower channel banks and provide setback levees or vegetated berms
25. Tributary channels/widen channel with concrete removal
26. Terrace banks
27. Modify trap channel to vertical sides
29. Invasive management
Potential Temporary Construction Staging Areas

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)

Los Angeles River Ecosystem Restoration (Feb, 2013)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008



0 0.2 0.4 Miles

LEGEND

Sub-Measures

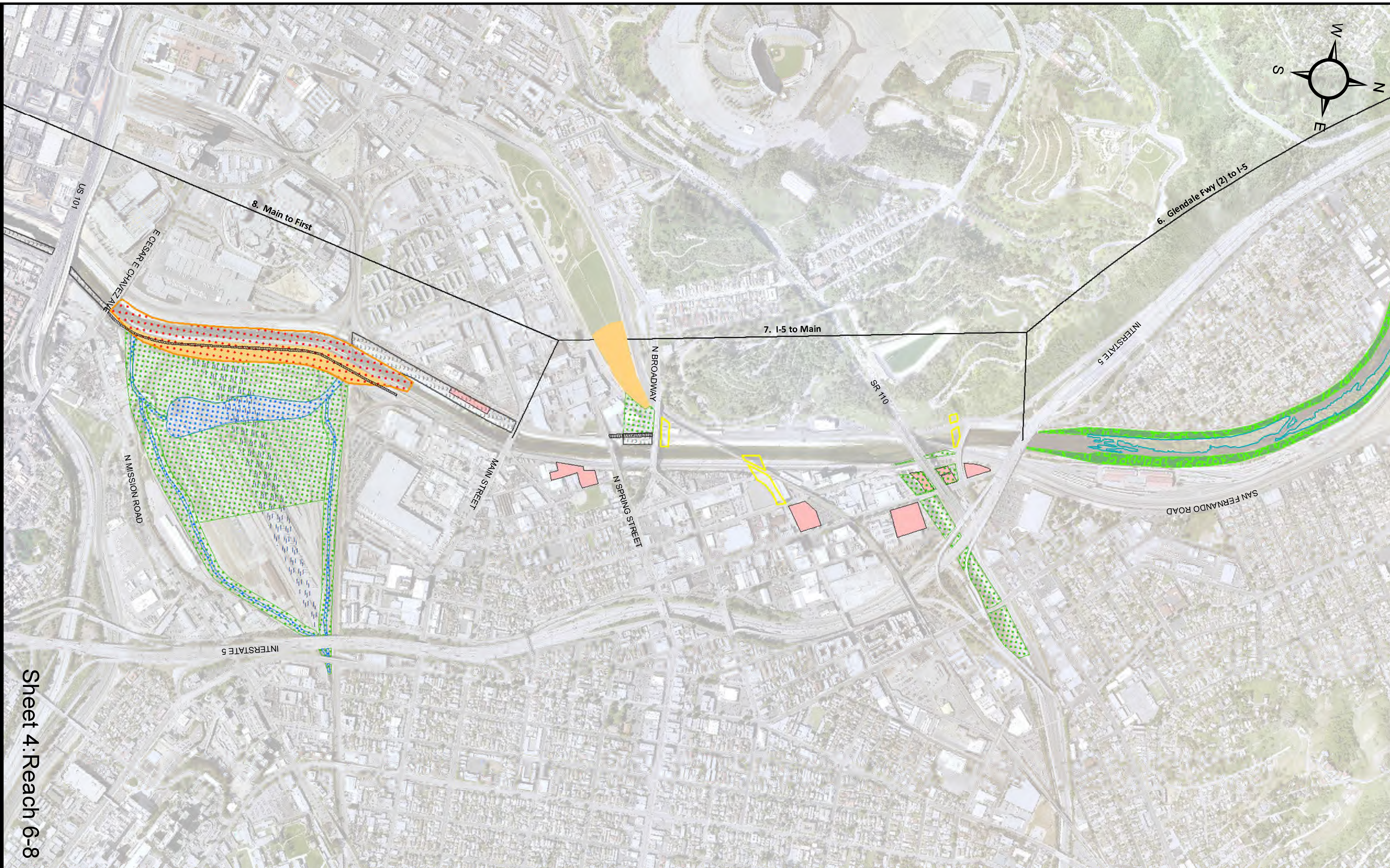
- 2. Expose stormdrain outlets; convert to natural stream confluence
- 3/5. Create geomorphology and plant for freshwater marsh
- 16. Bioengineer channel walls
- 17. Habitat corridors/riparian planting on banks
- 19. Planting built into channel walls
- 22. Channel banks mainstem/widen channel with concrete removal
- 26. Terrace banks
- 27. Modify trap channel to vertical sides
- 29. Invasive management
- Potential Temporary Construction Staging Areas

Los Angeles River Ecosystem Restoration (Feb, 2013)

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)

Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008

0 0.2 0.4 Miles



Sheet 4:Reach 6-8

LEGEND
Sub-Measures

- 1. Elevate railroads on trestles
- 2. Expose stormdrain outlets; convert to natural stream confluence
- 3/5. Create geomorphology and plant for freshwater marsh
- 6. Rebuild geomorphology for historic wash
- 10. Divert tributary & river flow into side channels
- 16. Bioengineer channel walls
- 17. Habitat corridors/riparian planting on banks
- 19. Planting built into channel walls
- 21. Lower channel banks and provide setback levees or vegetated berms
- 22. Channel banks mainstem/widen channel with concrete removal
- 26. Terrace banks
- 29. Invasive management
- Potential Temporary Construction Staging Areas

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration

Feasibility Study

Attachment 4 – Revised Cross Sections

September 2014

Attachment 4- Revised Cross Sections

Sheet	Alternative(s)	Location
1	Alternative 20	Reach 2
2	Alternatives 16 & 20	Reach 5
3	Alternatives 13,16 & 20	Reach 6a
4	Alternative 10	Taylor Yard
5	Alternatives 13, 16 & 20	Taylor Yard (6b)
6	Alternative 13, 16, & 20	Reach 6c
7	Alternatives 13 & 16	Reach 7
8	Alternatives 16 & 20	Piggyback Yard
9	Alternative 20	Verdugo Wash
10	Alternative 20	Verdugo Wash
11	Alternative 20	Verdugo Wash
12	Alternatives 13, 16 & 20	Arroyo Seco
13	Alternative 20	Cornfields

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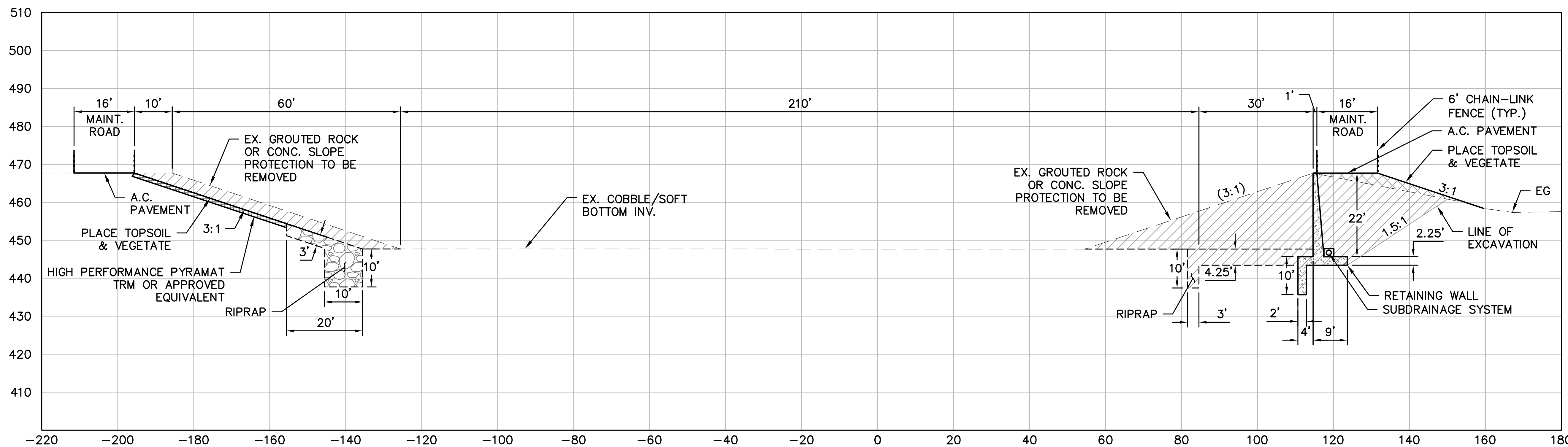

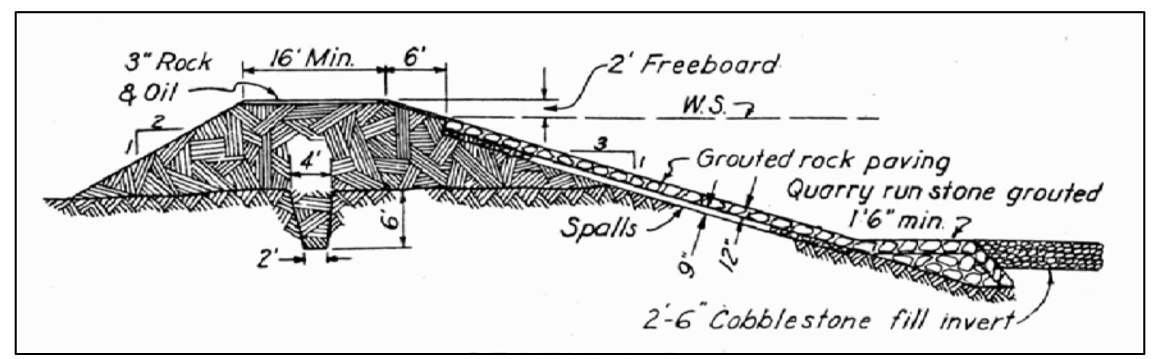

EXISTING TYPICAL SECTION
NTS

0 15 30 60

LEGEND

- EX. GROUND
- PROPOSED CHANNEL
- EXCAVATION
- COMPACTED FILL
- RIPRAP
- REINFORCED CONCRETE
- HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT

NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN.

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ALTERNATIVE 20
REACH 2 (R2A13)

DATE 04/16/13

SHT NO. 1 OF 13

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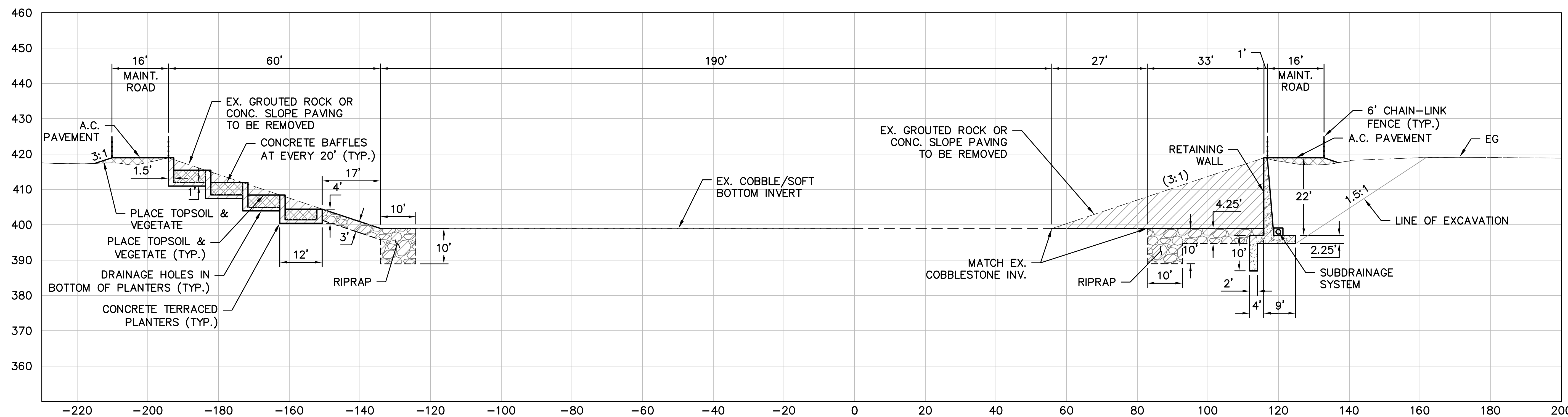

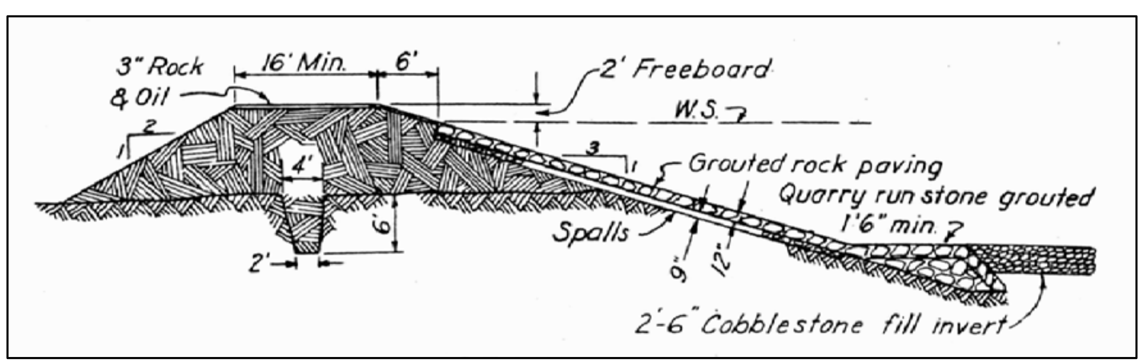

EXISTING TYPICAL SECTION

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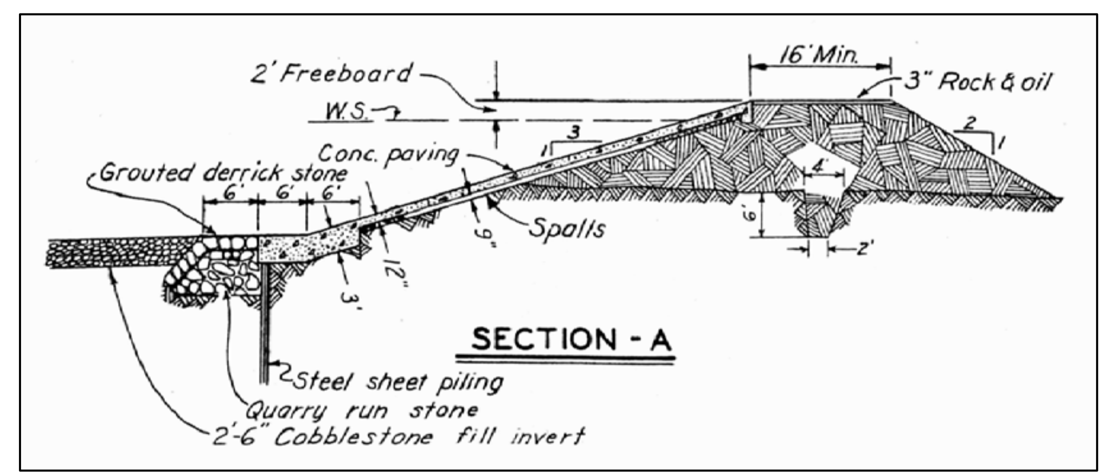

EXISTING TYPICAL SECTION

NTS

0 15 30 60

LEGEND

EX. GROUND		RIPRAP	
PROPOSED CHANNEL		REINFORCED CONCRETE	
EXCAVATION		HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT	
COMPACTED FILL		NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN.	

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LOS ANGELES RIVER FEASIBILITY STUDY
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ALTERNATIVES 16 & 20
REACH 5 (R5A5)

DATE
04/16/13

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2 OF 13

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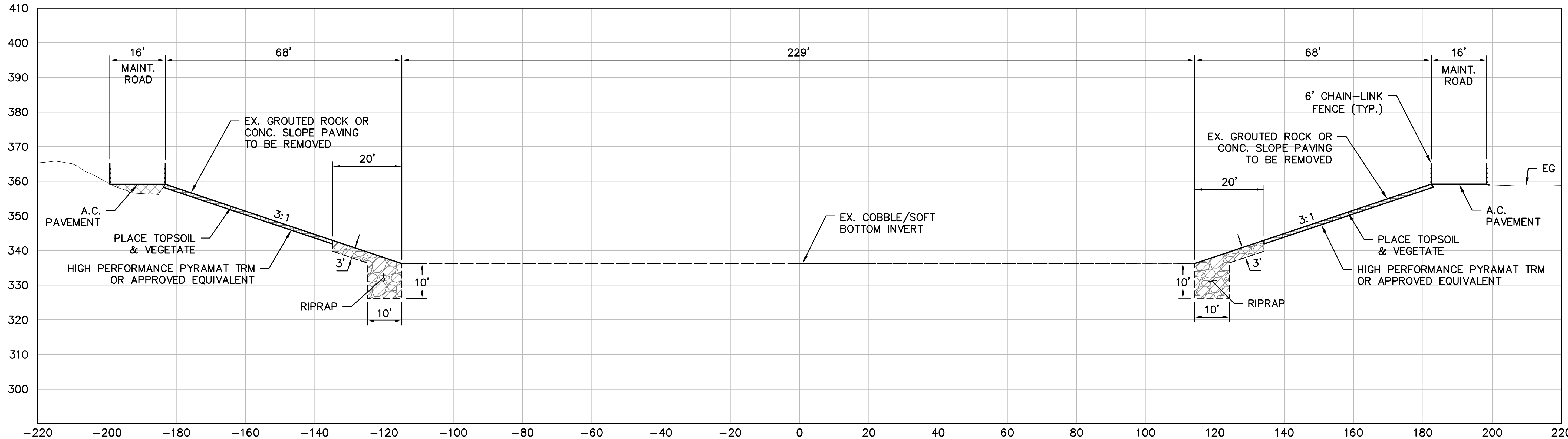

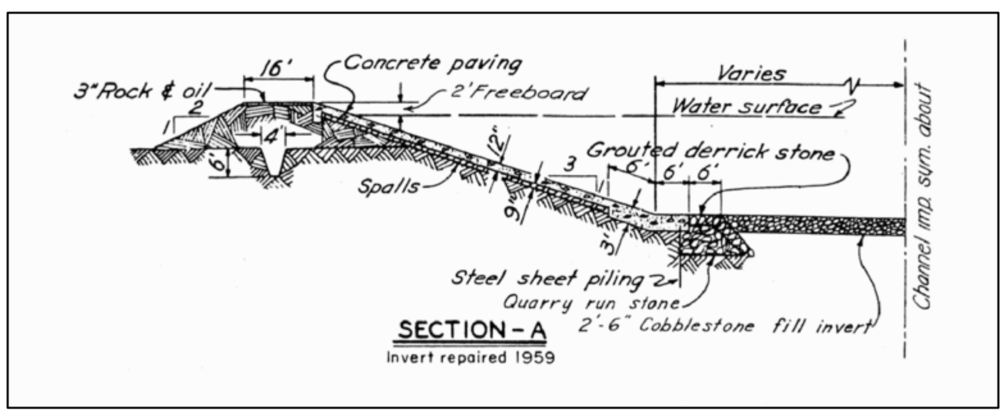

EXISTING TYPICAL SECTION
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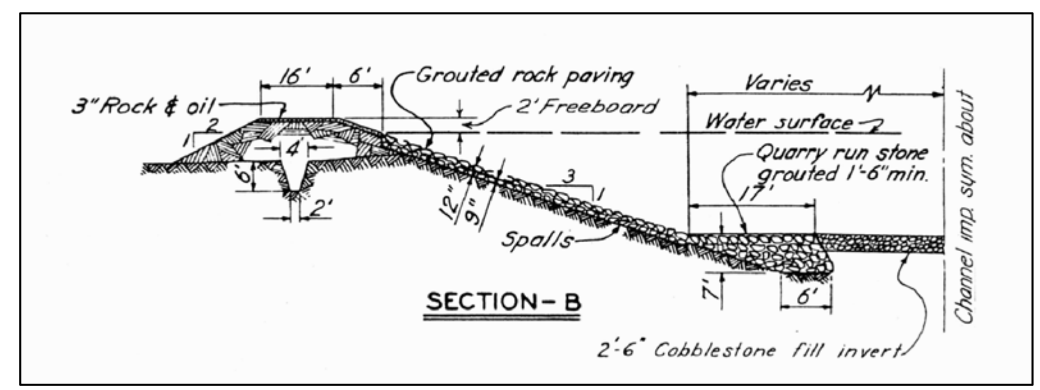

EXISTING TYPICAL SECTION
NTS

0 15 30 60

LEGEND

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———	PROPOSED CHANNEL		REINFORCED CONCRETE
	EXCAVATION		HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT
	COMPACTED FILL		NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN

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PRELIMINARY DESIGN

ALTERNATIVES 13, 16, & 20
REACH 6 (R6A13)

DATE
04/16/13

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3 OF 13

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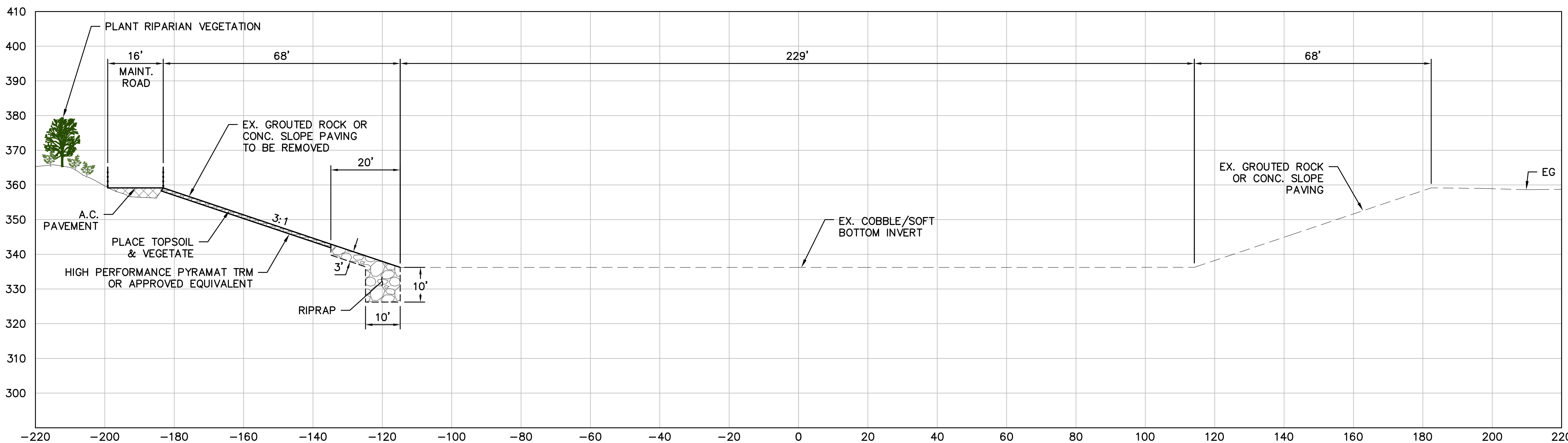

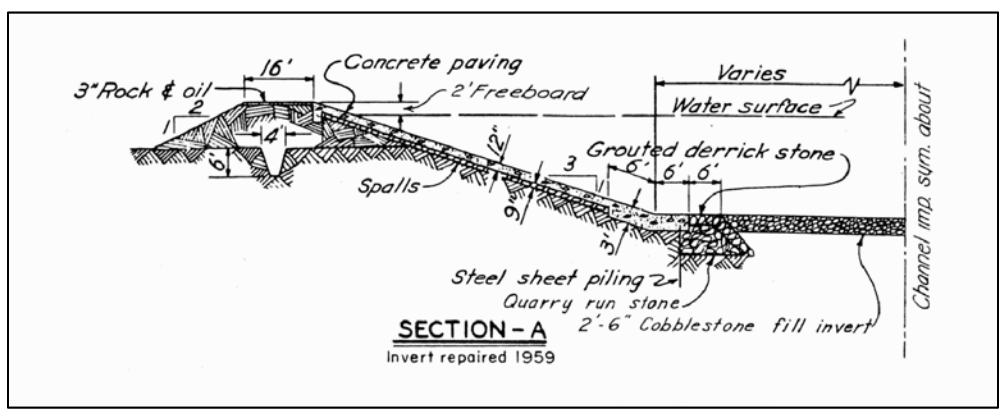

EXISTING TYPICAL SECTION
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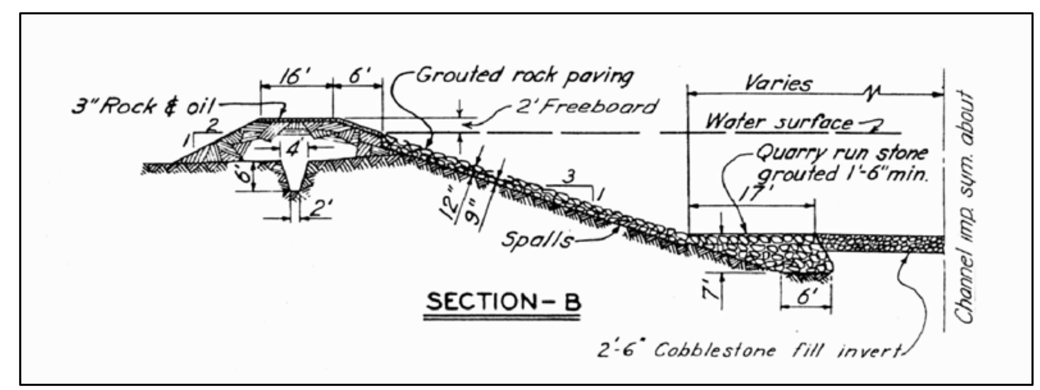

EXISTING TYPICAL SECTION
NTS

0 15 30 60

LEGEND

— — — —	EX. GROUND		RIPRAP
———	PROPOSED CHANNEL		REINFORCED CONCRETE
	EXCAVATION		HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT
	COMPACTED FILL		NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN

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ALTERNATIVE 10
REACH 6 (R6A14)

DATE 04/16/13

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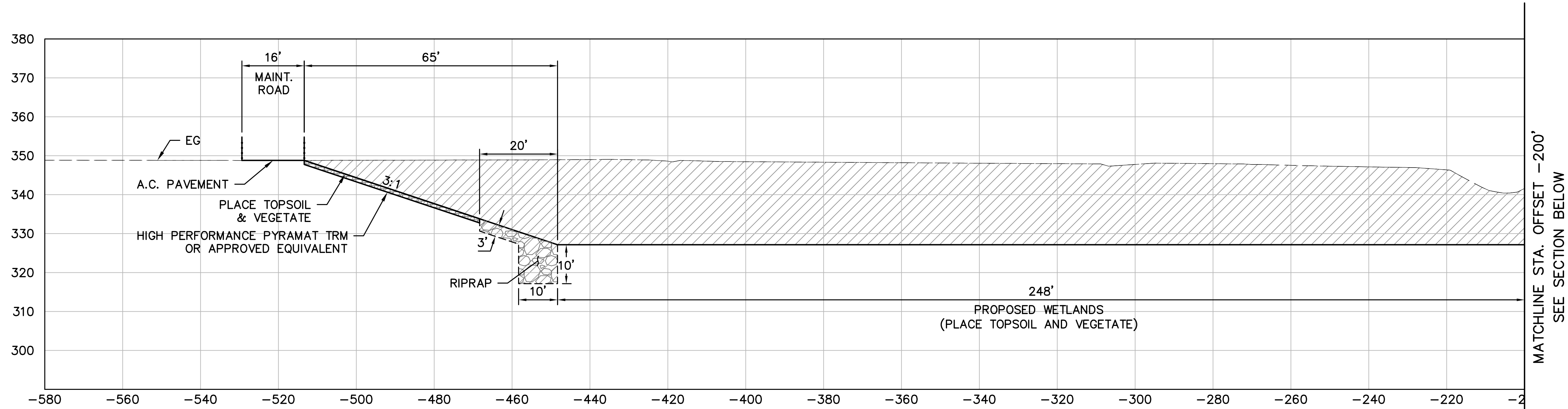

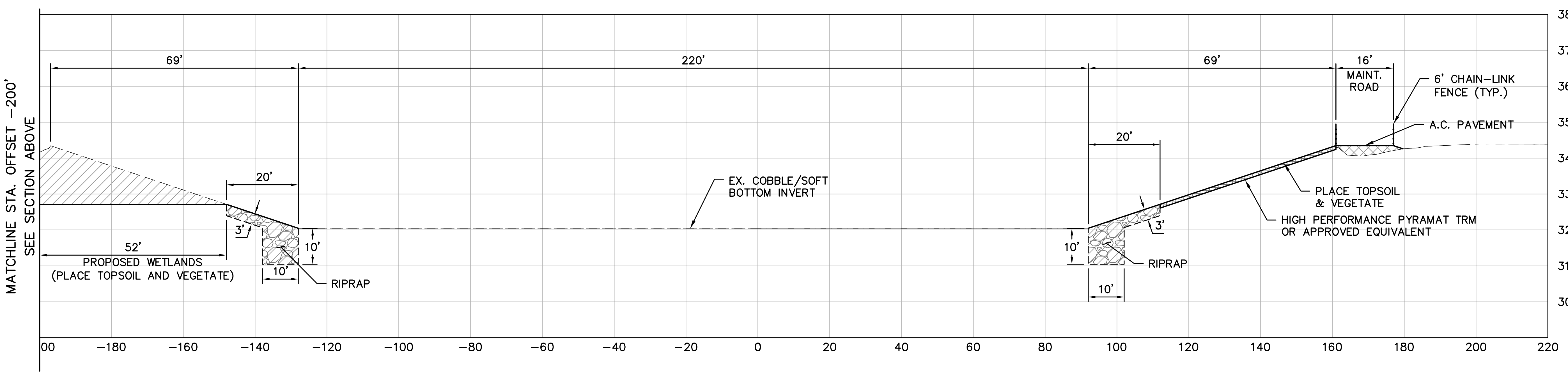

0 15 30 60

LEGEND

EX. GROUND	RIPRAP
PROPOSED CHANNEL	REINFORCED CONCRETE
EXCAVATION	HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT
COMPACTED FILL	NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN.

NOTE: EXISTING TYPICAL SECTIONS PER SHEET 3

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LOS ANGELES RIVER FEASIBILITY STUDY
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ALTERNATIVES 13, 16, & 20
REACH 6 (R6A13)

DATE 04/16/13

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0 15 30 60

LEGEND

	EX. GROUND		RIPRAP
	PROPOSED CHANNEL		REINFORCED CONCRETE
	EXCAVATION		HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT
	COMPACTED FILL		NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN

NOTE: EXISTING TYPICAL SECTIONS PER SHEET 3

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ALTERNATIVES 13, 16, & 20
REACH 6 (R6A13)

DATE
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6 OF 13

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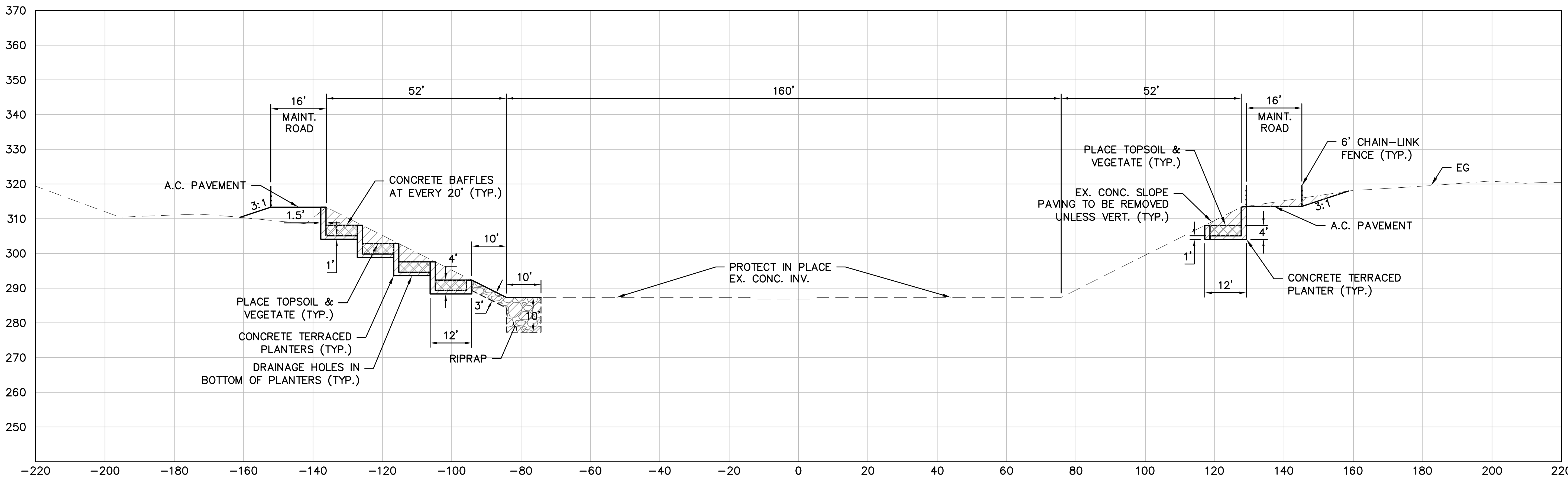
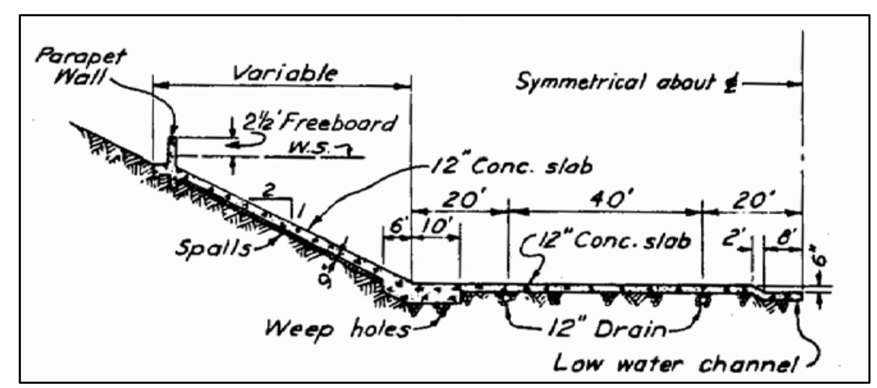


NOTE: EITHER DESIGN DEPENDENT ON HYDRAULIC ANALYSIS.



EXISTING TYPICAL SECTION

NTS

0 15 30 60

LEGEND

EX. GROUND	RIPRAP
PROPOSED CHANNEL	REINFORCED CONCRETE
EXCAVATION	HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT
COMPACTED FILL	NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN.

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ALTERNATIVES 13 & 16
REACH 7 (R7A12)

DATE
04/16/13

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7 OF 13

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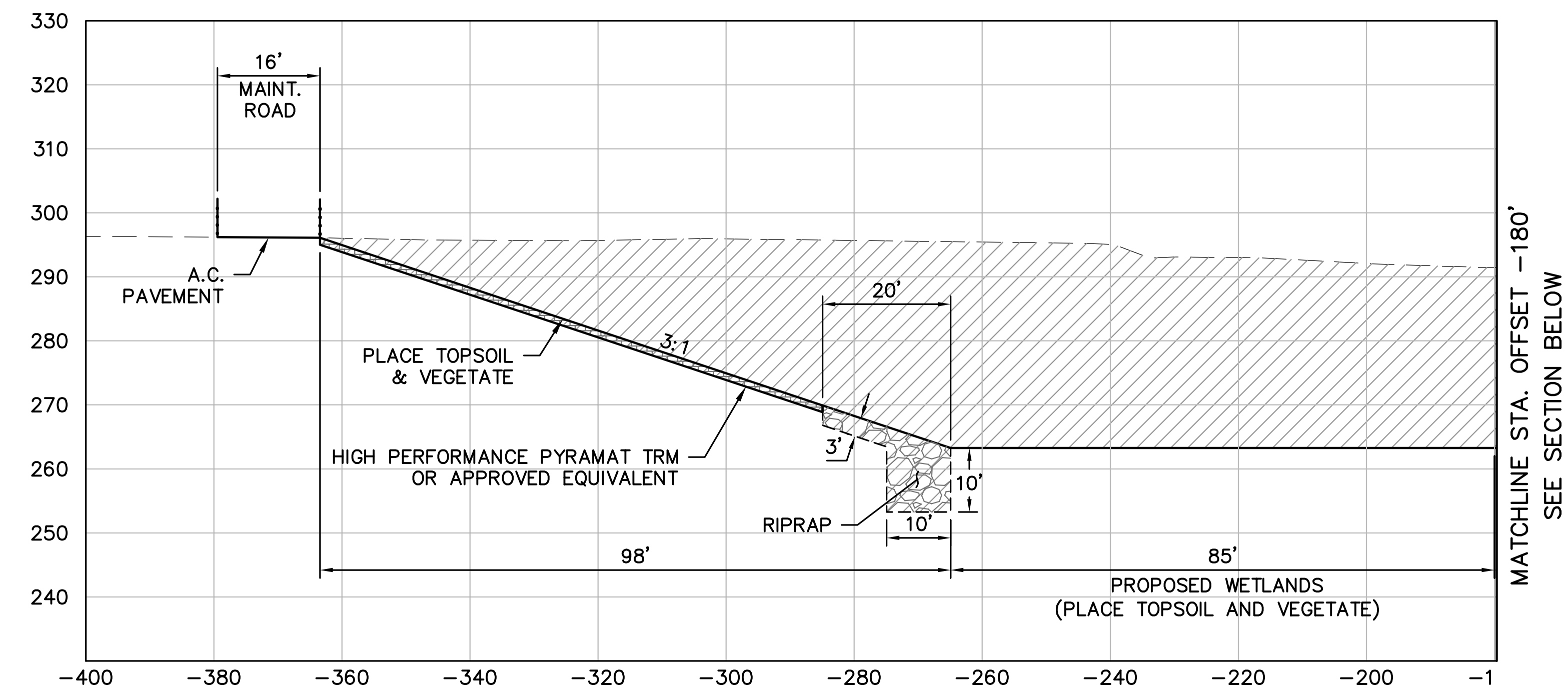

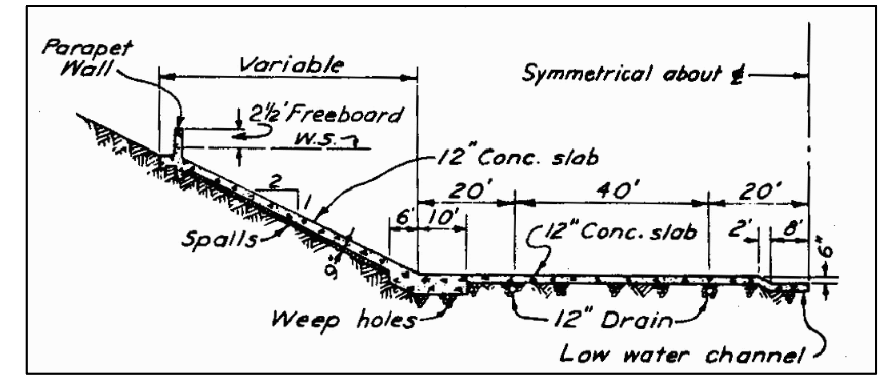

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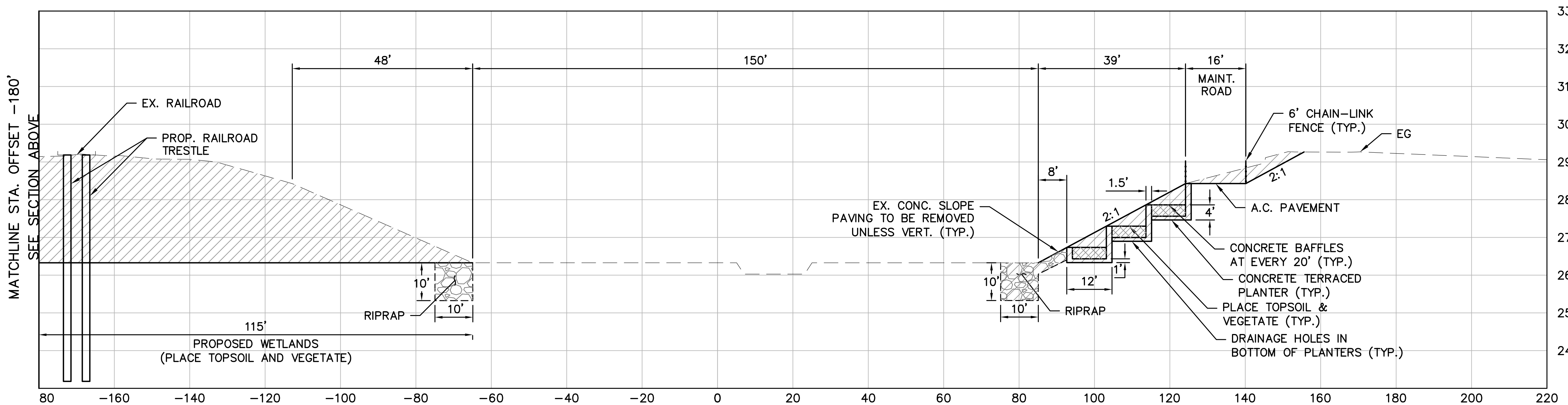

0 15 30 60

LEGEND

— — — —	EX. GROUND		RIPRAP
———	PROPOSED CHANNEL		REINFORCED CONCRETE
	EXCAVATION		HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT
	COMPACTED FILL		NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN.

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LOS ANGELES RIVER FEASIBILITY STUDY
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ALTERNATIVES 16 & 20
REACH 8 (R8A3)

DATE
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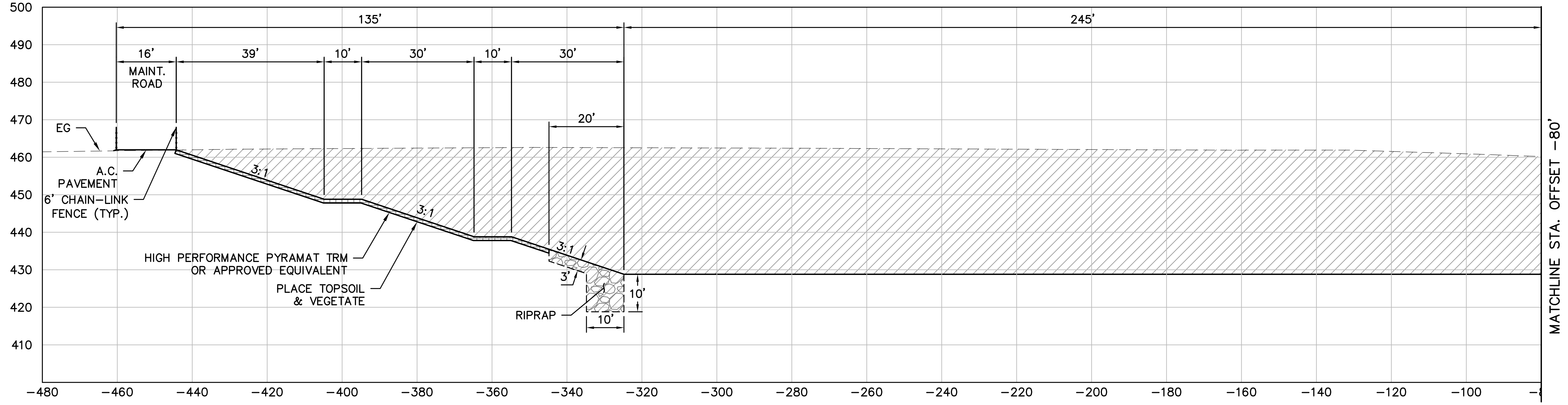
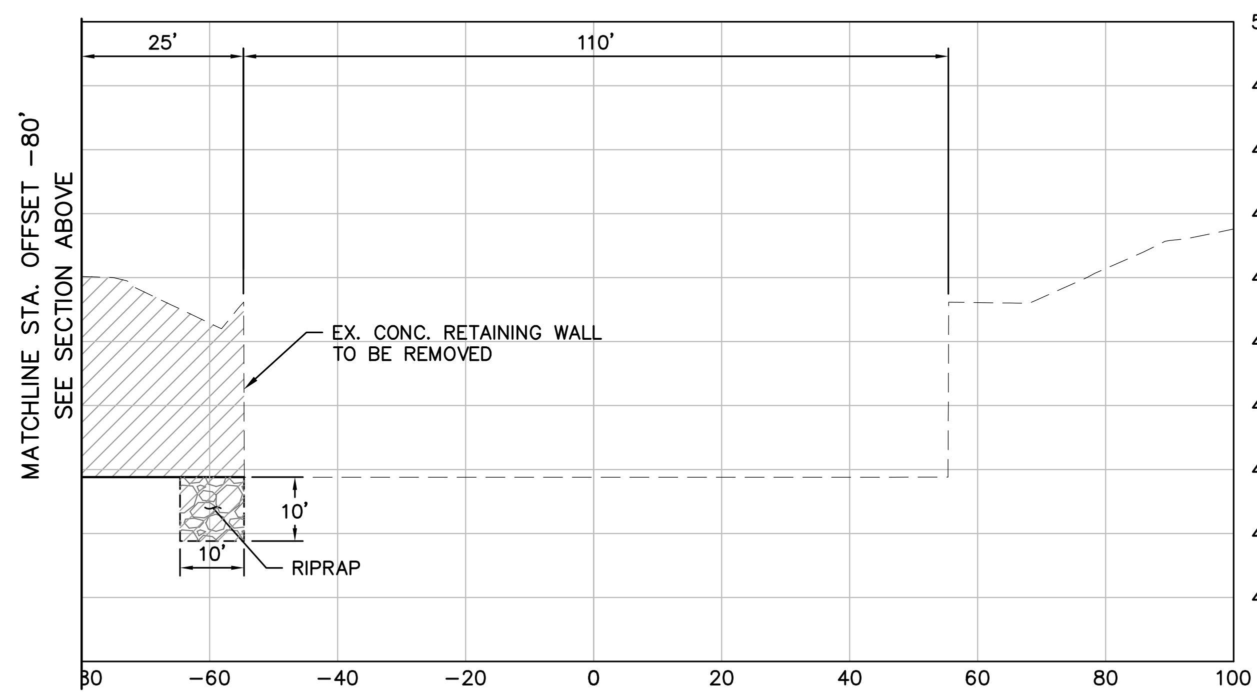
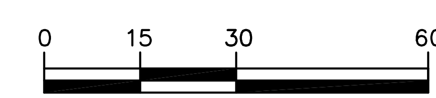




NOTE: FREEWAY PIER DEPTH/
AS-BUILT DRAWING INFORMATION BEING AQUIRED.



LEGEND

— — —	EX. GROUND		RIPRAP
———	PROPOSED CHANNEL		REINFORCED CONCRETE
	EXCAVATION		HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT
	COMPACTED FILL		NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ALTERNATIVE 20
REACH 3 (R3A18)

DATE
04/16/13

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9 OF 13

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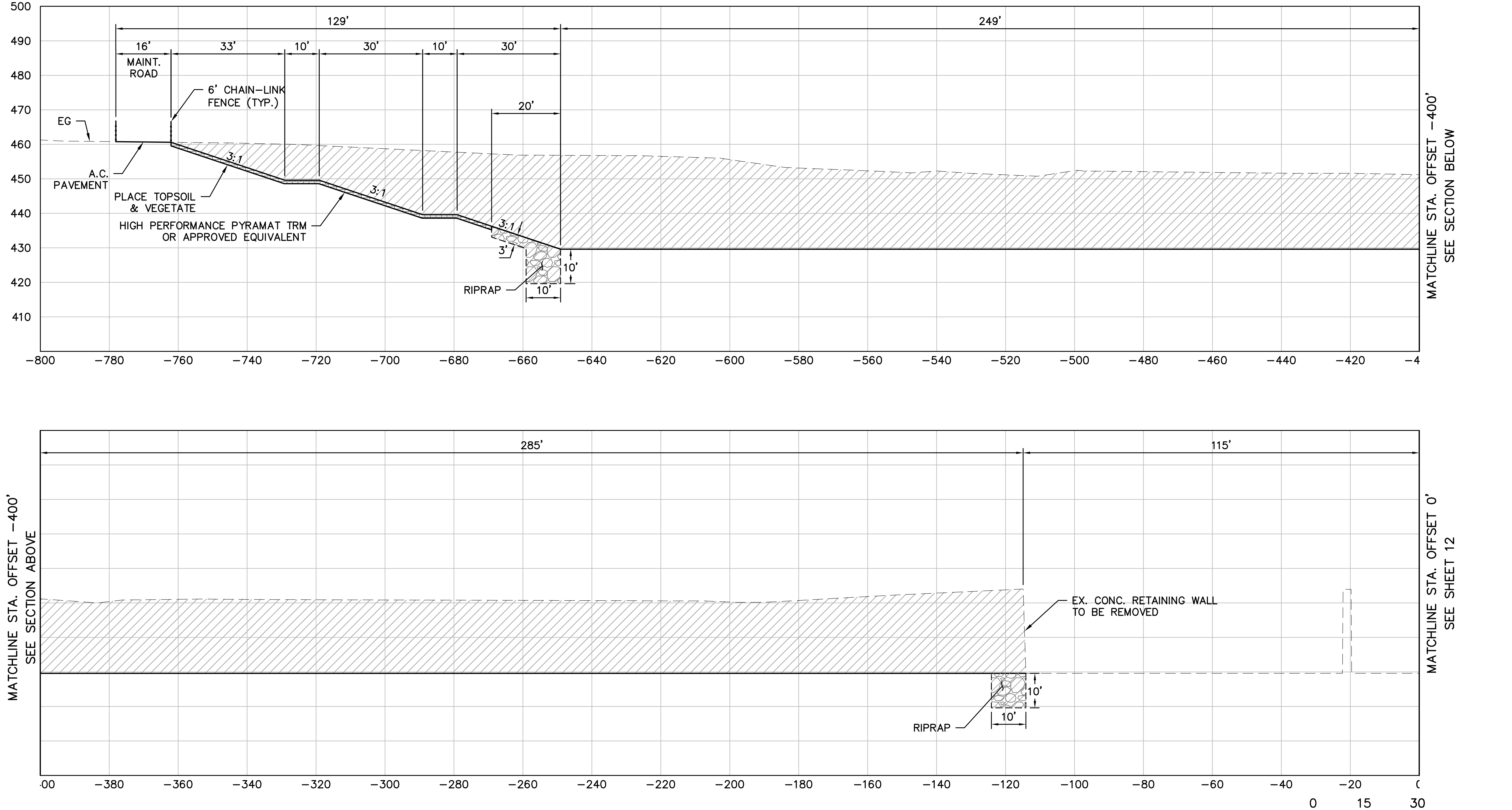

LEGEND

EX. GROUND		RIPRAP	
PROPOSED CHANNEL		REINFORCED CONCRETE	
EXCAVATION		HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT	
COMPACTED FILL		NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN	

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ALTERNATIVE 20
REACH 3 (R3A18)

DATE
04/16/13

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10 OF 13

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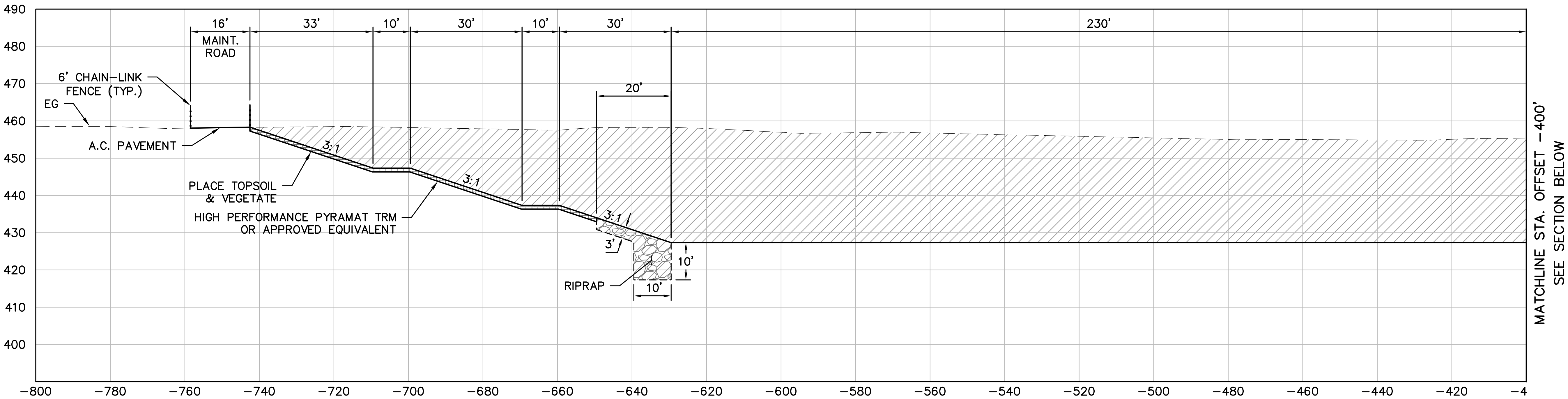

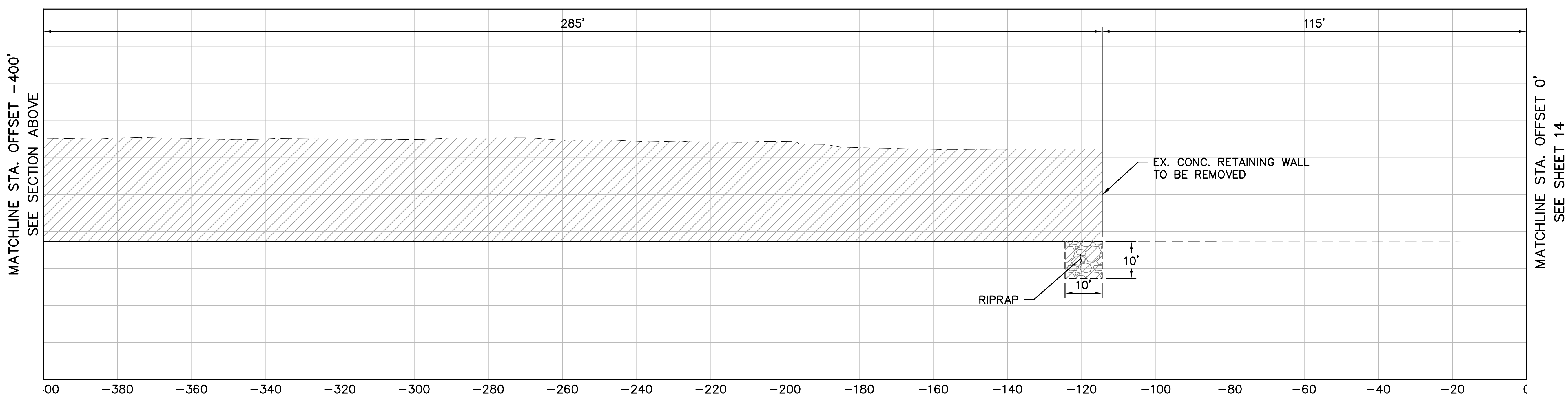

LEGEND

	EX. GROUND		RIPRAP
	PROPOSED CHANNEL		REINFORCED CONCRETE
	EXCAVATION		HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT
	COMPACTED FILL		NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ALTERNATIVE 20
REACH 3 (R3A18)

DATE
04/16/13

SHT NO.
11 OF 13

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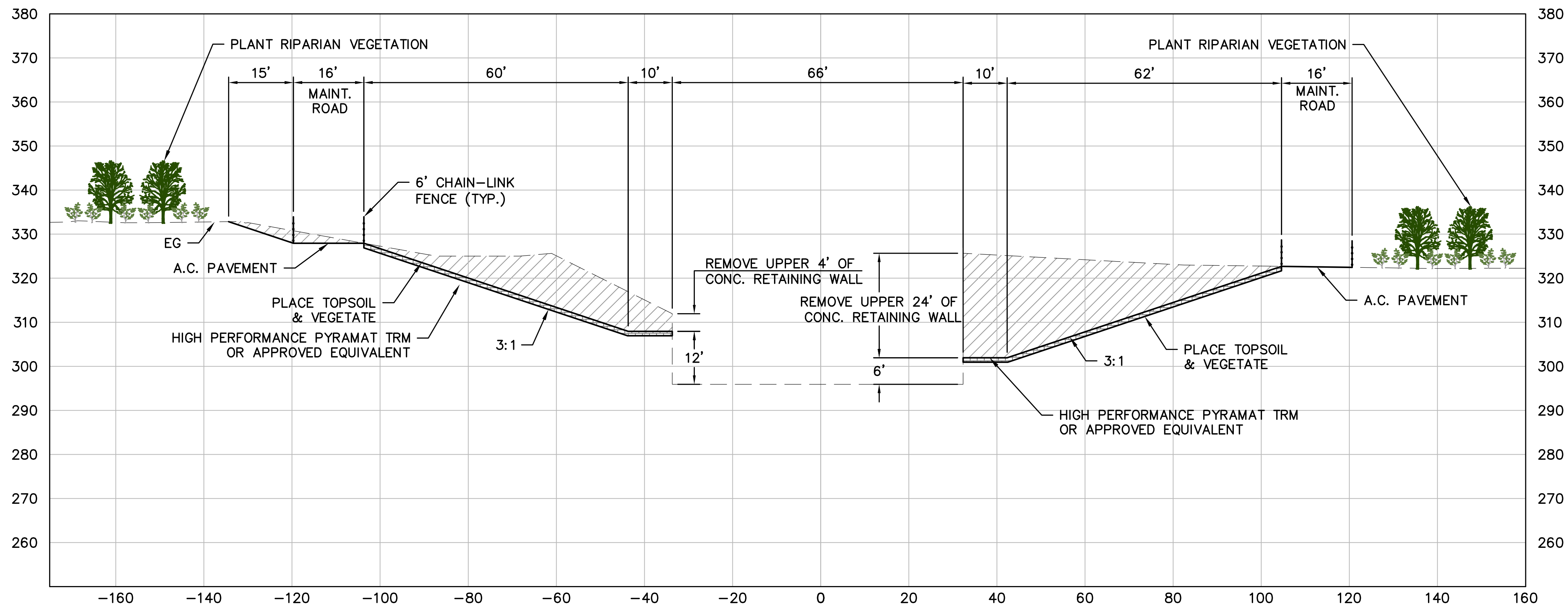

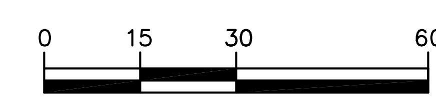

LEGEND

— — — —	EX. GROUND		RIPRAP
——	PROPOSED CHANNEL		REINFORCED CONCRETE
	EXCAVATION		HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT
	COMPACTED FILL		NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ALTERNATIVES 13, 16, & 20
REACH 7 (R7A12 & R7A16)

DATE
04/16/13

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12 OF 13

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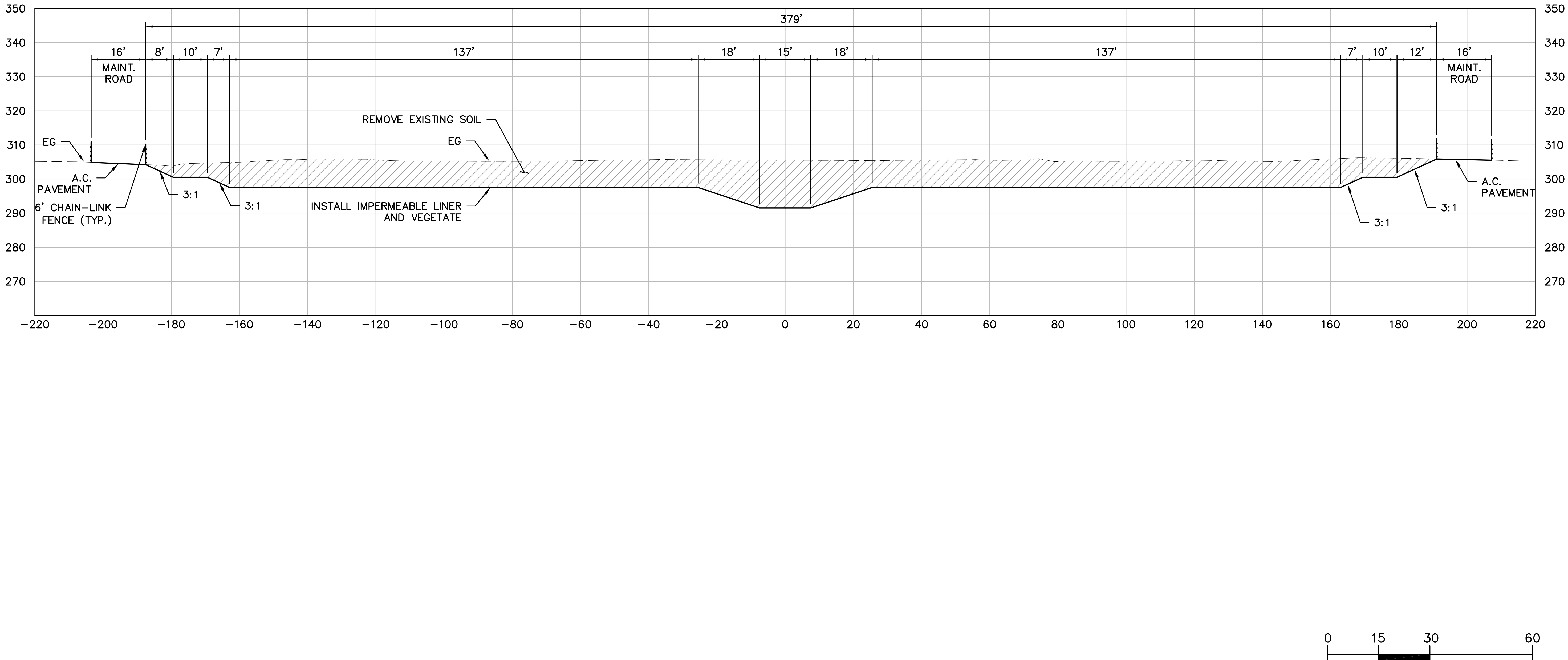

LEGEND

— — — —	EX. GROUND		RIPRAP
———	PROPOSED CHANNEL		REINFORCED CONCRETE
	EXCAVATION		HIGH PERFORMANCE PYRAMAT TURF REINFORCEMENT MAT (TRM) OR APPROVED EQUIVALENT
	COMPACTED FILL		NOTE: ALL DIMENSIONS SHOWN ARE APPROXIMATE AND SUBJECT TO REVISIONS DURING FINAL DESIGN

REVISIONS

MARK	DATE	DESCRIPTION	BY

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Irvine, CA 92614
Phone (949) 809-5000, FAX (949) 809-5003

LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ALTERNATIVE 20
REACH 7 (R7A16)

DATE
04/16/13

SHT NO.
13 OF 13

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

FINAL
Economic Appendix

September 2015

LOS ANGELES RIVER ECOSYSTEM RESTORATION FEASIBILITY STUDY

ECONOMIC APPENDIX

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1. INTRODUCTION

1.1 Purpose

The purpose of this appendix is to document the socioeconomic resources, regional economic development considerations and to present the economic evaluation of the benefits and costs associated with habitat restoration and compatible recreation features along the Los Angeles River (River) within the City of Los Angeles (City) in Los Angeles County, California.

1.2 Guidance and Reference

The principal controlling guidance of the analysis comes from the U.S. Army Corps of Engineers' (USACE) *Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook,* with specific guidance from Appendix D, Economic and Social Considerations. Evaluation of alternatives has been completed in accordance with *IWR Report #95-R-1, Evaluation of Environmental Investments Procedures Manual, Interim: Cost Effectiveness and Incremental Cost Analyses, May 1995*. Benefits and costs for plan formulation, comparison and evaluation were calculated at FY 2013 price levels utilizing a discount rate of 3.75 percent and a base year of 2022. Benefits and costs for the NER and LPP were refined and updated and are presented at October 2015 price levels, utilizing the current 3.375% federal discount rate, a 50 year period of analysis, and an assumed Base Year of 2033.

2. STUDY AREA

2.1 Watershed Description and Location

The confluence of Arroyo Calabasas and Bell Creek forms the start of the Los Angeles River. From the confluence, the River flows through the western San Fernando Valley and through Sepulveda Reservoir and then is joined from the north by Tujunga Wash. Tujunga Wash includes flow from both Hansen Dam and Pacoima Wash. Further downstream, the Burbank-Western channel and smaller creeks draining the western San Gabriel Mountains join the River as it flows easterly through the eastern San Fernando Valley. The River bends south around the Hollywood Hills and is joined from the east by Verdugo Wash, and then flows south though the Glendale Narrows and onto the broad coastal plain. The River is joined by a number of tributaries, including the Arroyo Seco and the Rio Hondo Diversion Channel, which carries runoff from Whittier Narrows Dam. From the Rio Hondo Diversion Channel confluence, the River continues south another 12 miles and discharges into the Pacific Ocean at the San Pedro/Long Beach Harbor.

The watershed has highly varied terrain consisting of precipitous mountains, low-lying foothills, valleys, and coastal plains. The upper portion of the watershed (~360 square miles) is predominantly forest or open space including more than 100 square miles of the Angeles National Forest. The remainder of the watershed (~464 square miles) lies in the coastal plain, which includes the entire City of Los Angeles. It is a highly developed area with commercial, industrial, and residential land uses. North of downtown Los Angeles to the confluence with the Rio Hondo, the river flows through industrial and commercial areas and is bordered by rail yards, freeways, and major commercial and government buildings. From the Rio Hondo Diversion Channel to the Pacific Ocean, the river flows through industrial, residential, and commercial areas, including major refineries and petroleum products storage facilities, major freeways, rail lines, and rail yards serving the Ports of Los Angeles and Long Beach. The river and most of its tributaries in the urbanized portions of the Los Angeles watershed have been highly modified from their original natural courses to protect property and human life from the effects of flooding.

From its headwaters to the Pacific Ocean, the River drops approximately 790 feet in elevation over roughly 51 miles (about 15 feet per mile, yielding an average slope of approximately 0.3 percent). During the rainy season from October to March, heavy flows and occasional floods occur. In times of peak flow the river carries more than 180,000 cubic feet of water per second (cfs) at velocities exceeding 25 feet per second in some areas. That volume of discharge is approximately 14 times the flow of New York's Hudson River moving at a velocity of upwards of 17 miles per hour.

Today, the River no longer resembles the naturally meandering and ephemeral river that periodically caused devastating floods during winter. Even though the River could no longer support the area's rapidly growing water demands by the late 19th century, extensive development on its natural floodplain have continued into the present. Seasonal flows slowed to a trickle throughout most of the dry season, and the winter storm flood threat increased as development expanded on the River's natural floodplain. Storms produced massive flows in the River causing flooding that resulted in the loss of lives and millions of dollars in property damage in the late 19th and early 20th centuries.

Modifying the River to contain these periodic floods has rendered it a flood conveyance channel that does not resemble a natural river system. Improvements for flood risk management have included bank hardening and lining the bed of the channel with concrete for approximately 44 of its 51 miles. An approximately 7 mile stretch of the River near the Verdugo Wash confluence has grouted riprap side slopes and is the only portion of the study area left with a soft bed, albeit this area has also been engineered with a cobblestone bed that has migrated or washed away over the years. During the dry season, base flows in the channel are often less than 100 cfs and are entirely comprised of discharge from municipal and industrial wastewater treatment plants and urban/irrigation runoff. Open space, parks, and greenways are scarce. Instead, impervious surfaces, industrial development, and residential and commercial areas dominate the study area. Additional details and figures of the watershed can be found in sections 1 and 2 of the Integrated Feasibility Report.

2.2 ARBOR Reach

The baseline study area that was initially considered during the planning process includes 32 miles of the River that is within the City of Los Angeles, within a half mile of each bank. It begins at the confluence of Bell Creek and Arroyo Calabasas in the northwest San Fernando Valley at Owensmouth Boulevard, and ends near the City of Vernon in the downtown Los Angeles area. Through initial investigation of constraints in the baseline study area and the identification of where ecosystem restoration might best be accomplished, the planning process resulted in defining the focused study area as the ARBOR (Area with Restoration Benefits and

Opportunities for Revitalization) Reach. This area extends from the Headworks downstream to First Avenue (See Figure 2.1). This study area includes the Glendale Narrows, which is the only portion of the River that does not have a hardened bed (bottom of the river channel), and contains several distinctive sites and connections including the Headworks, Pollywog Park, Bette Davis Park, the Burbank-Western Channel and Glendale River Walk, Griffith Park, Ferraro Fields, Verdugo Wash, Atwater Village, Taylor Yard and the Rio de Los Angeles State Park, the "Cornfields" (LA State Historic Park), Arroyo Seco, Elysian Park, "Piggyback Yard" (also known as "Los Angeles Transportation Center" as well as "Mission Yard"), and downtown Los Angeles. These sites, which are identified in later figures, provide key opportunities for restoration and enhanced connectivity.

2.2.1 Reaches

There are eight geomorphically different reaches within the study area (Figure 2.1). They were defined based on the physical characteristics of channel morphology, bank characteristics, soil exposure, existing habitat, and surrounding land uses. Specific geomorphic criteria include: (1) channel bed type (either soft bed with groundwater/surface water exchange, or concrete), (2) side slope type (vertical or trapezoidal), and (3) adjacent land uses or open space.

Reach 1: Pollywog Park/Headworks to Midpoint of Bette Davis Park: Reach 1 is the upstream segment of the study area and is approximately 1.5 river miles in length. It connects the study area to Burbank at Disney Studios and the Headworks Ecosystem Restoration Site. The channel here has a rectangular concrete-lined configuration with subdrains and no low flow channel. There is a rubber dam within the river bed near the upstream end of this reach that was once used to help divert water to the Headworks spreading grounds operated by Los Angeles Department of Water and Power (LADWP). The channel is approximately 18 feet deep and the bank-to-bank width is approximately 115 feet.

Reach 2: Midpoint Bette Davis Park to Upstream end Ferraro Fields: This reach is approximately 0.75 mile in length. It extends from the midpoint of Bette Davis Park on the left bank (facing downstream), where the bed transitions from concrete-lined to a cobble bed, and then transitions back to concrete at approximately the upstream edge of Ferraro Fields on the right bank. The channel has a trapezoidal configuration with grouted Derrick stone banks. The banks are toed-down (secured by extending the bank wall below the river bed) with sheet pile and quarry run stone. The bed is approximately 18 feet deep from the top of bank and approximately 175 feet wide. Sediment deposited in the channel has formed sand bars/islands, which have stabilized as the root systems of the many trees and other vegetation have trapped sediment over time. This reach, however, is not as densely vegetated as areas farther downstream in Reaches 4 to 6.

Reach 3: Ferraro Fields to Brazil Street: This reach is approximately 1 mile in length. It begins at the upstream edge of the Ferraro Soccer Fields on the right bank where the bed transitions from cobbles to concrete. It makes an approximately 90-degree curve to the south around Griffith Park and transitions back to cobbles at approximately Brazil Street on the left bank. The channel in this area has a rectangular concrete configuration. The bed is approximately 18 to 23 feet deep from the top of bank and approximately 180 feet wide, widening to 380 feet wide downstream of the Verdugo Wash confluence. State Route (SR)-134 (Ventura Freeway) crosses the River at Verdugo Wash.

Reach 4: Brazil Street to Los Feliz Boulevard: This reach is approximately 1.75 miles long and extends from Brazil Street on the left bank downstream to the Los Feliz Boulevard Bridge. The bed transitions from a concrete-lined rectangular channel to a trapezoidal channel with a cobble bed and grouted Derrick stone banks. Banks are toed-down with sheet pile and quarry run stone. The bed was constructed approximately 18 feet deep from the top of slope, and the channel ranges from approximately 130 to 160 feet wide from top of bank to top of bank. Sediment deposited in the channel has formed sand bars/islands, which are stabilized by the root systems of the many trees and other vegetation. This reach ends at the Los Feliz Boulevard Bridge, where localized concrete lining of the bed and banks plus pier noses that extend upstream have been constructed to protect the bridge and lower the water surface underneath the bridge.

Reach 5: Los Feliz Boulevard to Glendale Freeway: This reach is approximately 1.55 miles long and veers east between Hyperion Avenue and SR-2 (Glendale Freeway). The reach extends from the Los Feliz Boulevard Bridge, under the Sunnynook pedestrian bridge and the Hyperion Avenue Bridge, downstream to the Fletcher Drive Bridge and ends at the SR-2 Bridge. The bed transitions from concrete under each of the large bridges (e.g., Los Feliz Boulevard, Hyperion Avenue) to a trapezoidal channel with a cobble bed and grouted Derrick stone banks between the bridges. Banks are toed-down with sheet pile and quarry run stone. The bed is approximately 18 feet deep and the top of the channel is approximately 130 to 160 feet wide. Sediment deposited in the channel has formed sand bars/islands, which have stabilized as the root systems of the many trees and other vegetation have trapped sediment. This reach ends as the River begins to curve back east as it approaches Taylor Yard.

Reach 6: Glendale Freeway to I-5: This reach is approximately 2.34 miles long and meanders through three river bends. It extends from the SR-2 Bridge to the downstream crossing of Interstate 5 (I-5), where the bed transitions from cobble to concrete-lined. Here, the channel is in a trapezoidal configuration with a cobble bed and grouted Derrick stone banks. The banks are toed-down with sheet pile and quarry run stone. The bed is approximately 30 feet deep from the top of slope and the top of the channel ranges from approximately 190 to 215 feet wide. Sediment deposited in the channel has formed sand bars/islands, which have become stabilized as the root systems of the many trees and other vegetation have trapped sediment. The channel narrows to 170 feet and transitions to a rectangular configuration just upstream of the complicated I-5 and SR-110 interchange.

Reach 7: I-5 to Main Street: This approximately 1-mile-long reach begins at the I-5 Bridge and extends to the Main Street Bridge. The channel in this area transitions out of the rectangular concrete channel at the Arroyo Seco confluence, and becomes a trapezoidal concrete channel that is approximately 30 feet deep, with a top of bank width that ranges from approximately 150 to 190 feet. Three bridges cross the River in this reach, including a railroad bridge, the North Broadway Bridge, and the Spring Street Bridge. The channel has adjacent rail lines on both banks.

Reach 8: Main Street to First Street: This approximately 1-mile-long reach begins at the Main Street Bridge and extends downstream to the First Street Bridge. The trapezoidal concrete channel is approximately 30 feet deep with a top of channel width that ranges from approximately 170 to 200 feet. Rail lines run adjacent to the channel on both banks, and two railroad bridges cross the river. US-101 crosses the river between Cesar Chavez and First Street.

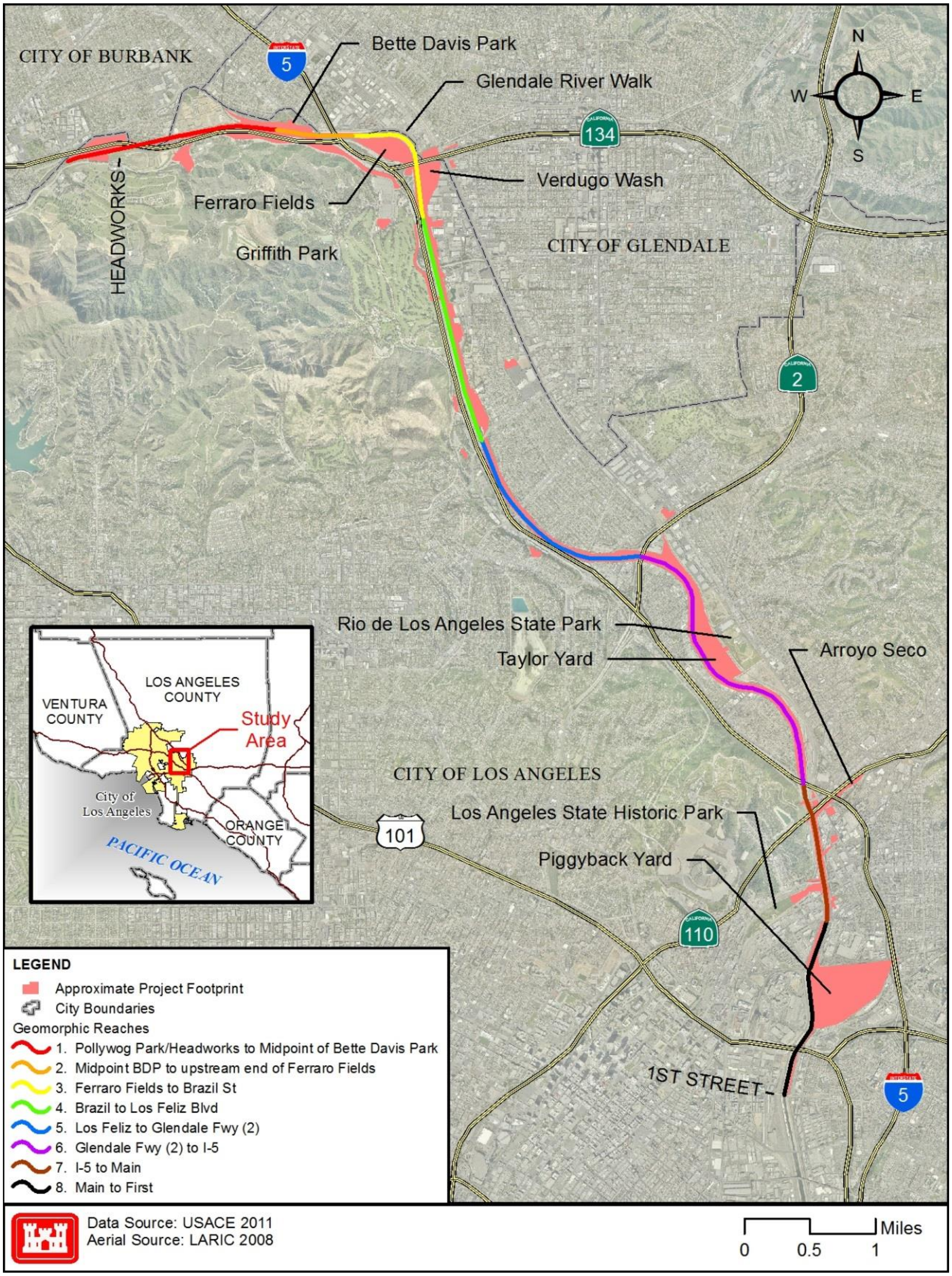

Figure 2.1 ARBOR Reach

2.3 Problems and Opportunities

The Los Angeles River watershed is unique due to the extremely large human population and massive infrastructure development in and adjacent to the river channel and floodplain. While flooding remains a concern in this reach, much had already been accomplished to manage flood risk, including construction and operation of Corps of Engineers and other dams in the watershed and channelization of the LA River and its tributaries. Further reductions in residual flood risk are not the focus of the current investigation. The following problems, which could potentially be addressed by the feasibility study, were agreed upon during planning charettes with key agency and stakeholder representatives and the Corps held in December of 2009 and are listed below.

2.3.1 Problems

Urbanization and flood risk management projects have created the following problems:

1. Loss of aquatic habitat for native valley foothills riparian, freshwater marsh, fish, and wildlife species since channelization of the river system and urbanization of the surrounding area during the 20th Century

2. Lack of ecological processes necessary to support ecosystem function in valley foothills riparian, and freshwater marsh habitat

3. Lack of substrate supporting valley foothills riparian, freshwater marsh, and fish habitats

4. Lack of connectivity to floodplains and functioning ecological zones

5. Highly altered hydrologic regime

6. High velocity flows within the study area that prevent establishment of riparian habitat

7. Disruption of natural sedimentation processes

8. Impervious surfaces in the drainage area preventing infiltration and recharge

9. Poor water quality caused by urban runoff and pollution that degrades aquatic habitat

10. Presence of non-native vegetation/exotics and trash accumulation in the river degrading aquatic habitat and prevent establishment of native vegetation

11. Lack of recreation and opportunities to interact with the natural environment

2.3.2 Public Concerns

Following construction of the Los Angeles County Drainage Area (LACDA) Project, walls were built higher downstream to protect the interests of downstream cities. However, in the years since LACDA, extensive growth of vegetation and concentration of sediment has occurred within the soft-bottomed reaches of the river, including within the study area. This condition has provided habitat but also reduced flood conveyance. Therefore, this condition is an important consideration—and both a problem related to potential flooding and an opportunity related to providing habitat—in formulating the study alternatives.

2.3.3 Opportunities

The study team and the agencies involved with these planning efforts agreed that the problems present the following opportunities for restoration of nationally and regionally significant ecosystem function within the study reach. The relationship between each problem and opportunity is noted with a notation. For example P1 would refer to problem one in the previous list. Opportunities are as follows:

- Restore lost aquatic habitat including valley foothill riparian, freshwater marsh, and native fish habitat (P1).
- Improve diversity and abundance of native valley foothill riparian and freshwater marsh plants to support the diversity and abundance of wildlife species (P1).
- Improve and restore ecological processes in the project area to support ecosystem function in valley foothill riparian communities, freshwater marsh, and native fish habitats (P2).
- Restore substrate in valley foothill riparian, freshwater marsh, and native fish habitats (P3).
- Improve connectivity to floodplains and functioning ecological zones (P4).
- Restore a more natural hydrologic regime (P5).
- Decrease peak discharges and/or increase floodplain area in the mainstem and at tributary confluences to reduce discharges and velocities that prevent establishment of native habitats (P6).
- Improve natural sedimentation processes (P7).
- Improve infiltration and recharge (P8).
- Improve water quality from urban runoff in the river, its tributaries, and other drainages entering the river to prevent degradation of aquatic habitat (P9).
- Remove and manage invasives/exotics and trash to reestablish native vegetation (P10).
- Increase recreation allowing compatible human interaction with restored ecosystems (P11).

3. SOCIOECONOMIC RESOURCES

This analysis focuses on the ARBOR Reach as defined in Section 2 (Figure 2.1). The study area is in a densely populated area of Los Angeles County with centers of substantial commercial and industrial activities. The study area contains a wide range of land uses and economic activities.

3.1 Land Use

Figure 3.1 shows the land use patterns along the three stretches of the river within the study area. In general, the land in the study area is dominated by high-density residential and mixed residential development[1]. The vast majority of land along and around the San Fernando Valley stretch is comprised of high-density single family residential development, a significant portion is also occupied by low-rise apartments, condominiums, and townhouses. Within a two-mile radius of the river the land use is almost exclusively residential with interspersed commercial and retail centers supporting the residential neighborhoods. Significant manufacturing and industrial activity (shown in light blue in Figure 3.1) occurs slightly further away from the river. The Sepulveda Dam and Reservoir are located along this stretch of the river.

The land immediately adjacent to and west of the Glendale Narrows reach is dominated by single-family and mixed residential use, while the land on the east side of the river is less homogeneous and is a combination of mixed residential use (high-density single family, low-rise apartments, condominiums, and townhouses), manufacturing and industrial uses, and some commercial and retail centers. This area includes the Silver Lake Reservoir and the Griffith Park recreational area.

The Downtown Los Angeles area is surrounded by mixed residential, commercial, and manufacturing and industrial uses, and, as can be seen in Figure 3.1, a high percentage of the area is used for manufacturing and industrial activity, as well as wholesaling and warehousing. While the land east of and immediately adjacent to the river is mostly used for manufacturing, industrial, and wholesaling purposes, beyond this narrow strip of land exists a densely-populated area comprised of mixed residential land use.

[1] "Mixed residential" refers here to areas with a variety of residential structure types and densities, such as single family homes, townhomes, condominiums, apartment complexes, etc.

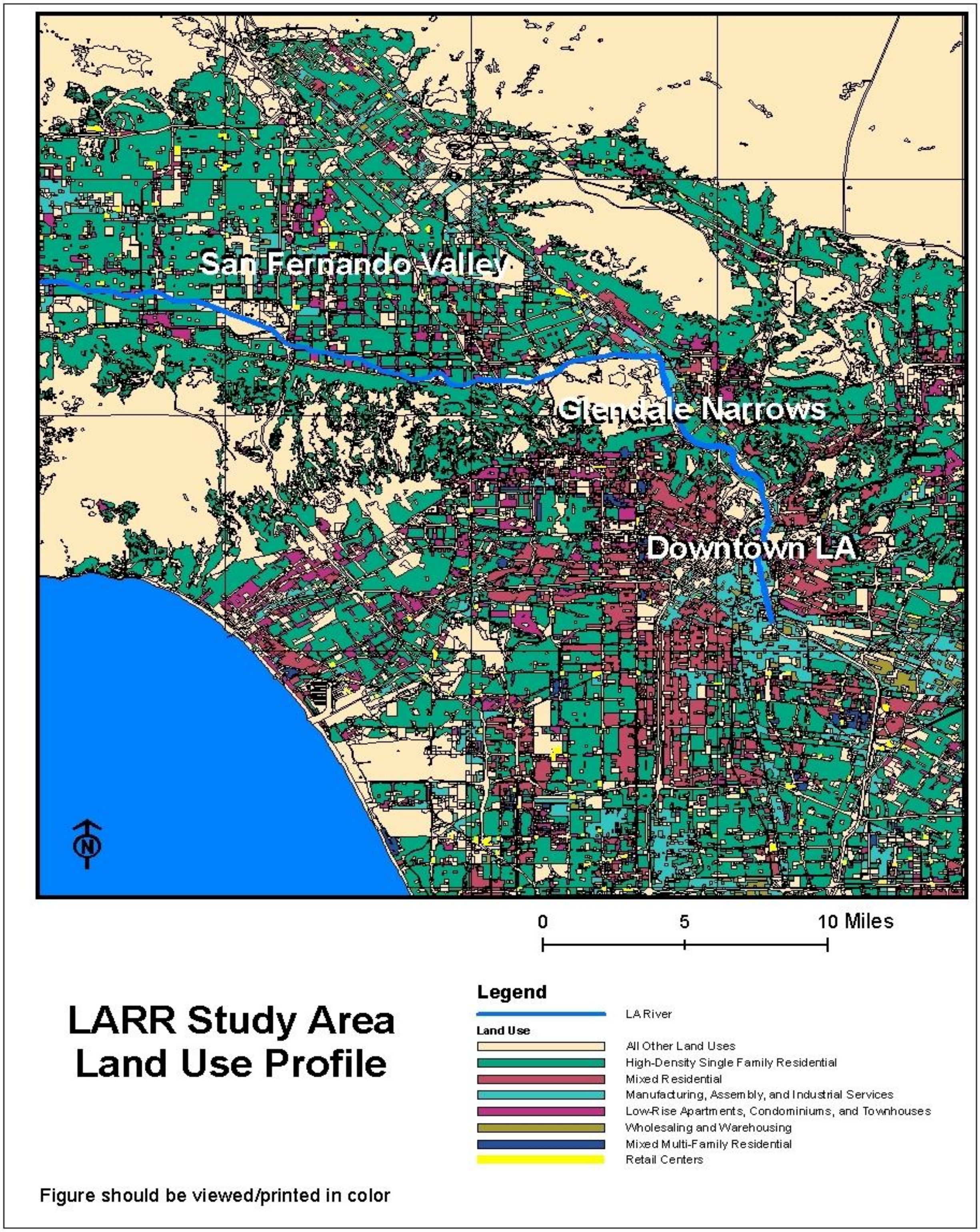

Figure 3.1 LA River Restoration (LARR) Study Area Land Use

3.1.1 Future Land Use

The study area is essentially built out; nearly all new housing development activity will involve recycling of land, as noted in the 2006 – 2014 Housing Element of the General Plan (City of Los Angeles 2009). No large scale changes to land use patterns are anticipated, however there are some trends and small scale changes which are noted below. The City's Planning Department has recently recommended zoning changes to the downtown industrial core that would rezone land from industrial to commercial and mixed-use in order to allow development that is "consistent with existing and surrounding areas".[2] At this point it is not clear to what extent, if any, this would include residential development. The City is also evaluating opportunities adjacent to the river to promote redevelopment – including the creation of recreation areas as well as commercial, residential, and mixed-use areas. The City has made it a priority to promote higher density housing development and mixed-use commercial and residential development through an increasing number of housing initiatives and incentive programs.

3.2 ARBOR Reach Demographics

The ARBOR Reach (Figure 2.1) starts slightly upstream of the Burbank-Western Channel's interception with the Los Angeles River through E 1st Street in downtown Los Angeles. Portions of three cities: Los Angeles, Glendale and Burbank are included in the census tracts located within a half mile of the river. The ½ mile zone is the most likely area to be directly influenced by project features.

Census tract and community level socioeconomic and demographic data is presented in this section. At the community level, data for the cities of Los Angeles, Glendale, and Burbank are presented. The map in Figure 3.2 displays the 35 census tracts, covering approximately 25.1 square miles that are used to compute census tract level statistics. These census tracts were chosen by selecting all census tracts located partially or wholly within a one-half mile buffer on either side of the river. The combined 35 census tracts are referred to as the assessment area in this appendix.

The description of the existing or without project socioeconomic conditions contained in the various sections below is based on the 2008-2012 American Community Survey as well as other regional and local data as available (U.S. Census Bureau 2012). Additional census data was obtained for incorporation into the final report in response to public comments. At release of the draft report, all available tract-level data was based on Census 2000 tract boundaries. Recently, detailed tract-level data based on the Census 2010 tract boundaries became available. The analysis has been updated to reflect Census 2010 tract boundaries in the final report.

[2] http://cityplanning.lacity.org/

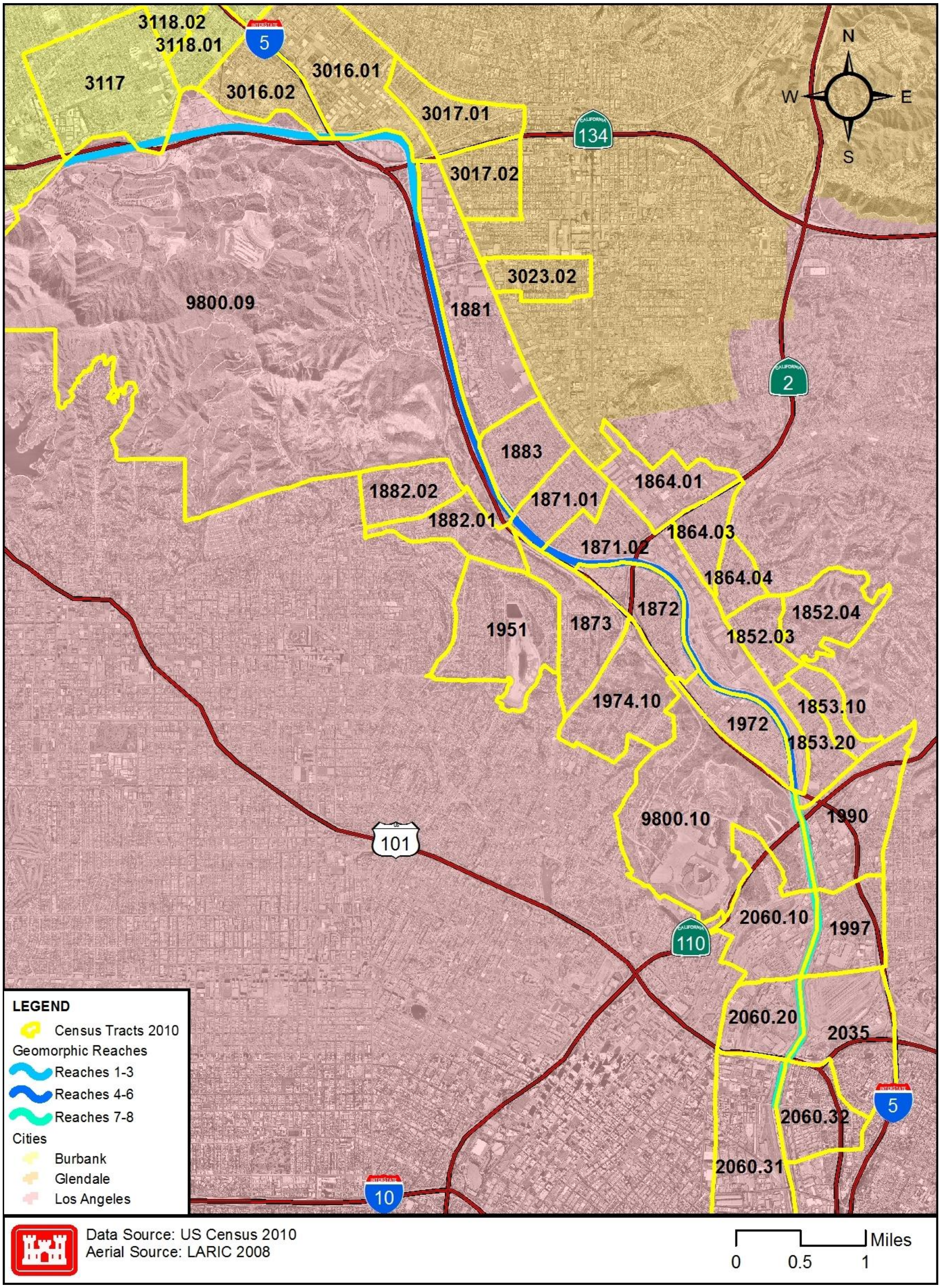

Figure 3.2 Study Area Census Tracts

3.2.1 Population and Housing

Los Angeles County spans over 4,700 square miles and has approximately ten million residents (U.S. Census Bureau 2010b). Within the 35 census tracts in the assessment area, total population is estimated at approximately 127,000 residents, equating to an average density of 5, 060 residents per square mile, about twice the density of the county as a whole. The population, density, and racial profile of each census tract are provided in Table 3-1.

Table 3-2 and Figure 3.3 show the recent and projected population for the county and cities in the study area. For both, the rate of annual growth has generally been declining, and the county and City population rate of growth is projected to be around 0.3 percent by 2040 (LAEDC 2012).

Because the extent to which redevelopment and increased density will affect population in the socioeconomic assessment area has not been quantified, it is assumed that conditions in the assessment area will generally follow the same trends as the county and the City, with overall growth slowing throughout the period of analysis.

Housing in the socioeconomic assessment area is summarized in Table 3-3, which includes household, housing and ownership metrics. Among the 35 census tracts, total housing units range from 0 to 2,707, with a total of 46,246 units in the assessment area, and an overall vacancy rate of 6.45 percent. The vacancy rate in the assessment area is 0.4 percent less than the City of Los Angeles, and 0.2 percent less than the county. Additionally, the assessment area contains a larger proportion of rental units, with only 33 percent owner-occupied units, compared to 38 percent in the City of Los Angeles and 47 percent in the county.

Table 3-1 Population, Density, and Race[1]

Area	2010 Population[2]	Density (per square mile)	% White	% Black	% Hispanic	% Asian	% Other
City of Burbank	103,340	5,890	58	3	25	12	3
City of Glendale	191,719	6,405	62	1	17	16	3
City of Los Angeles	3,792,621	8,092	29	10	49	11	3
Los Angeles County	9,818,605	2,397	27	9	48	15	1
Assessment Area Tracts							
1852.03	3,106	14,680	14	1	77	7	1
1852.04	2,087	5,609	26	3	45	26	0
1853.10	3,383	20,808	3	1	94	2	0
1853.20	3,072	13,473	4	0	85	11	0
1864.01	3,791	10,217	4	1	83	12	0
1864.03	2,947	14,132	5	2	72	22	0
1864.04	2,291	14,792	7	1	86	6	0
1871.01	3,004	9,872	38	1	39	21	0
1871.02	3,018	3,558	19	0	62	19	0
1872.00	3,058	8,325	5	1	82	12	0
1873.00	3,461	7,669	53	2	26	18	1
1881.00	4,113	5,013	23	2	64	11	0
1882.01	3,282	10,951	65	1	13	21	0
1882.02	2,613	8,920	65	2	15	17	0
1883.00	3,335	9,360	37	1	40	21	1
1951.00	4,673	6,385	72	4	10	14	0
1972.00	4,028	13,425	2	1	54	41	1
1974.10	4,005	7,445	41	2	41	15	1
1990.00	5,095	8,456	3	0	60	37	0
1997.00	3,314	8,843	6	0	72	21	0
2035.00	3,507	5,480	2	0	86	11	0
2060.10	2,963	5,334	4	2	59	33	3
2060.20	7,298	21,638	21	33	41	4	1
2060.31	2,736	1,498	43	11	12	35	0
2060.32	5,318	14,010	3	2	79	17	1
3016.01	6,324	7,221	78	2	17	3	0
3016.02	4,154	10,595	38	3	38	20	1
3017.01	2,678	7,443	62	1	24	13	0
3017.02	6,025	19,171	59	1	21	20	0
3023.02	5,134	21,006	46	3	33	17	1
3117.00	6,204	6,829	63	3	24	10	0
3118.01	3,378	14,935	42	2	46	10	0
3118.02	3,680	11,570	27	3	54	16	1
9800.09	2	0	50	0	0	50	0
9800.10	192	130	40	2	20	38	0
Totals[1]	127,269	5,077	32	4	48	16	0

[1]The most recent complete data source was the 2008-2012 American Community Survey. Race information derived from tables "Hispanic or Latino and Race," where Hispanic includes all those identifying as Hispanic or Latino, and races are one-race statistics (White-Alone, Black-Alone, etc.).
[2] Population is a sum. Race profile totals are weighted averages using population as the weights. Source: U.S. Census Bureau 2012.

Table 3-2 Historical and Projected Population

Year	Compound Annual Growth Rate[1]	Population (thousands)[2]			
		LA County	City of Los Angeles	City of Burbank	City of Glendale
2000	-	9,540	3,695	100	195
2005	-	9,810	3,731	100	195
2010	-	9,819	3,793	103	192
2015	0.65%	10,140	3,917	107	198
2020	0.70%	10,500	4,056	110	205
2030	0.59%	11,140	4,303	117	217
2040	0.27%	11,450	4,423	120	224

[1] Growth rate from LAEDC 2012 and applied to area cities.[2] LAEDC 2012 and U.S. Census American Fact Finder

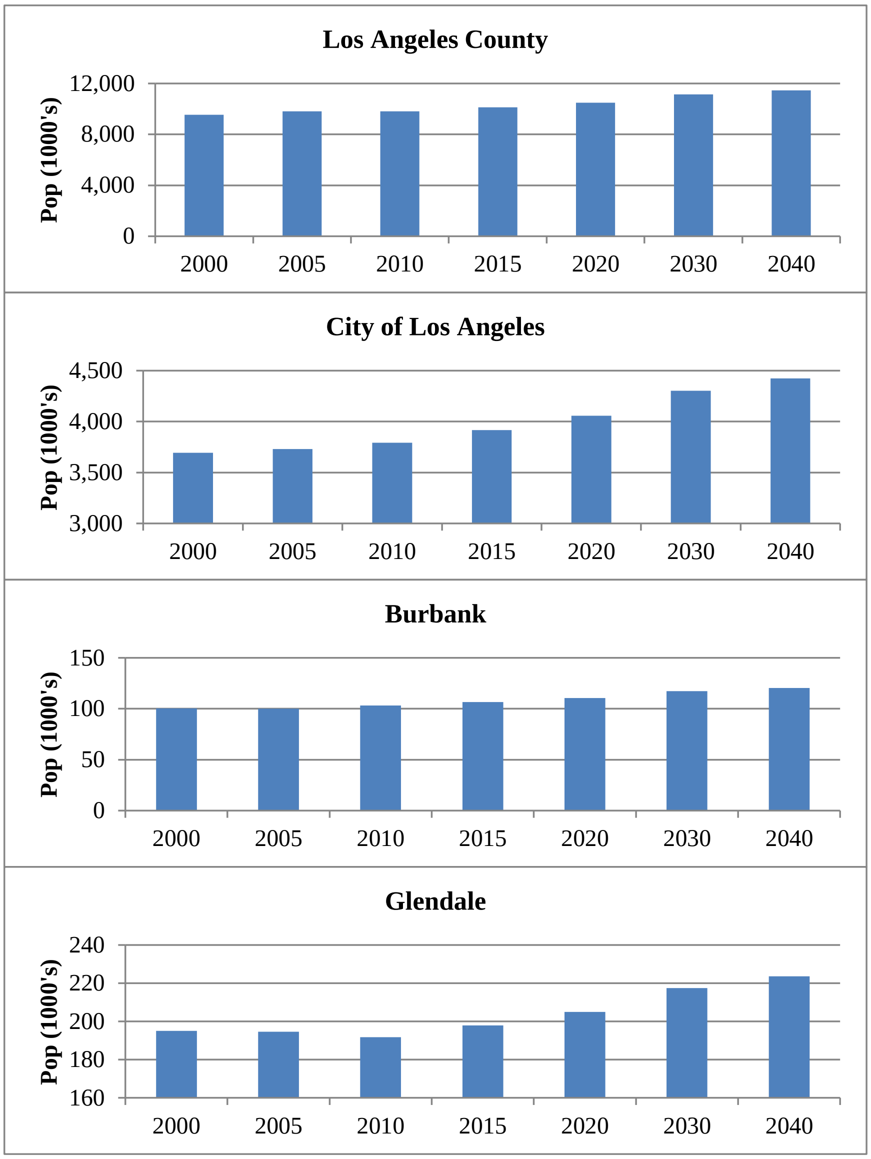

Figure 3.3 Historical and Projected Population

Table 3-3 Housing in the Assessment Area

Area	# Households	# Housing Units	% Vacant	% Owner Occupied
City of Burbank	40,864	44,309	7.8	44,0
City of Glendale	70,710	76,269	7,3	39.2
City of Los Angeles	1,317,663	1,413,995	6.8	38.0
Los Angeles County	3,218,511	3,444,342	6,6	47.3
Assessment Area Tracts				
1852.03	941	956	1.6	47.1
1852.04	669	727	8.0	86.2
1853.10	779	901	13.5	37.9
1853.20	903	930	2.9	42.3
1864.01	989	1,061	6.8	16.4
1864.03	832	861	3.4	32.1
1864.04	668	719	7.1	28.9
1871.01	1,285	1,319	2.6	51.0
1871.02	1,109	1,218	8.9	33.1
1872.00	907	958	5.3	36.9
1873.00	1,514	1,636	7.5	34.3
1881.00	1,726	1,827	5.5	23.2
1882.01	1,938	2,017	3.9	13.1
1882.02	1,189	1,297	8.3	60.1
1883.00	1,382	1,494	7.5	51.7
1951.00	2,079	2,176	4.5	59.7
1972.00	1,141	1,215	6.1	43.9
1974.10	1,738	1,810	4.0	44.0
1990.00	1,526	1,707	10.6	22.5
1997.00	997	1,057	5.7	19.1
2035.00	920	1,046	12.0	13.5
2060.10	981	1,086	9.7	10.1
2060.20	206	220	6.4	1.5
2060.31	1,499	1,700	11.8	40.2
2060.32	1,564	1,625	3.8	11.0
3016.01	2,257	2,308	2.2	11.3
3016.02	1,597	1,697	5.9	36.1
3017.01	1,063	1,151	7.6	61.6
3017.02	1,916	2,083	8.0	26.1
3023.02	1,760	1,818	3.2	9.1
3117.00	2,505	2,707	7.5	55.7
3118.01	1,321	1,352	2.3	16.4
3118.02	1,303	1,484	12.2	12.0
9800.09	0	0	-	-
9800.10	58	83	30.1	34.5
TOTAL	**43,262**	**46,246**	**6.5**	**33.0**
Source: U.S. Census Bureau 2012.				

3.2.2 Employment and Income

Los Angeles County has a highly diverse economy, with a gross annual product in 2010 of approximately $544 billion (LAEDC 2012), or approximately 29 percent of the gross annual product for all of California. Table 3-4 shows some of the basic economic indicators at the county and state level. Socioeconomic conditions in the assessment area are likely to reflect similar trends as the county and state. Trends over the last decade largely mimic the effects of the Great Recession that began in 2008 and has had national impact. California still has one of the highest unemployment rates in the nation, and this is reflected in parts of the assessment area, though on the whole, the unemployment rate in the assessment area is about 2 percent lower than the unemployment rate for Los Angeles County (12.4 percent) and 2.6 percent lower than the City of Los Angeles. Within the census tracts making up the environmental justice communities, the unemployment rate ranges from 6.2 to 21.8 percent, with an average of 12.6 percent, nearly 50 percent higher than in the study area as a whole.

Table 3-4 Comparison of Southern California Economic Indicators

Area	Median Household Income	2010 Unemployment Rate	2010 Poverty Rate	2010 Median Home Value
City of Burbank	$67,693	9.2	8.5	$570,500
City of Glendale	$54,369	12.7	12,9	$597,000
City of Los Angeles	$49,745	13.0	21.2	$470,000
Los Angeles County	$56.241	12.4	17.1	$443,400
All of California	$61,400	12.8	15.3	$383,900
Assessment Area Tracts				
1852.03	$46,744	10.4	16.30	$350,400
1852.04	$80,950	11.6	18.30	$522,900
1853.10	$40,915	6.2	28.90	$352,800
1853.20	$44,253	11.7	13.10	$371,600
1864.01	$33,382	15	30.70	$371,400
1864.03	$49,353	5.1	15.30	$436,300
1864.04	$48,250	4.8	18.20	$433,500
1871.01	$55,391	4	14.50	$509,300
1871.02	$45,781	6.1	8.70	$566,900
1872.00	$45,455	8.2	20.40	$357,700
1873.00	$74,135	13.8	9.10	$605,100
1881.00	$45,759	11.9	22.50	$567,200
1882.01	$65,859	8.8	8.90	$576,900
1882.02	$100,325	13.5	8.30	$1,000,000+
1883.00	$61,934	9.2	10.90	$600,900
1951.00	$95,184	13.3	8.60	$889,600
1972.00	$43,205	14.1	16.70	$356,800
1974.10	$51,493	9.6	14.70	$566,700
1990.00	$25,149	13.5	39.00	$358,800
1997.00	$35,484	21.8	40.40	$322,000
2035.00	$39,345	12.7	28.00	$389,500
2060.10	$14,583	10.2	49.40	$371,000
2060.20	$102,617	5.3	10.20	-
2060.31	$43,102	12.4	31.20	$402,900
2060.32	$23,511	11.1	37.40	$317,600
3016.01	$43,066	12.5	18.20	$543,500
3016.02	$55,202	13.1	14.40	$550,000
3017.01	$63,304	5.9	3.90	$575,300
3017.02	$48,456	12	15.20	$463,500
3023.02	$40,644	11.2	17.90	$436,500
3117.00	$74,539	5.6	4.90	$585,100
3118.01	$62,500	8.5	10.30	$549,700
3118.02	$43,560	9.8	8.90	$558,800

Area	Median Household Income	2010 Unemployment Rate	2010 Poverty Rate	2010 Median Home Value
9800.09	$117,905	50	-	-
9800.10	$108,472	15.6	36.60	-
TOTAL	**$53,072**	**10.4**	**18.4**	**$485,100**
Sources: U.S. Census Bureau 2012, U.S. Census Bureau 2011, LAEDC 2012.				

According to the Los Angeles County Economic Development Corporation (LAEDC 2012), Los Angeles County's economic base (based on the concept of exports of goods and services), in order of importance, resides in the entertainment, trade (transportation, logistics, distribution), business services, knowledge creation, and fashion industry clusters. Los Angeles County had an estimated non-farm employment of 3.77 million in 2010, reflecting a loss of over 350,000 jobs during the recession which began in 2008, a loss which contributed to the high unemployment rate. Unemployment rates are currently estimated at 7.0 percent for California and 7.5 percent for LA County.[3]. Like the state overall, the LAEDC forecasts a slow but steady recovery for Los Angeles County. Table 3–4 includes the most recent available tract level data, however it should be assumed that the unemployment rates shown there have had similar declines to the County.

Table 3-5 provides the aggregated employment by industry for the 35 census tracts in the socioeconomic assessment area. This data illustrates that while the largest industries in the county are entertainment and trade, employment in the assessment area is driven by the education, health care, social services, and professional and scientific industries.

Table 3-5 Assessment Area Employment by Industry

Industry	Percent
Educational services, and health care and social assistance	18.4
Professional, scientific, and management, and administrative and waste management services	13.3
Retail trade	10.8
Arts, entertainment, and recreation, and accommodation and food services	10.6
Information	9.3
Manufacturing	8.6
Construction	6.2
Other services, except public administration	5.3
Finance and insurance, and real estate and rental and leasing	4.9
Transportation and warehousing, and utilities	4.7
Public administration	3.7
Wholesale trade	3.7
Agriculture, forestry, fishing and hunting, and mining	0.5
Source: U.S. Census Bureau 2010b	

3.2.3 Environmental Justice

This section provides a discussion of environmental justice in accordance with Executive Order (EO) 12898 and the protection of children from environmental health risks in accordance with

[3] February 2015, Bureau of Labor Statistics www.data.bls.gov

EO 13045. The racial and ethnic data from the 2008-2012 American Community Survey and the 2010 Census (U.S. Census Bureau 2010a, 2012) for the census tracts comprising the assessment area, as well as Los Angeles County, are illustrated in Table 3-1 above.

Within the census tracts that encompass the study area, the Hispanic or Latino population was the dominant group with about 48 percent of the population. The White population was second, with about 30 percent of the population. Third was the Asian population, with 14 percent, followed by the African-American population at 4 percent, and other races at 2 percent. Largely similar, the City of Los Angeles reported a 49 percent Hispanic, 29 percent White, 11 percent Asian, 10 percent African-American, and 1 percent other races. In the county, some differences become apparent, where the population is 60 percent White, 25 percent Hispanic, 10 percent Asian, 2 percent African-American, and 3 percent other races.[4]

In 2010, approximately 25 percent of the state's population was under 18 years old. Approximately 24 percent of the population in Los Angeles County was under 18 years of age (U.S. Census Bureau 2011). Within the 28 census tracts of the assessment area, approximately 22 percent of the population was under 18 years of age (U.S. Census Bureau 2010a).

As shown in Table 3-6, about two thirds of the population's primary language spoken at home is non-English. About 41 percent of the population in the study area tracts speak Spanish at home, 35 percent speak English, and the remaining 24 percent speak other languages. The substantial Spanish-speaking population is consistent with the demographic information summarized previously.

Table 3-6 Language Spoken at Home

Area	English Only	Other than English	Spanish	Other Indo-European languages	Asian and Pacific Islander languages	Other languages
Study Area Tracts	34.7	65.3	41.2	10.6	12.9	0.5
Los Angeles County	43.9	56.1	39.6	5.3	10.2	1.0
Burbank	55.9	44.1	20.1	16.0	6.3	1.7
Glendale	32.7	67.3	15.2	37.8	12.8	1.5
Los Angeles	40.3	59.7	43.6	6.7	8.1	1.4

U.S. Census 2010, 2010a, and 2012.
Percentages for study area tracts are based on a weighted average using population as the weights.

As shown in Table 3-7 below, poverty in the study area is generally consistent with regional data. Poverty in the study area is slightly lower than the City of Los Angeles, but about 1 percent higher than in the whole County. Burbank and Glendale have much lower overall poverty rates than the areas of those cities in the study area.

[4] Data source: 2005-2009 American Community Survey. Race information derived from tables "Hispanic or Latino and Race," where Hispanic includes all those identifying as Hispanic or Latino, and races are one-race statistics (White-Alone, Black-Alone, etc.). Note that the U.S. Census Bureau considers the race category of White to include Hispanics, while it considers the ethnicity category of Hispanic or Latino as distinct.

Table 3-7 People in Poverty

Area	People in Poverty (percent)			
	All People	Under 18	18 to 64	Over 64
Study Area Tracts	18.5	28.0	16.2	15.6
Los Angeles County, California	15.4	22.1	13.5	10.7
Burbank city, California	8.3	9.7	8.3	5.8
Glendale city, California	12.3	16.4	10.8	13.1
Los Angeles city, California	19.1	27.9	16.7	13
U.S. Census 2010, 2010a, and 2012. Percentages for study area tracts are based on a weighted average using population as the weights.				

Table 3-8 presents the percent of people with disabilities in Los Angeles County, the City of Los Angeles, Burbank, and Glendale, as well as in the project area. The proportion of people with disabilities in the project area is 10 percent greater than in the County or City as a whole, 20 percent higher than Burbank, and slightly higher than Glendale. The proportion is also higher in all age groups than the corresponding rates in the County and the three cities

Table 3-8 People with Disabilities

Area	People with Disabilities (percent)			
	All People	Under 18	18 to 64	Over 64
Study Area Tracts	10.4	3.2	7.3	41.8
Los Angeles County, California	9.3	2.8	7	38.1
Burbank city, California	8.1	1.7	4.4	34.1
Glendale city, California	10.1	0.9	6.4	44
Los Angeles city, California	9.4	3	6.9	40.1
U.S. Census 2010, 2010a, and 2012.				

The information above does not illustrate the difference in race, poverty, and disabilities among the communities along the river. Census tracts with poverty rates above the Los Angeles City and County averages are found in the southern portion of Reach 6 and in most Reaches 7 and 8, and along both sides of the Los Angeles River. Census tracts with percentages of non-white population above the City and County average are generally concentrated in Reaches 4 through 8, and generally along the eastside of the river (both sides in portions of Reaches 7 and 8). Finally, a look at disabled populations show a focus again in Reaches 6 through 8 (both sides of the river), as well as in zones 2, 3, and 4 (east side of the river). When all of these factors are taken into account, the Environmental Justice communities can generally be found in the southern reaches of the project (Reaches 7 and 8). Table 3-9 highlights the variables in the environmental justice communities compared to the study area, City of Los Angeles, and Los Angeles County.

Table 3-9 Environmental Justice Criteria, Select Census Tracts (Percentages in 2010)

		% Poverty	% Disabled	% Non-White
Los Angeles City		19.1	9.4	71
Los Angeles County		15.4	9.3	73
Study Area		18.5	10.4	70
Environmental Justice Community Census Tracts				
1853.10	(Reach 6)	**29**	9	**97**
1853.20	(Reach 6)	13	**13**	**96**
1990	(Reach 7)	**39**	**11**	**97**
1997	(Reach 7/8)	**40**	**13**	**94**
2035	(Reach 7/8)	**28**	**13**	**98**
2060.10	(Reach 7/8	**49**	**11**	**96**
2060.31	(Reach 8)	**31**	**12**	59
2060.32	(Reach 8)	**37**	**13**	**97**
9800.1	(Reach 6/7)	**32**	**13**	60

Source: U.S. Census 2012
Note: Percentages in **bold** are above Los Angeles City and Los Angeles County averages.

4. FLOOD RISK CONSIDERATIONS

Flood risk was considered in the plan formulation process to address ecosystem restoration opportunities. The Hydrology and Hydraulic (H&H) Appendix E documents the existing and future with project condition as it relates to flooding and potential for induced flooding related to implementation of ecosystem restoration measures. One of the constraints taken into consideration during the formulation of alternatives was that induced flood damages should be avoided; therefore efforts were made to avoid measures that increase flooding.

As described in the H&H Appendix E, inundation mapping was generated for the 4, 2, 1, and 0.2 percent annual exceedance chance events for both existing and with project conditions. The existing conditions 100-year floodplain has two major breakout areas within the ARBOR Reach, both corresponding to vegetated reaches of the Los Angeles River. The upstream area with extensive overbank flooding is between Barham Boulevard and the confluence with Verdugo Wash, and has an average floodwater depth of 5.2 feet in the overbank areas. The downstream area with extensive overbank flooding is from the Verdugo Wash confluence to the Golden State Freeway, where the in-channel vegetation ends, and has an average floodwater depth of 3.9 feet in the overbank areas. Floodplain mapping can be found within Appendix E.

The final array of alternatives was analyzed and compared to the existing conditions to determine their impacts on the flood conveyance function of the channel. For the most part, the reaches that showed an increase in water surface elevation for the design event were at transition areas, either geometric (trapezoidal to rectangular or from a widened section to a narrow section) or construction material (soft-bottom vs. concrete). Induced flooding will be avoided by the project design and Operation and Maintenance (O&M) requirements for the project. See Appendix E, Hydrology and Hydraulics, for a detailed discussion of the effects of the final array on flood conveyance.

5. RECREATION RESOURCES

Section 5 characterizes recreational resources in the baseline study area and considers recreational opportunities within the ARBOR Reach. A draft recreation alternative has been developed and analyzed. The economic analysis of the recreation plan is summarized in Section 7 and detailed in Attachment 1 to this appendix.

5.1 Regional Context and Demand

The City of Los Angeles has approximately 24,000 acres of parks, with approximately 16,000 acres of parkland under the jurisdiction of the Department of Recreation and Parks. Other agencies managing parklands include the Los Angeles Department of Water and Power (LADWP), the Mountains Recreation and Conservation Authority (MRCA), the Santa Monica Mountains Conservancy (SMMC), California State Parks, and the Los Angeles County Department of Parks and Recreation (LACDPR). In all, this equates to a City-wide average of 6.26 acres of park per 1000 residents (Trust for Public Land 2011). The City of Glendale has 39 developed parks comprising 280 acres, or about 1.4 acres per 1000 residents (City of Glendale 2012). The City of Burbank operates 27 park facilities covering 155 acres, as well as 500 acres of open space, equating to approximately 6.34 acres of parkland per 1000 residents (City of Burbank 2010). Including all parks identified in the ARBOR reach presented below, the recreation resource area has an estimated 5,000 acres of park, or 38.77 acres per 1000 residents. This value is high compared to the City-wide average due to the presence of some larger than average parks near the study area, such as Griffith Park (the largest park at 4,210 acres) and Elysian Park (575 acres).

Much of Los Angeles is considered to be “park poor” which refers to any geographic area that provides less than three acres of green space per 1,000 residents, as defined by California law (Green Info Network 2010). In particular, the industrial areas surrounding reaches 7-8 (from the I-5 overpass to Main Street) have the least parkland, with fewer than 3 acres per 1,000 people. Other areas, particularly on the southwest side of Reaches 1-3 (from Pollywog Park to Brazil Street), have greater than 3 acres of parkland per 1,000 residents, which is due to the presence of Griffith Park. In general, access to parks and acres of parkland per 1,000 residents is lowest in areas that have the highest number of families below the poverty line of $47,331 annual income.

According to SCAG, public parks are intended to serve all residents, but not all neighborhoods and people have equal access to these public resources. SCAG calls for a multiagency effort and public transportation to improve access for all to parks throughout Southern California (SCAG 2008). The City Project has been initiated to find resolutions to improving park availability for all neighborhoods, regardless of ethnicity or income level (Garcia et al. 2009).

Residents of Los Angeles place a high priority on the quality of natural and environmental resources. In a study from 2000, 75 percent of those surveyed said that preserving wetlands, rivers, and environmentally sensitive areas would be either “somewhat effective” or “very effective” at improving their quality of life. There is also strong support for protecting cultural resources and for environmental education (Public Policy Institute of California 2000).

5.1.1 Recreational Opportunities in the Study Area

For this analysis, the recreation resources most likely to be affected by project alternatives are those within a half-mile buffer on either side of the River. The inventory of larger regional parks and other resources that exist outside the study area are beyond the geographic scope of this inventory other than to demonstrate the lack of regional parks and open space available within the greater Los Angeles area.

Approved year-round uses along the River in the study area are limited to pedestrian, cyclist, and equestrian trails along the banks. Seasonal passive recreation use, including birdwatching, walking, fishing, and non-motorized boating is allowed within the Elysian Valley portion of the study area under the auspices of the Los Angeles River Recreational Zone, under the oversight of the Mountains Recreation and Conservation Authority as approved by the City of Los Angeles in coordination with the County and the Corps. There are no areas approved for swimming in the study area, and instances of swimming and wading are likely low due to water quality concerns as local agencies and interest groups typically advise users to stay out of the water (LARRC 2011b).

Small parks along the River's pathways provide an improved pedestrian recreation experience with facilities such as benches and grassy areas. These parks are a combination of city parks and small pocket parks funded by local non-profit groups seeking to develop a greenway along the River (SMMC and MRCA 2007).

The Los Angeles River Bike Path is a Class II Bike Path (off-roadway, paved), and runs along the right bank of the River from Griffith Park through Glendale Narrows to Elysian Park, offering an off-roadway route for pedestrians and cyclists. Another route between Griffith Park and Elysian Park relies on a combination of bike lanes and bike routes (on-roadway) but does not follow the River, making it a Class III Route, less appropriate for recreation and more of a transportation route. Both of these routes are managed by Los Angeles County Metro, and are included in the City of Los Angeles Bicycle Plan (Metro 2012).

Table 5-1 Recreational Resources in Study Area

Name	Type, Location	Amenities
Bette Davis Picnic Area	Public, Los Angeles	Picnicking, walking, jogging, viewing
Chevy Chase Park and Recreation Center	Public, Los Angeles	Playground, basketball, handball, gym, picnicking, auditorium, pool
Crystal Springs Picnic Area	Public, Los Angeles	Picnicking
Ferraro Soccer Fields	Public, Los Angeles	Soccer fields
Griffith Park	Public, Los Angeles	Amphitheatre, bird sanctuary, camping, educational programming, equestrian, golf, hiking, jogging, museum, observatory, picnicking, soccer, swimming, tennis
Harding Golf Course	Public, Los Angeles	18-hole golf course
Lincoln Park	Public, Burbank	Playground, picnicking
Los Angeles Equestrian Center	Private, Los Angeles	Boarding stalls, training rings, indoor/outdoor show arenas, grass fields, riding academy, professional trainers, equestrian trails
Los Angeles Zoo	Public, Los Angeles	Municipal zoo and botanical gardens
Los Feliz Golf Course	Public, Los Angeles	9-hole golf course

Name	Type, Location	Amenities
Milford Mini Park	Public, Glendale	Playground, picnicking
Mountain View Park	Public, Burbank	Playground, restrooms, picnicking, tennis, basketball, horseshoe
North Atwater Park	Public, Los Angeles	Baseball, basketball, playground, volleyball, restrooms
Pelanconi Park	Public, Glendale	Ballfield, basketball, playground, picnicking, special facilities
Roosevelt Municipal Golf Course	Public, Los Angeles	9-hole golf course
Wilson Golf Course	Public, Los Angeles	18-hole golf course
Chavez Ravine Arboretum	Public, Los Angeles	Picnicking, playground, restrooms
Egret Park	Public, Los Angeles	Viewpoint, plantings, interpretive signage
Elysian Park	Public, Los Angeles	Walking, hiking, jogging, restrooms, picnicking, horseshoe, arboretum, baseball, sports field, therapeutic center, lodge, art exhibits, historical monument, community garden, playground
Elysian Valley Gateway Park	Public, Los Angeles	Plantings, benches, River access, picnicking
Elysian Valley Recreation Center	Los Angeles	Community rooms, auditorium, baseball, basketball, playground, handball
Glenhurst Park	Public, Los Angeles	Playground
Oso Park	Public, Los Angeles	Plantings, art, interpretive signage
Marsh Park	Public, Los Angeles	River access, viewing, picnicking, grass field, playground, infiltration area
Rattlesnake Park	Public, Los Angeles	Art exhibit, plantings, benches
Rio De Los Angeles State Park	Public, Los Angeles	Natural wetlands, hiking trails, sports fields, playground, recreation building
River Garden Park	Public, Los Angeles	Fountain, benches, picnicking, lawn area, restrooms
Silver Lake Recreation Center	Public, Los Angeles	Playground, community room, gym, picnicking, sports field, walking, jogging trails, classes, summer camps
Steelhead Park	Public, Los Angeles	Plantings, outdoor amphitheater
Sunnynook Park (under construction)	Public, Los Angeles	Plantings, walking paths, outdoor classroom
William Mulholland Memorial	Public, Los Angeles	Memorial fountain, seating, grass area
Chavez Ridge Disc Golf Course	Public, Los Angeles	18-hole course, restrooms
Confluence Park	Public, Los Angeles	Fountain, benches, plantings,
Dodger Stadium	Private, Los Angeles	Professional baseball stadium
Downey Recreation Center	Public, Los Angeles	Auditorium, baseball, playground, picnicking
Lacey Street Neighborhood Park	Public, Los Angeles	Picnicking, parking lot
Los Angeles Historic State Park	Public, Los Angeles	Walking, jogging, cycling paths, picnicking, natural and urban viewing, multipurpose field, restrooms, telescopes
Pecan Recreation Center	Public, Los Angeles	Baseball, playground, community room, handball, gym, picnicking, restrooms, seasonal pool, volleyball
Radio Hill Gardens	Public, Los Angeles	Trails, plantings, viewing
Solano Canyon Community Garden	Public, Los Angeles	Community gardening, picnicking
Sources: LARRC 2011c. City of Los Angeles 2012c, 2012d, 2012e. CDPR 2012a, 2012b, Linton 2012, PDGA 2012. Sources: SMMC & MRCA 2007. LARRC 2011c. City of Los Angeles 2012c, 2012d, 2012e, CDPR 2012a, 2012b, Linton 2012. Sources: City of Burbank 2012c, City of Glendale 2012, 2012d, City of Los Angeles 2012c, 2012d, and 2012e.		

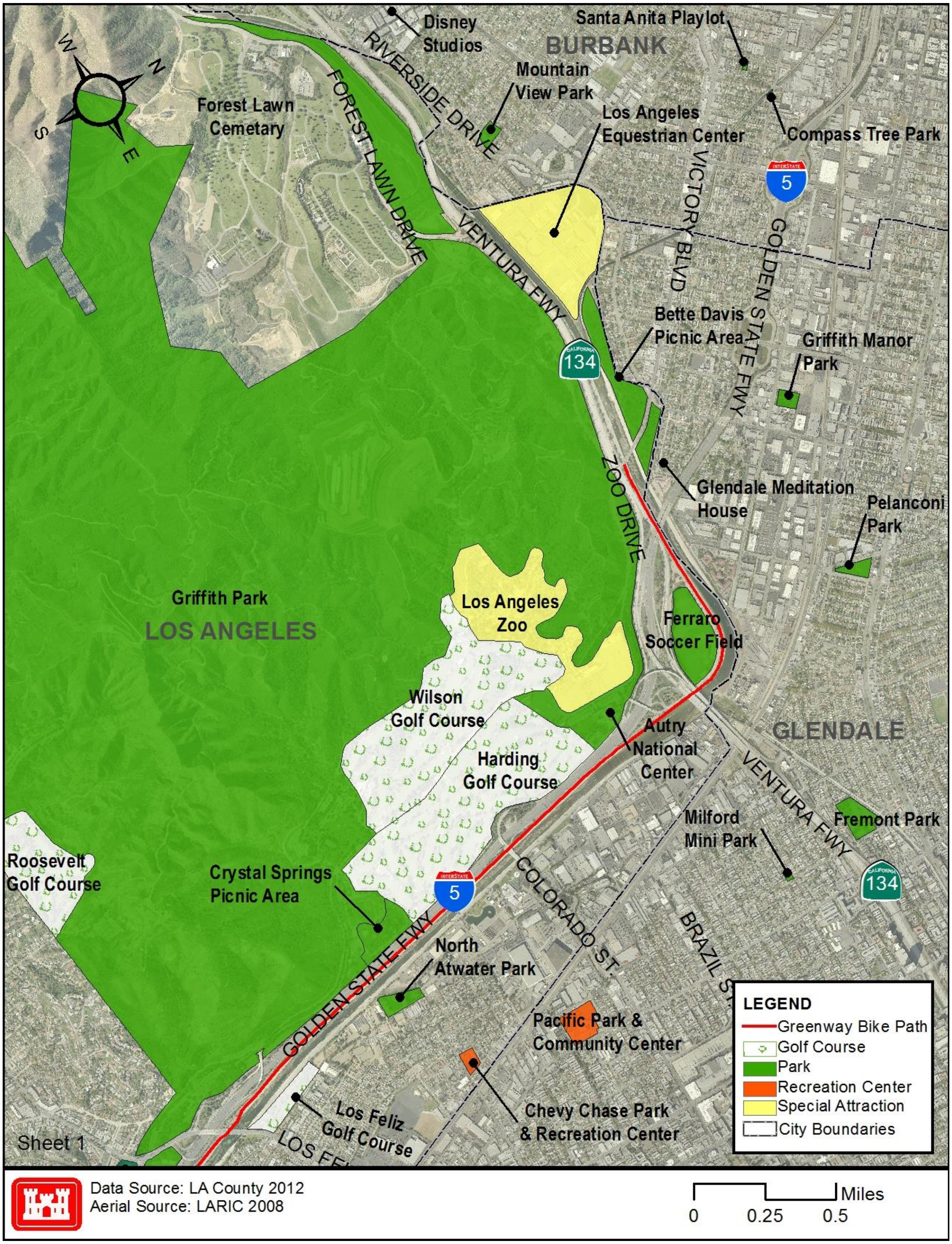

Figure 5.1 Recreation Resources, Reach 1 - 3

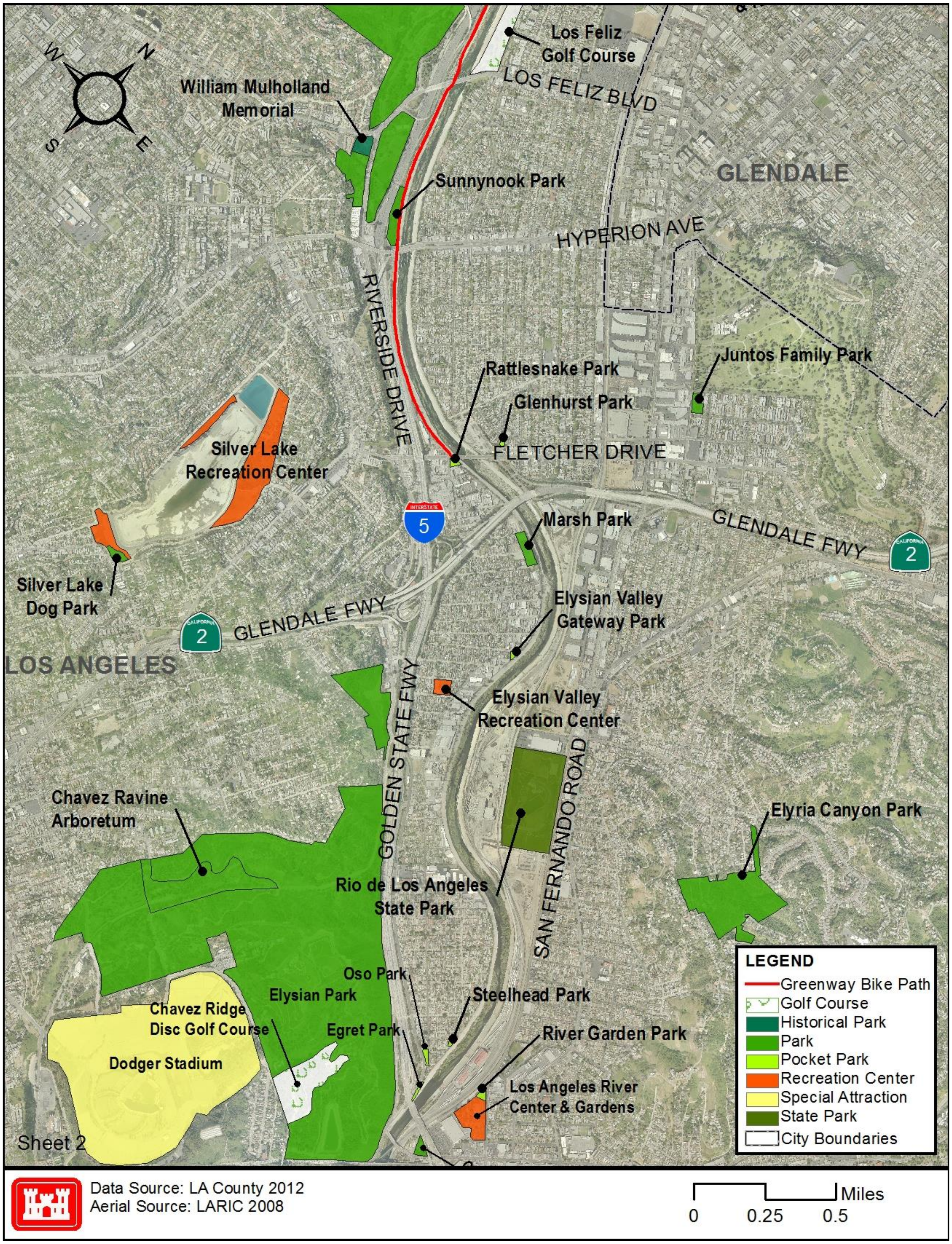

Figure 5.2 Recreation Resources, Reaches 4 - 6

Figure 5.3 Recreation Resources, Reaches 7 - 8

5.1.2 Future Without Project Condition

Because the study area is largely developed, the potential for substantial conversion of land to recreational uses is limited. However, recreational features will continue to be pursued by state or local entities wishing to develop recreational park areas along the River corridor. Local groups, such as the Los Angeles River Revitalization Corporation (LARRC), MRCA, MRCA, North East Trees (NET), Friends of the LA River (FoLAR), and The River Project (TRP) are likely to continue working to enhance the Los Angeles River Greenway through improvements of existing facilities along the River and installation of new park features.

The MTA, LARRC, and City of Los Angeles are actively planning bridges across the river that will provide a safe and convenient bicycle and pedestrian link between the Los Angeles River Bikeway on the west bank, and the Taylor Yard on east bank. The proposed bikeway improvement will consist of a minimum 15-foot wide bridge over the LA River, and a minimum 12-foot wide connection to the Union Pacific's Taylor Yard property (LARRC 2011d). As part of the North Atwater Park Expansion Project, a multimodal bridge is proposed to provide a connection from just downstream of North Atwater Park to the west side of the River. This bridge will provide pedestrian, bicycle, and equestrian access (LARRC 2011d).

Demand for recreation in the area is expected to increase proportionally to growth of population in the study area. Continued implementation of the Los Angeles River Revitalization Master Plan (City of Los Angeles 2007a) could increase recreational opportunities significantly over the long-term in the study area.

6. ECOSYSTEM RESTORATION ALTERNATIVES

The plan formulation process is described in detail in Section 3 of the Integrated Report. That section describes how each of the alternative plans were developed and evaluated at each step in the process, and ultimately included or excluded from the array of plans being considered. This appendix mentions briefly some of the plan formulation processes, evaluation criteria and arrays of plans that were considered. It does not describe these processes or information in detail. For a more detailed description the reader should refer to Sections 3 and 6 of the Integrated Report.

Ecosystem restoration is one of the primary missions of the Corps of Engineers Civil Works program. The Corps objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to NER are increases in the net quantity and/or quality of desired ecosystem resources. Measurement of NER is based on changes in ecological resource quality and a function of improvement in habitat quality and/or quantity and expressed quantitatively in physical units or indexes (but not monetary units). These net changes are measured in the planning area and in the rest of the nation. Thus, single purpose ecosystem restoration plans shall be formulated and evaluated in terms of their net contributions to increases in ecosystem value (NER outputs) expressed in non-monetary units (habitat units).

For ecosystem restoration projects, a plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, shall be selected. The selected plan must be shown to be a cost effective plan for achieving the desired level of output and economically justified (determined to be worth its investment cost). This plan shall be identified as the NER Plan. This formulation, evaluation, and selection process is described below.

6.1 Preliminary Alternatives

Following the charette workshop held December 2-4, 2009, an initial array of alternative plans was identified, which was then subject to additional screening. The screening process that was used applied the evaluation criteria established under the Principles and Guidelines (P&Gs) to assess the feasibility of alternative solutions. Completeness, Effectiveness, Efficiency, and Acceptability were considered as well as the technical feasibility, environmental impacts/benefits, and public acceptability of the alternatives.

A significant effort was undertaken in the development of preliminary restoration features at each site. Restoration features and a set of initial alternatives were developed during the charette workshop. Alternatives were subsequently evaluated and screened and a total of 19 alternatives were formulated, with each alternative containing different combination of measures in the eight reaches. The following 19 preliminary alternative plans, each of which contains different combinations of features in the eight reaches, were evaluated in this study. More detailed description of the formulation of measures and alternatives is found in the main report.

- 1: Comprehensive A. Includes these features throughout entire River study area: development of freshwater marsh, open water ponds, fish refugia, and riparian corridors; exposing storm drain outlets and converting to natural stream confluences; diversion of flow into side channels lined with habitat; development of underground basins and culverts to attenuate flow; bioengineering of channel walls; channel modification to increase width by terracing; channel widening, and/or modification of channel walls; connections to green streets; modification along tributary confluences to more natural habitat; and development of wildlife crossings.

- 2: Atwater to Cornfields. Includes all of the above within the Atwater to Cornfields part of the reach.

- 3: Banks and Tributaries Only. Leaves the flood control channel bed primarily "as is" and restores floodplain by creating side channels in open areas along the River with freshwater marsh and riparian corridors and restoring tributary confluences. Includes modification of storm drain outlets and bank terracing.

- 4: Comprehensive B. Includes most of the features included in Alternative 1 Comprehensive A with fewer locations, less terracing and side channels, and omits elevating railroads on trestles, bioengineering walls, creating open water areas, and modifying trapezoid channels to vertical channels.

- 5: Los Feliz to Arroyo Seco. Implements all features from Comp A or B within Los Feliz to Arroyo Seco reach.

- 6: Comprehensive C. Includes most of the features included in Alternative 1 Comprehensive A with fewer locations and omits railroad elevation, bioengineering walls, open water area creation, and trapezoid channel modification to vertical. Includes more terracing and storm drain modifications and different locations for wildlife crossings than Alternative C-17 Comprehensive B.

- 7: Channel Reshaping A. Focus is on channel reshaping and attenuation of flow through detention basins, bypass channels, and channel widening. Using culverts and underground basins to attenuate flows, the channel is geomorphically changed to a wider, softer channel, with more naturalized storm drain outlets and some restored riparian corridors.

- 8: Habitat Variation. This alternative focuses on maximizing habitat restoration for species diversity, including fish, through attenuation or reduction in flow, as well as augmentation or creation of freshwater marsh, riparian and aquatic habitat.

- 9: Soft Bed Channel and Associated Banks. This alternative focuses restoration in reaches that already have a soft riverbed. Where open areas are adjacent to the River, the River will be widened rather than terraced. Storm drains are converted to natural stream confluences and restored with riparian vegetation. Habitats include aquatic, freshwater marsh and riparian areas.

- 10: Channel Modifications. This alternative implements features in locations with the least impact to infrastructure and engineering challenges, while still including features in all reaches to attenuate flow, and restore riparian, freshwater marsh habitat and tributary confluences.

- 11: Habitat Connectivity. This alternative focuses on bank to bank and upstream to downstream connections for wildlife and linkages to wildlife areas through channel widening and terracing.

- 12: Hydrologic Connection Improvements. This alternative focuses on lowering elevations of large open areas adjacent to the River to improve connectivity to the floodplain, and features to improve hydrologic connections between the banks, storm drains and River. It also includes features for increasing wildlife movement between the River and adjacent open areas.

- 13: Channel Reshaping B. Using culverts and underground basins to attenuate flows, the channel is geomorphically changed to a wider, softer channel, with naturalized storm drain outlets and restored riparian corridors. Includes bioengineering of channel walls, side channels and has more riparian and freshwater marsh replanting than Channel Reshaping A.

- 14: Channel Widening. This alternative focuses on widening the channel. Attenuation is accomplished with culvert bypasses. Includes planting of freshwater marsh and riparian corridors.

- 15: Bypass with Bank and Tributary Confluence Restoration. Reduces flow using culvert bypass to allow for terracing and channel bank softening. Improves freshwater marsh habitat in soft bed areas and adds riparian habitat to downstream locations on the river overbank. Emphasizes widening and restoration at tributary confluences.

- 16: Side Channels Only. Leaves the flood control channel bed and banks primarily "as is" and restores floodplain by creating side channels in open areas along the river, creating freshwater marsh and riparian corridors and restoring tributary confluences.

- 17: Opportunity Area Restoration With Channel Widening at Tributaries. Restores wetlands on the overbank and major tributaries at the River Glen confluence with Verdugo Wash, Griffith Park, Bowtie/Taylor Yard, Arroyo Seco Confluence, Burbank-Western Channel, Cornfields, and LATC. Widens the river at Verdugo, Arroyo Seco and Burbank-Western Channel.

- 18: Comprehensive Pockets. Leaves flood control channel bed and banks "as is" and restores wetlands on the overbank and major tributaries at the River Glen confluence with Verdugo Wash, Bowtie/Taylor Yard, Arroyo Seco Confluence, and Cornfields.

- 19: Taylor Yard. Restores wetlands on the overbank and widens the river at this single key location on the River, and includes the Bowtie parcel.

- T: Tunnel: In addition to the 19 alternatives a tunnel measure was evaluated. Construction of tunnels or large culverts to divert storm season flows around the project reach. This would require excavation and construction of culverts that would need to be sized and designed based on results hydraulic modeling.

6.2 Cost Effectiveness and Incremental Cost Analysis

Although 19 preliminary alternatives were developed in 2009, the features that made-up each alternative were not selected based on cost effectiveness or incremental cost; they were instead based on a common concept or theme. The features are essentially management measures modified for specific locations. The preliminary alternatives represented a combination of these features, one feature per reach.

The study area was broken down into eight reaches, and the output and costs of the 19 preliminary alternatives for the study area were accordingly broken out by these eight reaches to allow recombination of the features in any of the 19 preliminary alternatives on a reach-by-reach basis, as appropriate. As shown later in Figure 6.2, the original 19 preliminary alternatives were then compared to the alternatives which were formulated via the Cost Effectiveness and Incremental Cost Analysis (CE/ICA) software methodology described below.

6.2.1 Methodology

A CE/ICA analysis was conducted using benefit and cost inputs on a reach-by-reach basis using the certified IWR-Planning Suite software version 1.0.11.0 (IWR-PLAN). The various separable element features of the alternative plans were evaluated and compared, and recombined by the software as discussed within this section. The results were then manually inspected to identify apparent break-points in order to identify a final array of alternatives.

CHAP Analysis

For this study, benefits (or outputs) have been quantified using the Combined Habitat Assessment Protocols (CHAP) approach. The CHAP analysis is an accounting and appraisal method that utilizes species-habitat-functions to derive current habitat unit values, which are annualized over the period of analysis to create average annual habitat units (AAHUs). To determine a change in these values over time, projections are needed to alter either the species, habitat, or function parameters. Applying these changes over several time periods requires some conjecture to deduce the amount of influence that might be expected during each time period. Details pertaining to the CHAP analysis are found within Appendix G.

Cost Estimates

Preliminary feasibility level cost estimates for the 19 alternatives were developed using the Civil Works Cost Database as well as input from local regional construction firms and materials suppliers. All costs are presented in FY13 price level. Supporting cost information can be found in Appendix C.

CE/ICA

Cost-effectiveness and incremental cost analyses were performed using IWR-PLAN. The CE/ICA is an evaluation tool which considers and identifies the relationship between changes in cost and changes in quantified, but not monetized, habitat benefits. The evaluation is used to identify the most cost-effective alternative plans to reach various levels of restoration output and to provide information about whether increasing levels of restoration are worth the successively added costs. The CE/ICA is a planning tool to help identify cost-effective plans which provide a certain level out habitat output at the least cost.

Functionally, the CE/ICA provides a framework for combining individual measures (called features in this case) into alternative plans. The software expedites this effort of testing each combination of features and tabulating the resulting costs and environmental benefits.

Cost Effectiveness Analysis

When there is no monetary measure of benefits but project outcomes can be described and quantified in some dimension, cost effectiveness analysis can be used to assist on the decision making process. Cost effectiveness analysis seeks to answer the question: given an adequately described objective, what is the least-costly way of attaining the objective? A plan is considered cost effective if it provides a given level of output for the least cost. Cost effectiveness analysis was used to identify the least cost solution for each level of environmental output being considered.

The cost effectiveness analysis is the first step in the CE/ICA, and compares the Average Annual Habitat Units (AAHUs) potentially achieved by each alternative to the cost of each alternative to generate a “cost per AAHU.” This cost provides a means to compare the cost-effectiveness of each plan. The three criteria used for identifying non-cost effective plans or combinations include (1) the same level of output could be produced by another plan at less cost; (2) a larger output level could be produced at the same cost; or (3) a larger output level could be produced at the least cost. Cost-effectiveness is one of the criteria by which all plans are judged and plays a role in the selection of the National Ecosystem Restoration (NER) Plan. Non-cost effective combinations of plans are dropped from further consideration.

Incremental Cost Analysis

Incremental cost analysis compares the additional costs to the additional outputs of an alternative. It is a tool that can assist in the plan formulation and evaluation process, rather than a dictum that drives that process. The analysis consists of examining increments of plans or project features to determine their incremental costs and incremental benefits. Increments of plans continue to be added and evaluated as long as the incremental benefits exceed the incremental costs. When the incremental costs exceed the incremental benefits, no further increments are added. Incremental analysis helps to identify and display variations in costs among different increments of restoration measures and alternative plans. Thus, it helps decision makers determine the most desirable level of output relative to costs and other decision criteria.

The incremental cost analysis portion of the CE/ICA compares the incremental costs for each additional unit of output from one cost effective plan to the next to identify "best buy" plans. The first step in developing "best buy" plans is to determine the incremental cost per unit. The plan with the lowest incremental cost per unit over the No Action Alternative is the first incremental best buy plan. Plans that have a higher incremental cost per unit for a lower level of output are eliminated. The next step is to recalculate the incremental cost per unit for the remaining plans. This process is reiterated until the lowest incremental cost per unit for the next level of output is determined. The intent of the incremental analysis is to identify successively larger plans with the smallest incremental cost per unit of incremental output.

Selection Considerations

For ecosystem restoration, the recommended plan should be the justified alternative and scale having the maximum excess of monetary and non-monetary beneficial effects over monetary and nonmonetary costs. This plan occurs where the incremental beneficial effects just equal the incremental costs, or alternatively stated, where the extra environmental value is just worth the extra costs. A plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, is identified as the National Ecosystem Restoration (NER) Plan. The selected plan should be cost effective and justified in achieving the desired level of output. Thus, the NER plan is selected from the suite of cost effective plans identified in the CE/ICA. While the NER Plan is not required to be a best buy plan, this is often the case. The results of the CE/ICA do not provide a discrete decision, but rather they offer tools to help inform a decision.

Development of Features

For the purposes of the CE/ICA, the aforementioned 19 preliminary alternatives were broken down into the component features for each reach. The breakdown was necessary for the incremental analysis of alternatives and appropriate because the alternatives had been conceptualized as separable elements. In each of the eight reaches, not all 19 alternatives included a feature.

In addition to whether or not each reach contained a feature for a given alternative, some features were dependent on the inclusion of a diversion tunnel to alleviate flows in the channel. The diversion tunnel costs were developed as a separate measure. The features dependent on the diversion tunnel are indicated by pink highlighting in Table 6-1.

Once the alternatives were broken down into the measures presented in Table 6-1 and entered into IWR-PLAN, the software program considered all possible combinations of these measures (taking dependencies into account). The cost-effective and best buy plans were drawn from a list of all possible reach-wise combinations of the preliminary 19 alternatives, as explained in the following section.

Table 6-1 Matrix of Features Comprising the Preliminary Alternatives

Preliminary Alternative	**Reach**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								

Pink-highlighted cells indicate features dependent on the diversion tunnel.

6.2.2 CE/ICA Model Implementation

To conform to the software structure, each of the eight reaches was defined as a "measure"[5] (in the language of the software). For each reach, there were a possible 19 different mutually

[5] Measures—also called "features" when they are structural measures and "activities" when they are non-structural measures—are typically defined as a type of restoration action (create wetland, remove levee, etc.). In this case, the measures are defined as each of the eight study reaches.

exclusive "scales"[6] that might be implemented (corresponding to the measures with checkmarks in Table 6-1). "Scales," in the CE/ICA software, are mutually exclusive, so the software would choose one measure for each reach to formulate alternatives that combine multiple reaches. Costs and benefits are tabulated by the software for each suite of measures that have been combined into a new alternative plan. Costs and benefits for the diversion tunnel were a separate measure which was called using the dependency relationships in the CE/ICA software. Due to computational limitations, plans requiring the diversion tunnel and those not requiring the diversion tunnel were run separately. As it turned out, Tunnel-Dependent alternatives were screened from further analysis based on prohibitive cost. As such, the Non-Tunnel model became the only model further evaluated. The following sub-sections describe each of the two model runs.

(a) Tunnel-Dependent Model

The Tunnel-Dependent model evaluated those features which were dependent on the diversion tunnel (corresponding to the pink-shaded cells in Table 6-1). The tunnel itself had an average annual cost of $70,943,000. The least cost tunnel-dependent plan was shown to result in only a 0.12 percent increase in habitat output and a of 53 percent increase in cost compared to the largest non-tunnel plan, as illustrated by Figure 6.1 below. Based on these results, the opinion of the study team was that the benefits associated with the diversion tunnel did not exceed the costs. Features requiring the tunnel were screened from further consideration (pink cells in Table 6-1).

[6] Scales are typically defined as a potential quantity of a measure (create 100, 200, or 300 acres of wetland). In this case, the scales are reach-specific alternatives (derived from the preliminary 19 alternatives) which may be recombined (1 scale per reach) to form new alternatives.

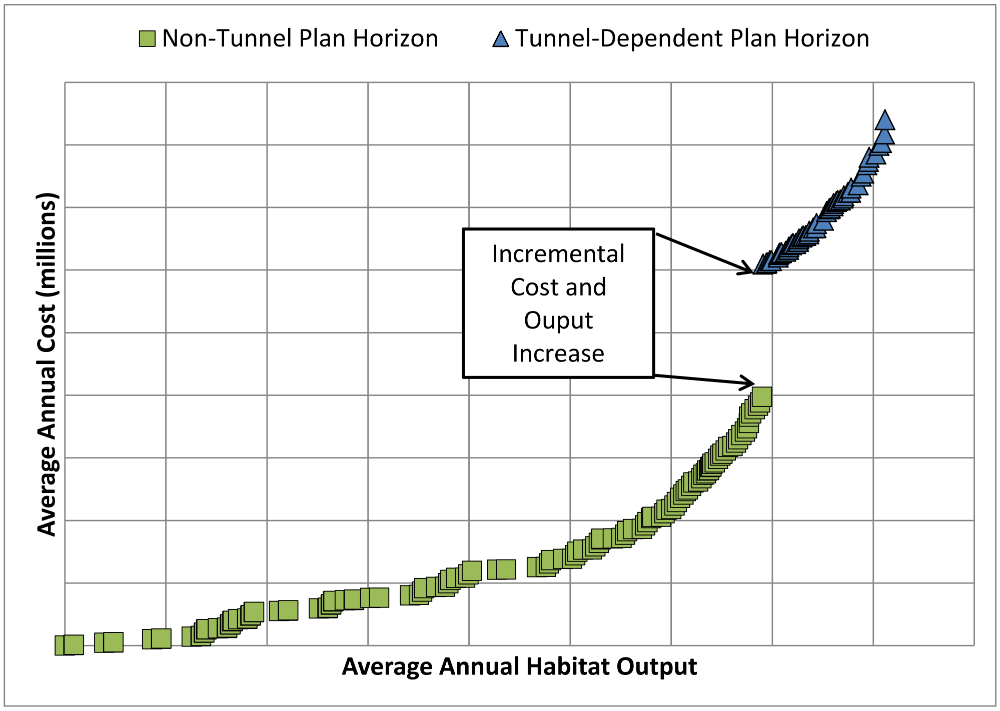

Figure 6.1 Tunnel-Dependent Plan Horizon

(b) Non-Tunnel Model

The Non-Tunnel model included only those features which could be implemented without the diversion tunnel measure. This is equivalent to the blue-shaded cells in Table 6-2 and Table 6-3, which present the annual costs and benefits for each feature, respectively.

As shown in the tables, Reach 1 contains only three features which do not require the diversion tunnel that was originally formulated at part of preliminary alternatives 11, 16, and 18 (compare to shading in Table 6-3, which also contains only three blue cells for reach 1). Thus, only these three features are included in the Non-Tunnel model for Reach 1, and are assigned a code for the reach and the scale in the software. The same methodology is applied to the other seven reaches to generate a complete input sheet for the model run.

Table 6-2 Non-Tunnel Features Annual Cost Matrix

Prelim. Alternative	Reach*							
	1	2	3	4	5	6	7	8
1						$11,996		
2						$12,009		
3						$11,265		$18,003
4						$6,861		$16,170
5					$6,871	$12,009		
6						$10,085		$16,773
7						$6,836		$11,803
8						$8,859		$12,779
9		$1,114		$9,394	$61	$10,085	$177	$105
10						$8,333		$11,561
11	$377	$147				$8,892		$16,253
12			$9,692			$11,222	$1,795	$12,680
13		$1,945				$6,413		$6,822
14		$404	$4,500			$4,557		$14,627
15		$405	$3,833	$150		$7,741		$8,864
16	$2,038	$736	$1,243	$1,775	$61	$3,690	$4,815	$12,727
17			$105	$589		$5,088		$4,539
18	$377		$9,312			$8,922	$3,591	
19						$10,074		
**Costs presented in thousands ($1000), Based on FY2013 Price levels and 3.75% discount rate*								

Table 6-3 Non-Tunnel Features Annual Output Matrix

Prelim. Alternative	Reach*							
	1	2	3	4	5	6	7	8
1						1,489		
2						1,489		
3						1,476		2,501
4						1,265		2,379
5					352	1,489		
6						1,316		2,340
7						1,334		1,843
8						1,548		2,192
9		425		474	87	1,316	29	20
10						1,465		1,942
11	866	392				1,545		2,282
12			269			1,476	259	2,170
13		447				1,447		734
14		392	201			1,256		1,942
15		392	109	120		1,316		2,159
16	884	395	200	492	87	570	347	2,080
17			40	120		661		701
18	866		330			1,476	251	
19						1,287		
**Output presented in Average Annual Habitat Units (AAHUs)*								

6.2.3 Results Summary

The model run resulted in a total of 171 cost effective plans, including the no action plan. Of these cost effective plans, 21 plans were identified as best buy plans. Table 6-4 presents the cost, benefits, and incremental cost for each of the 21 best buy plans. The best buy plans were numbered from 1 to 21. Letters A through H in the plan code stand for reaches 1 through 8, while numbers in the plan code correspond to the preliminary alternative numbers in Table 6-2 and Table 6-3.

For the purposes of comparison, the costs and benefits for the 19 preliminary alternatives were tabulated as well. Table 6-5 presents the costs and benefits of these alternatives. The code 'P-#' denotes that the plan is one of the 19 preliminary alternatives.

Table 6-4 Best Buys Incremental Cost Summary

#	Plan	AACost ($)	AAHU	Inc AACost ($)	Inc AAHU	Inc Cost ($)
1	No Action Plan	$0	0	$0	0	$0
2	B2	$146,743	392	$146,743	392	$374
3	A1B2	$523,358	1,258	$376,615	866	$435
4	A1B2E2	$583,950	1,345	$60,592	87	$696
5	A1B2D2E2	$733,885	1,465	$149,935	120	$1,249
6	A1B2C5D2E2	$839,159	1,505	$105,274	40	$2,632
7	A1B2C5D2E2F14	$5,396,226	2,761	$4,557,067	1,256	$3,628
8	A1B2C5D2E2F14H12	$14,260,310	4,920	$8,864,084	2,159	$4,106
9	A1B2C5D3E2F14H12	$15,884,884	5,292	$1,624,574	372	$4,367
10	A1B2C5D3E2F14G1H12	$16,062,161	5,321	$177,277	29	$6,113
11	A1B2C5D3E2F14G2H12	$17,680,091	5,551	$1,617,930	230	$7,034
12	A1B2C4D3E2F14G2H12	$18,817,690	5,711	$1,137,599	160	$7,110
13	A1B2C4D3E2F13G2H12	$20,673,266	5,902	$1,855,576	191	$9,715
14	A1B2C4D3E2F8G2H12	$23,119,812	6,003	$2,446,546	101	$24,223
15	A1B2C4D3E1F8G2H12	$29,930,469	6,268	$6,810,657	265	$25,701
16	A1B2C4D3E1F8G2H1	$39,069,505	6,610	$9,139,036	342	$26,722
17	A1B1C4D3E1F8G2H1	$40,036,386	6,643	$966,881	33	$29,299
18	A1B1C4D3E1F8G3H1	$43,055,891	6,731	$3,019,505	88	$34,313
19	A1B3C4D3E1F8G3H1	$43,887,027	6,753	$831,136	22	$37,779
20	A1B3C6D3E1F8G3H1	$51,955,779	6,883	$8,068,752	130	$62,067
21	A2B3C6D3E1F8G3H1	$53,616,857	6,901	$1,661,078	18	$92,282

Table 6-5 Preliminary Alternatives Costs and Benefits

Alternative	AA Cost ($)	AAHU
P-1	$11,996,483	1489
P-2	$12,009,286	1489
P-3	$29,267,897	3976
P-4	$23,030,955	3644
P-5	$18,880,535	1841
P-6	$26,858,358	3656
P-7	$18,638,396	3177
P-8	$21,638,317	3740
P-9	$20,936,199	2352
P-10	$19,894,592	3406
P-11	$25,668,150	5084
P-12	$35,389,302	4173
P-13	$15,179,266	2629
P-14	$24,087,662	3790
P-15	$20,992,030	4096
P-16	$27,083,375	5054
P-17	$10,321,082	1522
P-18	$22,201,739	2923
P-19	$10,074,318	1287

In order to summarize the results of the model graphically, three figures are included on the following pages. Data labels in the figures correspond to the left columns in Table 6-4 and Table 6-5.

- Figure 6.2 displays the cost effective plans, the best buy plans, and the 19 preliminary alternatives. The Y-axis measures average annual cost, and the X-axis measures average annual habitat output. The figure also notes which of the best buy plans included features in all eight reaches, and which did not.

- Figure 6.3 displays the incremental cost box plot for all 21 of the best buy plans. The X-axis measures incremental cost per unit incremental output, and the Y-axis measures total average annual habitat units.

- Figure 6.4 is also an incremental cost box plot, but displays only those alternatives which included features in all eight of the study reaches. This corresponds to best buys 10 through 21.

Following the figures, Table 6-6 provides a detailed breakdown of each best buy plan. In the table, each plan is broken down to show which feature is applied in each reach. The naming convention in this table references the name of the preliminary 19 alternatives in order to trace where each feature came from. The first column indicates Best Buys in numerical order. Column two indicates the Reach and which of the preliminary array of alternatives make up the best buy alternatives. The table also shows the average annual cost and output, incremental cost, and Net Present Value (NPV). NPV reflects the current worth of the future stream of annual costs for each alternative, and consistent with the annual costs used in the CE/ICA, includes construction, mobilization, contingency, PED/EDC, S&A, IDC, LERRDs, and O&M.

6.2.3.1 Interpretation of Results

As shown in Figure 6.2, by recombining the reach-specific features from the preliminary 19 alternatives, a new horizon of cost effective and best buy alternatives was created. The figure shows that none of the preliminary 19 alternatives meet the cost effective criteria when compared with the new horizon of plans. Additionally, the new plans offer higher total habitat benefits. As an example, preliminary alternative 11 is close to Best Buy plan 10 on Figure 6.2. Best buy 10 has an annual investment cost of $16 million compared to preliminary alternative 11 which has an annual cost of nearly $26 million. However Best Buy 10 provides 5,321 AAHU versus the 5,084 in preliminary alternative 11.

Among the cost effective plans generated in the CE/ICA analysis, 21 are best buy plans, as indicated by blue triangles and purple diamonds in Figure 6.2. Of particular value are the best buy plans which contain a feature in all eight reaches of the ARBOR stretch of river (purple diamonds in the figure), continuous and complete restoration of the reach was a key consideration in formulation for the study team. Of the best buy plans, Alternatives 10-21 include restoration in all reaches.

As shown in Figure 6.4, best buy plans 10 through 13 show gradual growth incremental cost and output, followed by a large jump in cost to plans 14 through 16, and then sharply rising incremental cost and more slowing rising incremental output for plans 17 through 21.

Alternative 10 total costs are $360 million, adds the additional reach (7) connecting the entire study area and provides 5,321 habitat units. The group of alternatives 10-13 range in total costs from $347 million to $444 million dollars for Alternative 13. Habitat benefits increase from 5,321 units to 5,902 for Alternative 13. Within this grouping there are significant changes within Alternatives 10 to 13. Reach 3, 6, and 7 are changed. Alternative 13 accomplishes all that Alternative 10 does, and adds freshwater marsh habitat to better meet objectives. Connectivity is increased with additional contiguous riparian corridors and restoration of the confluence at Arroyo Seco, the most significant tributary in the ARBOR reach with potential to connect to future restoration planning on that tributary.

The next incrementally grouped alternatives are 14-16. These alternatives range in benefits from 6,003 to 6,610 with a total cost range from $518 million to $876 million. These all meet targets for performance on Objective 1 with Alternative 16 showing an incremental jump in restoration of freshwater marsh, riffle-pool complexes, and conditions for native fish survival, greater hydrologic/hydraulic connections and other related conditions.

The remaining alternatives 17-21 incrementally increase the habitat value from 6,643 to 6,901 and have significantly increased total costs ranging from $898 million to $1.2 billion. In addition to the benefits and measures included in the other alternatives, these alternatives include widening and increased habitat in the river bed in reach 2, and connection to the Los Angeles River State Historic Park (Cornfields) in Alternatives 18-21. Alternative 20 shows the greatest single increase in habitat value in this group with the addition of restoration at the confluence of a major tributary (Verdugo Wash), increasing natural hydraulic conditions and regional connectivity.

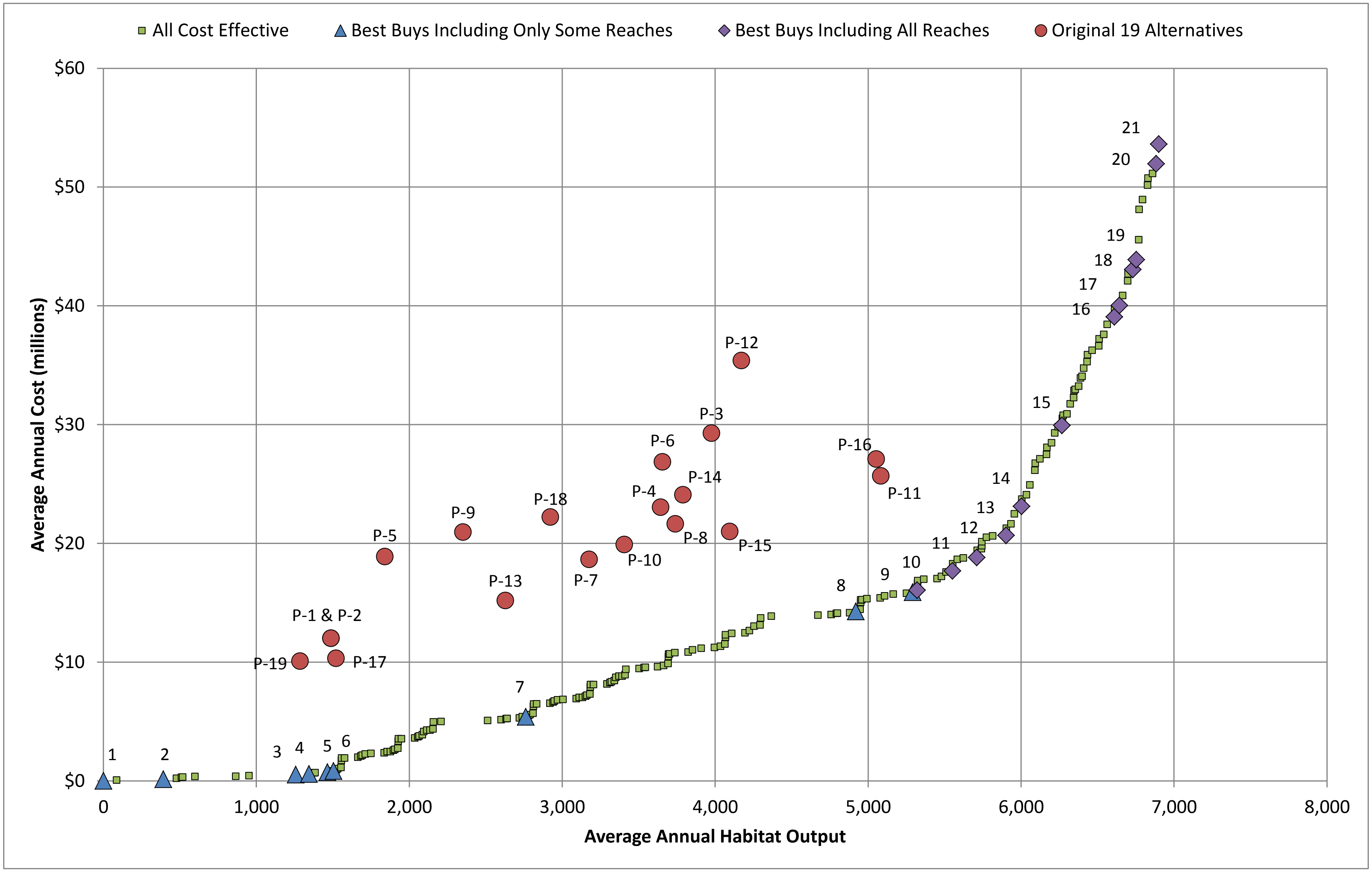

Figure 6.2 Model Output Summary

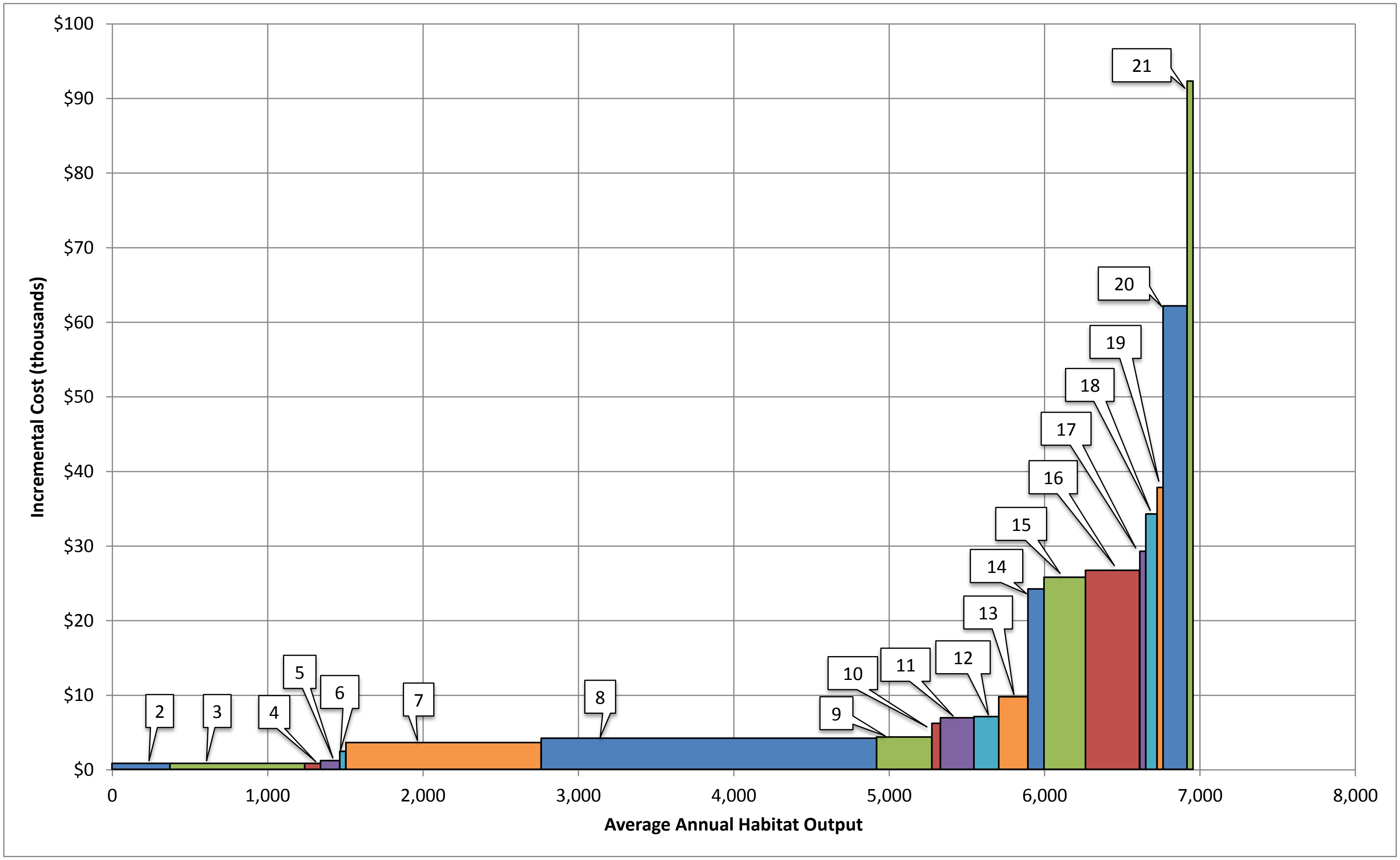

Figure 6.3 All Best Buy s Incremental Cost Box Plot

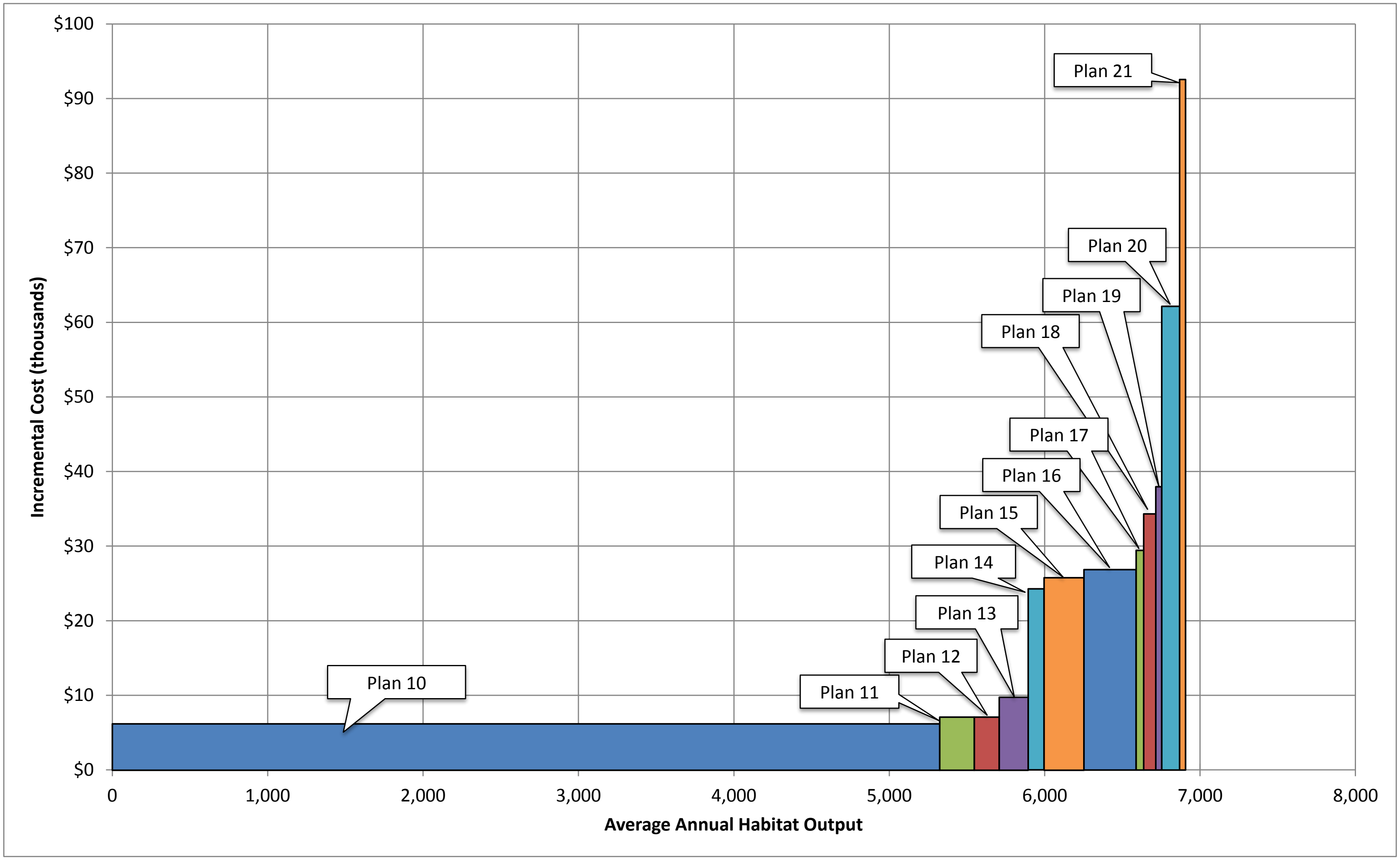

Figure 6.4 Best Buy Plans 10-21 Incremental Cost Box Plot

Table 6-6 Combined Model – Best Buy Plans Descriptions and Cost Data

Best Buy #	Plan Components (Meas./Scale)	Plan Components (Reach - Alt./Feat.)	Plan Components (Name)	Average Annual Cost ($)	Average Annual Habitat Units	Incremental Cost ($)	Net Present Value ($)
1	No Action	No Action	No Action	$0	0	$0	$0
2	B2	R2 - A11	Reach 2 - Charette Team 4	$146,743	392	$374	$3,292,105
3	**A1**	**R1 - A11**	**Reach 1 - Charette Team 4**	$523,358	1,258	$435	$11,741,271
	B2	R2 - A11	Reach 2 - Charette Team 4				
4	A1	R1 - A11	Reach 1 - Charette Team 4	$583,950	1,345	$696	$13,100,622
	B2	R2 - A11	Reach 2 - Charette Team 4				
	E2	R5 - A9 OR R5 - A16	Reach 5 - (Soft Bot. Ch. & Assoc. Banks) OR (Side Channels Only)				
5	A1	R1 - A11	Reach 1 - Charette Team 4	$733,885	1,465	$1,249	$16,464,338
	B2	R2 - A11	Reach 2 - Charette Team 4				
	D2	**R4 - A15**	**Reach 4 - Charette Team 2**				
	E2	R5 - A9 OR R5 - A16	Reach 5 - (Soft Bot. Ch. & Assoc. Banks) OR (Side Channels Only)				
6	A1	R1 - A11	Reach 1 - Charette Team 4	$839,159	1,505	$2,632	$18,826,107
	B2	R2 - A11	Reach 2 - Charette Team 4				
	C5	**R3 - A17**	**Reach 3 - Charette Team 7**				
	D2	R4 - A15	Reach 4 - Charette Team 2				
	E2	R5 - A9 OR R5 - A16	Reach 5 - (Soft Bot. Ch. & Assoc. Banks) OR (Side Channels Only)				
7	A1	R1 - A11	Reach 1 - Charette Team 4	$5,396,226	2,761	$3,628	$121,061,595
	B2	R2 - A11	Reach 2 - Charette Team 4				
	C5	R3 - A17	Reach 3 - Charette Team 7				
	D2	R4 - A15	Reach 4 - Charette Team 2				
	E2	R5 - A9 OR R5 - A16	Reach 5 - (Soft Bot. Ch. & Assoc. Banks) OR (Side Channels Only)				
	F14	**R6 - A14**	**Reach 6 - Charette Team 5**				
8	A1	R1 - A11	Reach 1 - Charette Team 4	$14,260,310	4,920	$4,106	$319,922,827
	B2	R2 - A11	Reach 2 - Charette Team 4				
	C5	R3 - A17	Reach 3 - Charette Team 7				
	D2	R4 - A15	Reach 4 - Charette Team 2				
	E2	R5 - A9 OR R5 - A16	Reach 5 - (Soft Bot. Ch. & Assoc. Banks) OR (Side Channels Only)				
	F14	R6 - A14	Reach 6 - Charette Team 5				
	H12	**R8 - A15**	**Reach 8 - Charette Team 2**				
9	A1	R1 - A11	Reach 1 - Charette Team 4	$15,884,884	5,292	$4,367	$356,369,322
	B2	R2 - A11	Reach 2 - Charette Team 4				
	C5	R3 - A17	Reach 3 - Charette Team 7				
	D3	**R4 - A16**	**Reach 4 - Side Channels Only**				
	E2	R5 - A9 OR R5 - A16	Reach 5 - (Soft Bot. Ch. & Assoc. Banks) OR (Side Channels Only)				
	F14	R6 - A14	Reach 6 - Charette Team 5				
	H12	R8 - A15	Reach 8 - Charette Team 2				
10	A1	R1 - A11	Reach 1 - Charette Team 4	$16,062,161	5,321	$6,113	$360,346,441
	B2	R2 - A11	Reach 2 - Charette Team 4				
	C5	R3 - A17	Reach 3 - Charette Team 7				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E2	R5 - A9 OR R5 - A16	Reach 5 - (Soft Bot. Ch. & Assoc. Banks) OR (Side Channels Only)				
	F14	R6 - A14	Reach 6 - Charette Team 5				
	G1	**R7 - A9**	**Reach 7 - Soft Bot. Ch. & Assoc. Banks**				
	H12	R8 - A15	Reach 8 - Charette Team 2				
11	A1	R1 - A11	Reach 1 - Charette Team 4	$17,680,091	5,551	$7,034	$396,643,881
	B2	R2 - A11	Reach 2 - Charette Team 4				
	C5	R3 - A17	Reach 3 - Charette Team 7				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E2	R5 - A9 OR R5 - A16	Reach 5 - (Soft Bot. Ch. & Assoc. Banks) OR (Side Channels Only)				
	F14	R6 - A14	Reach 6 - Charette Team 5				
	G2	**R7 - A12**	**Reach 7 - Charette Team 3**				
	H12	R8 - A15	Reach 8 - Charette Team 2				
12	A1	R1 - A11	Reach 1 - Charette Team 4	$18,817,690	5,711	$7,110	$422,165,338
	B2	R2 - A11	Reach 2 - Charette Team 4				
	C4	**R3 - A16**	**Reach 3 - Side Channels Only**				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E2	R5 - A9 OR R5 - A16	Reach 5 - (Soft Bot. Ch. & Assoc. Banks) OR (Side Channels Only)				
	F14	R6 - A14	Reach 6 - Charette Team 5				
	G2	R7 - A12	Reach 7 - Charette Team 3				
	H12	R8 - A15	Reach 8 - Charette Team 2				
13	A1	R1 - A11	Reach 1 - Charette Team 4	$20,673,266	5,902	$9,715	$463,794,245
	B2	R2 - A11	Reach 2 - Charette Team 4				
	C4	R3 - A16	Reach 3 - Side Channels Only				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E2	R5 - A9 OR R5 - A16	Reach 5 - (Soft Bot. Ch. & Assoc. Banks) OR (Side Channels Only)				
	F13	**R6 - A13**	**Reach 6 - Charette Team 6**				
	G2	R7 - A12	Reach 7 - Charette Team 3				
	H12	R8 - A15	Reach 8 - Charette Team 2				

Best Buy #	Plan Components (Meas./Scale)	Plan Components (Reach - Alt./Feat.)	Plan Components (Name)	Average Annual Cost ($)	Average Annual Habitat Units	Incremental Cost ($)	Net Present Value ($)
14	A1	R1 - A11	Reach 1 - Charette Team 4	$23,119,812	6,003	$24,223	$518,681,264
	B2	R2 - A11	Reach 2 - Charette Team 4				
	C4	R3 - A16	Reach 3 - Side Channels Only				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E2	R5 - A9 OR R5 - A16	Reach 5 - (Soft Bot. Ch. & Assoc. Banks) OR (Side Channels Only)				
	F8	**R6 - A8**	**Reach 6 - Charette Team 1**				
	G2	R7 - A12	Reach 7 - Charette Team 3				
	H12	R8 - A15	Reach 8 - Charette Team 2				
15	A1	R1 - A11	Reach 1 - Charette Team 4	$29,930,469	6,268	$25,701	$671,474,902
	B2	R2 - A11	Reach 2 - Charette Team 4				
	C4	R3 - A16	Reach 3 - Side Channels Only				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E1	**R5 - A5**	**Reach 5 - City: Los Feliz to Arroyo Seco**				
	F8	R6 - A8	Reach 6 - Charette Team 1				
	G2	R7 - A12	Reach 7 - Charette Team 3				
	H12	R8 - A15	Reach 8 - Charette Team 2				
16	A1	R1 - A11	Reach 1 - Charette Team 4	$39,069,505	6,610	$26,722	$876,504,543
	B2	R2 - A11	Reach 2 - Charette Team 4				
	C4	R3 - A16	Reach 3 - Side Channels Only				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E1	R5 - A5	Reach 5 - City: Los Feliz to Arroyo Seco				
	F8	R6 - A8	Reach 6 - Charette Team 1				
	G2	R7 - A12	Reach 7 - Charette Team 3				
	H1	**R8 - A3**	**Reach 8 - Banks & Tribs Only**				
17	A1	R1 - A11	Reach 1 - Charette Team 4	$40,036,386	6,643	$29,299	$898,196,028
	B1	**R2 - A9**	**Reach 2 - Soft Bot. Ch. & Assoc. Banks**				
	C4	R3 - A16	Reach 3 - Side Channels Only				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E1	R5 - A5	Reach 5 - City: Los Feliz to Arroyo Seco				
	F8	R6 - A8	Reach 6 - Charette Team 1				
	G2	R7 - A12	Reach 7 - Charette Team 3				
	H1	R8 - A3	Reach 8 - Banks & Tribs Only				
18	A1	R1 - A11	Reach 1 - Charette Team 4	$43,055,891	6,731	$34,313	$965,937,093
	B1	R2 - A9	Reach 2 - Soft Bot. Ch. & Assoc. Banks				
	C4	R3 - A16	Reach 3 - Side Channels Only				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E1	R5 - A5	Reach 5 - City: Los Feliz to Arroyo Seco				
	F8	R6 - A8	Reach 6 - Charette Team 1				
	G3	**R7 - A16**	**Reach 7 - Side Channels Only**				
	H1	R8 - A3	Reach 8 - Banks & Tribs Only				
19	A1	R1 - A11	Reach 1 - Charette Team 4	$43,887,027	6,753	$37,779	$984,583,208
	B3	**R2 - A13**	**Reach 2 - Charette Team 6**				
	C4	R3 - A16	Reach 3 - Side Channels Only				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E1	R5 - A5	Reach 5 - City: Los Feliz to Arroyo Seco				
	F8	R6 - A8	Reach 6 - Charette Team 1				
	G3	R7 - A16	Reach 7 - Side Channels Only				
	H1	R8 - A3	Reach 8 - Banks & Tribs Only				
20	A1	R1 - A11	Reach 1 - Charette Team 4	$51,955,779	6,883	$62,067	$1,165,601,569
	B3	R2 - A13	Reach 2 - Charette Team 6				
	C6	**R3 - A18**	**Reach 3 - Comprehensive Pockets**				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E1	R5 - A5	Reach 5 - City: Los Feliz to Arroyo Seco				
	F8	R6 - A8	Reach 6 - Charette Team 1				
	G3	R7 - A16	Reach 7 - Side Channels Only				
	H1	R8 - A3	Reach 8 - Banks & Tribs Only				
21	**A2**	**R1 - A16**	**Reach 1 - Side Channels Only**	$53,616,857	6,901	$92,282	$1,202,867,012
	B3	R2 - A13	Reach 2 - Charette Team 6				
	C6	R3 - A18	Reach 3 - Comprehensive Pockets				
	D3	R4 - A16	Reach 4 - Side Channels Only				
	E1	R5 - A5	Reach 5 - City: Los Feliz to Arroyo Seco				
	F8	R6 - A8	Reach 6 - Charette Team 1				
	G3	R7 - A16	Reach 7 - Side Channels Only				
	H1	R8 - A3	Reach 8 - Banks & Tribs Only				

6.3 Final Array of Alternatives

Four alternatives were identified from the list of best buys as the final array for analysis and given a new name to identify the recombination of restoration features. Those four alternatives include: 10-ARBOR Riparian Transitions, 13-ARBOR Corridor Extension, 16-ARBOR Narrows to Downtown, and 20-ARBOR Riparian Integration via Varied Ecological Reintroduction (numbers correspond to the best buy plan numbers in the previous section's tables and figures). These four alternatives were identified as the best representation of the range of restoration approaches that resulted from the CE/ICA. General description and rationale for selection is provided below.

Substitution

The study team reviewed and considered the sub reach plans identified in the best buys. In Reach 6 a recommended modification was made that the team considers a more effective plan. Best buy Alternative 13 includes preliminary Alternative 13 in Reach 6. However, Best Buy 16 and 20 included Preliminary Alternative 8 instead. Preliminary Alternative 13 in Reach 6 includes freshwater marsh and widens the riverbed more than the reach sub-plan from Preliminary Alternative 8. Preliminary Alternative 13 also represents a cost savings of $51 million dollars versus Preliminary Alternative 8. Therefore, reach sub-plan Reach 6 Alternative 13 will be carried forward in place of Reach 6 Alternative 8 in the Final Array Alternatives 16 and 20. To distinguish these alternatives they will be designated Alternatives 16A and 20A with the understanding that this change has been made. Table 6-7 includes a summary of the measures included in each alternative and total acres restored.

Alternative 10, ARBOR Riparian Transitions (ART) - Focuses on areas upstream and downstream of existing soft-bottomed Glendale Narrows; includes all reaches but limited restoration in reaches 3, 4 and 5.

- Alternative 10 is the first best buy plan which included restoration in all eight ARBOR reaches. Creating a corridor of continuous restoration was an important formulation consideration for the study team.
- Alternative 10 provides 5,321 AAHU.
- Relative to the No Action alternative, Alternative 10 has an incremental cost per unit output of $3,000.

Alternative 13, ARBOR Corridor Extension (ACE) - Includes all 8 river reaches, with side-channels in key locations and treatments into Downtown LA, but not at the Cornfields/LA State Historic Park.

- Alternative 13 provides an 11 percent increase in habitat output versus Alternative 10 for a 29% increase in project cost.
- As shown in Figure 6.4, Alternative 13 is located just before a large increase in incremental cost associated with Alternative 14, making it a logical break point on the incremental cost box plot.

- Relative to Alternative 10, Alternative 13 has an incremental cost per unit output of $7,900.

Alternative 16A, ARBOR Narrows to Downtown (AND) - Includes all river reaches and reaches 1-4 are similar to the smaller two alternatives. Reach 5 includes channel widening and terracing, includes restoration of Arroyo Seco and LATC.

- Alternative 16 provides a 12 percent increase in habitat output versus Alternative 13 for an 89 percent increase in project cost.

- As shown in Figure 6.4, this alternative is located at the next logical major breakpoint on the incremental cost box plot. It provides a relatively substantial increase in habitat benefit at a low incremental cost relative to Alternative 15. Moving to Alternative 17 would provide little increased habitat benefit at relatively high incremental cost.

- Relative to Alternative 13, Alternative 16 has an incremental cost per unit output of $26,000.

Alternative 20A, ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER) - Most extensive, includes measures in all eight reaches with channel widening at Verdugo Wash, Arroyo Seco, Cornfields/LA State Historic Park, and LATC.

- Alternative 20 provides a 4 percent increase in habitat output versus Alternative 16 for a 33 percent increase in project cost.

- Alternative 20 is the second to last best buy plan. Figure 6.4 shows that among all the plans larger than Alternative 16, Alternative 20 provides the largest marginal increase in habitat benefits.

- Relative to Alternative 16, Alternative 20 has an incremental cost per unit output of $47,200.

Table 6-7 Final Alternative Measure Matrix

Reach	Submeasure	Alternative			
		10	13	16	20
1. Pollywog Park area of Griffith Park	Riparian habitat corridors	x	x	x	x
2. Bette Davis Park area of Griffith Park	Restructure top of bank to support vines				x
	Riparian habitat corridors	x	x	x	x
	Modify trap channel to vertical banks				x
3. Ferraro Fields area of Griffith Park	Create pool & riffle system and plant for freshwater marsh		x	x	x
	Daylight streams plant with riparian fringe and freshwater marsh	x	x	x	x
	Divert flow into side channels with riparian fringe and return to the river		x	x	x
	Riparian habitat corridors		x	x	x
	Open water habitat	x			

	Widen mainstem				x
	Widen tributaries				x
4. Griffith Park	Create pool & riffle system and plant for freshwater marsh	x	x	x	x
	Daylight streams plant with riparian fringe and freshwater marsh	x	x	x	x
	Divert flow into side channels with riparian fringe and return to the river	x	x	x	x
	Riparian habitat corridors	x	x	x	x
5. Riverside Drive	Create pool & riffle system and plant for freshwater marsh			x	x
	Daylight streams plant with riparian fringe and freshwater marsh	x	x	x	x
	Wildlife access from river to bank (in daylighted streams)			x	x
	Restructure channel walls to support vines			x	x
	Riparian habitat corridors	x	x	x	x
	Terrace banks			x	x
	Modify trap channel to vertical banks			x	x
6. Taylor Yard	Create pool & riffle system and plant for freshwater marsh		x	x	x
	Restructure channel walls to support vegetation		x	x	x
	Riparian habitat corridors	x	x	x	x
	Restructure top of bank to support vines and other vegetation		x	x	x
	Widen channel mainstem	x	x	x	x
	Widen channel sloping or terracing back to overbank levels	x	x	x	x
7. Arroyo Seco/ Los Angeles State Historic Park	Create pool & riffle system and plant for freshwater marsh				x
	Daylight streams plant with riparian fringe and freshwater marsh	x			x
	Divert flow into side channels with riparian fringe and return to the river				x
	Riparian habitat corridors		x	x	x
	Restructure channel walls to support vegetation, plantings.		x	x	
	Widen channel (Arroyo Seco) sloping or terracing back to overbank levels		x	x	x
8. LATC	Create pool & riffle system and plant for freshwater marsh			x	x
	Restore historic wash with riparian habitat	x	x	x	x
	Divert flow into side channels with riparian fringe and return to the river			x	x
	Wildlife access from river to bank	x	x	x	x
	Riparian habitat corridors	x	x	x	x
	Widen channel			x	x
	Terrace banks			x	x

Preliminary costs and benefits included in the Draft IFR for each of the final array are summarized in Table 6-8. This includes first costs and annualized costs. Average Annual Habitat Units per alternative are also displayed. Note that the costs in this table have been further refined after those displayed in Table 6-6 so do not match precisely. These refinements include the risk based contingencies developed as part of the Abbreviated Risk Analysis, refined LERRDs estimates, and update to the FY2015 interest rate of 3.375%. See Appendix C– Cost Appendix, for further description. The refinements to the costs for the Final Array alternatives resulted in minor changes in total first cost and average annual cost (less than 10% for all alternatives). Economic evaluation confirmed that these impacts would not have had a material impact on the CE/ICA analysis, best buy plans, or Final Array plan selection.

Table 6-8 Final Array Cost Information Ecosystem Restoration

	Alt 10	Alt 13	Alt 16	Alt 20
Construction	$37,160,342	$82,287,850	$241,814,809	336,184,471
Mobilization (7.5%)	$2,787,026	$6,171,589	$19,938,361	$27,391,085
Construction First Cost	$39,947,368	$88,459,438	$261,753,170	$363,575,556
Construction Contingency	38.83%	36.01%	37.89%	39.38%
Total Construction Cost	**$55,456,944**	**$120,312,641**	**$360,927,221**	**$506,743,287**
PED/EDC (11%)	$4,394,210	$9,730,538	$31,436,149	$43,186,611
PED/EDC Contingency	24.40%	24.40%	24.40%	24.40%
Total PED/EDC	**$5,466,398**	**$12,104,790**	**$39,106,569**	**$53,724,144**
S&A (6.5%)	$2,596,579	$5,749,864	$18,575,906	$25,519,361
S&A Contingency	26.25%	26.25%	26.25%	26.25%
Total S&A	**$3,278,181**	**$7,259,203**	**$23,452,081**	**$32,218,193**
Lands & Damages	$247,425,237	$250,048,826	$278,031,210	$352,858,303
Lands & Damages Contingency	20.00%	20.00%	20.00%	20.00%
Relocations	$11,392,360	$11,392,360	$35,422,360	$49,072,002
Relocations Contingency	20.00%	20.00%	32.14%	31.46%
Total LERRDs	**$310,581,116**	**$313,729,423**	**$380,442,863**	**$487,941,715**
TOTAL FIRST COST	**$374,782,639**	**$453,406,057**	**$803,928,734**	**$1,080,627,339**
Interest During Construction	$8,525,508	$11,466,426	$49,902,201	$60,615,729
Total Investment Cost	**$383,308,147**	**$464,872,483**	**$853,830,935**	**$1,141,243,068**
Annualized Investment Cost	$15,975,233	$19,374,611	$35,585,332	$47,563,882
Annualized O&M	$579,141	$872,445	$2,257,215	$2,515,390
Total Annual Cost	**$16,554,374**	**$20,247,056**	**$37,842,547**	**$50,079,272**
AAHU	**5,321**	**5,902**	**6,509**	**6,782**
Final Array costs based upon FY2013 Price levels, Annual costs updated with FY2015 Interest Rate 3.375%				

6.4 National Ecosystem Restoration (NER) and Locally Preferred Plan (LPP)

As part of the planning process, the Corps and City identify an "NER" Plan, the National Ecosystem Restoration Plan. As described in Corps planning guidance, the NER Plan is the alternative and scale having the maximum monetary and non-monetary beneficial effects over monetary and nonmonetary costs. This plan occurs where the incremental beneficial effects just equal the incremental costs, or alternatively stated, where the extra environmental value is just worth the extra costs. The Los Angeles District (District) circulated the Los Angeles River Ecosystem Restoration Feasibility Study Integrated Feasibility Report (IFR) for a 45-day public review period beginning on September 20, 2013, and a public meeting was held on October 17, 2013. The Draft IFR identified Alternative 13 as the Tentatively Selected Plan (TSP) as it reasonably maximizes net NER benefits.

6.4.1 Preliminary Identification of NER Plan

Alternative 13 was identified as the NER Plan in the Draft Report based on comparison of costs and outputs, and the planning objectives. The CE/ICA supports selection of Alternative 13 as the NER Plan. The incremental Average Annual Cost/AAHU for Alternative 16 is over four times higher than for Alternative 13. Alternative 13 meets objectives through restoration of Valley Foothill Riparian strand and freshwater marsh and also provides the greatest percent incremental increase in habitat connectivity.

6.4.2 Public Review Comments

Review comments during the public comment period came from letters, emails, and participants at the Public Meeting. The District received and evaluated nearly 500 comments. Federal agencies including U.S Environmental Protection Agency, U.S. Fish and Wildlife Service, Department of Interior, the Urban Waters Federal Partnership, state and local agencies, non-governmental organizations, interest groups, elected officials, and private citizens provided comments. The public meeting included over 300 attendees, with close to unanimous support for Alternative 20. In addition, the District received over 8,000 petition signatures in support of Alternative 20.

Key comments related to the following topics:

- Scope of the recommended plan
- Acceptability and completeness of the plans
- Habitat and hydrologic connectivity benefits associated with the plans
- Model used to calculate benefits
- Environmental justice
- Union Pacific Rail Road Yard (LATC) relocation

6.4.3 Independent External Peer Review

Independent External Peer Review (IEPR) was conducted on the Draft IFR and Appendices. IEPR comments were addressed and responses provided in December 2013. The IEPR Panel recommended quantification of connectivity outputs of proposed alternatives and reevaluation of Alternative 13 as the TSP after factoring in connectivity outputs as well as public review comments in support of Alternative 20. A framework suggested by the IEPR panel was applied to quantify the beneficial outputs of connectivity noted by public comments as not being fully captured in the alternatives analysis. By evaluating hydrologic, local, and regional connectivity and combining the resultant output with the initial habitat model output, USACE was able to more comprehensively compare the alternatives in the final array.

Quantifying connectivity benefits showed more restoration outputs for each of the alternatives, as well as for key features included in Alternatives 16 and 20 but not Alternative 13. By capturing these additional benefits, this analysis showed that the incremental costs per output for larger scale plans were substantially lower, but still in excess of $100 million. Notwithstanding the incremental increase in benefits, based on the magnitude of this incremental increase in cost it was determined that the additional benefits were not worth the additional investment. Accordingly, Alternative 13 remained as the NER and Corps supported recommended plan.

6.4.4 Locally Preferred Plan Request

By letter dated April 10, 2014, the City of Los Angeles requested a recommended plan of Alternative 20. The basis for the sponsor's request for Alternative 20 included: the Administration's America's Great Outdoors and Urban Waters Federal Partnership initiatives; strong public, agency, and stakeholder support; Los Angeles Congressional delegation support; the Corps' acceptability criteria; redressing environmental injustice; the scarcity of Mediterranean-type habitat; and the need to connect to opportunity areas highlighted in the City's LA River Revitalization Master Plan.

The April 10, 2014 letter also referenced the August 8, 2013, approval of the City's request to waive Federal reimbursement for land, easements, rights-of-way, relocation, and disposal area (LERRD) costs above the standard 35% cost commitment of local sponsors. It proposed that the Corps and City divide the costs of implementing Alternative 20 at 50% Federal cost and 50% City cost. The letter also reaffirmed the City's understanding of its responsibility to acquire the necessary real estate interests.

Section 103 of WRDA 1986, as amended by Section 210 of WRDA 1996, specifies non-Federal share for "environmental protection and restoration" to be 35% of project costs. Implementation requirements are found in the Planning Guidance Notebook (ER 1105-2-100), Appendix E. In summary: projects may deviate from the NER Plan if requested by the non-Federal sponsor and approved by ASA(CW). Plans requested by the non-Federal sponsor that deviate from the NER plan shall be identified as the LPP. If the sponsor prefers a plan more costly than the NER Plan, and the increased scope of the plan is not sufficient to warrant full Federal participation, ASA(CW) may grant an exception as long as the sponsor pays the difference in cost between the NER plan and the locally preferred plan. The LPP, in such a case, must have outputs similar in-kind and equal to or greater than the outputs of the Federal plan. It may also have other outputs.

6.4.5 Updated NER Plan Features

Subsequent to release of the Draft Report, cost estimates for the NER Plan and Locally Preferred Plan were updated and refined to reflect: updated assumptions relating to the design and layout of plan features; a full cost and schedule risk analysis applied to generate cost contingencies; more detailed and accurate estimates of LERRDs costs based upon a Gross Appraisal; and utilization of the Corps MCACES software to generate more detailed project cost estimates than those used in the initial evaluation to identify the NER Plan. During the process of completing design and cost refinements, it was determined that the plan features in Reach 7 included in the NER Plan (Alternative 13) were less cost effective and efficient than the plan features in Reach 7 included in the LPP (Alternative 20). This was attributable to both a reduction in LPP Reach 7 plan costs, as well as an increase in Alternative 13 Reach 7 plan costs. The relative changes in costs resulted in the LPP Reach 7 Plan having a lower cost and higher output than the Alternative 13 Reach 7 plan. Therefore, the NER Plan has been modified for Reach 7 to include the same features for this reach as are included in the LPP. Specifically, the NER Plan will include restoration at Arroyo Seco, terracing of the right bank near the Los Angeles State Historic Park and wetland/riparian restoration at the Park. The revised NER Plan is identified as Alternative 13v (indicating it is a variation of Alternative 13).

The most significant change to the costs estimates for both the NER Plan and the LPP relate to the basis for costs in Reach 8 at the LATC Intermodal Facility. Both plans require the acquisition of the LATC parcel for restoration purposes. However, the costs developed for plan formulation, comparison, and evaluation purposes (as shown in Table 6-8) were based upon the appraised value of the property, and did not include the relocation costs for LATC operations. Updated costs for these plans include these relocation costs, which resulted in a substantial increase in overall project costs. The inclusion of utility relocation costs not accounted for in previous cost estimates also resulted in cost increases for this reach. Most of the difference in updated costs for both the NER Plan and LPP is attributable to the increase in costs in Reach 8.

Table 6–9 provides a summary comparison of Alternative 13 and Alternative 13v (the updated NER Plan). As shown, the updated NER Plan provides 87 additional AAHUs and 10 additional acres of restoration, with reduced project costs relative to Alternative 13.

Table 6-9 Comparison of Alternative 13 and Alternative 13v (October 2014 Prices)

	Alt 13	Alt 13v
Construction Cost	$147,851,000	$113,958,000
PED/EDC (14%)*	$24,182,000	$15,954,120
S&A (9.5%)*	$16,856,000	$10,826,010
Lands & Damages	$350,474,000	$348,648,000
Relocations	$168,437,000	$177,886,000
Total LERRDs**	$518,911,000	$526,534,000
TOTAL FIRST COST	$707,800,000	$667,272,130
AAHU	5,902	5,989
Annualized Investment Cost***	$31,147,128	$27,810,000
Annual O&M	$941,566	$951,887
Total Annual Cost	$32,088,695	$28,761,887
Total Annual Cost per AAHU	$5,438	4,802
Acres	588	598

* A portion of the PED and CM costs relate to Relocations, and are therefore a LERRDs costs. The IFR identifies these specific costs and categorizes them appropriately in cost apportionment tables.
** Lands and Damages include some costs for federal administration, which are not part of LERRDs
*** IDC is included via simple addition of individual reach-based IDC calculations.

6.4.6 Updated NER Plan and LPP Summary

MCACES cost estimates were developed for both the NER and LPP, and are included in Appendix C. Table 6–10 summarizes project cost for both plans. These costs reflect the TPCS, updated NER plan configuration, final LERRDs estimates, and the FY2015 interest rate of 3.375%.

Table 6-10 NER and LPP Project Cost Summary

ECOSYSTEM RESTORATION	NER	LPP
Construction	$85,685,000	$329,118,000
Contingency	$28,952,000	$121,115,000
Total Construction Cost	**$114,637,000**	**$450,233,000**
PED/EDC	$19,760,000	$62,305,000
Contingency	$6,555,000	$20,666,000
Total PED/EDC*	**$26,315,000**	**$82,971,000**
Construction Management	$9,649,000	$28,711,000
Contingency	$3,207,000	$9,541,000
Total Construction Management*	**$12,856,000**	**$38,252,000**
Adaptive Management & Monitoring	$7,763,000	$8,955,000
Contingency	$2,623,000	$3,295,000
Total Adaptive Management & Monitoring	**$10,386,000**	**$12,250,000**
Lands & Damages	$303,144,000	$457,104,000
Contingency	$45,471,000	$69,181,000
Relocations	$134,387,000	$168,718,000
Contingency	$46,918,000	$59,844,000
Total LERRDs**	**$529,920,000**	**$754,847,000**
Ecosystem Restoration First Cost	**$694,114,000**	**$1,338,553,000**
Interest During Construction	$26,235,000	$57,911,000
Total Investment Cost	**$720,349,000**	**$1,396,464,000**
Annualized Investment Cost	$30,022,000	$58,201,000
Annualized O&M	$1,366,000	$2,306,000
Total Annual Cost	**$31,388,000**	**$60,507,000**
AAHU	**5,989**	**6,782**
Average Annual Costs/AAHU	**$5,172**	**$8,825**
Acres Restored	**598**	**719**

* A portion of the PED and CM costs relate to Relocations, and are therefore a LERRDs costs. The IFR identifies these specific costs and categorizes them appropriately in cost apportionment tables.
** Lands and Damages include some costs for federal administration, which are not part of LERRDs

Costs shown in Table 6-10 above are categorized consistent with the Total Project Cost Summary certified by the Cost Estimating Mandatory Center of Expertise. The Lands and Damages costs shown in the table include some costs for federal administration, which are not part of LERRDs. Also, a portion of the PED and Construction Management costs relate to Relocations, and are therefore a LERRDs costs. The IFR identifies these specific costs and categorizes them appropriately in cost apportionment tables.

6.4.7 Recommended Plan

By memorandum dated May 27, 2014 the Assistant Secretary of the Army (Civil Works) approved the Locally Preferred Plan Request. A memorandum dated July 3 2014 provided further guidance per the Locally Preferred Plan. It directed that the Final Feasibility Report is to present the LPP as the recommended plan instead of the NER Plan (Alternative 13). Costs and benefits of the Recommended Plan (Alternative 20) are show in Table 6-10 above and further described in the IFR.

7. Recreation Plan

This section provides a summary of the recreation analysis conducted for the IFR. Attachment 1 to this appendix contains detailed documentation of the analysis. For this analysis, the recreation resource area is the ARBOR reach. The focus is on those recreation resources connected to or otherwise affected by the River.

The objective of the recreation plan is to maintain and improve the quality and quantity of recreation amenities that complement the ecosystem restoration in the ARBOR reach, especially in regard to promoting access and connectivity between both banks of the river and throughout the length of the ARBOR reach. The recreation features will be designed to avoid any negative impacts to the restoration areas. The recreation plan was formulated cooperatively by USACE and the non-Federal sponsor. The features of the recreation plan are designed to capitalize on the areas where substantial ecosystem restoration is proposed.

Two potential recreation plan options were defined, with the second building incrementally on the first, corresponding to ecosystem restoration Alternatives 13 and 20, respectively. Each recreation plan option was developed to be consistent with, and complementary to, its corresponding ecosystem restoration alternative. Both plan options are documented in detail in Attachment 1.

Both of the recreation plan options include modification, upgrade, or creation of multi-use trails and related basic amenities (access points, wildlife viewpoints, parking lots, restrooms, signage). The plan options also include non-motorized multi-use bridges and smaller pedestrian bridges across tributaries or within large restored areas. The plan options differ in the location and quantity of the recreation features included.

- The Alternative 13 recreation plan option would result in a 41% increase in accessible trail and multi-use pathways. Including multi-use pathways created by the ecosystem restoration plan, the total increase in accessible trails and pathways would be 51.2%. This plan option would also include two bridges, one small pedestrian bridge in Taylor Yard, and a medium bridge within LATC.
- The Alternative 20 recreation plan option would result in a 58.1% increase in accessible trail and multi-use pathways. Including multi-use pathways created by the ecosystem restoration plan, the total increase in accessible trails and pathways would be 66.9%. This plan option would also include seven bridges, ranging from small to large, with two bridges spanning the LA River, one at Verdugo Wash, and one at LATC.

The two recreation plan options would provide both direct and indirect benefits to recreation participants as well as the communities surrounding the ARBOR reach, albeit to varying amounts. Direct benefits of either recreation plan option would include:

- Improved quality and quantity of trails for multiple user groups along the river
- Increased connectivity of each side of the river's recreation resources

- Increased public safety through better signage and trail development along the river
- Improved viewing and lines of sight along the river, especially in areas of substantial restoration via the ecosystem restoration plan
- Opportunity for interpretive signage and environmental education
- Improved public health by providing opportunities for exercise and psychological respite

In addition to these direct benefits, communities along the ARBOR reach will receive benefits in the form of increased quantity and quality of neighborhood parks. As discussed in the main report, parks provide OSE benefits to communities they serve. The addition of trails and amenities in the restored LATC will benefit the surrounding historically-underserved communities along the downstream end of the ARBOR reach, providing substantial open space in highly-developed neighborhoods which are currently considered park-deficient. Both recreation plan options will also help support the projected RED benefits related to redevelopment in the study area. For documentation of the Recreation analysis and RED/OSE analysis, see Attachments 1 and 2 to this appendix.

The benefits and costs of the proposed recreation features were estimated based on the guidelines in Appendix E, ER 1105-2-100 Planning Guidance Notebook, dated 22 April 2000. The Unit Day Value (UDV) method was selected as the appropriate valuation method as detailed in EGM 15-03 (USACE 2014). Table 7-1 presents the MCACES cost estimates and benefits summary table for both the NER plan and the recommended LPP. These costs reflect the TPCS, updated NER plan configuration, final LERRDs estimates, and the FY2015 interest rate of 3.375%.

- The Alternative 13 recreation plan option had annual benefits of $2.48 million and annual costs of $606,000, resulting in net benefits of $1.87 million and a BCR of 4.09.
- The Alternative 20 recreation plan option had annual benefits of $3.51 million and annual costs of $978,000, resulting in net benefits of $2.53 million and a BCR of 3.59.

Table 7-1 NER and LPP Recreation Component Summary

RECREATION	NER	LPP
Construction	$6,396,000	$10,907,000
Contingency	$2,160,000	$4,014,000
Total Construction Cost	**$8,556,000**	**$14,921,000**
PED/EDC	$932,000	$1,625,000
Contingency	$309,000	$539,000
Total PED/EDC	**$1,241,000**	**$2,164,000**
Construction Management	$418,000	$728,000
Contingency	$138,000	$242,000
Total Construction Management	**$556,000**	**$970,000**
Recreation First Cost	**$10,353,000**	**$18,055,000**
Interest During Construction	$33,200	$53,700
Total Investment Cost	**$10,386,000**	**$18,109,000**
Annualized Investment Cost	$433,000	$755,000
Annualized O&M	$173,000	$223,000
Total Annual Cost	**$606,000**	**$978,000**
Average Annual Benefits	**$2,479,000**	**$3,510,000**
Net Benefits	**$1,873,000**	**$2,532,000**
BCR	**4.09**	**3.59**

The results of the analysis show that the Alternative 20 recreation plan is expected to provide positive net benefits, and is economically justified. Between the two recreation plan options evaluated, the Alternative 20 recreation plan provided the largest net recreation benefits. Sensitivity analysis showed that the Alternative 20 option would result in positive net benefits even if visitation grew just 10% above the without project condition and UDV scores used in the analysis were reduced by 9 points. Further, the Alternative 20 recreation plan option adds additional features considered essential by the project sponsor.

As documented in Section 6.4, ecosystem restoration Alternative 20 is selected for recommendation as a locally preferred plan (LPP). As such, the corresponding Alternative 20 recreation plan option is selected as well, and will be carried forward into the pre-construction engineering and design (PED) phase of the study. For detailed documentation of the recreation analysis, see Attachment 1 to this appendix.

8. RED and OSE Considerations

Attachment 2 to this appendix documents the analysis of Regional Economic Development (RED) effects and Other Social Effects (OSE). The analysis was completed during the alternatives evaluation and comparison phase, based upon planning level alternatives formulation and cost estimates. For these results, please see the Attachment.

The RECONS model was run again to update the estimated RED impacts of construction spending based upon February 2015 NER and LPP estimates. These updated results are summarized below. Note that subsequent to the February 2015 cost update upon which the construction related RED impacts were calculated and presented in Sections 8.1 and 8.2 below, costs were further refined, with certification by the Cost Mandatory Center of Expertise on March 9, 2015. The difference in construction costs for the Recommended Ecosystem Restoration Plan is only one percent, and the difference in construction costs for the Recommended Recreation Plan is less than one percent. Therefore, RED benefits relating to construction of project features were not reanalyzed to reflect the March 2015 updated costs.

Note that redevelopment impacts modeled in IMPLAN were not updated. Because redevelopment effects are a function of the restoration plan components rather than their costs, no substantial changes in the redevelopment effects documented in Attachment 2 are expected. Additionally, the updated NER and Recommended plans aren't expected to result in substantial differences OSE effects compared to those already documented in Attachment 2.

Updated effects of construction spending are summarized via four tables, as bulleted below:

- Table 8-1: Overall Impacts for NER plan Ecosystem Restoration Construction Spending
- Table 8-2: Overall Impacts for the NER-plan-compatible Recreation Plan
- Table 8-3: Overall Impacts for the Recommended Plan Ecosystem Restoration Construction Spending
- Table 8-4: Overall Impacts for the Recommended-plan-compatible Recreation Plan

These results represent total effect over the duration of construction, not average annual effect. Results are presented in total for quicker comparison to the results shown in Section 2. Average annual effects can be estimated on a constant annual expenditure basis by dividing these total by the approximate construction duration in years.

8.1 NER Plan

Ecosystem Restoration Construction

The USACE is planning on expending $336,339,000 on the project, excluding lands and damages. Of this total project expenditure $312,413,859 will be captured within the regional impact area. The rest will be leaked out to the state or the nation.

Table 8-1 NER Plan - Ecosystem Construction RED Impacts

Impacts	Impact Areas	Regional	State	National
Total Spending		$336,339,000	$336,339,000	$336,339,000
Direct Impact				
	Output	$312,413,859	$333,770,155	$334,993,047
	Job	2,769.17	3,271.69	3,305.29
	Labor Income	$151,798,611	$168,680,986	$169,647,695
	GRP	$177,116,961	$193,661,261	$194,608,611
Total Impact				
	Output	$659,750,801	$737,860,216	$966,318,565
	Job	4,781.31	5,609.80	6,964.07
	Labor Income	$275,351,761	$307,327,529	$373,034,022
	GRP	$384,759,602	$429,748,303	$540,718,316

Recreation Construction

The USACE is planning on expending $10,377,000 on the project, and there are no lands and damages for recreation. Of this total project expenditure $10,377,000 will be captured within the regional impact area. The rest will be leaked out to the state or the nation.

Table 8-2 NER Plan - Recreation Construction RED Impacts

Impacts	Impact Areas	Regional	State	National
Total Spending		$10,377,000	$10,377,000	$10,377,000
Direct Impact				
	Output	$10,377,000	$10,377,000	$10,377,000
	Job	58.51	58.51	58.51
	Labor Income	$4,288,202	$4,288,202	$4,288,202
	GRP	$5,368,902	$5,368,902	$5,368,902
Total Impact				
	Output	$21,920,484	$23,023,824	$30,105,589
	Job	125.22	131.57	172.60
	Labor Income	$8,455,129	$8,694,361	$10,741,646
	GRP	$12,289,089	$12,765,131	$16,226,295

8.2 Recommended Plan

Ecosystem Restoration Construction

The USACE is planning on expending $804,017,000 on the project, excluding lands and damages. Of this total project expenditure $746,824,048 will be captured within the regional impact area. The rest will be leaked out to the state or the nation.

Table 8-3 Locally Preferred Plan - Ecosystem Construction RED Impacts

Impacts	Impact Areas	Regional	State	National
Total Spending		$804,017,000	$804,017,000	$804,017,000
Direct Impact				
	Output	$746,824,048	$797,876,186	$800,799,505
	Job	6,619.69	7,820.95	7,901.29
	Labor Income	$362,873,957	$403,231,205	$405,542,119
	GRP	$423,397,369	$462,946,449	$465,211,087
Total Impact				
	Output	$1,577,131,584	$1,763,851,820	$2,309,980,566
	Job	11,429.69	13,410.20	16,647.58
	Labor Income	$658,227,256	$734,665,198	$891,736,300
	GRP	$919,766,251	$1,027,311,555	$1,292,584,917

Recreation Construction

The USACE is planning on expending $18,014,000 on the project, and there are no lands and damages for recreation. Of this total project expenditure $18,014,000 will be captured within the regional impact area. The rest will be leaked out to the state or the nation.

Table 8-4 Locally Preferred Plan - Recreation Construction RED Impacts

Impacts / Impact Areas		Regional	State	National
Total Spending		$18,014,000	$18,014,000	$18,014,000
Direct Impact				
	Output	$18,014,000	$18,014,000	$18,014,000
	Job	101.57	101.57	101.57
	Labor Income	$7,444,124	$7,444,124	$7,444,124
	GRP	$9,320,169	$9,320,169	$9,320,169
Total Impact				
	Output	$38,052,963	$39,968,311	$52,261,934
	Job	217.37	228.39	299.62
	Labor Income	$14,677,719	$15,093,015	$18,647,009
	GRP	$21,333,299	$22,159,686	$28,168,111

8.3 Regional Economic Development and Economic Impacts Summary

Table 8-5 presents the cumulative regional economic impacts from construction through the study's period of analysis for the alternatives. These results were developed by the study team as reasonable factors, based upon available information, for developing a general estimate of potential redevelopment RED benefits associated with project alternatives.

Table 8-5 Cumulative RED & Economic Impacts of Ecosystem Restoration

Ecosystem Construction Cumulative Impacts		
	NER	**LPP**
Jobs	4,781	11,430
Labor Income	$275,351,761	$658,227,256
Sales	$659,750,801	$1,577,131,584
GRP	$384,759,602	$919,766,251
Recreation Construction Cumulative Impacts		
Jobs	125	217
Labor Income	$8,455,129	$14,677,719
Value	$12,289,089	$21,333,299
Output	$21,920,484	$38,052,963
Redevelopment Construction Cumulative Impacts		
Jobs	1,281	5,087
Labor Income	$84,665,000	$336,278,000
Value	$115,791,000	$460,153,000
Output	$193,002,000	$767,247,000
Redevelopment Long-term Economic Activity Cumulative Impacts		
Jobs	675	2,671
Labor Income	$964,851,000	$3,815,989,000
Taxes - Local	$5,789,000	$22,896,000

The cumulative effects of the construction/redevelopment components over the period of analysis will create between 6,862 (NER Plan) to 19,405 (LPP) jobs with incomes from $1.3 billion to nearly $5 billion as shown in Table 8-6.

Table 8-6 Employment and Income Cumulative Impacts

	NER	LPP
Jobs	6,862	19,405
Labor Income	$1,333,322,890	$4,825,171,975

8.4 Other Social Effects

The Other Social Effects account describes the potential effects of project alternatives in areas that are not dealt with explicitly in the NER and RED accounts. This OSE analysis describes the potential social effects of the alternatives under consideration. The OSE account explores the following categories of effects from the implementation of the alternatives considered. In most cases it is not possible to significantly differentiate between the social effects of the restoration alternatives because the scale of the categories on an overall community level exceeds the scale of differences among the alternatives.

- Displacement/Impacts to Population
- Public Health and Safety
- Displacement/Impacts to Minorities and Special Interest Groups
- Displacement/Impacts to Businesses
- Displacement/Impacts to Agriculture
- Displacement/Impacts to Recreational Areas
- Community Growth
- Project Impacts and Connectivity of the Community

Attachment 2 includes the OSE analysis. Each of the alternatives analyzed include benefits to various OSE categories such as public health and safety, environmental health, community well-being, and connectivity to the community. Both the NER and LPP result in business displacement in Reach 8, and Alternative 20 also includes business relocations in Reach 3.

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U.S. Army Corps
of Engineers
Los Angeles District

Los Angeles River Ecosystem Restoration Integrated Feasibility Study Los Angeles County, California

Recreation Analysis

September 2015

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1 INTRODUCTION

1.1 RECREATION STUDY AREA

This is the Recreation Analysis report for the Los Angeles River Ecosystem Restoration Feasibility Study Integrated Feasibility Report (IFR). For this analysis, the recreation resource area is the same as the IFR area—defined as being approximately one-half mile buffer on either side of the Los Angeles River (approximately 11 square miles), also known as the ARBOR or Area with Restoration Benefits and Opportunities for Revitalization. The focus is on those recreation resources connected to or otherwise affected by the River. The inventory of larger regional parks and other resources that exist outside this area are beyond the geographic scope of the recreation plan benefit analysis, but are presented below to provide an overview of the regional recreation context along the ARBOR reach.

1.1.1 CURRENT RECREATION USES

Plates 1 through 3 provide an overview of the recreation context along the ARBOR reach. Approved recreation uses of the River in the study area are limited to pedestrian, cyclist, and equestrian trails along the banks. Some areas in the River's watershed have recently been permitted for seasonal fishing or canoeing/kayaking (Sepulveda Basin and a portion of the ARBOR reach—from Fletcher Drive to Barclay Street in Elysian Valley), but these uses are not approved in the rest of the study area. Even in those places users are not often admonished or given citations by the authorities, and unapproved uses do occur, mostly in the soft-bed areas of the River (Los Angeles 2011a). Other activities along the River include bird watching, sightseeing, impromptu performances, small-scale art exhibitions, and tours by local interest groups. There are no areas approved for swimming in the study area, instances of swimming and wading are likely low due to water quality concerns, and local agencies and interest groups typically advise users to stay out of the water (Los Angeles River Revitalization Corporation [LARRC] 2011b). The Los Angeles River Pilot Recreation Zone was opened from Memorial Day in May to Labor Day in September 2013 in the 2.5-mile portion of the River in Elysian Valley, described above. The recreation zone included the river channel and five feet of adjacent riverbank. The public was allowed to walk, fish, and kayak in this zone during the period. The Recreation Zone was renewed in 2014 and 2015.

Small parks along the River's pathways provide an improved pedestrian recreational experience with facilities, such as benches, native habitat, open space areas, interpretive signage, art installations, and some play areas. These parks have been implemented by the city and a combination of other organizations, including local non-profit groups and the State of California—seeking to develop a greenway along the River (Santa Monica Mountains Conservancy and Mountains Recreation Conservation Authority 2007). The Los Angeles River Greenway is a priority of the County of Los Angeles as expressed in its 1996 Los Angeles River Master Plan, the City of Los Angeles via its 2007 Los Angeles River Revitalization Master Plan, the 2012 and 2010 Bicycle Plans of both agencies, respectively, and the Los Angeles River Revitalization Corporation via its "Greenway 2020" campaign initiated in 2013.

The Los Angeles River Bike Path is a Class I Bike Path (off-roadway, paved), and runs along the right bank (facing downstream) of the River from Griffith Park through the Glendale Narrows to Elysian Park (begins in Reach 2 and ends in Reach 7), offering an off-roadway route for pedestrians and cyclists. That portion of the Los Angeles River Bike Path was included in the National Recreational Trail System by the U.S. Department of the Interior in 2012. The existing and future trails on both sides of the River throughout the study area also coincide with the National Park Service's Juan Bautista de Anza National

Historic Trail. Another route between Griffith Park and Elysian Park relies on a combination of bike lanes and bike routes (on-roadway) but does not follow the River, making it a Class III Route, less appropriate for recreation and more of a transportation route. Both of these routes are managed by the Los Angeles County Metropolitan Transportation Authority (Metro), and are included in the City of Los Angeles Bicycle Plan (Metro 2012d).

1.1.2 Existing Trails, Pathways, and Access Roads

The study area contains a mixture of trails, pathways, and access roads which may see some degree of recreation use in the existing condition. Existing trails along the river or those affected by the recreation plan were quantified and categorized via analysis of aerial photographs and available data in geographic information systems (GIS). Plates 4 through 10 summarize the existing features while noting how they will be affected by the proposed recreation plan.

1.1.3 Recreation Supply and Demand

The City of Los Angeles has approximately 24,000 acres of parks, with approximately 16,000 acres of parkland under the jurisdiction of the Department of Recreation and Parks (RAP). Other agencies managing parklands include the Los Angeles Department of Water and Power (LADWP), the Mountains Recreation and Conservation Authority (MRCA), the Santa Monica Mountains Conservancy (SMMC), California State Parks, the Los Angeles County Department of Parks and Recreation (LACDPR) and the Los Angeles County Flood Control District (LACFCD). In all, this equates to a Citywide average of 6.26 acres of park per 1,000 residents (Trust for Public Land 2011). The City of Glendale has 39 developed parks comprising 280 acres, or about 1.4 acres per 1,000 residents (City of Glendale 2012). The City of Burbank operates 27 park facilities covering 155 acres, as well as 500 acres of open space, equating to approximately 6.34 acres of parkland per 1,000 residents (City of Burbank 2010). Including all parks identified in the ARBOR reach presented below, the recreation resource area has an estimated 5,000 acres of parkland, or 38.77 acres per 1,000 residents. This value is high compared to the Citywide average due to the presence of some larger-than-average parks near the study area, such as Griffith Park (the largest park at 4,210 acres) and Elysian Park (575 acres). However, access to these large open space areas has been historically-restricted due to many factors, including infrastructural barriers, such as freeways, streets, rail lines, and prohibited public circulation in/around the River.

Even given the presence of large open spaces like Griffith Park, much of Los Angeles is considered to be park deficient because of distribution and access; this condition is defined as any geographic area that provides less than three acres of green space per 1,000 residents, as prescribed by California law (Green Info Network 2010). In particular, the industrial areas surrounding reaches 7-8 (from the I-5 overpass to Main Street) have the least parkland, with fewer than 3 acres per 1,000 people. Other areas, particularly on the southwest side of Reaches 1-3 (from Pollywog Park to Brazil Street), have greater than 3 acres of parkland per 1,000 residents, which is due to the presence of Griffith Park. In general, access to parks and acres of parkland per 1,000 residents is lowest in areas that have the highest number of families below the poverty line of $47,331 annual income.

According to the Southern California Association of Governments (SCAG), public parks are intended to serve all residents, but not all neighborhoods and people have equal access to these public resources. SCAG calls for a multiagency effort and public transportation to improve access for all to parks throughout Southern California (SCAG 2008). The City Project has been working toward finding resolutions to improve park availability for all neighborhoods, regardless of ethnicity or income level (Garcia et al. 2009).

Residents of Los Angeles place a high priority on the quality of natural and environmental resources. In a study from 2000, 75 percent of those surveyed said that preserving wetlands, rivers, and environmentally sensitive areas would be either “somewhat effective” or “very effective” at improving their quality of life. There is also strong support for protecting cultural resources and for environmental education (Public Policy Institute of California 2000). A notable move forward for public recreation was the California Legislature’s passage of Senate Bill 1201 (authored by Senator Kevin De León and signed by Governor Jerry Brown) in 2012, which calls for expanded public access to the River for recreational purposes.

1.2 Recreation Plan Context within Restoration Plan

The recreation plan was formulated cooperatively by USACE and the non-Federal sponsor. The USACE generated GIS shapefiles outlining the basic features of the recreation plan and provided those files for use in development of the recreation plan cost estimate (discussed further in Section 4.1). Two potential recreation plan options were defined, with the second building incrementally on the first, corresponding to ecosystem restoration Alternatives 13 and 20, respectively. Each recreation plan option was developed to be consistent with, and complementary to, its corresponding ecosystem restoration alternative. Both plan options are documented in this appendix.

The recreation plan features are integrated into the ecosystem restoration plan; however, these features are evaluated as separable components of the plan. The features of the recreation plan are designed to capitalize on the areas where substantial ecosystem restoration is proposed. As such, it is assumed that the ecosystem restoration will have taken place when considering the effects of the recreation plan features. For example, the proposed wildlife viewpoints in the recreation plan are dependent upon the ecosystem restoration plan providing the restored area. In this way, the success of the recreation plan is linked to, and affected by, the selected ecosystem restoration plan.

Additionally, all ecosystem restoration plans which call for modification of the channel banks implicitly require that existing top-of-levee access and maintenance roads be replaced to some degree. Per discussion with the study team, it is assumed that the ecosystem restoration plan will include in its design the designation of these top-of-levee or equivalent access roads as multiple-use pathways that may be used for various general recreation activities by the public. It is beyond the scope of this recreation plan analysis to quantify the recreation benefits that these multi-use access roads would provide, as their exact location, length, and type will be determined in future phases of the ecosystem restoration plan design, but their inclusion would be key to providing full connectivity of recreation trails, on both sides of the river, throughout the ARBOR reach. No costs or direct benefits for these access roads associated with the ecosystem restoration plan are included in the recreation cost estimate or recreation benefit calculation.

1.3 Proposed Recreation Features

The objective of the recreation plan is to maintain and improve the quality and quantity of recreation amenities that complement the ecosystem restoration in the ARBOR reach, especially in regard to promoting access and connectivity between both banks of the river and throughout the length of the ARBOR reach. The recreation features will be designed to avoid any negative impacts to the restoration areas.

The recreation plan includes the modification, upgrade, or creation of multi-use trails and related basic amenities (access points, wildlife viewpoints, parking lots, restrooms, signage). The plan also includes non-motorized multi-use bridges across the River, tributaries, or within large restored areas. This planning level design assumes that signage would include trail markers, wayfinding signage, trail access point markers, and educational/interpretive signage, as appropriate and complementary to the ecosystem restoration features, such as at wildlife viewpoints or in areas of trail through new restoration areas.

Further, some details of trail design and trail access points will be refined during the design phase of the project. One potential refinement to the design includes consideration of Arizona Crossings to facilitate safe access to the recreation and restoration areas. Additionally, future phases of design of the ecosystem restoration plan will consider provision of water access for recreation as a complementary component of the safety/maintenance ramps that will be included in the ecosystem restoration plan design.

The specific listing of features for each of the recreation plan options is summarized in the following subsections.

1.3.1 Alternative 13 Recreation Plan Option Features

The recreation plan option corresponding to ecosystem restoration Alternative 13 includes the following specific features:

- 5.89 miles of new unpaved non-motorized multi-use trail *(to include decomposed granite surface and trail signage)*
- 0.3 miles of new paved multi-use trail *(short extension of current southern end of LA River Bike Path)*
- 1 small bridge/crossing within Taylor Yard
- 1 medium bridge within LATC
- 2 paved parking lots, one at Taylor Yard and one at LATC *(each about 15,000 square feet)*
- 4 restrooms, one at Bette Davis Park, two at Taylor Yard, and one at LATC
- 1 pedestrian underpass at the south end of Taylor Yard
- 24 trail access points throughout the study area *(access points would include grading and planting, signage, stairs, benches, gating, and trash receptacles to provide quality trail access)*
- 6 wildlife viewing points throughout the study area *(viewpoints would include an elevated wood deck with railing, benches, interpretive signage, and trash receptacles to allow users to enjoy high quality viewsheds within the restored ARBOR reach)*
- 4 pedestrian underpasses along the river to support trail connectivity

Plates 4 through 10 display these features. Table 1, below, summarizes the two proposed bridges. Table 2, below, summarizes the proposed changes in trails. As shown in the table, this recreation plan option would result in a 41% increase in accessible trail and multi-use pathways. Including multi-use pathways created by the ecosystem restoration plan, the total increase in accessible trails and pathways would be 51.2%.

Table 1. Proposed Bridges, Alternative 13 Option

ID	*Length (ft)*	*Location*	*Description*
1	150	R6; in Taylor Yard	1 pedestrian bridge within Taylor Yard over restoration area
2	250	R8; LATC	medium pedestrian bridge over restoration area within LATC

Note: See Appendix C – Cost Appendix for detailed backup of the recreation plan option costs summarized in Section 4.1.

As shown in Table 2 below, 13.07 miles of existing accessible trail would not be modified by the recreation plan. However, there would be 1.12 miles of existing length that would be upgraded to a fully-developed multi-use trail. There would also be 6.19 miles of new trail added in the study area. Lastly, this recreation plan option would convert 0.82 miles of currently inaccessible access road to multi-use trail.

The ecosystem restoration plan would also upgrade 5.28 miles of existing trail, and convert 2.96 miles of currently inaccessible access road to multi-use trail. These changes would result in 29.44 miles of accessible trail and multi-use pathway.

At the current level of design, un-paved trails are assumed to be multiple-use, twelve feet wide, using a decomposed granite surface, and paved trails are assumed to be similar to the existing LA River Bike Path (cost provided by City).

Table 2. Summary of Accessible Trail and Multi-Use Pathway, Alternative 13 Option

Trail Type	***Miles***	***% of Tot With Project Miles***
Existing Trail/Pathway Remaining As-Is	13.07	44.4%
Existing Trail/Pathway Upgraded per Recreation Plan	1.12	3.8%
New Paved and Unpaved Trail/Pathway per Recreation Plan	6.19	21.0%
Inaccessible access road converted to trail per Recreation Plan	0.82	2.8%
Existing Trail Upgraded per Ecosystem Restoration Plan	5.28	17.9%
Inaccessible access road converted to trail per Restoration Plan	2.96	10.1%
TOTAL	**29.44**	100.0%

1.3.2 ALTERNATIVE 20 RECREATION PLAN OPTION FEATURES

The recreation plan option corresponding to ecosystem restoration Alternative 20 includes the following specific features:

- 7.98 miles of new unpaved non-motorized multi-use trail *(to include decomposed granite surface and trail signage)*
- 1.26 miles of new paved multi-use trail *(extension of current southern end of LA River Bike Path)*
- 2 bridges spanning the LA River
- 1 smaller bridge/crossing within Taylor Yard
- 4 small/medium bridges within LATC
- 2 paved parking lots, one at Taylor Yard and one at LATC *(each about 15,000 square feet)*
- 4 restrooms, one at Bette Davis Park, two at Taylor Yard, and one at LATC
- 1 pedestrian underpass at the south end of Taylor Yard
- 28 trail access points throughout the study area *(access points would include grading and planting, signage, stairs, benches, gating, and trash receptacles to provide quality trail access)*
- 11 wildlife viewing points throughout the study area *(viewpoints would include an elevated wood deck with railing, benches, interpretive signage, and trash receptacles to allow users to enjoy high quality viewsheds within the restored ARBOR reach)*
- 6 pedestrian underpasses along the river to support trail connectivity

Plates 11 through 17 display these features. Table 3, below, summarizes the seven proposed bridges. Shaded rows indicate bridges which were also included in Table 1. Table 4, below, summarizes the proposed changes in trails. As shown in the table, this recreation plan option would result in a 58.1%

increase in accessible trail and multi-use pathways. Including multi-use pathways created by the ecosystem restoration plan, the total increase in accessible trails and pathways would be 66.9%.

Table 3. Proposed Bridges, Alternative 20 Option

ID	*Length (ft)*	*Location*	*Description*
1	450	R3; Verdugo Wash	spans LA River on diagonal downstream of Verdugo Wash, connecting the LA River Bike path to the Verdugo Wash confluence on the opposite bank
2	150	R6; in Taylor Yard	1 pedestrian bridge within Taylor Yard over restoration area
3	300	R8; LATC	spans the LA River adjacent to the upstream end of LATC connecting the left and right bank in Reach 8 and providing access to LATC from the right bank
4	25	R8; LATC	small pedestrian bridge over restoration area within LATC
5	100	R8; LATC	medium pedestrian bridge over restoration area within LATC
6	250	R8; LATC	medium pedestrian bridge over restoration area within LATC
7	30	R8; LATC	small pedestrian bridge over restoration area within LATC
Notes: Shaded rows indicate features common to both the Alternative 13 and Alternative 20 recreation plan options. See Appendix C – Cost Appendix for detailed backup of the recreation plan option costs summarized in Section 4.1.			

As shown in Table 4 below, 12.93 miles of existing accessible trail would not be modified by the recreation plan. However, there would be 1.26 miles of existing length that would be upgraded to a fully-developed multi-use trail. There would also be 9.24 miles of new trail added in the study area. Lastly, this recreation plan option would convert 0.82 miles of currently inaccessible access road to multi-use trail.

The ecosystem restoration plan would also upgrade 5.28 miles of existing trail, and convert 2.96 miles of currently inaccessible access road to multi-use trail. These changes would result in 32.49 miles of accessible trail and multi-use pathway.

At the current level of design, un-paved trails are assumed to be multiple-use, twelve feet wide, using a decomposed granite surface, and paved trails are assumed to be similar to the existing LA River Bike Path (cost provided by City).

Table 4. Summary of Accessible Trail and Multi-Use Pathway, Alternative 20 Option

Trail Type	*Miles*	*% of Tot With Project Miles*
Existing Trail/Pathway Remaining As-Is	12.93	39.8%
Existing Trail/Pathway Upgraded per Recreation Plan	1.26	3.9%
New Paved and Unpaved Trail/Pathway per Recreation Plan	9.24	28.4%
Inaccessible access road converted to trail per Recreation Plan	0.82	2.5%
Existing Trail Upgraded per Ecosystem Restoration Plan	5.28	16.3%
Inaccessible access road converted to trail per Restoration Plan	2.96	9.1%
TOTAL	**32.49**	100.0%

1.3.3 BENEFITS OF THE RECREATION PLANS

The two recreation plan options would provide both direct and indirect benefits to recreation participants as well as the communities surrounding the ARBOR reach, albeit to varying amounts. Direct benefits of either recreation plan option would include:

- Improved quality and quantity of trails for multiple user groups along the river
- Increased connectivity of each side of the river's recreation resources
- Increased public safety through better signage and trail development along the river
- Improved viewing and lines of sight along the river, especially in areas of substantial restoration via the ecosystem restoration plan
- Opportunity for interpretive signage and environmental education
- Improved public health by providing opportunities for exercise and psychological respite

In addition to these direct benefits, communities along the ARBOR reach will receive benefits in the form of increased quantity and quality of neighborhood parks. As discussed in the main report, parks provide OSE benefits to communities they serve. The addition of trails and amenities in the restored LATC will benefit the surrounding historically-underserved communities along the downstream end of the ARBOR reach, providing substantial open space in highly-developed neighborhoods which are currently considered park-deficient. Both recreation plan options will also help support the projected RED benefits related to redevelopment in the study area.

The recreation analysis documented in this report evaluates the two recreation plan options in order to estimate net benefits (excess of benefits over cost) of each plan and assess whether the recreation features are economically justified.

2 UNIT DAY VALUE ANALYSIS

The benefits of recreation features are measured through approximation of visitors' willingness to pay for the recreation resource. Willingness-to-pay is assumed to represent the economic value, in dollars, that a visitor places on a recreation resource. Measuring the economic value of the recreation resource without a project and comparing it to the value of the project in place, allows the calculation of net recreation benefits resulting from construction of the recreation plan option being evaluated.

The appropriate valuation methodology was selected based on the guidelines in Appendix E, ER 1105-2-100 Planning Guidance Notebook, dated 22 April 2000. For this study, recreation is incidental to the primary ecosystem restoration purpose; there is no regional model available; the project is not creating specialized recreation activities as defined in the ER; projected increase in visitation is well below the 750,000 threshold requiring more rigorous approaches; and the increase in Federal costs for adding recreation purpose is well below the 10% limit. As such, the Unit Day Value (UDV) method was selected as the appropriate valuation method.

When applying the Unit Day Value methodology, two categories of outdoor recreation visits, general and specialized, may be differentiated for evaluation purposes. "General" refers to a recreation visit involving primarily those activities that are attractive to the majority of outdoor users and that generally require the development and maintenance of convenient access and adequate facilities. "Specialized" refers to a recreation visit involving those activities for which opportunities in general are limited, intensity of use is low, and a high degree of skill, knowledge, and appreciation of the activity by the user may often be involved (USACE 2014). All of the activities at the project site, with and without project, were assumed to fall into the general recreation category.

The unit day value (UDV) method for estimating recreation benefits relies on expert or informed opinion and judgment to approximate the average willingness to pay of users of Federal or Federally assisted recreation resources. By applying a unit day value per visitor, an approximation of project recreation benefits is obtained.

The UDV process includes scoring of the project site using five guidance-defined criteria to yield a point score for the groups of recreation activities at the site. The point score is converted to dollars per visit using tables provided in the UDV guidance (updated annually). The final dollars-per-visit value is the UDV. The UDV is then multiplied by the number of annual visitors to generate an estimate of the annual recreation value at the site. This annual value is then projected over the 50 year period of analysis based on visitation projections for the study area.

This method of annual recreation value estimate is completed twice. First, a valuation is completed for the without project condition. Second, a valuation is completed for the with project condition. The difference between the two estimates is the recreation benefit attributable to the proposed recreation features. The option that returns the greatest excess of benefits over cost (net benefits) is the most desirable from a national economic development perspective. Total benefits may also be compared to the total costs of the recreation features to generate a benefit to cost ratio. The following sections describe the development of visitation estimates and UDV scores.

2.1 Visitation Estimate via Trails

Trail visitation was only counted for recreation tied to or in close proximity to the River. For example, use of trails in off-river areas of Griffith Park are not likely to be directly affected by the proposed recreation plan.

Visitation estimates were developed for the without- and with-project conditions. No official, comparable visitor count data were readily available by activity. Inquiries were made with contacts at the Audubon Society, the LA River Equestrian Center, and the Los Angeles Department of Recreation and Parks. The contacts indicated that, while the assumed types of recreation were consistent with their knowledge of the study area, no specific trail counts or total user counts were available for the study area, and that those counts would require a separate data collection effort, determined to be beyond project budget and schedule constraints. The study team identified that following methodology for estimating baseline project visitation.

General trail use was estimated based on published design standards for urban trails in the “Recreation Park and Open Space Standards and Guidelines,” by the National Recreation and Parks Association (NRPA 1983). It cites a standard for urban trail use at 90 users per day per mile of trail. This base value was adjusted for weekday/weekend and seasonality, and then applied to a GIS-based estimate of the length of trails in the existing and with-project conditions. Existing trails include trail segments provided by the Local Sponsor in GIS as well as additional areas of trail identified via aerial photographs in GIS. Seasonality weekday/weekend adjustments were based on professional judgment and familiarity with the ARBOR reach. Because inclement weather, which would prevent trail use, is rare in the study area, weekday/weekend use was estimated to have a stronger effect than the season.

As shown in Plates 4 through 17, in order to limit the visitation estimate to those users affected by the River, only trails adjacent to the River or affected directly by proposed recreation plan features were included in the evaluation.

It was qualitatively estimated that the with project condition would experience a higher volume of visitation because of the added amenities of the recreation plan, including the increased access points, parking, restrooms, and connectivity of existing trails in the ARBOR reach. In order to estimate this increase consistent with the methodology in the without project condition, the increase in with project condition was estimated as a function of the additional miles of trail that would be added via the recreation plan and the ecosystem restoration plan. The recreation plan options corresponding to ecosystem restoration Alternative 13 and ecosystem restoration Alternative 20 provide different quantities of trail, and therefore have differing estimates of visitation.

It was noted that some portion of the with project visitation may be a transfer from other regional recreation areas, but due to lack of area-specific visitation data, there was no basis for quantifying transfers. Qualitatively, the team expects that transfer will not be substantial. For example, new visitors may be residents of the communities around the ARBOR reach which are currently underserved by community parks.

As shown in the tables below, annual visitation for the with project condition was estimated to be 51% higher than in the without project condition for the Alternative 13 option, and 67% higher for the Alternative 20 option, based on the expected increase in accessible trails with the recreation plan and ecosystem restoration features. No estimate of visitation growth from general population growth was included, as this was judged to be a relatively minor effect compared to the increase already described. Based on this methodology, annual visitation is held constant throughout the period of analysis in the with project and without project conditions.

Table 5. Without Project Visitation

Season	*Miles*	*User/Mile*	*Users/Day*	*Days*	*Subtotal Users*
Summer Weekend	19.47	80	1,557.60	26	40,498
Summer Weekday	19.47	65	1,265.55	65	82,261
Fall Weekend	19.47	70	1,362.90	26	35,435
Fall Weekday	19.47	55	1,070.85	65	69,605
Winter Weekend	19.47	70	1,362.90	26	35,435
Winter Weekday	19.47	55	1,070.85	65	69,605
Spring Weekend	19.47	70	1,362.90	26	35,435
Spring Weekday	19.47	55	1,070.85	65	69,605
TOTAL ESTIMATED ANNUAL USE					437,879
Average Users/Day					1,203

Table 6. With Project Visitation, Alternative 13 Option

Season	*Miles*	*User/Mile*	*Users/Day*	*Days*	*Subtotal Users*
Summer Weekend	29.44	80	2,355.20	26	61,235
Summer Weekday	29.44	65	1,913.60	65	124,384
Fall Weekend	29.44	70	2,060.80	26	53,581
Fall Weekday	29.44	55	1,619.20	65	105,248
Winter Weekend	29.44	70	2,060.80	26	53,581
Winter Weekday	29.44	55	1,619.20	65	105,248
Spring Weekend	29.44	70	2,060.80	26	53,581
Spring Weekday	29.44	55	1,619.20	65	105,248
TOTAL ESTIMATED ANNUAL USE					662,106
Average Users/Day					1,819

Table 7. With Project Visitation, Alternative 20 Option

Season	*Miles*	*User/Mile*	*Users/Day*	*Days*	*Subtotal Users*
Summer Weekend	32.49	80	2,599.20	26	67,579
Summer Weekday	32.49	65	2,111.85	65	137,270
Fall Weekend	32.49	70	2,274.30	26	59,132
Fall Weekday	32.49	55	1,786.95	65	116,152
Winter Weekend	32.49	70	2,274.30	26	59,132
Winter Weekday	32.49	55	1,786.95	65	116,152
Spring Weekend	32.49	70	2,274.30	26	59,132
Spring Weekday	32.49	55	1,786.95	65	116,152
TOTAL ESTIMATED ANNUAL USE					730,701
Average Users/Day					2,007

2.2 UDV Scoring/Point Assignment

Per USACE guidance, scores are required for both the without project and with projection condition. Because two recreation plan options were considered, two with project scores were developed, one for each option.

The five UDV scoring criteria from the guidance, for which points are assigned, include the following items:

- Recreation Experience: score increases in proportion to the number of available activities at the site
- Availability of Opportunity: score is based on availability of substitute sites; the fewer the sites in the region that offer comparable recreation experience, the higher the score
- Carrying Capacity: score rates level of facilities at the site to support the activities
- Accessibility: score rates ease of access to the site
- Environmental: rates the aesthetic/environmental quality of the recreation site/activities

Scoring was based on the consideration of general recreation activities that would be affected on those trails along the river in the ARBOR reach. This includes some specific activities, such as equestrian, bird watching, and biking, but also includes more general park-related activities, such as walking/jogging, viewing, picnicking, or general use of outdoor park areas along the River.

The table below summarizes the scores assigned for the Alternative 13 recreation plan option and for the Alternative 20 recreation plan option. In the sections following the table, the rationale is provided for the point assignments according to the five UDV criteria. Because the Alternative 20 recreation plan option builds incrementally on the Alternative 13 recreation plan option, discussion of rationale for point selection integrated. Attachment 1 provides a copy of the USACE guidance which contains the scoring rubric.

Table 8. UDV Score Summary

UDV Criteria	General Recreation		
	Without Project	Alt 13 Option	Alt 20 Option
Recreation Experience	13	16	17
Availability of Opportunity	5	5	5
Carrying Capacity	5	7	10
Accessibility	9	12	14
Environmental	2	7	9
Total Score	**34**	**47**	**55**

2.2.1 RECREATION EXPERIENCE

Without Project. In the without project condition, this criteria received a score of 13 out of 30 possible points. The project site currently supports the identified general activities, and in the existing condition is a high quality bird watching location, uniquely situated in an urban environment. Per USACE guidance, a high quality activity is defined as an activity which is not common to the region or Nation, and that are usually of high quality. The ARBOR reach is located upstream of a seven-mile stretch of the LA River designated as an Important Bird Area by the National Audubon Society due to high level of use by migrating shorebirds for feeding from July to October.

With Alternative 13 Recreation Plan Option. In the with project condition, this criterion received a score of 16 out of 30 possible points. The number and type of activities remain largely the same as in the without project condition. All activities related to wildlife viewing along the trail will improve substantially in quality by provided designated viewpoints to take advantage of newly restored areas.

Improvement of ecosystem conditions in the ARBOR reach is likely to improve opportunities for bird watching in the ARBOR reach, as well as provide indirect benefits to downstream reaches of the river already included in the Important Bird Area.

Additionally, the restoration of the ARBOR reach may induce participation in additional recreation activities which do not currently exist, or which see very low participation levels. These might include activities such as wildlife viewing, new areas for bird watching, non-motorized boating, environmental education, stewardship training, or even visits to the ARBOR reach specifically to view the ecosystem restoration features.

With Alternative 20 Recreation Plan Option. In the with project condition, this criterion received a score of 17 out of 30 possible points. This recreation plan option would marginally improve the quality of the recreation due to the additional bridges, viewpoints, and trail access points which would further highlight and capitalize on the ecosystem restoration project features.

2.2.2 AVAILABILITY OF OPPORTUNITY

The study team noted that the availability of other substitute recreation resources would likely remain the same between the without and with project conditions. Because the same general types of activities would be available to the same user groups, it was determined that, from a regional perspective, the construction of the recreation plan features would not alter the relative availability of substitute sites. Thus, in both the without project and for both recreation plan options, a score of 5 out of 18 possible points was given. This score reflects that there are several substitute locations which would provide similar recreation activities within one hour, including areas of Griffith Park or Elysian Park not adjacent to the river. However, these areas would not be perfect substitutes. For example, residents living adjacent to the ARBOR reach are likely to view the River as a community park, rather than a regional one. Additionally, in the with project condition, the newly restored ARBOR reach may become a destination for tourists, environmental educators, artists, and others looking to take advantage of the River's recreation opportunities that were not previously accessible.

2.2.3 CARRYING CAPACITY

Without Project. This criteria received a score of 5 out of 14 possible points. Because the study area already has recreation features, basic facilities already exist to conduct the identified general recreation activities at the site. There is currently very little connectivity, so it may discourage users from exploring.

With Alternative 13 Recreation Plan Option. This criteria received a score of 7 out of 14 possible points. This reflects a change from the "basic" to "adequate" category on the rubric. The proposed features would make substantial improvements toward connecting the left and right bank of the river for recreation purposes, add new trails, viewing points, interpretive signage, and provide additional parking and restroom facilities.

With Alternative 20 Recreation Plan Option. This criteria received a score of 10 out of 14 possible points. This reflects a change from the "adequate" to "optimal" category on the rubric. The additional mile of trail would further increase capacity in the study area. Also the additional bridges, underpasses, and trail access points would substantially improve connectivity both along the banks and across the river.

2.2.4 ACCESSIBILITY

Without Project. This criteria received a score of 9 out of 18 possible points. Because the study area is situated in a highly-urbanized area, the existing road network provides fair access to the site, and there are established road networks within park areas as well. However, trail connectivity and access can be improved, as there are few opportunities for users to cross the River, and many trail lengths are not connected.

With Alternative 13 Recreation Plan Option. This criterion received a score of 12 out of 18 possible points. The additional trails and access points in the proposed recreation plan would substantially increase the connectivity of trail segments along the River, including connecting the left and right bank for trail users. This would constitute a jump from the "fair" to "good" access rating.

With Alternative 20 Recreation Plan Option. This criterion received a score of 14 out of 18 possible points. The additional points were awarded to reflect the increase in accessibility provided by the additional bridges, underpasses, trail lengths, and access points. These additional components were judged to raise the score to the top end of the "good" rating.

2.2.5 ENVIRONMENTAL

Without Project. This criterion received a score of 2 out of 20 possible points. In its present condition, the ARBOR reach is surrounded by a highly-urbanized areas, with commercial and industrial uses, infrastructure barriers, blight, and likely contamination, which lower the quality of the sites.

With Alternative 13 Recreation Plan Option. This criterion received a score of 7 out of 20 possible points. The addition of recreation plan features would bump the score into the "above average" range by improving the amenities within the site, as well as through the addition of wildlife viewpoints and bridges which would highlight restored areas rather than adjacent commercial and industrial areas. The presence of the new ecosystem restoration features would also greatly improve the aesthetic quality of the site. While there would remain commercial and industrial activity in close proximity to the recreation resource, the effects of these factors would be relatively minor due to improvements within the site that capitalize on the restoration plan features.

With Alternative 20 Recreation Plan Option. This criterion received a score of 9 out of 20 possible points. While still in the "above average' range, this recreation plan option adds a number of bridges and viewpoints which would substantially increase opportunities for viewing the ecosystem restoration treatments associated with Alternative 20. It was judged that these additional features would raise the score, but that the larger urban-industrial setting would keep the rating the "above average" category.

2.3 UNIT DAY VALUE CONVERSION

For the with and without project conditions for both the Alternative 13 and the Alternative 20 plan options, the points were converted to a dollar value based on the FY2015 UDV conversion table in EGM 15-03 (USACE 2014). Scores were interpolated linearly as necessary. The table below shows the point conversion table from the guidance and the dollar values generated for general recreation activities for both the Alternative 13 recreation plan option and the Alternative 20 recreation plan option.

Table 9. FY2014 UDV Conversion Table

<table>
<tr><th colspan="2">General Recreation</th><th rowspan="3"></th><th colspan="3">General Recreation</th></tr>
<tr><th>Point Values</th><th>Values ($)</th><th colspan="3">Value per Visit ($)</th></tr>
<tr><td>0</td><td>$3.91</td><th>Without Project</th><th>Alt 13 Option</th><th>Alt 20 Option</th></tr>
<tr><td>10</td><td>$4.64</td><td rowspan="12"></td><td rowspan="12">34 pts
$6.44</td><td rowspan="12">47
$8.01</td><td rowspan="12">55 pts
$8.67</td></tr>
<tr><td>20</td><td>$5.13</td></tr>
<tr><td>30</td><td>$5.86</td></tr>
<tr><td>40</td><td>$7.32</td></tr>
<tr><td>50</td><td>$8.30</td></tr>
<tr><td>60</td><td>$9.03</td></tr>
<tr><td>70</td><td>$9.52</td></tr>
<tr><td>80</td><td>$10.50</td></tr>
<tr><td>90</td><td>$11.23</td></tr>
<tr><td>100</td><td>$11.72</td></tr>
<tr><td colspan="2">USACE CECW-CP EGM 15-03 for FY2015</td></tr>
</table>

3 EXPECTED RECREATION BENEFITS

Using the UDV dollar values per visit and visitation estimates generated in the previous sections, recreation values for the without and with project conditions were calculated for both of the recreation plan options. Taking the difference between the with project and the without project, recreation benefits attributable to each option were estimated. The following tables summarize expected recreation benefits in terms of present value and an amortized annual value for each option. Amortization over the period of analysis uses the FY2015 Federal discount rate of 3.375% over a 50-year period of analysis. The analysis estimates amortized annual benefits of $2,479,128 for the Alternative 13 recreation plan option and $3,509,832 for the Alternative 20 recreation plan option.

Table 10. Summary of Recreation Value Calculation, Alternative 13 Option

	Without Project	With Project
Average Annual Visitation	437,879	662,106
Value per Visit*	$6.44	$8.01
Average Annual Recreation Value	$2,821,692	$5,300,821
Average Annual Benefits	**$2,479,128**	
Present Value of Benefits	**$59,483,960**	
* Interpolated value rounded to nearest cent in tables; multiplication results may differ due to rounding		

Table 11. Summary of Recreation Value Calculation, Alternative 20 Option

	Without Project	With Project
Average Annual Visitation	437,879	730,701
Value per Visit*	$6.44	$8.67
Average Annual Recreation Value	$2,821,692	$6,331,524
Average Annual Benefits	**$3,509,832**	
Present Value of Benefits	**$84,214,558**	
* Interpolated value rounded to nearest cent in tables; multiplication results may differ due to rounding		

4 BENEFIT COST ANALYSIS

4.1 CONSTRUCTION COST

Separate construction cost estimates were developed for the proposed recreation features in the Alternative 13 and the Alternative 20 recreation plan options. Costs are presented in FY2015 price level and are consistent with the MCACES cost estimates presented in the Economics Appendix. Detailed cost documentation can be found in the Cost Appendix to the IFR. The following bullets summarize the information in the tables below:

Alternative 13 recreation plan option

- The present value total estimated investment cost for the proposed recreation features is $10,386,000 or $433,000 in amortized annual dollars.
- Operations and maintenance of the recreation plan features adds an additional amortized annual cost of $173,000 or $4,151,000 in present value dollars.
- Total present value project cost is estimated at $14,540,000.

Alternative 20 recreation plan option

- The present value total estimated investment cost for the proposed recreation features is $18,109,000, or $755,000 in amortized annual dollars.
- Operations and maintenance of the recreation plan features adds an additional amortized annual cost of $223,000 or $5,351,000 in present value dollars.
- Total present value project cost is estimated at $23,466,000.

These recreation plan costs do not include LERRDs, as there are no LERRDs costs over and above those required for the ecosystem restoration features. Tables 12 and 13 show the derivation of the annual cost for each option. Interest during construction was calculated separately for the recreation plan to reflect only the construction duration for the recreation features, as the recreation plan is separable project element. The Cost Appendix (Appendix C) provides more detail on the recreation plan option cost estimates, including individual costs and backup components of the recreation plan option for each alternative.

Table 12. Derivation of Costs, Alternative 13 Option

Construction First Cost	$10,353,000
IDC (3.375%)	$33,200
Investment Cost PV	$10,386,000
Annual Investment Cost	$433,000
Annual O&M	$173,000
Total Annual Cost	**$606,000**
Total NPV	**$14,540,000**

Table 13. Derivation of Costs, Alternative 20 Option

Construction First Cost	$18,055,000
IDC (3.375%)	$53,700
Investment Cost PV	$18,109,000
Annual Investment Cost	$755,000
Annual O&M	$223,000
Total Annual Cost	**$978,000**
Total NPV	**$23,466,000**

4.2 NET RECREATION BENEFITS AND BENEFIT TO COST RATIO

For both the Alternative 13 and the Alternative 20 recreation plan options, benefits exceed cost. Annual benefits, annual costs, net benefits, and the benefit-to-cost ratio (BCR) for each of the options are summarized in Table 14, below. Because the BCR for the proposed recreation features is above 1.0 for both options, the recreation features are economically justified. The Alternative 20 recreation plan option provides the greatest net benefits of the two options under evaluation.

Table 14. Benefit-to-Cost Ratio by Alternative Recreation Plan Option

Alternative	**Annual Benefits ($)**	**Annual Costs ($)**	**Net Benefits ($)**	**BCR**
No Action	$0.00	$0.00	$0.00	0.00
Alternative 13 Recreation Plan Option	$2,479,000	$606,000	$1,873,000	4.09
Alternative 20 Recreation Plan Option	$3,510,000	$978,000	$2,532,000	3.59

4.3 Sensitivity Analysis

Visitation

Visitation estimates are typically a source of uncertainty in recreation analyses. Visitation estimates directly affect the benefits of each alternative and the BCR. As discussed in Section 2.1, a key assumption in this analysis was the estimate of existing condition visitation and growth of visitation from the without project to the with project based on additional miles of trails associated with the recreation plan.

- Sensitivity analysis showed that if the without project baseline visitation estimate was not increased at all in the with project, while holding UDV scores the same, both recreation plan options would remain near unity. In this scenario, the Alternative 13 recreation plan option would have a BCR of 1.13 and the Alternative 20 recreation plan option would have a BCR of 0.99.
- Further analysis of sensitivity to visitation was done by reducing the without project baseline visitation and projected with project growth in visitation by the same amount while holding UDV scores constant. In order to drop the Alternative 13 recreation plan BCR below 1.0, baseline and with project visitation would need to be reduced by 76%. For the Alternative 30 recreation plan the reduction would need to be 73%.

Furthermore, visitation is judged to be likely to increase in the with project condition, both in response to the ecosystem restoration, and due to the recreation improvements drawing more visitors. Therefore, the risk of the BCR falling below 1.0 because of visitation uncertainty is judged to be very low for both the Alternative 13 and the Alternative 20 recreation plan options.

UDV Score

Another source of uncertainty in the UDV methodology is the UDV scoring itself. The differential between the without project and the with project UDV scores drives the estimate of recreation benefits from the proposed features. In this analysis, the without project was scored 34 total points, the Alternative 13 option was scored 47 points, and the Alternative 20 option was scored 55 points.

- For the both the Alternative 13 and Alternative 20 recreation plan options, assuming growth of visitation as in the main analysis, a drop in UDV score alone would not be sufficient to drop the BCR below 1.0. For both options, the additional visitation in the with project would add benefits above the cost of the recreation plan even if the score did not change in the with project condition.

Visitation and UDV Score

Combining the visitation uncertainty and the UDV score uncertainty, a more reasonable scenario might be one where with project visitation does not increase as significantly as estimated in the analysis, which estimated a 51 to 67% increase in annual visitation depending on the recreation plan option. Tables 15 and 16 summarize the effects on the BCR if with project visitation increase were instead limited to 10% and the with project UDV score was reduced.

Table 15. Alternative 13 Option Sensitivity Summary

% Growth in Visits versus No Action	With Project Visitation	UDV Score & Value per Visit	Annual Benefits	Annual Cost	Net Benefits	BCR
10%	481,667	47pts; $8.01	$1,034,500	$606,000	$428,500	1.71
10%	481,667	44pts; $7.71	$892,900	$606,000	$287,000	1.47
10%	481,667	40pts; $7.32	$704,100	$606,000	$98,100	1.16
10%	**481,667**	**39pts; $7.17**	**$633,800**	**$606,000**	**$27,800**	**1.05**
10%	481,667	38pts; $6.74	$563,500	$606,000	-$42,500	0.93

Table 16. Alternative 20 Option Sensitivity Summary

% Growth in Visits versus No Action	With Project Visitation	UDV Score & Value per Visit	Annual Benefits	Annual Cost	Net Benefits	BCR
10%	481,667	55pts; $8.67	$1,352,000	$978,000	$374,000	1.38
10%	481,667	50pts; $8.30	$1,176,100	$978,000	$198,100	1.20
10%	481,667	47pts; $8.01	$1,034,500	$978,000	$56,500	1.06
10%	**481,667**	**46pts; $7.91**	**$987,300**	**$978,000**	**$9,300**	**1.01**
10%	481,667	45pts; $7.81	$940,100	$978,000	-$37,800	0.96

Even with visitation growth of just 10%, the UDV scores for the Alternative 13 and the Alternative 20 recreation plan options would need to drop by 9 to 10 points each before the BCRs fell to 1.0. In addition to the strong recreation demand expected form the City and other stakeholders, at a minimum, some increase in visitation would be expected from general population growth and the increased carrying capacity of the site with either recreation plan option. Further the study team judges that there is low risk that the recreation plan would not be economically justified because the proposed recreation features would have a more substantial impacts on the ARBOR reach's recreation value than would be captured by scores of 38 and 45 for the Alternative 13 and Alternative 20 recreation plan options, respectively. Therefore, the study team concludes that there is federal interest in construction of the recreation plan and recommends its inclusion in the project.

4.4 SELECTED ECOSYSTEM RESTORATION PLAN OPTION

As documented in the main feasibility report, ecosystem restoration Alternative 20 is selected for recommendation as a locally preferred plan (LPP). As such, the corresponding Alternative 20 recreation plan option is selected as well, and will be carried forward into the pre-construction engineering and design (PED) phase of the study.

The Alternative 20 recreation plan is expected to provide positive net benefits and has an expected benefit cost ratio of 3.59. Between the two recreation plan options evaluated, the Alternative 20 recreation plan provided the largest net recreation benefits. Sensitivity analysis showed that the Alternative 20 option would result in positive net benefits even if visitation grew just 10% above the without project condition and UDV scores used in the analysis were reduced by 9 points. Further, the

Alternative 20 recreation plan option adds additional features considered essential by the project sponsor.

The recommended recreation plan is the optimum recreation plan consistent and compatible with the recommended ecosystem restoration plan features. The plan is comprised of a system of trail improvements, trail connections, and supporting ancillary facilities. These facilities are not separable recreation features but rather parts of the whole trail system plan. A larger plan was not analyzed, because additional features would potentially negatively impact the ecosystem restoration outputs and would not meet Corps guidance for recreation at restoration projects. As demonstrated in this appendix, a smaller trail system plan was developed based upon the NER Plan restoration features. This smaller plan had lower net benefits, offers a reduced number of trail system miles in the study area, provides fewer connections along the river, between trails and the restored areas, and specifically would not include trail linkages that allow visitors to enjoy some of the key restoration features included in the Recommended Plan (Alternative 20) and not in the NER Plan.

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6 PLATES

Plate 1. Current Recreation Areas, Reaches 1-3

Plate 2. Current Recreation Areas, Reaches 4-6

Plate 3. Current Recreation Areas, Reaches 7-8

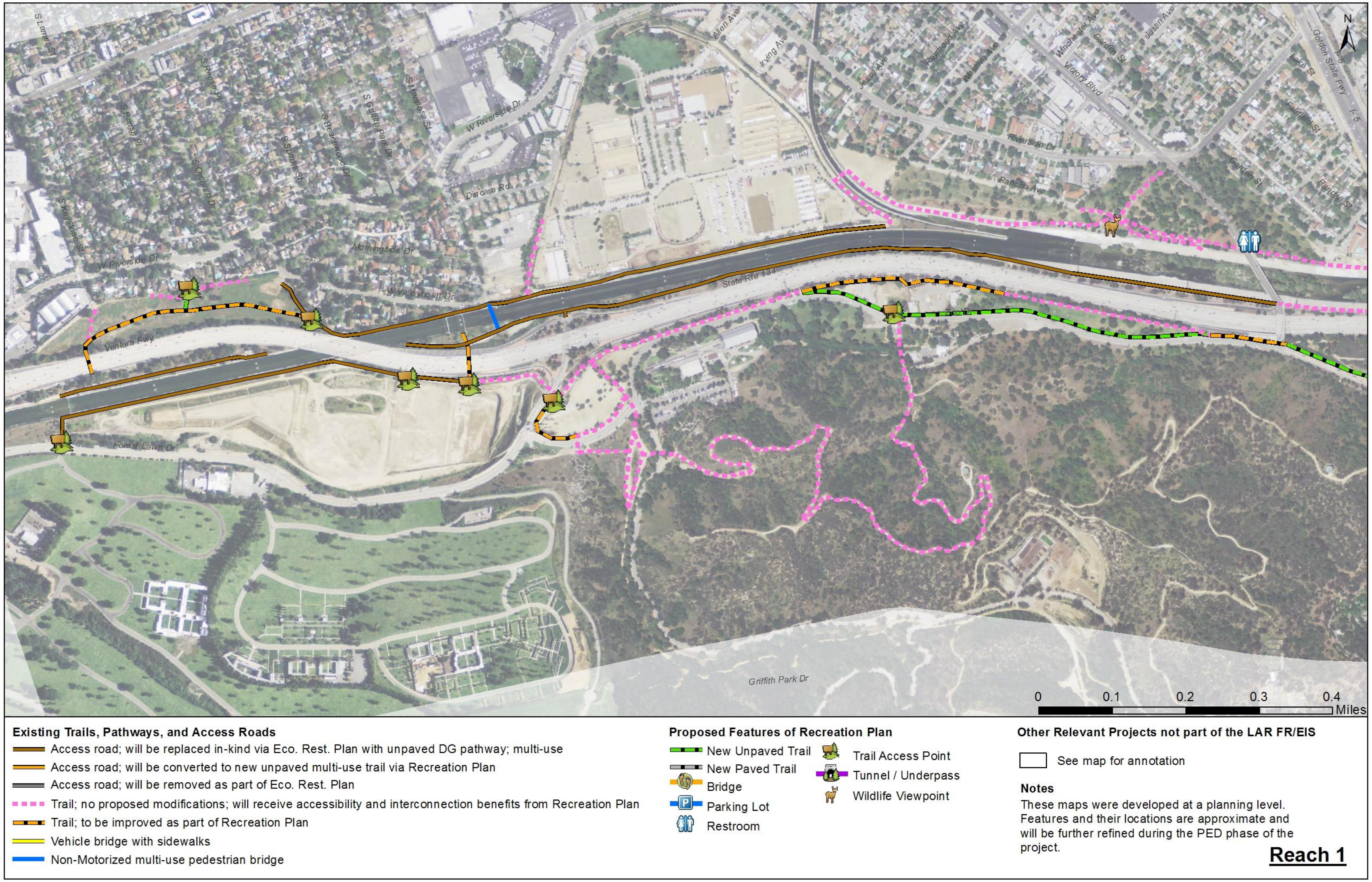

Plate 4. Recreation Plan Reach 1, Alternative 13 Option

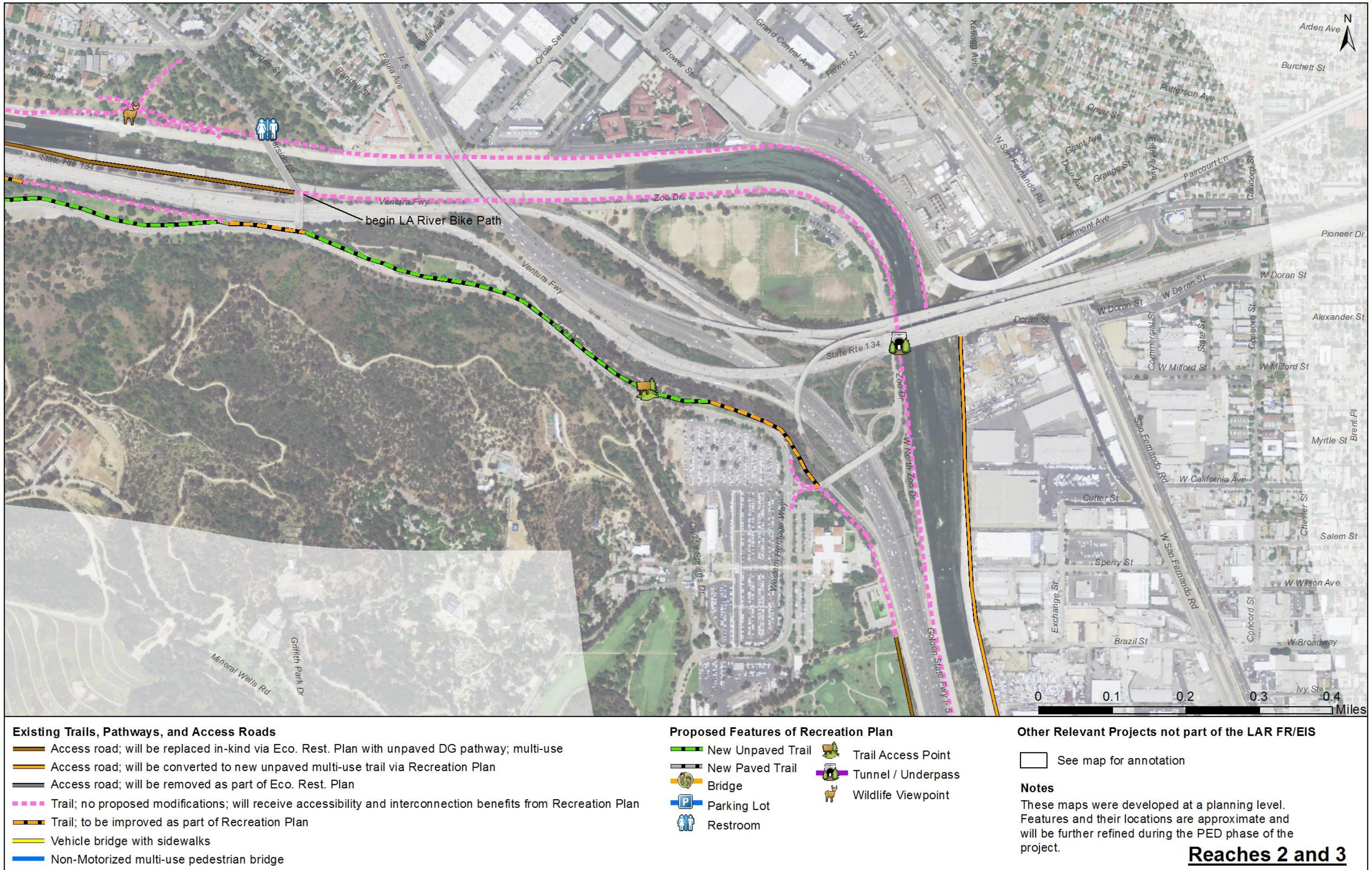

Plate 5. Recreation Plan Reaches 2 and 3, Alternative 13 Option

Plate 6. Recreation Plan Reach 4, Alternative 13 Option

Plate 7. Recreation Plan Reach 5, Alternative 13 Option

Plate 8. Recreation Plan Reach 6, Alternative 13 Option

Plate 9. Recreation Plan Reach 7, Alternative 13 Option

Plate 10. Recreation Plan Reach 8, Alternative 13 Option

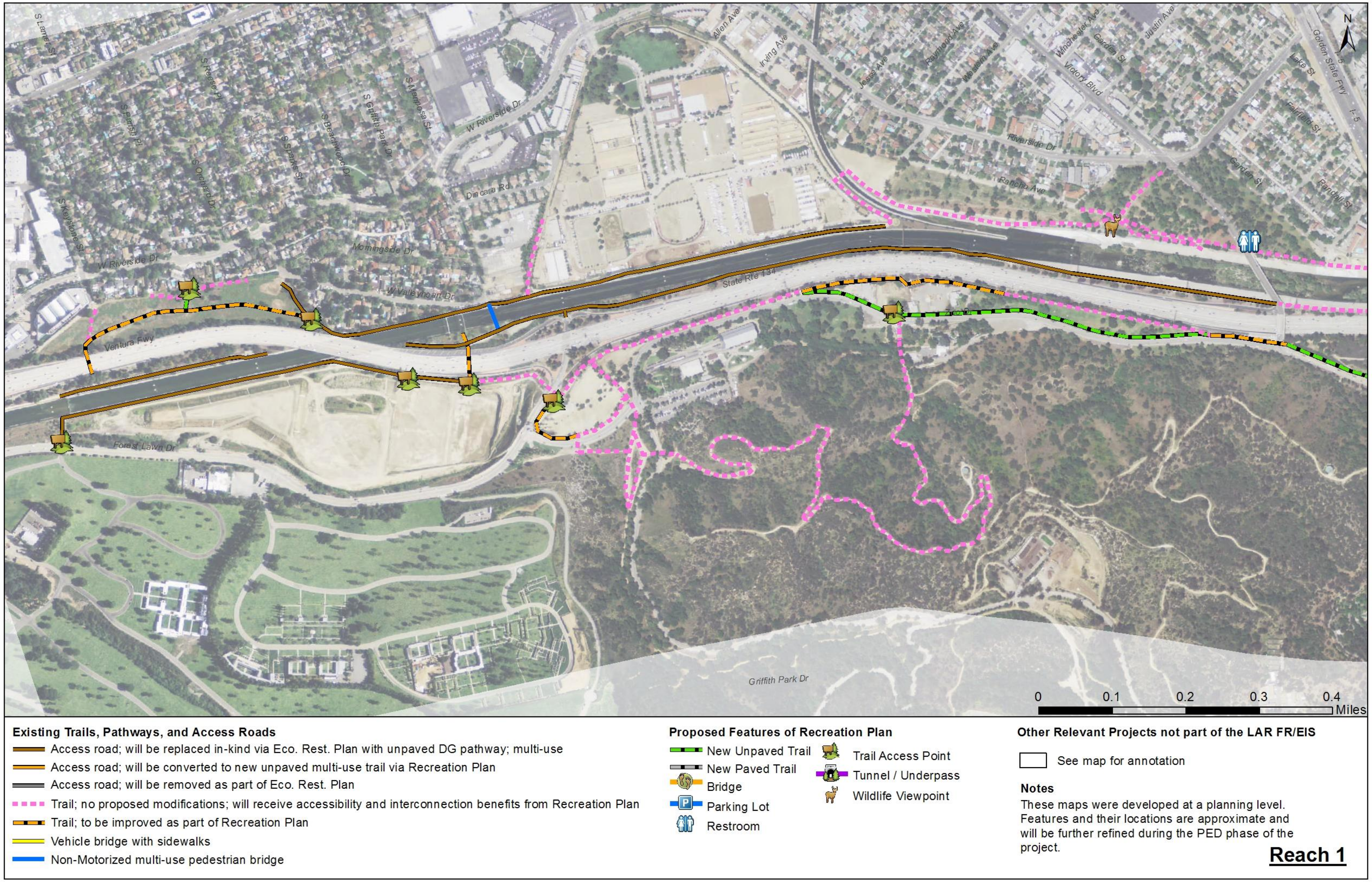

Plate 11. Recreation Plan Reach 1, Alternative 20 Option

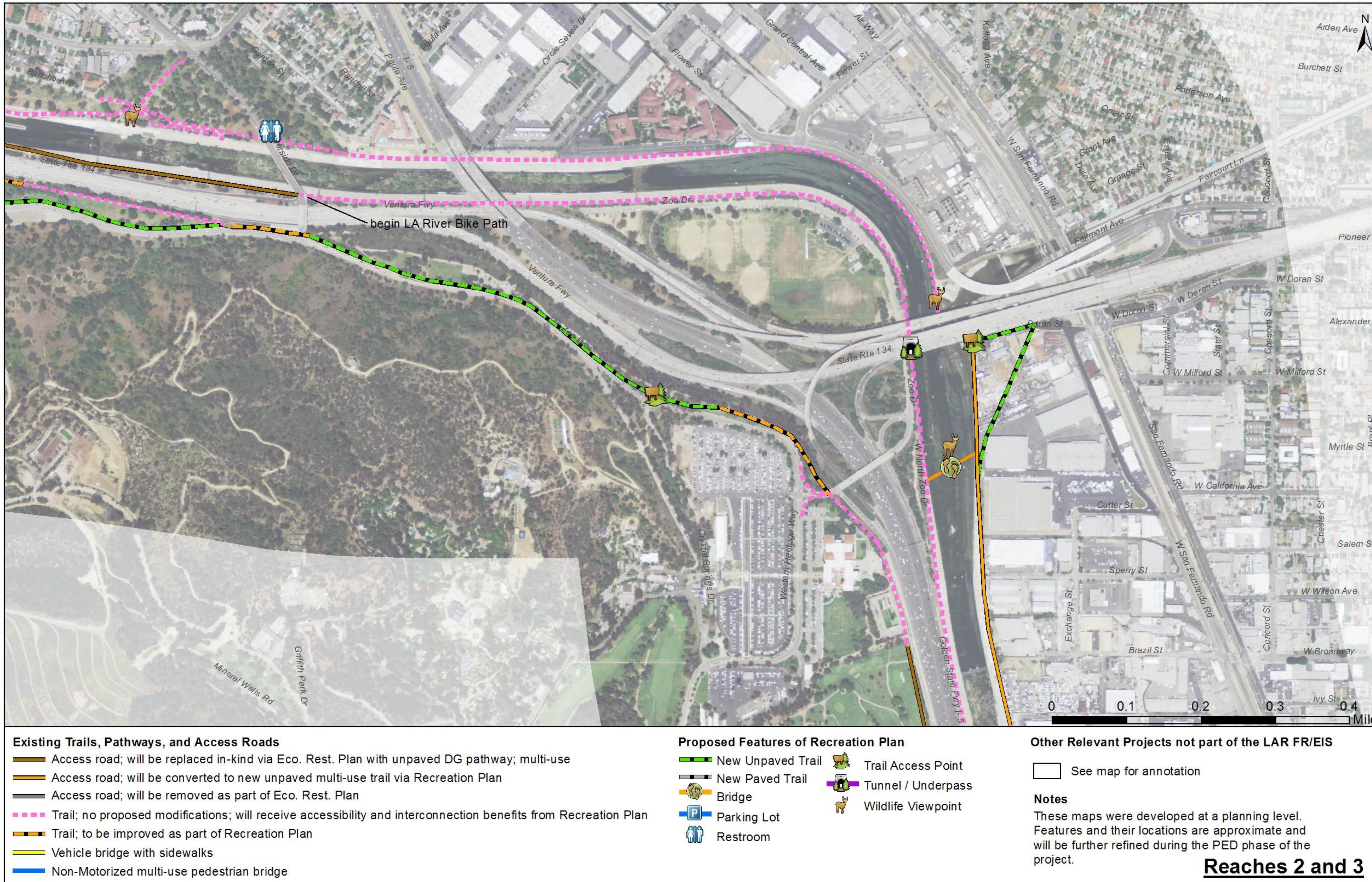

Plate 12. Recreation Plan Reaches 2 and 3, Alternative 20 Option

Plate 13. Recreation Plan Reach 4, Alternative 20 Option

Plate 14. Recreation Plan Reach 5, Alternative 20 Option

Plate 15. Recreation Plan Reach 6, Alternative 20 Option

Plate 16. Recreation Plan Reach 7, Alternative 20 Option

Plate 17. Recreation Plan Reach 8, Alternative 20 Option

Attachment 1 – USACE Unit Day Value Guidance (EGM 15-03) Excerpts

Unit Day Values for Recreation, Fiscal Year 2015

The national economic development (NED) benefit evaluation procedures contained in ER 1105-2-100 (22 Apr 2000), Appendix E, Section VII, include three methods of evaluating the beneficial and adverse NED effects of project recreation: travel cost method (TCM), contingent valuation method (CVM), and unit day value (UDV) method.

The criteria for selecting the appropriate method are described in paragraph E-50b(4) and Figure E-10 of ER 1105-2-100 and in the attached document. If the UDV approach is used, the range of unit day value for FY 2015 studies is:

General Recreation	$ 3.91	$ 11.72
Specialized Recreation	$ 15.87	$ 46.39

If, when using the UDV method, evidence indicates a value outside the published range, use either TCM or CVM to evaluate recreation benefits.

The attached document provides a detailed description of the application of the UDV method. The tables provided in the attachment are constructed as guidance for planners in the selection of unit day values for particular recreation activities. Tables 1 and 2 illustrate a method of assigning a point rating to a particular activity. Point values are assigned based on measurement standards described for the five criteria of activities: recreational experience; availability of opportunity; carrying capacity; accessibility; and environmental quality.

Table 1 covers general recreation, involving relatively intensive development of access and facilities. The specialized recreation category, covered in Table 2, includes such unique experiences as big game hunting, wilderness pack trips, white water canoeing, and other activities generally characterized by more extensive, low density use.

Values provided for FY 2015 may be used to convert points to a UDV dollar amount if the point assignment method is used. The table was adjusted from Table K-3-1, Federal Register Vol. 44, No. 242, p.72962, December 14, 1979, and the subsequent Table VIII-3-1 "Conversion of Points to Dollar Values", Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, March 10, 1983, using the Consumer Price Index (CPI) factors published by the Bureau of Labor Statistics. The CPI basis of Table VIII-3-1 from Principles and Guidelines is July 1, 1982 (CPI value = 97.5). The FY 2015 CPI basis is September, 2014 (CPI value = 238.031).

As a special note of warning, it is important to recognize that all specialized recreation activities claimed will require a regional model or a site-specific study, the results of which would probably not agree with the specialized values in the attached

Encl 1

table. The only exception would be in those specific cases for which the unreliability or infeasibleness of TCM or CVM can be stated convincingly.

Conversion of Points to Dollar Values

Point Values	General Recreation Values (1)	General Fishing and Hunting Values (1)	Specialized Fishing and Hunting Values (2)	Specialized Recreation Values other than Fishing and Hunting (2)
0	$ 3.91	$ 5.62	$ 27.34	$ 15.87
10	$ 4.64	$ 6.35	$ 28.08	$ 16.85
20	$ 5.13	$ 6.84	$ 28.56	$ 18.07
30	$ 5.86	$ 7.57	$ 29.30	$ 19.53
40	$ 7.32	$ 8.30	$ 30.03	$ 20.75
50	$ 8.30	$ 9.03	$ 32.96	$ 23.44
60	$ 9.03	$ 10.01	$ 35.89	$ 25.88
70	$ 9.52	$ 10.50	$ 38.08	$ 31.25
80	$ 10.50	$ 11.23	$ 41.01	$ 36.38
90	$ 11.23	$ 11.47	$ 43.94	$ 41.50
100	$ 11.72	$ 11.72	$ 46.39	$ 46.39

(1) Points from Table 1 in attachment.
(2) Points from Table 2 in attachment.

Table 1: Guidelines for Assigning Points for **General Recreation**

Criteria	Judgment factors				
Recreation experience[1] Total Points: 30 Point Value:	Two general activities[2] 0-4	Several general activities 5-10	Several general activities: one high quality value activity[3] 11-16	Several general activities; more than one high quality high activity 17-23	Numerous high quality value activities; some general activities 24-30
Availability of opportunity[4] Total Points: 18 Point Value:	Several within 1 hr. travel time; a few within 30 min. travel time 0-3	Several within 1 hr. travel time; none within 30 min. travel time 4-6	One or two within 1 hr. travel time; none within 45 min. travel time 7-10	None within 1 hr. travel time 11-14	None within 2 hr. travel time 15-18
Carrying capacity[5] Total Points: 14 Point Value:	Minimum facility for development for public health and safety 0-2	Basic facility to conduct activity(ies) 3-5	Adequate facilities to conduct without deterioration of the resource or activity experience 6-8	Optimum facilities to conduct activity at site potential 9-11	Ultimate facilities to achieve intent of selected alternative 12-14

Table 1: Guidelines for Assigning Points for **General Recreation** (Continued)

Accessibility Total Points: 18 Point Value:	Limited access by any means to site or within site 0-3	Fair access, poor quality roads to site; limited access within site 4-6	Fair access, fair road to site; fair access, good roads within site 7-10	Good access, good roads to site; fair access, good roads within site 11-14	Good access, high standard road to site; good access within site 15-18
Environmental quality Total Points: 20 Point Value:	Low aesthetic factors[6] that significantly lower quality[7] 0-2	Average aesthetic quality; factors exist that lower quality to minor degree 3-6	Above average aesthetic quality; any limiting factors can be reasonably rectified 7-10	High aesthetic quality; no factors exist that lower quality 11-15	Outstanding aesthetic quality; no factors exist that lower quality 16-20

[1]Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.
[2]General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.
[3]High quality value activities include those that are not common to the region and/or Nation, and that are usually of high quality.
[4]Likelihood of success at fishing and hunting.
[5]Value should be adjusted for overuse.
[6]Major esthetic qualities to be considered include geology and topography, water, and vegetation.
[7]Factors to be considered to lowering quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.

U.S. Army Corps
of Engineers
Los Angeles District

Los Angeles River Ecosystem Restoration
Integrated Feasibility Study
Los Angeles County, California

Regional Economic Development (RED) and Other Social Effects (OSE) Analysis

April 2015

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1. INTRODUCTION

The purpose of this attachment to the Economic Appendix is to document the analysis of Regional Economic Development (RED) effects and Other Social Effects (OSE) associated with habitat restoration and compatible recreation features along the Los Angeles River (River) within the City of Los Angeles (City) in Los Angeles County, California.

The principal controlling guidance of the analysis comes from the U.S. Army Corps of Engineers' (USACE) *Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook*, with specific guidance from Appendix D, Economic and Social Considerations. For study area definition, socioeconomic profile, flood risk considerations, recreation resources, and alternatives analysis documentation, see the Economics Appendix.

2. REGIONAL ECONOMIC DEVELOPMENT

The US Water Resources Council's Principles and Guidelines for Water Resources and Related Land Implementation Studies (P&G), which replace the 1972 "Principles and Standards," direct the studies of major water projects by Federal water resources development agencies. A stated purpose of the P&G is to ensure that the formulation and evaluation of water resource studies are done properly and consistently by federal agencies. The federal objective in project planning is to contribute to national economic development (NED) while protecting the environment. NED contributions are increases in the net values of national goods and services outputs, both marketed and non-marketed. A plan, consistent with federal objectives and which maximizes NED benefits, is the "NED plan."

In addition to NED, the P&G include three other accounts: regional economic development (RED), environmental quality (EQ), and other social effects (OSE). Collectively, the four accounts are required to include all significant effects of a plan on the human environment. The RED account includes the regional incidence of NED effects, income transfers, and employment effects. The EQ account shows the non-quantifiable effects of a plan on ecological, cultural, and aesthetic attributes of significant natural and cultural resources. The OSE account displays the effects of a plan on urban and community settings and on life, health, and safety.

The P&G require only that the NED account be developed for the selection of a plan. However, information on the other three accounts, which may bear significantly on selection of a plan, should be included in the alternative assessment.

The RED account shows the effects of plan alternatives on the distribution of regional economic activity in the area where the plan will have significant income and employment effects. All or most of the NED benefits for a plan will typically accrue to the region, and this is also the case for the current project. Effects outside the study region are categorized as "rest of the United States" impacts. The effects on regional income are the sum of 1) the NED income benefits accrued within the region, and 2) transfers from outside the region. Income transfers comprise income from implementation outlays, transfers of economic activities, and indirect and induced effects. Indirect effects are those that result from the changed outputs of goods and services in industries which help meet changes in final products and export demands. Induced effects result from changes in consumer expenditures stimulated by changes in personal income. The effects of a plan on regional employment parallel those on regional income. Typically, employment impacts of a plan are developed for individual industries at some level of aggregation in order to discern the distributional impacts on business sectors.

2.1 Relation of the RED Account to Other Accounts

RED impacts include, principally, changes in income and employment. However, the nuances of each of those categories may easily overlap with other accounts defined within the P&Gs. As indicated above, NED impacts are also RED impacts if they occur within the region of interest. However, the NED account is to reflect all effects on the national economy and excludes indirect and induced effects because they represent inter-regional transfers of regional economic activity. Conversely, indirect and induced impacts are shown in the RED account, and differences between it and the NED accounts are therefore accounted for as transfers from or to the rest of the nation.

The RED account may also overlap with the OSE account. The OSE account includes urban and community impacts, in particular those on income, population and employment distribution, fiscal conditions, and displacement of people and businesses and farms. A flood event may have social impacts through reduced property values, contaminated drinking water, and greater exposure to biological toxins. All may have regional impacts as typically defined by the RED account, but many may not be quantifiable and thus be included in the OSE account. Others which are measurable may fit into the OSE account and concurrently be an RED impact. For example, people in flooded areas may be unable to live in their homes or commute to work. The inability to live in their homes is an OSE impact, while the inability to commute to work is also an OSE impact, but with RED implications. In the latter case, the outputs of industries will decline if employees are unable to reach their places of employment.

2.2 Study Area RED Analysis

The study area for the RED analysis is the Los Angeles metropolitan area. The metropolitan area is defined by the Office of Management and Budget as the Los Angeles-Long Beach-Santa Ana metropolitan statistical area (MSA), consisting of Los Angeles and Orange counties. Its land area is 4,850 sq. mi (12,562 km^2). At its core, the MSA has the most densely populated urbanized area (the cities of Los Angeles-Long Beach-Santa Ana) in the United States with a population of 12,828,837 as of the 2010 Census. The Census Bureau, based on commuting patterns, defines the Combined Statistical Area (the MSA plus the counties of Ventura, Riverside, and San Bernardino) as home to 18.2 million people, making it the most populous metropolitan area in the western United States and the largest in area in the United States. If the Greater Los Angeles Combined Statistical Area were counted as a country it would have the 15th largest economy in the world in terms of nominal GDP (Gross Domestic Product), placing it just below Australia and above the Netherlands, Turkey, Sweden, Belgium, and Indonesia.[1]

[1] CIA World Factbook. 2009. GDP (Official Exchange Rate), October, 2009.

2.3 Regional Economic Modeling

Many of the RED effects considered in this report are quantified using regional economic models that are based on the principles of input-output (I-O) analysis. I-O analysis represents a means of measuring the flow of commodities and services among industries, institutions, and final consumers within an economy (or study area). I-O models capture all monetary market transactions in an economy, accounting for inter-industry linkages and availability of regionally-produced goods and services. The resulting mathematical formulae allow I-O models to simulate or predict the economic impacts of a change in one or several economic activities on an entire economy.

I-O analyses use three main metrics to measure economic impacts – industry output, value added, and employment. Industry output refers to the value of goods and services produced in a region. Value added consists of four components – employee compensation, proprietor income, other property income, and indirect business tax. Labor income represents the sum of employee compensation and proprietor income. Lastly, employment is measured by the number of full- and part time jobs. For the purposes of this study, the focus is on value added, which represents regional income, and employment, which is consistent with the guidance on RED analysis presented in the P&Gs.

The primary input variable for I-O analysis is the dollar change in purchases of products or services for final use, the "final demand." Final demand changes drive I-O models. Industries respond to meet demands directly or indirectly by supplying goods and services to meet final demand changes. The primary output variables are predicted changes in direct, indirect, and induced economic output, employment, and income for the affected industries within a study area. Direct economic effects refer to the response of a given industry (i.e., changes in output, income, and employment) based on final demand for that industry. Indirect effects refer to changes in output, income, and employment resulting from the iterations of industries purchasing from other industries caused by the direct economic effects. As an example, ecosystem restoration will purchase plants and trees – a direct effect. But to supply these plants and trees the seller would have purchased seeds, soil, fertilizers, containers and other items from other businesses to produce them – these "backward linkages" effects are indirect. Induced economic effects refer to changes in output, income, and employment caused by the expenditures associated with new household income generated by direct and indirect economic effects. The incomes earned by the workers in the industries supplying the goods and services for the direct and indirect products are then spent in other sectors of the economy – for example, retail stores, restaurants, doctor offices, and entertainment. Figure 2.1 shows additional examples of these linkages.

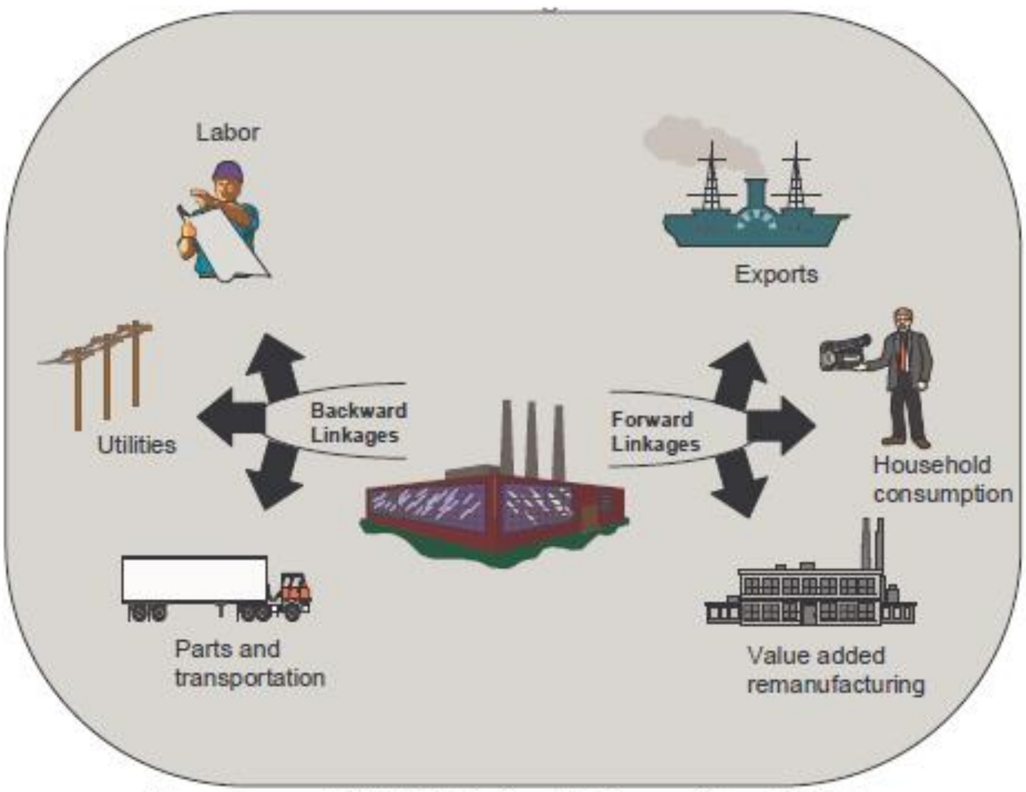

Figure source: IMPLAN Professional, Reference Manual, MIG, Inc.

Figure 2.1 Input-Output Model Linkage Examples

The measurement of direct, indirect, and induced linkages within a regional economy is based on the concept of a multiplier. A multiplier is a single number that quantifies the total economic effect resulting from direct effects. For example, an output multiplier of 1.7 for the planting and forestry sector indicates that every $100,000 of plant sales (the direct output of this industry) supports a total of $170,000 in business sales (like fertilizer, soil, and seeds) throughout the economy (total output of all industries), including the initial $100,000 in plant sales. Several types of multipliers are produced by an I-O model, including output, employment, and income multipliers.

For this study, two I-O models are employed. The first is the Corps RECONS model that is utilized to analyze the economic impacts of project construction expenditures. The Civil Works Regional Economic System (RECONS) Program is a regional economic impact modeling tool that was developed to provide accurate and defendable estimates of regional economic impacts associated with USACE spending. RECONS is the only USACE certified RED model for agency-wide use. This modeling tool automates calculations and generates estimates of jobs and other economic measures such as income and sales associated with USACE's annual Civil Work program spending, as well as that stemming from effects of additional economic activities associated with USACE's core programs (such as water transportation, tourism spending, etc.). RECONS incorporates impact area data, as well as multipliers, direct ratios (jobs to sales, income to sales, etc.), and geographic capture rates that were extracted from the IMPLAN models performed for different USACE projects.

The second model is IMPLAN. IMPLAN (IMpact Analysis for PLANning) is used to estimate regional economic effects of the redevelopment improvements anticipated to occur along the restoration corridor of the project. IMPLAN is a computer-driven system of software and data commonly used to perform economic impact analysis. It was originally developed by the USDA Forest Service (USFS) to assist in land and resource management planning and has been in use since 1979. It is a widely used for economic analyses in Federal, state and local governments, universities, and the private sector. The system is now maintained and marketed by the Minnesota IMPLAN Group, Inc. (MIG), which updates the data annually using information collected at the national, state, county, and local level. The incorporation of IMPLAN to the study is due to RECONS structure being primarily focused on Corps construction projects and isn't as well-suited to measure redevelopment as IMPLAN.

IMPLAN and RECONS are "non-survey" or secondary I-O system, as they do not require primary, survey-based data, which is often difficult and expensive to obtain. National technical relationships among industries form the basis for the model, but are adjustable to account for unique regional conditions. Information on regional economic activity is also incorporated into the models. Changes can be made to data elements to account for regional conditions when better information, such as from primary surveys, is available.

The 2011 IMPLAN dataset was used in the analysis, and no adjustments were made to the regional data or economic model. All input values into IMPLAN were aligned to 2013 dollars employing the 2011 I/O modeling database. The RED analyses are based on the Los Angeles-Long Beach-Santa Ana MSA where impacts are anticipated to occur.

2.4 RED Study Analyses

The RED analysis of the Los Angeles River Ecosystem Restoration Project is divided into three separate levels. The first level is the RED impacts of the construction of the project's alternatives. As noted earlier, this will be accomplished using the Corps' RECONS model. The second level will be redevelopment construction induced by the Corps' ecosystem restoration project. This level of RED benefits will be analyzed using IMPLAN and statistical relationships. The third level will be the analysis of housing and employment generated by the second level's construction. Again, this level will be analyzed using IMPLAN and statistical relationships.

Modeling of the RED impacts of ecosystem restoration expenditures consisted of placement of costs in the standardized account of "*Environment – Construction Activities for Ecosystem*" within the IMPLAN sectors of the RECONS model. The industry sectors considered most appropriate within this account are the following: "*construction of other new nonresidential structures*" and "*support activities for agriculture and forestry*." These contain several related sub-industries within them. Standard default settings for this account were applied for all ecosystem restoration alternatives, which results in a 75/25 percent split between the construction and agriculture/forestry (covering the planting industry) categories, respectively.

2.5 Ecosystem Restoration Alternatives

Brief descriptions of the alternatives under consideration are as follows.

- Alternative 10 – ARBOR Riparian Transitions (ART): The smallest restoration plan focusing on areas upstream and downstream of existing soft-bottomed Glendale Narrows.
- Alternative 13 – ARBOR Corridor Extension (ACE): The plan includes all eight ARBOR reaches, with side channels in key locations and treatments into Downtown LA.
- Alternative 16A – ARBOR Narrows to Downtown (AND): Similar to Alternative 13 the plan includes measures in all eight reaches with channel widening at Verdugo Wash, Arroyo Seco, Cornfield/LA State Historic Park, and LATC.
- Alternative 20A – ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER): The most extensive plan including measures of Alternative 16 with the addition of marsh creations in the River Glen and Cornfield/LA State Historic Park areas.

The relative contributory acreage provided by these alternatives are indicated in Table 2-1.

Table 2-1 Acreage of Habitat Restoration, by Alternative

Alternative			
10	**13**	**16A**	**20A**
528	588	659	719

Table 2–2 presents costs adjusted to only show first cost without LERRDs. As noted in the table, Alts 16A and 20A contain LERRDs costs for construction of railroad trestles. These are included here because even though they are not cost shared costs, they are an actual construction cost.

Table 2-2 Cost Basis for RED Construction Impacts

	Alt 10	Alt 13	Alt 16A	Alt 20A
Construction	$37,160,342	$82,287,850	$265,844,810	$365,214,471
Mobilization (7.5%)	$2,787,026	$6,171,589	$19,938,361	$27,391,085
Construction First Cost	$39,947,368	$88,459,438	$261,753,170	$363,575,556
Construction Contingency	38.83%	36.01%	37.89%	39.38%
Total Construction Cost	**$55,456,944**	**$120,312,641**	**$360,927,221**	**$506,743,287**
PED/EDC (11%)	$4,394,210	$9,730,538	$31,436,149	$43,186,611
PED/EDC Contingency	24.40%	24.40%	24.40%	24.40%
Total PED/EDC	**$5,466,398**	**$12,104,790**	**$39,106,569**	**$53,724,144**
S&A (6.5%)	$2,596,579	$5,749,864	$18,575,906	$25,519,361
S&A Contingency	26.25%	26.25%	26.25%	26.25%
Total S&A	**$3,278,181**	**$7,259,203**	**$23,452,081**	**$32,218,193**
Total LERRDs*			**$33,134,579**	**$40,461,349**
TOT FIRST COST	**$64,202,000**	**$139,677,000**	**$456,620,000**	**$633,147,000**

**For Alts 16 and 20, LERRDs costs for railroad trestle construction are included. They are included in LERRDs because the cost will not be cost shared, but they do represent a construction cost that should be included in the input to the RED analysis.*

2.5.1 Alternative 10: ARBOR Riparian Transitions (ART)

2.5.1.1 Ecosystem Restoration Project RED Construction Impacts – RECONS

ART's project's construction consists of ecosystem restoration and recreation facilities. Ecosystem restoration construction (excluding LERRDs) is estimated at $64,202,000. Ecosystem restoration construction is estimated to occur over 10 years, an estimate that assumes optimal funding and schedule.

(a) Ecosystem Restoration Construction – RED Impacts

Ecosystem restoration construction is estimated to support overall regional employment of 913 during its development with 529 being directly related to the construction. With the construction period, average annual total employment for ecosystem restoration construction is 1,329. The expenditure to total employment ratio for the project is approximately $48,300 per job or about $121,400 per direct regional employment. Direct regional labor income is estimated at $28,976,000 with total regional labor income at $52,560,000.[2] The results of the RECONS model for ecosystem restoration are displayed in the following tables.

Table 2-3 Project Information

Project Name:	Alternative 10 - ARBOR Riparian Transitions (ART) Construction
Project ID:	3001711
Division:	South Pacific
District:	Los Angeles
Type of Analysis:	Civil Works Budget Analysis
Business Line:	Environmental Stewardship
Work Activity:	Construction Activities for Ecosystem and Habitat Restoration or Improvements

Table 2-4 Economic Impact Regions

Regional Impact Area:	Los Angeles Long Beach Santa Ana CA MSA
Regional Impact Area ID:	24
Counties included	Los Angeles/Orange
State Impact Area:	California
National Impact:	Yes

[2] As discussed above in Section 2.3, *direct* employment/labor income is the first expenditure of money—in the current case that associated with construction and vegetation. These businesses then buy supplies from others, which is *indirect* employment/labor income. Finally, the workers and new employees within both the direct and indirect categories have income changes which they spend, causing induced employment/labor income. The sum of direct, indirect, and induced amounts is the *total* employment/labor income. A higher expenditure to employment ratio (cost per job) is typically the result of only considering the direct category. Both are offered herein.

Table 2-5 Input Assumptions (Spending and LPCs) – Alternative 10: ARBOR Riparian Transitions (ART) Construction

Category	Spending (%)	Spending Amount	Local Purchase Coefficient[3] (LPC) (%)	State LPC (%)	National LPC (%)
Planting and Forestry Activities	25%	$16,050,500	72%	97%	98%
Heavy Construction Activities	75%	$48,151,500	100%	100%	100%
Total[4]	100%	$64,202,000	93%	99%	99%

USACE is planning on expending $64,202,000 on the project. Of this total project expenditure $59,635,000 will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by USACE for various services and products are expected to generate additional economic activity that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table 2-6 shows the overall economic impacts for this analysis.

Table 2-6 Overall Summary Economic Impacts – Alternative 10: ARBOR Riparian Transitions (ART) Construction

Impact	Impacts Areas	Regional	State	National
Total Spending		$64,202,000	$64,202,000	$64,202,000
Direct Impact				
	Output	$59,635,000	$63,712,000	$63,945,000
	Job	529	625	631
	Labor Income	$28,976,000	$32,199,000	$32,383,000
	GRP	$33,809,000	$36,967,000	$37,148,000
Total Impact				
	Output	$125,936,000	$140,846,000	$184,456,000
	Job	913	1,071	1,329
	Labor Income	$52,560,000	$58,664,000	$71,207,000
	GRP	$73,445,000	$82,032,000	$103,215,000

Table 2-7 reports the total effects over the lifespan of construction. Table 2-7 reports these values on an average annual basis during construction.

[3] Purchase coefficients determine the mix of goods and services purchased with each dollar in their respective sectors at the indicated (local, state, national) level.

[4] Figures represent a weighted average, by industry.

Table 2-7 Overall Economic Impact at Regional Level – Alternative 10: ARBOR Riparian Transitions (ART) Construction

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
19	Support activities for agriculture and forestry	$11,484,000	257	$9,078,000	$8,896,000
36	Construction of other new nonresidential structures	$48,152,000	272	$19,898,000	$24,913,000
	Total Direct Effects	$59,635,000	529	$28,976,000	$33,809,000
	Secondary Effects	$66,301,000	384	$23,584,000	$39,636,000
	Total Effects	$125,936,000	913	$52,560,000	$73,445,000

Table 2-8 Average Annual Economic Impact at Regional Level – Alternative 10: ARBOR Riparian Transitions (ART) Construction

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
19	Support activities for agriculture and forestry	$1,148,400	26	$907,800	$889,600
36	Construction of other new nonresidential structures	$4,815,200	27	$1,989,800	$2,491,300
	Total Direct Effects	$5,963,500	53	$2,897,600	$3,380,900
	Secondary Effects	$6,630,100	38	$2,358,400	$3,963,600
	Total Effects	$12,593,600	91	$5,256,000	$7,344,500

Table 2-9 shows the top ten industries that typically benefit from the types of expenditures made for this project. This analysis was conducted at the national level and thus it cannot be guaranteed that these industries would be present in the regional impact area as analyzed.

Table 2-9 Top Ten Industries Affected by Work Activity– Alternative 10: ARBOR Riparian Transitions (ART) Construction

Rank	Industry	IMPLAN No.	% of Total Employment
1	Construction of other new nonresidential structures	36	34 %
2	Food services and drinking places	413	4 %
3	Architectural, engineering, and related services	369	4 %
4	Real estate establishments	360	2 %
5	Wholesale trade businesses	319	2 %
6	Employment services	382	2 %
7	Offices of physicians, dentists, and other health practitioners	394	1 %
8	Private hospitals	397	1 %
9	Retail Stores - General merchandise	329	1 %
10	Retail Stores - Food and beverage	324	1 %
			53 %

2.5.2 Alternative 13: ARBOR Corridor Extension (ACE)

2.5.2.1 Ecosystem Restoration Project RED Construction Impacts – RECONS

Analysis of Alternative 13 and all others follow the procedures employed for the analysis of Alternative 10. ACE's construction consists of ecosystem restoration and recreation facilities.

Ecosystem restoration construction is estimated at $139,677,000 (excluding LERRD). Construction is assumed to take 10 years for completion.

(a) Ecosystem Restoration Construction – RED Impacts

Ecosystem restoration construction is estimated to support overall regional employment of 1,986 with 1,150 directly related its construction. Again, with a one year construction schedule, average annual regional employment is the same. Overall total employment is estimated at 2,892 with 1,373 being direct employment. The expenditure to total employment ratio for the project is approximately $48,300 per job. At a direct regional employment level this ratio is $121,500-to-1. Direct regional labor income is estimated at $63,040,000 with total regional labor income at $114,350,000. The results of the RECONS model for ecosystem restoration are displayed in the following tables.

Table 2-10 Input Assumptions (Spending and LPCs) – Alternative 13: ARBOR Corridor Extension (ACE) Construction

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Planting and Forestry Activities	25%	$34,919,000	72%	97%	98%
Heavy Construction Activities	75%	$104,758,000	100%	100%	100%
Total [5]	100%	$139,677,000	93%	99%	99%

USACE is planning on expending $139,677,000 on the project. Of this total project expenditure $129,741,000 will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table 2-11 is the overall economic impacts for this analysis.

[5] Figures represent a weighted average, by industry.

Table 2-11 Overall Summary Economic Impacts – Alternative 13: ARBOR Corridor Extension (ACE) Construction

Impact	Impacts Areas	Regional	State	National
Total Spending		$139,677,000	$139,677,000	$139,677,000
Direct Impact				
	Output	$129,741,000	$138,610,000	$139,118,000
	Job	1,150	1,359	1,373
	Labor Income	$63,040,000	$70,051,000	$70,452,000
	GRP	$73,554,000	$80,425,000	$80,818,000
Total Impact				
	Output	$273,986,000	$306,423,000	$401,299,000
	Job	1,986	2,330	2,892
	Labor Income	$114,350,000	$127,629,000	$154,916,000
	GRP	$159,785,000	$178,469,000	$224,553,000

Table 2-12 reports the total effects over the lifespan of construction. On an average annual basis during construction, these effects are estimated in Table 2-13.

Table 2-12 Overall Economic Impact at Regional Level – Alternative 13: ARBOR Corridor Extension (ACE) Construction

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
19	Support activities for agriculture and forestry	$24,983,000	559	$19,750,000	$19,354,000
36	Construction of other new nonresidential structures	$104,758,000	591	$43,290,000	$54,200,000
	Total Direct Effects	$129,741,000	1,150	$63,040,000	$73,554,000
	Secondary Effects	$144,244,000	836	$51,310,000	$86,231,000
	Total Effects	$273,986,000	1,986	$114,350,000	$159,785,000

Table 2-13 Average Annual Economic Impact at Regional Level – Alternative 13: ARBOR Corridor Extension (ACE) Construction

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
19	Support activities for agriculture and forestry	$2,498,300	56	$1,975,000	$1,935,400
36	Construction of other new nonresidential structures	$10,475,800	59	$4,329,000	$5,420,000
	Total Direct Effects	$12,974,100	115	$6,304,000	$7,355,400
	Secondary Effects	$14,424,400	84	$5,131,000	$8,623,100
	Total Effects	$27,398,600	199	$11,435,000	$15,978,500

2.5.3 Alternative 16A: ARBOR Narrows to Downtown (AND)

2.5.3.1 Ecosystem Restoration Project RED Construction Impacts – RECONS

Alternative 16's construction consists of ecosystem restoration and recreation facilities. Ecosystem restoration construction is estimated at $456,620,000. This construction is assumed to take 15 years for completion.

(a) Ecosystem Restoration Construction – RED Impacts

Ecosystem restoration construction is estimated to support overall regional employment of 6,491 during its development. Direct regional construction employment is estimated at 3,759. Overall total employment is estimated at 9,455 with 4,487 being direct. The expenditure to total employment ratio for the project is approximately $48,300 per job and $121,500 at a direct regional job level. A more accurate picture of employment is average annual employment, as a given job may last over several years and is counted each year. Average annual overall regional employment for ecosystem restoration is 2,160 with 1,250 being direct construction employment. Total regional labor income during construction is estimated at $373,823,000 or $124,608,000 per year. The results of the RECONS model for ecosystem restoration are displayed in the following tables.

Table 2-14 Input Assumptions (Spending and LPCs) – Alternative 16A: ARBOR Narrows to Downtown (AND) Construction

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Planting and Forestry Activities	25%	$114,155,000	72%	97%	98%
Heavy Construction Activities	75%	$342,465,000	100%	100%	100%
Total[6]	100%	$456,620,000	93%	99%	99%

USACE is planning on expending $456,620,000 on the project. Of this total project expenditure $424,139,000 will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table 2-15 shows the overall economic impacts for this analysis.

[6] Figures represent a weighted average, by industry.

Table 2-15 Overall Summary Economic Impacts – Alternative 16A: ARBOR Narrows to Downtown (AND) Construction

Impact	Impacts Areas	Regional	State	National
Total Spending		$456,620,000	$456,620,000	$456,620,000
Direct Impact				
	Output	$424,139,000	$453,132,000	$454,793,000
	Job	3,759	4,442	4,487
	Labor Income	$206,085,000	$229,004,000	$230,317,000
	GRP	$240,457,000	$262,918,000	$264,204,000
Total Impact				
	Output	$895,690,000	$1,001,733,000	$1,311,892,000
	Job	6,491	7,616	9,455
	Labor Income	$373,823,000	$417,233,000	$506,438,000
	GRP	$522,357,000	$583,434,000	$734,089,000

Table 2-16 reports the total effects over the lifespan of construction, while Table 2-17 reports the effects on an average annual basis during construction.

Table 2-16 Overall Economic Impact at Regional Level – Alternative 16A: ARBOR Narrows to Downtown (AND) Construction

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
19	Support activities for agriculture and forestry	$81,674,000	1,829	$64,564,000	$63,271,000
36	Construction of other new nonresidential structures	$342,465,000	1,931	$141,521,000	$177,186,000
	Total Direct Effects	$424,139,000	3,759	$206,085,000	$240,457,000
	Secondary Effects	$471,551,000	2,732	$167,738,000	$281,899,000
	Total Effects	$895,690,000	6,491	$373,823,000	$522,357,000

Table 2-17 Average Annual Economic Impact at Regional Level – Alternative 16A: ARBOR Narrows to Downtown (AND) Construction

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
19	Support activities for agriculture and forestry	$5,444,900	122	$4,304,300	$4,218,100
36	Construction of other new nonresidential structures	$22,831,000	129	$9,434,700	$11,812,400
	Total Direct Effects	$28,275,900	251	$13,739,000	$16,030,500
	Secondary Effects	$31,436,700	182	$11,182,500	$18,793,300
	Total Effects	$59,712,700	433	$24,921,500	$34,823,800

2.5.4 Alternative 20A: ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER)

2.5.4.1 Ecosystem Restoration Project RED Construction Impacts – RECONS

The RIVER's construction consists of ecosystem restoration and recreation facilities. Ecosystem restoration construction is estimated at $633,147,000. Construction is assumed to take 15 years to complete.

(a) Ecosystem Restoration Construction – RED Impacts

Ecosystem restoration construction is estimated to support overall regional employment of 9,001 during its development. Direct regional employment is estimated at 5,213. The cost per total job ratio is approximately $48,300-to-1 or $121,500-to-1 at the direct regional job level. A more accurate picture of employment is average annual employment, as a given job may last over several years and is counted each year. Average annual total regional employment for ecosystem restoration is 3,000. Total regional labor income during the construction period is estimated at $518,341,000 or $172,780,000 per year. The results of the RECONS model for ecosystem restoration are displayed in the following tables.

Table 2-18 Input Assumptions (Spending and LPCs) – Alternative 20A: ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER) Construction

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Planting and Forestry Activities	25%	$158,287,000	72%	97%	98%
Heavy Construction Activities	75%	$474,860,000	100%	100%	100%
Total [7]	100%	$633,147,000	93%	99%	99%

USACE is planning on expending $633,147,000 on the project. Of this total project expenditure $588,108,716 will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table 2-19 is the overall economic impacts for this analysis.

[7] Figures represent a weighted average, by industry.

Table 2-19 Overall Summary Economic Impacts – Alternative 20A: ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER) Construction

Impact	Impacts Areas	Regional	State	National
Total Spending		$633,147,000	$633,147,000	$633,147,000
Direct Impact				
	Output	$588,109,000	$628,311,000	$630,613,000
	Job	5,213	6,159	6,222
	Labor Income	$285,756,000	$317,536,000	$319,356,000
	GRP	$333,417,000	$364,561,000	$366,344,000
Total Impact				
	Output	$1,241,959,000	$1,388,997,000	$1,819,063,000
	Job	9,001	10,560	13,110
	Labor Income	$518,341,000	$578,534,000	$702,224,000
	GRP	$724,297,000	$808,987,000	$1,017,884,000

Table 2-20 reports the total effects over the lifespan of construction, while Table 2-21 shows the total effects on an average annual basis during construction.

Table 2-20 Overall Economic Impact at Regional Level – Alternative 20A: ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER) Construction

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
19	Support activities for agriculture and forestry	$113,248,000	2,535	$89,524,000	$87,731,000
36	Construction of other new nonresidential structures	$474,860,000	2,677	$196,232,000	$245,685,000
	Total Direct Effects	$588,109,000	5,213	$285,756,000	$333,417,000
	Secondary Effects	$653,850,000	3,788	$232,585,000	$390,880,000
	Total Effects	$1,241,959,000	9,001	$518,341,000	$724,297,000

Table 2-21 Average Annual Economic Impact at Regional Level – Alternative 20A: ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER) Construction

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
19	Support activities for agriculture and forestry	$7,549,900	169	$5,968,300	$5,848,700
36	Construction of other new nonresidential structures	$31,657,300	178	$13,082,100	$16,379,000
	Total Direct Effects	$39,207,300	348	$19,050,400	$22,227,800
	Secondary Effects	$43,590,000	253	$15,505,700	$26,058,700
	Total Effects	$82,797,300	600	$34,556,100	$48,286,500

2.6 Alternatives Summary – RED Benefits of Ecosystem Restoration Construction

Each of the proposed alternatives will produce significant impacts to employment, income and gross regional product (GRP) during their construction periods. Employment gains are estimated to range from 913 to over 9,000 depending upon alternative over their construction lifespans. Incomes derived from construction and its related employment effects would add between $52 million to over $518 million to the regional economy. The regional economy as a whole is anticipated to show growth from $73 million to over $720 million in gross regional product depending upon the alternative. Note that the effects shown are proportional to the size and/or expenditure of the respective alternatives because they share the same RECONS model type and default settings.

Table 2-22 Total Regional Effects of Alternative Construction

	Alt 10: ART	Alt 13: ACE	Alt 16A: AND	Alt 20A: RIVER
Sales	$125,936,000	$273,986,000	$895,690,000	$1,241,959,000
Jobs	913	1,986	6,491	9,001
Labor Income	$52,560,000	$114,350,000	$373,823,000	$518,341,000
GRP	$73,445,000	$159,785,000	$522,357,000	$724,297,000

2.7 Recreation Development

A recreation project has been proposed for the alternatives (see Section 5). The plan complements ecosystem restoration features covering the same geographic extent in all four final alternatives, and as such, the RED impacts of recreation construction do not differ by alternative. The plan is estimated to cost $6,134,000 and will take less than one year to construct. To analyze the regional economic impacts of the plan the Corps' RECONS model was employed. Under RECONS' New Construction in Recreation Areas sector the model estimates 100% of the construction cost will be captured in the local impact area. The overall impacts of recreation construction are as follows.

Table 2-23 Overall Summary Impacts – Recreation Construction

Impact	Impacts Areas	Regional	State	National
Total Spending		$6,134,000	$6,134,000	$6,134,000
Direct Impact				
	Output	$6,134,000	$6,134,000	$6,134,000
	Job	35	35	35
	Labor Income	$2,535,000	$2,535,000	$2,535,000
	GRP	$3,174,000	$3,174,000	$3,174,000
Total Impact				
	Output	$12,958,000	$13,610,000	$17,796,000
	Job	74	78	102
	Labor Income	$4,998,000	$5,139,000	$6,350,000
	GRP	$7,264,000	$7,546,000	$9,592,000

With construction being less than one year, overall regional impacts and annual average regional impacts are the same. The model's estimate of overall regional impacts is as follows.

Table 2-24 Regional/Average Annual Impacts of Recreation Construction

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
36	Construction of other new nonresidential structures	$6,134,000	35	$2,535,000	$3,174,000
	Total Direct Effects	$6,134,000	35	$2,535,000	$3,174,000
	Secondary Effects	$6,824,000	39	$2,463,000	$4,091,000
	Total Effects	$12,958,000	74	$4,998,000	$7,265,000

2.8 RED Benefits From Induced Development

In the preceding sections the analysis focused on what is commonly referred to as backward linkages in I/O modeling terms. A backward linkage is between an industry and its suppliers, or a household and the producers of household goods and services. So for the ecosystem restoration alternatives of the previous sections the analysis focused on their construction demands on their supplying industries and labor market demands. I/O models are well suited to examine these backward linked industry multipliers. However, I/O models are not well-suited to examine what is referred to as forward linkages. A forward linkage is between an industry producing a good or service and the consumers of that good or service. The consumers may be another industry who will add further value to the purchased good in the production of their product. Potential forward linkages to the proposed ecosystem restoration plans are the redevelopment possibilities and economic activity (employment and housing) spurred by the ecosystem restoration in surrounding areas. An important underlying assumption in the analysis is that any existing businesses that are displaced by the redevelopment do so as a result of a free exchange in an open market; that is, conversion of the property would be voluntary due to beneficial economic terms to the existing owner. Thus, the forward linkage in the analysis is for jobs created to supply the projected redevelopment's employment requirements for the workspace created as well as the workforce induced by residential development. This represents new demand that would be generated rather than transferred from another location in the MSA.

To assess how the ecosystem restoration plan could spur economic redevelopment, a qualitative approach utilizing interviews with developers, business groups, and City officials was undertaken. A consistent theme among those interviewed is that the project could alter the development and redevelopment path for the project area. While there is some concern that the project could entice development away from other parts of the city, all agree that the overall net gains would be positive.

The qualitative assessment that the project would be a key environmental and recreational amenity that would positively impact development and property values is also supported and informed by numerous examples and studies of property values and development projects nationwide. One such example is the Rio Salado Ecosystem Restoration Project, the first authorized ecosystem restoration project studied and subsequently constructed by USACE, the City of Phoenix, and the City of Tempe. The project has experienced $500 million dollars in seven square miles of new development since implementation of the restoration project. Another example is the Trinity River Vision Authority’s master plan being implemented in Fort Worth to preserve and enhance the river corridor in a multi-purpose context with greenways for open space, wildlife habitat, trails, neighborhood focal points, and special recreation areas. The Authority reports that developers actively embrace the setting by planning river-centric communities within areas dedicated to flood risk management, ecosystem restoration, and urban revitalization. A significant project partner in the Trinity River Vision is USACE. Further, in a study carried out by Indiana University's Eppley Institute as reported by the Trust for Public Land, 66 percent of property owners living near a former railroad line that was converted into a park for bicycling, skating, and walking felt that it increased the resale value of their property, while only 5 percent felt the opposite….and 64 percent felt the trail made their property easier to sell while 10 percent felt the opposite.

The primary challenge for the project is to maintain a consistent vision for development standards while taking into account changes in the real estate market and the political environment. Cooperation among developers, public officials, business, and community groups will be required which has already been demonstrated considering the representatives currently involved in the project. Officials with the City believe the project itself, along with the associated infrastructure, should provide sufficient incentive to attract the expected commercial, residential, and mixed-use development. Further, redevelopment is assumed to occur in a free market setting. Current owners will freely exchange property rights with developers if the economics of the offers make business sense. Existing vacancy rates in retail, office and industrial locations suggest current businesses, if they desired, could relocate to new locations making business redevelopment and its employment a total RED gain to the economy.

2.8.1 Redevelopment Projections

Redevelopment projections for this study were developed through discussions with the City of Los Angeles staff and the Los Angeles Economic Development Corporation with consideration to the Los Angeles River Revitalization Master Plan (City of Los Angeles 2007a). The Revitalization Master Plan provides both a long-term vision and implementation guidance for revitalizing the River, and as such is referenced in the Water Resources Development Act of 2007 as a source of information with which to help accomplish the current study.[8] Although the Revitalization Master Plan is more extensive than the current study's alternatives, each of the alternatives is consistent with the river changes evaluated in the Revitalization Master Plan. This consistency allows the detailed work of the Master Plan—developed through redevelopment experts, City personnel, and the public—to be a basis of extrapolation for the alternatives.

2.8.1.1 Revitalization Master Plan: Context

The Los Angeles River Revitalization Master Plan identified 20 Opportunity Areas having revitalization potential, as seen in Figure 2.2. Five areas (highlighted in red in the figure) were identified for their considerable potential in demonstrating revitalization and redevelopment. The

[8] Section 4018 of the Water Resources Development Act of 2007, PL 110-114 includes the following language: "prepare a feasibility study…that is consistent with the goals of the Los Angeles River Revitalization Master Plan published by the [C]ity of Los Angeles," and "[i]n preparing the study… use, to the maximum extent practicable…information obtained from the Los Angeles River Revitalization Master Plan."

Canoga Park and Downtown Industrial areas are outside the current study area and are not addressed in this report.

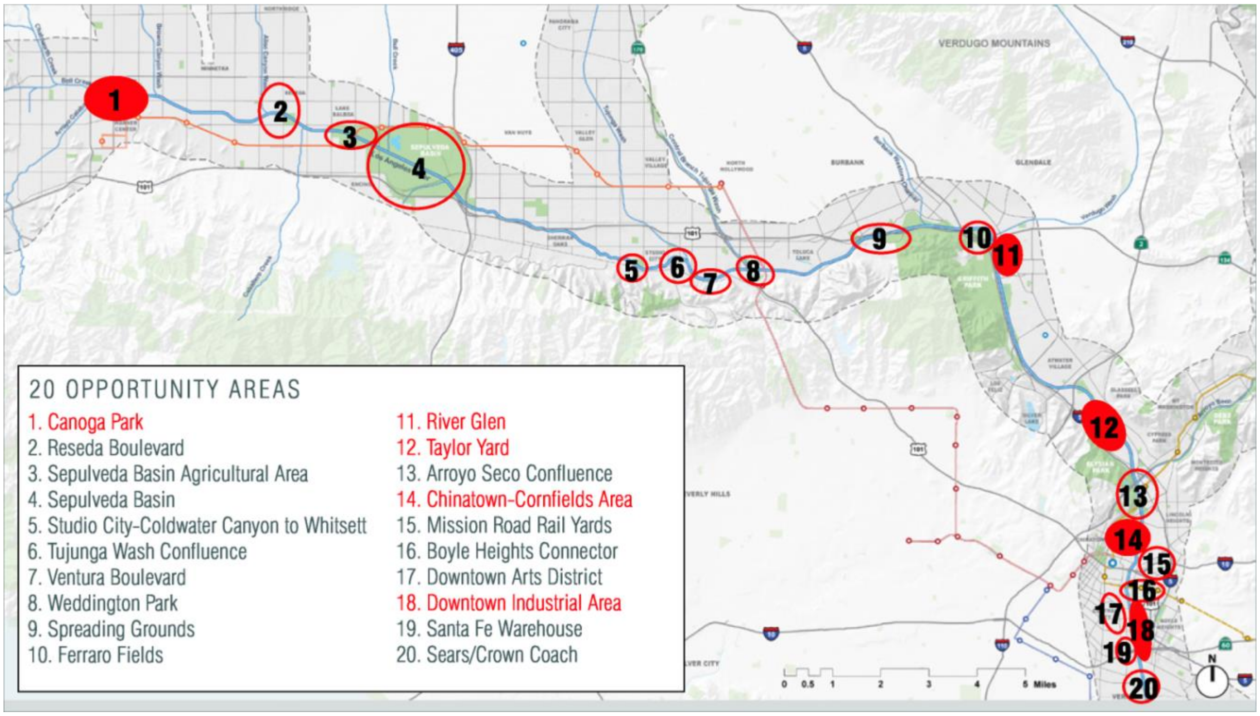

Figure 2.2 Los Angeles River Opportunity Areas

Two areas of the Master Plan, River Glen (area at the confluence with Verdugo Wash) and Chinatown-Cornfields, are of redevelopment interest to this study. Each of these areas consists of older commercial and light industrial buildings, with some public housing within the Chinatown-Cornfields area. The older building stock along with the sites' locations—especially the Chinatown-Cornfields' proximity to downtown and adjacent transportation facilities—are identified by the City as prime redevelopment opportunities for the City's long-term development. Within the Chinatown-Cornfields Opportunity Area, the Revitalization Master Plan projects redevelopment of nearly 5,000 residential units with 1 million square feet of retail & manufacturing and 1.6 million square feet of office space. The projection for the River Glen Opportunity Area is for 600,000 square feet of office/industrial space.

The City's desire and commitment to this redevelopment program is reflected by the creation of the Cornfield Arroyo Seco Specific Plan (CASP)[9] currently under consideration. The CASP was a direct outgrowth of the Revitalization Master Plan and focuses on river and community changes in its place-making recommendations. The Specific Plan calls for rezoning of industrial property for mixed-uses, and the establishment of additional design guidelines to ensure that economic and community development strategies are mutually complementary. The CASP

[9] Cornfield Arroyo Seco Specific Plan, Draft, 2012. City of Los Angeles, Planning Department, August 6, 2012.

boundary includes the Los Angeles River from the confluence with the Arroyo Seco downstream to the Cornfields.

Further, the projected increases in residential development are well-below the expected demand: The maximum residential redevelopment projection within the ARBOR study area represents approximately 900 housing units. The California Department of Finance estimates the population of Los Angeles County to increase by 1.8 million from 2010 to 2060. With a per-household occupancy rate of nearly 3, this population growth would require over 600,000 housing units. The potential for displacement of other development, given the small number of redevelopment in comparison to the overall county requirement, is minimal. Similarly, redevelopment's non-residential estimate is also minimal to the future demand of the county. In comparison to the projected demands of the Revitalization Master Plan the estimated demands are between 20 to 30 percent at the maximum level. Note that these percentages were developed by the study team as reasonable factors, based upon available information, for developing a general estimate of potential redevelopment RED benefits associated with project alternatives.

2.8.1.2 Revitalization Master Plan: Methodology

The economic analysis used in the Revitalization Master Plan was based on projected urban development within each of the Opportunity Areas that would occur as a consequence of river revitalization. This included estimates of new housing units, businesses, and manufacturing areas as an outgrowth of changes in the River. The methodology used included:

Under the without-project condition, the redevelopment areas are expected to exist without much improvement, as they have for decades. Past improvements have mostly been limited to replacement of physically obsolete or damaged structures. Therefore, in the without-project condition, it is expected that over the next several decades a limited number of random structures would be redeveloped in the absence of the project, but that this redevelopment would not significantly alter the evaluation below. It is the proposed project in conjunction with the City's Revitalization Master Plan that provides the backbone for any significant redevelopment efforts in these areas.

The analysis was conducted by several urban development professionals on the Revitalization Master Plan team which included City staff from the Bureau of Engineering and the Planning Department, with input from the Los Angeles Economic Development Corporation. The analysis considered the types of uses, densities, and mix of building types that the market would support. Improvements that were considered as stimuli to economic development included the proposed restoration of the River, associated parks and connections, green streets, and transit improvements. Urban design considerations suggested that neighborhoods would have more mixed uses, be better connected, and be more active and walkable than current conditions. It is important to note that the projected development within the Opportunity Areas is hypothetical and intended to demonstrate only that if economic development is pursued, then new jobs, housing production, new businesses, and tax revenues might result. Any actual agenda for economic development in these Areas is expected to come from a combination of community planning and private initiatives in response to River restoration.

Taking the Chinatown-Cornfields Opportunity Area as an example: The development program was based on a new recreational riverfront anchored by the changes in the River as both an inducement and component to redevelopment. The riverfront village concept was that Main Street would once again become an important mixed-use walking street, with arterials in the area becoming entertainment and shopping destinations with a substantial mix of office and residential uses in dense buildings and towers at key locations, especially along the new riverfront and the habitat and park facilities in the Los Angeles State Historic Park. A destination riverfront with retail and restaurants, cafes, hotels, and opportunities for the arts could emerge. This new destination would likely cause substantial redevelopment connecting the area continuously from the River to Chinatown.

Projections of potential new or redeveloped areas include specific land use quantities for residential units, retail areas, office space, and manufacturing. From this number, the team worked with the Los Angeles Economic Development Corporation and used its own experience on similar projects to develop formulas for estimating the number of jobs, wage-levels, and tax revenues that could result from the specific densities and uses prescribed for each alternative in the Revitalization Master Plan. Table 2-25 displays the results from the Revitalization Master Plan for the two Opportunity Areas, with each Opportunity Area having a higher and lower level estimate of potential development.

Table 2-25 Potential Development Program as Evaluated in the Revitalization Master Plan

Opportunity Area	Residential (units)	Retail (ft^2)	Office (ft^2)	Manufacturing (ft^2)
Chinatown/Cornfields "higher range"	4,665	871,402	1,477,144	241,648
Chinatown/Cornfields "lower range"	3,041	589,584	1,616,073	147,270
River Glen "higher range"	1,085	--	150,742	450,830
River Glen "lower range"	--	--	--	349,207

In examining restoration as an attribute for the current study, the alternatives were examined with respect to the Revitalization Master Plan to compare their potential development to that programmed within the Revitalization Master Plan. None of the restoration alternatives within the current feasibility study are as extensive nor have as widespread channel changes as the River Glen or Chinatown areas depicted in the Revitalization Master Plan. Therefore, discussions with members of the Project Delivery Team took place to reflect a more conservative approach compared to the economic analysis programmed in the Revitalization Master Plan. Factors considered were as follows:

- The channel restoration herein is less extensive than the Revitalization Master Plan, which envisioned a wider channel less constrained by rights-of-way. More rights-of-way allowed additional features such as gateways, promenades, paseos, and other revitalization components to be programmed in the Master Plan. However, these features would not provide incremental habitat benefits and are therefore not part of a Federal project. Even though the City is anticipating these features in the future following the restoration of the River, a more conservative approach is taken when programming future redevelopment in the current RED analysis.

- The River Glen area would likely remain with industrial land uses mixed with commercial land uses, such as found within an industrial park. The effect of a restored river would therefore have a smaller impact on RED benefits compared to the Chinatown-Cornfields area, the latter of which is anticipated to have a larger shopping/entertainment presence. Still, the value of open space is already demonstrated in the River Glen area by some of the businesses that have created “aesthetic space” for their employees. Since the area is expected to continue to evolve into higher density/higher tech uses consolidated closer to San Fernando Road, the amenities of adjacent habitat, open space, and trails are expected to attract higher-skilled employees seeking higher wages, thereby providing higher value associated with the alternatives.

- Ecosystem restoration within the Los Angeles River is only one component of neighborhood revitalization albeit a critical anchor feature around which redevelopment is expected to occur. As shown by other river restoration projects referenced herein, restoration would make a meaningful difference to the region and help leverage overall revitalization within the ARBOR. However, to reflect a conservative approach and the uncertainty of a cause-effect relationship, the development programmed within the Revitalization Master Plan was scaled downward for the RED analysis.

The resulting estimate as described below is that restoration in the River Glen area is projected to influence 10 to 15 percent of the development projected within the Revitalization Master Plan, and 20 to 30 percent of the development projected in the Revitalization Master Plan for the Chinatown-Cornfields area.

2.8.2 River Glen Opportunity Area – Redevelopment Construction

River Glen (Figure 2.3) is characterized by industrial, biomedical, and film/studio-related land uses. Once an area occupied by low-rent businesses, it now is poised to become the premier eco-industrial park in the City.

The River Glen area is approximately 150 acres. It includes three distinct sub-areas that can be defined, based on the quality of building stock and stability of current land use. The most stable of the areas is between Colorado Street and one half-block south of Brazil Street, and is occupied by large employers, such as Baxter, Huntsman Advanced Materials Americas Inc., Quixote Studios, and Kaiser Permanente, which are viewed as long-term and stable job creators for the area.

The second area, between Brazil Street and one-half block south of Doran Street, contains land uses comprising light-industrial and warehouse-type facilities including a vacated Levitz Furniture building, a used car dealership, and the Priority Pak Shipping Facility. Within this area, the dominant pattern is consolidation of multiple parcels into single ownership, resulting in large-format warehouse buildings that wall off the River on its eastern edge.
The third and most susceptible area of potential change is the area’s northern boundary, which includes an assortment of metal and paper recycling facilities, and a California Department of Transportation maintenance facility located directly below Interstate 134.

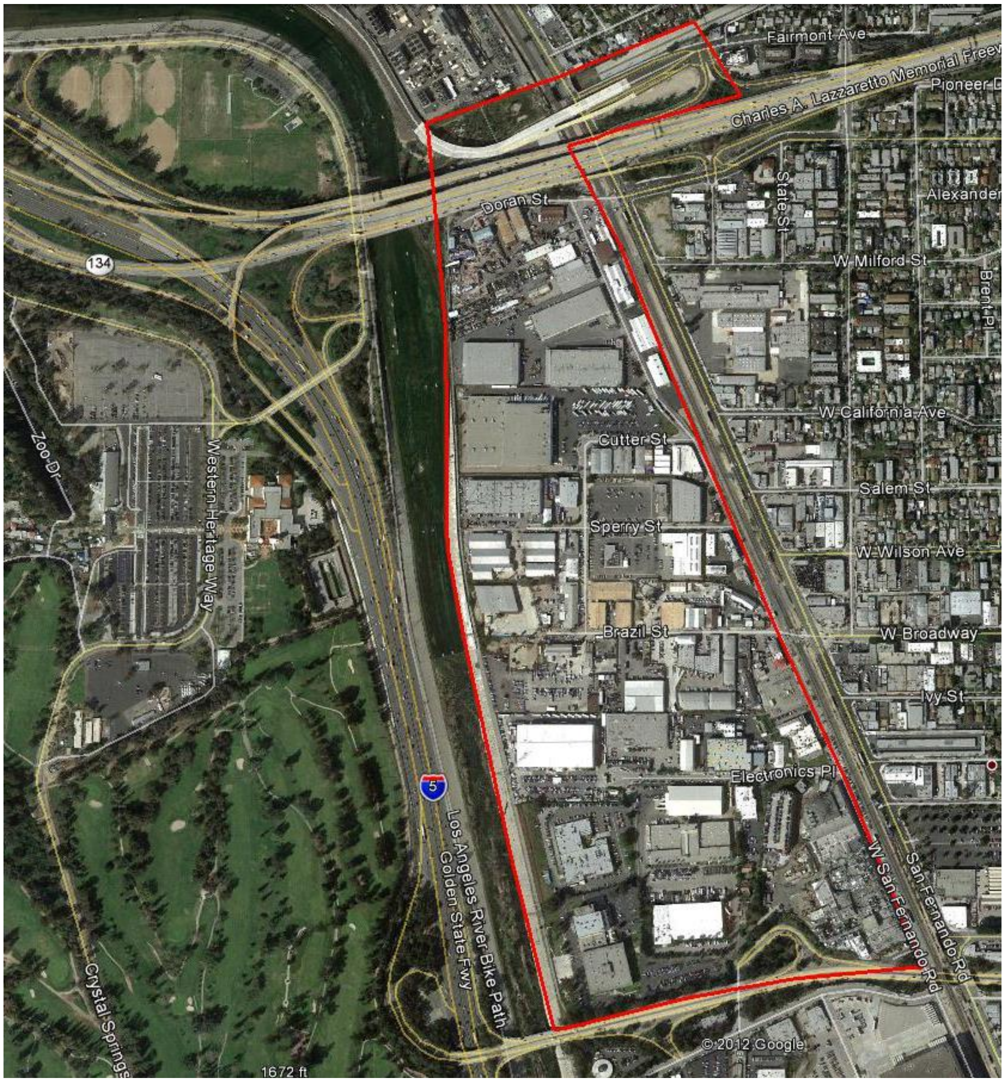

Figure 2.3 River Glen Opportunity Area

Seventy percent of the River Glen area is considered as having redevelopment potential. This area is currently zoned for industrial uses, which could either be modified or maintained with higher density/smaller footprint uses, as mentioned above. Either way, the City recognizes that the area is isolated by aging infrastructure and access, and has underutilized potential for green space and habitat. This provides the impetus for riverly redevelopment at the confluence anchored by a proposed project.

Under Alternative 10 (ART) minor restoration activities take place in the area and as such no change is anticipated to the area's existing development process. The restoration plans of Alternatives 13 (ACE) and 16 (AND) are the same for the River Glen area, with both proposing modest restoration changes to the channel bank. The plan for Alternative 20 (RIVER) proposes the acquisition of recycling yards at the north end of the area to allow for dramatic expansion and greening of the confluence of Verdugo Wash with the River along with the channel bank improvements. This alternative would promote redevelopment of industrial uses within River Glen to a much larger extent.

It is estimated that up to 300,000 square feet of light manufacturing redevelopment in response to restoration may occur during the period of analysis, depending upon alternative–about 5 percent of the total 6.5 million square feet available. In comparison to the LA River Revitalization Plan, the maximum redevelopment is less than 15 percent of the Plan's. This potential redevelopment has a value of $24 million based on a Marshall & Swift construction value of $80 per square foot. The potential for redevelopment by alternative is estimated in Table 2-26.

Table 2-26 River Glen Redevelopment Construction

Alternative	Manufacturing Square Feet	Value
Alt 10: ART	0	$0
Alt 13: ACE	50,000	$4,000,000
Alt 16A: AND	50,000	$4,000,000
Alt 20A: RIVER	300,000	$24,000,000

RED impacts for River Glen redevelopment by alternative as estimated by IMPLAN for the Los Angeles-Orange Counties area are presented below. Total cumulative employment impacts, direct, indirect and induced, over the 50-year redevelopment period are estimated in Table 2-27.

For these alternatives, the investment to total job ratio is approximately $73,000-to-1 and $120,000-to-1 at a direct job ratio. Assuming equal development for each year, annual employment impacts are shown in Table 2-28.

Overall industry and summary cumulative impacts for River Glen redevelopment are shown in Table 2-29. Impacts on an annual basis, assuming a constant annual expenditure during the redevelopment period, are shown in Table 2-30.

Table 2-27 River Glen Redevelopment Construction Employment Impacts by Alternative

Alternative 13: ACE				
Industry	**Direct**	**Indirect**	**Induced**	**Total**
Total	33.2	5.5	15.7	54.5
Agriculture	0.0	0.0	0.0	0.0
Mining	0.0	0.0	0.0	0.0
Construction	33.2	0.1	0.1	33.4
Manufacturing	0.0	0.8	0.3	1.1
TIPU	0.0	0.2	0.5	0.7
Trade	0.0	0.5	3.3	3.8
Service	0.0	3.9	11.4	15.3
Government	0.0	0.0	0.1	0.2

Alternative 16A: AND				
Industry	**Direct**	**Indirect**	**Induced**	**Total**
Total	33.2	5.5	15.7	54.5
Agriculture	0.0	0.0	0.0	0.0
Mining	0.0	0.0	0.0	0.0
Construction	33.2	0.1	0.1	33.4
Manufacturing	0.0	0.8	0.3	1.1
TIPU	0.0	0.2	0.5	0.7
Trade	0.0	0.5	3.3	3.8
Service	0.0	3.9	11.4	15.3
Government	0.0	0.0	0.1	0.2

Alternative 20A: RIVER				
Industry	**Direct**	**Indirect**	**Induced**	**Total**
Total	199.4	33.1	94.2	326.7
Agriculture	0.0	0.0	0.1	0.1
Mining	0.0	0.1	0.1	0.2
Construction	199.4	0.4	0.8	200.6
Manufacturing	0.0	4.6	1.7	6.3
TIPU	0.0	1.4	2.8	4.2
Trade	0.0	2.7	19.9	22.6
Service	0.0	23.5	68.2	91.7
Government	0.0	0.2	0.9	1.1

Table 2-28 River Glen Redevelopment Construction Average Annual Employment Impacts

Alternative	Direct	Indirect	Induced	Total
Alt 13: ACE	0.7	0.1	0.3	1.1
Alt 16A: AND	0.7	0.1	0.3	1.1
Alt20A: RIVER	4.0	0.7	1.9	6.5

Table 2-29 River Glen Redevelopment Construction Overall Impacts by Alternative

Impact Type	Employment	Labor Income	Value Added[10]	Output[11]
Alternative 13: ACE				
Direct Effect	33.2	$2,464,000	$2,610,000	$4,000,000
Indirect Effect	5.5	$396,000	$597,000	$1,056,000
Induced Effect	15.7	$824,000	$1,452,000	$2,317,000
Total Effect	54.5	$3,684,000	$4,659,000	$7,373,000
Alternative 16A: AND				
Direct Effect	33.2	$2,464,000	$2,610,000	$4,000,000
Indirect Effect	5.5	$396,000	$597,000	$1,056,000
Induced Effect	15.7	$824,000	$1,452,000	$2,317,000
Total Effect	54.5	$3,684,000	$4,659,000	$7,373,000
Alternative 20A: RIVER				
Direct Effect	199.4	$14,785,000	$15,662,000	$24,000,000
Indirect Effect	33.1	$2,375,000	$3,580,000	$6,336,000
Induced Effect	94.2	$4,943,000	$8,709,000	$13,903,000
Total Effect	326.7	$22,103,000	$27,952,000	$44,240,000

RED impacts on an annual basis assuming a constant annual expenditure during the redevelopment period are:

Table 2-30 River Glen Redevelopment Construction Average Annual Impacts Summary by Alternative

Impact Type	Employment	Labor Income	Value Added	Output
Alternative 13: ACE				
Direct Effect	0.7	$49,283	$52,208	$80,000
Indirect Effect	0.1	$7,916	$11,934	$21,122
Induced Effect	0.3	$16,477	$29,031	$46,344
Total Effect	1.1	$73,677	$93,173	$147,466
Alternative 16A: AND				
Direct Effect	0.7	$49,283	$52,208	$80,000
Indirect Effect	0.1	$7,916	$11,934	$21,122
Induced Effect	0.3	$16,477	$29,031	$46,344
Total Effect	1.1	$73,677	$93,173	$147,466
Alternative 20A: RIVER				
Direct Effect	4.0	$295,700	$313,246	$480,000
Indirect Effect	0.7	$47,498	$71,604	$126,730
Induced Effect	1.9	$98,862	$174,187	$278,067
Total Effect	6.5	$442,060	$559,038	$884,797

[10] IMPLAN's Value Added is equivalent to RECON's Gross Regional Product (GRP)

[11] IMPLAN's Output is equivalent to RECON's Sales

2.8.2.1 River Glen Redevelopment State and Local Tax Impacts

The previous section discussed the employment, income, and sales gains projected with redevelopment. In addition to these gains, redevelopment construction will generate new state and local taxes since taxes would be paid on these income and sale gains. Over the entire redevelopment period, these taxes are shown in Table 2-31 and Table 2-32 for the three alternatives, according to the IMPLAN model.

Table 2-31 River Glen Redevelopment Construction State & Local Taxes Impacts Alternatives 13-ACE and 16A-AND

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends					
Social Ins Tax- Employee Contribution	$4,000				
Social Ins Tax- Employer Contribution	$6,000				
Indirect Bus Tax: Sales Tax			$74,000		
Indirect Bus Tax: Property Tax			$79,000		
Indirect Bus Tax: Motor Vehicle Lic			$2,000		
Indirect Bus Tax: Severance Tax					
Indirect Bus Tax: Other Taxes			$13,000		
Indirect Bus Tax: S/L NonTaxes			$6,000		
Corporate Profits Tax					$12,000
Personal Tax: Income Tax				$101,000	
Personal Tax: NonTaxes (Fines- Fees				$24,000	
Personal Tax: Motor Vehicle License				$4,000	
Personal Tax: Property Taxes				$2,000	
Personal Tax: Other Tax (Fish/Hunt)				$1,000	
Total State and Local Tax	$10,000		$174,000	$132,000	$12,000

Table 2-32 River Glen Redevelopment Construction State & Local Taxes Impacts Alternative 20A-RIVER

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends					$3,000
Social Ins Tax- Employee Contribution	$22,000				
Social Ins Tax- Employer Contribution	$39,000				
Indirect Bus Tax: Sales Tax			$446,000		
Indirect Bus Tax: Property Tax			$471,000		
Indirect Bus Tax: Motor Vehicle Lic			$10,000		
Indirect Bus Tax: Severance Tax					
Indirect Bus Tax: Other Taxes			$80,000		
Indirect Bus Tax: S/L NonTaxes			$39,000		
Corporate Profits Tax					$72,000
Personal Tax: Income Tax				$604,000	
Personal Tax: NonTaxes (Fines- Fees				$147,000	
Personal Tax: Motor Vehicle License				$27,000	
Personal Tax: Property Taxes				$11,000	
Personal Tax: Other Tax (Fish/Hunt)				$6,000	
Total State and Local Tax	$61,000		$1,046,000	$794,000	$75,000

2.8.3 River Glen Opportunity Area – Long-Term Redevelopment Impacts

The preceding section examined the construction activities of potential redevelopment, but construction is only the initial impact of redevelopment. It follows that the building of retail, office, or industrial facilities is in anticipation of employment within these facilities. Employment in these facilities will produce long-term impacts in the area through the wages employees receive. The following sections will analyze the potential long-term impacts on jobs, wages, and taxes that redevelopment may create.

2.8.3.1 Long-Term Employment, Wages, and Taxes – River Glen Opportunity Area

Each of the alternatives is anticipated to create manufacturing floor space. In a study for the Southern California Association of Governments it is estimated that the average square feet per employee in this sector ranges from 829 to 1,796.[12] For this employment analysis it is assumed that light manufacturing requires 1,000 sq. ft. per employee and that a 5 percent vacancy rate

[12] The Natelson Company, Inc. 2001. Employment Density Study – Summary Report. Prepared for the Southern California Association of Governments.

exists in manufacturing.[13] Like the ground space development, employment growth follows a similar straight-line approach over the 50-year analysis period. The Bureau of Labor Statistics (BLS) reports the average weekly wage rate for manufacturing in Los Angeles County at $1,067 or $55,484 per year.[14] Employment and wage results are shown in the following table.

Table 2-33 River Glen Long-Term Employment & Wages

Alternative	Total Employment	Average Annual Employment	Total of all Wages	Average Annual Wages	NPV of all Wages
Alternative 13: ACE	47.5	24.2	$67,205,000	$1,344,000	$21,562,000
Alternative 16: AND	47.5	24.2	$67,205,000	$1,344,000	$21,562,000
Alternative 20: RIVER	285.0	145.4	$403,230,000	$8,065,000	$129,375,000

The sales tax rate for Los Angeles County and the City of Los Angeles is 9 percent. Of this tax rate, 6.5 percent goes to the State and the remaining 2.5 percent is returned to the county and city. Sales taxes generated from employment, assuming 24 percent of wages are taxable expenditures, are:[15]

Table 2-34 River Glen Long-Term Sales Tax Revenues

	Cumulative			
Alternative	**Sales Tax: State**	**Sales Tax: Local**	**Average Annual: Local**	**NPV: Local**
Alternative 13: ACE	$1,048,000	$403,000	$8,000	$129,000
Alternative 16A: AND	$1,048,000	$403,000	$8,000	$129,000
Alternative 20A: RIVER	$6,290,000	$2,419,000	$48,000	$776,000

2.8.4 Taylor Yard Opportunity Area

The Taylor Yard opportunity area (Figure 2.4) is within the Elysian Valley and bordered on the northeast by San Fernando Road and southwest by the River and extends from near Arroyo Seco to Fletcher Drive. The area includes the Rio del Los Angeles State Park but along the east side of the river there are many industrial parcels and both freight and Metrolink Railroad tracks and large industrial parcels. The Elysian Valley residential community on the west side is connected to the River with most east/west streets terminating at the River.

An RED analysis was not conducted for this Opportunity Area. The Los Angeles River Revitalization Master Plan states:

The Taylor Yard Opportunity Area demonstrates a significant opportunity for ecosystem restoration on a large scale. Because stakeholders and many community members expressed that this area is inappropriate for more intensive development, and active open space is being incorporated into the Rio de Los Angeles State Park to the east, this Opportunity Area was

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[13] Colliers International. 2012. Central Los Angeles Market Report: Industrial. 2nd Quarter.

[14] Bureau of Labor Statistics. 2013. County Employment and Wages – Second Quarter 2012. January 8, 2013. USDL-13-0013.

[15] City of Los Angeles, Department of Public Works. 2007. *Los Angeles River Revitalization Master Plan.* 284 pp.

selected to illustrate the potential for restoration of the River's hydro-ecological functions, and as a showcase for removing the concrete channel walls.

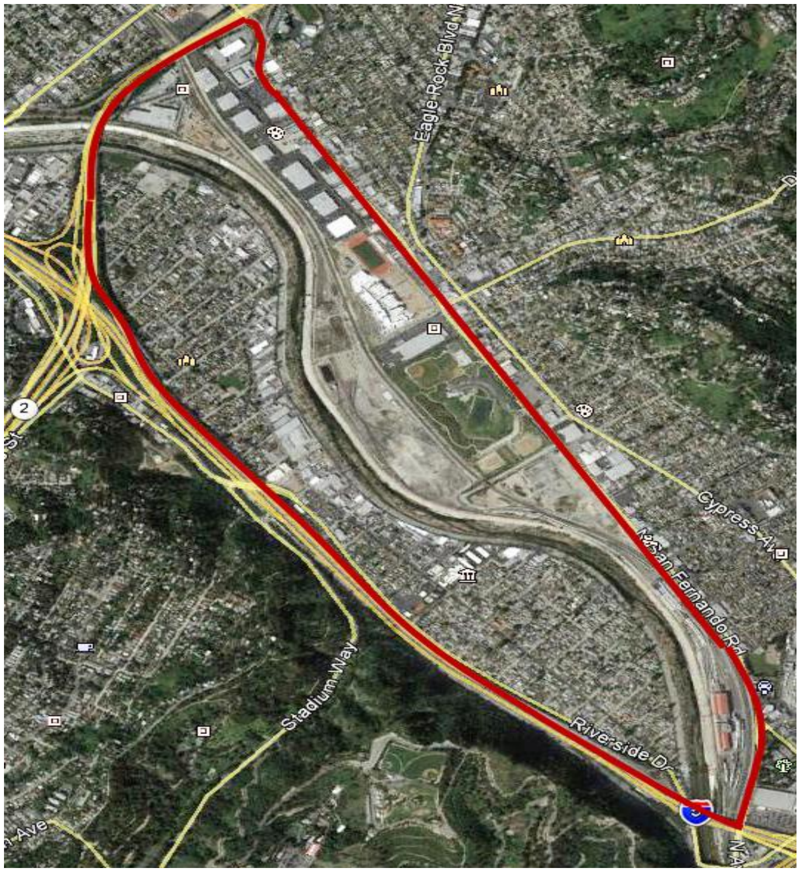

Figure 2.4 Taylor Yard Opportunity Area

The community's desire to keep this area from development is one of the reasons that an analysis was not conducted to evaluate the value of future development. Another reason is that the area of proposed restoration is approximately 1,000 feet away from the main thoroughfare where redevelopment potential exists, with an existing, newly created natural area, park, and school in between that area and the proposed habitat area. Any redevelopment related to the proposed habitat restoration—in light of the just-stated, existing facilities at Taylor Yard—would have an indeterminate cause/effect because the surrounding land uses are already benefiting from some of the adjacent open space and aesthetic amenities. However, even though the evaluation was not conducted, it should still be recognized that the proposed restoration is expected to provide positive benefits. These include increased real estate values, the improved desirability of the neighborhood, and greater redevelopment potential due to the enhanced environment and proximity to additional green space and recreation.

2.8.5 Chinatown–Cornfields Opportunity Area

The Chinatown-Cornfields Opportunity Area (Figure 2.5) boasts grand views of Downtown and the River from its historic bridges. The area is completely cut off from the River because of existing heavy rail lines. The Department of Water and Power facility and the William Mead housing development combine to make up about 40 percent of the entire Opportunity Area of approximately 210 acres. The remaining 60 percent is composed of a series of light industrial and manufacturing facilities, commercial food warehousing and distribution facilities, and large-vehicle parking lots. Existing building character generally varies from block to block, with small pockets of historically significant and aesthetically beautiful structures interspersed throughout the area. At the area's western edge is the Los Angeles State Historic Park (LASHP); which will provide a catalyst for transforming development along its edge.

Any of the proposed restoration plans in combination with LASHP, Metro Link's Gold Line and its 1.5 mile proximity to the heart of downtown Los Angeles will bring a catalyst of change to this often overlooked area. Redevelopment within this area will certainly occur with the proposed restoration and recreation features of the plan.

Figure 2.5 Chinatown – Cornfields Opportunity Area

Redevelopment in the Chinatown-Cornfields area will require substantial rezoning of industrial property for mixed-uses, and the establishment of additional design guidelines through the River Improvement Overlay or a Specific Plan to fully garner the benefits of the restoration and recreation plan. The potential range in redevelopment by alternative is shown in Table 2-35. Ecosystem system restoration plans for 10-ART, 13-ACE, and 16-AND are essentially the same – modest restoration along the river's bank. Thus, redevelopment is estimated at the same level for these plans. For the 20-RIVER plan, restoration increases occur not only along the river's edge but also include the development of a marsh area in the northern area of the site. Redevelopment for the RIVER is estimated to be more extensive than the others for these reasons.

Table 2-35 Chinatown-Cornfields Redevelopment Construction Potential

Chinatown-Cornfields Potential Redevelopment Alternative 10: ART	
Redevelopment Use	**Square Feet (in thousands)**
Residential	281,250
Retail	44,250
Office	111,000
Manufacturing	44,100
Chinatown-Cornfields Potential Redevelopment Alternative 13: ACE	
Residential	281,250
Retail	44,250
Office	111,000
Manufacturing	44,100
Chinatown-Cornfields Potential Redevelopment Alternative 16A: AND	
Residential	281,250
Retail	44,250
Office	111,000
Manufacturing	44,100
Chinatown-Cornfields Potential Redevelopment Alternative 20A: RIVER	
Residential	1,125,000
Retail	177,000
Office	444,000
Manufacturing	44,100

Square footage Marshall & Swift construction estimates are $165/retail, $230/residential, $235/office, and $80/manufacturing. Potential redevelopment values by alternative are indicated in Table 2-36.

Table 2-36 Chinatown-Cornfields Redevelopment Construction Values

Chinatown-Cornfields Redevelopment Valuation Alternative 10: ART	
Redevelopment Use	**Value**
Residential	$64,688,000
Retail	$7,301,000
Office	$26,085,000
Manufacturing	$3,528,000
Total	$101,602,000
Chinatown-Cornfields Redevelopment Valuation Alternative 13: ACE	
Residential	$64,688,000
Retail	$7,301,000
Office	$26,085,000
Manufacturing	$3,528,000
Total	$101,602,000
Chinatown-Cornfields Redevelopment Valuation Alternative 16A: AND	
Residential	$64,688,000
Retail	$7,301,000
Office	$26,085,000
Manufacturing	$3,528,000
Total	$101,602,000
Chinatown-Cornfields Redevelopment Valuation Alternative 20A: RIVER	
Residential	$258,750,000
Retail	$29,205,000
Office	$104,340,000
Manufacturing	$3,528,000
Total	$395,823,000

RED impacts for Chinatown-Cornfields redevelopment by alternative as estimated by IMPLAN for the Los Angeles-Orange Counties area are presented in Table 2-37, which shows total cumulative employment impacts, direct, indirect and induced, over the 50-year redevelopment period.

Table 2-37 Chinatown-Cornfields Redevelopment Construction Cumulative Employment Impacts

Alternatives 10, 13, & 16A				
Industry	**Direct**	**Indirect**	**Induced**	**Total**
Total	675.7	205.4	345.0	1,226.1
Agriculture	0.0	0.1	0.2	0.3
Mining	0.0	1.2	0.2	1.5
Construction	675.7	2.1	2.7	680.5
Manufacturing	0.0	23.1	6.1	29.2
TIPU	0.0	12.7	10.1	22.8
Trade	0.0	63.3	72.8	136.1
Service	0.0	101.7	249.5	351.3
Government	0.0	1.2	3.3	4.4

Alternative 20A				
Industry	**Direct**	**Indirect**	**Induced**	**Total**
Total	2,615.0	807.0	1,338.5	4,760.4
Agriculture	0.0	0.5	0.8	1.3
Mining	0.0	4.8	0.9	5.7
Construction	2,615.0	8.0	10.7	2,633.7
Manufacturing	0.0	90.5	23.6	114.0
TIPU	0.0	50.2	39.3	89.5
Trade	0.0	252.0	282.4	534.4
Service	0.0	396.5	968.1	1,364.6
Government	0.0	4.5	12.7	17.2

The investment to total job ratio for ART, ACE, and AND is approximately $83,000-to-1 and $150,000-to-1 on a direct employment basis. The ratios for the RIVER plan are approximately the same. Annual employment impacts are shown in Table 2-38, which assumes equal development during each year.

Table 2-38 Chinatown-Cornfields Redevelopment Construction Average Annual Employment Impacts

Alternative	Direct	Indirect	Induced	Total
Alternatives 10, 13, & 16	13.5	4.1	6.9	24.5
Alternative 20	52.3	16.1	26.8	95.2

The overall industry and summary cumulative impacts for the Chinatown-Cornfields area, as estimated by IMPLAN are presented in Table 2-39.

Table 2-39 Chinatown-Cornfields Redevelopment Construction Cumulative Economic Impacts by Alternative

Overall Impact Summary – Alternatives 10, 13, & 16A				
Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**
Direct Effect	675.7	$50,265,000	$60,207,000	$101,602,000
Indirect Effect	205.4	$12,622,000	$19,046,000	$33,136,000
Induced Effect	345.0	$18,094,000	$31,879,000	$50,891,000
Total Effect	1,226.1	$80,981,000	$111,132,000	$185,629,000
Overall Impact Summary – Alternative 20A				
Direct Effect	2,615.0	$194,539,000	$233,920,000	$395,823,000
Indirect Effect	807.0	$49,439,000	$74,607,000	$129,749,000
Induced Effect	1,338.5	$70,197,000	$123,674,000	$197,434,000
Total Effect	4,760.4	$314,175,000	$432,201,000	$723,007,000

The impacts on an average annual basis are shown in Table 2-40.

Table 2-40 Chinatown-Cornfields Redevelopment Construction Average Annual Impacts by Alternative

Average Annual Impact Summary – Alternatives 10, 13, & 16A				
Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**
Direct Effect	13.5	$1,005,000	$1,204,000	$2,032,000
Indirect Effect	4.1	$252,000	$381,000	$663,000
Induced Effect	6.9	$362,000	$638,000	$1,018,000
Total Effect	24.5	$1,620,000	$2,223,000	$3,713,000
Average Annual Impact Summary – Alternative 20A				
Direct Effect	52.3	$3,891,000	$4,678,000	$7,916,000
Indirect Effect	16.1	$989,000	$1,492,000	$2,595,000
Induced Effect	26.8	$1,404,000	$2,473,000	$3,949,000
Total Effect	95.2	$6,284,000	$8,644,000	$14,460,000

2.8.5.1 Chinatown-Cornfields Redevelopment State and Local Tax Impacts

Redevelopment construction will generate state and local taxes. Over the entire redevelopment period, these taxes will amount to the following, according to the IMPLAN model, as shown in Table 2-41 and Table 2-42.

Table 2-41 Chinatown-Cornfields Redevelopment Construction Cumulative State & Local Taxes Impacts – Alternatives 10, 13, and 16A

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends					$16,000
Social Ins Tax- Employee Contribution	$75,000				
Social Ins Tax- Employer Contribution	$133,000				
Indirect Bus Tax: Sales Tax			$2,334,000		
Indirect Bus Tax: Property Tax			$2,469,000		
Indirect Bus Tax: Motor Vehicle Lic			$53,000		
Indirect Bus Tax: Severance Tax			$1,000		
Indirect Bus Tax: Other Taxes			$417,000		
Indirect Bus Tax: S/L NonTaxes			$203,000		
Corporate Profits Tax					$368,000
Personal Tax: Income Tax				$2,223,000	
Personal Tax: Non Taxes (Fines- Fees				$540,000	
Personal Tax: Motor Vehicle License				$99,000	
Personal Tax: Property Taxes				$41,000	
Personal Tax: Other Tax (Fish/Hunt)				$22,000	
Total State and Local Tax	$209,000		$5,476,000	$2,925,000	$383,000

Table 2-42 Chinatown-Cornfields Redevelopment Construction Cumulative State & Local Taxes Impacts - Alternative 20A

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations
Dividends					$61,000
Social Ins Tax- Employee Contribution	$291,000				
Social Ins Tax- Employer Contribution	$516,000				
Indirect Bus Tax: Sales Tax			$9,139,000		
Indirect Bus Tax: Property Tax			$9,666,000		
Indirect Bus Tax: Motor Vehicle Lic			$209,000		
Indirect Bus Tax: Severance Tax			$5,000		
Indirect Bus Tax: Other Taxes			$1,633,000		
Indirect Bus Tax: S/L NonTaxes			$794,000		
Corporate Profits Tax					$1,440,000
Personal Tax: Income Tax				$8,625,000	
Personal Tax: NonTaxes (Fines- Fees				$2,096,000	
Personal Tax: Motor Vehicle License				$384,000	
Personal Tax: Property Taxes				$158,000	
Personal Tax: Other Tax (Fish/Hunt)				$87,000	
Total State and Local Tax	$807,000		$21,445,000	$11,349,000	$1,501,000

2.8.6 Chinatown–Cornfields Opportunity Area – Long-Term Redevelopment Impacts

2.8.6.1 Long-Term Employment, Wages, and Taxes – Chinatown-Cornfields Opportunity Area

Each of the alternatives is anticipated to create a mixture of floor space. Light manufacturing is assumed to require 1,000 sq. ft. per employee with a yearly wage of $55,484, as previous stated. The U.S. Energy Information Agency (EIA) reports an average of 766 square feet per worker for commercial businesses.[16] BLS reports the average weekly wage rate for retail in Los Angeles County at $826 or $42,952 per year.[17] The vacancy rate among retail establishments is assumed

[16] U.S. Energy Information Agency, Department of Energy. 2001. http://www.eia.gov/emeu/consumptionbriefs/cbecs/pbawebsite/retailserv/retserv_howmanyempl.htm

[17] Bureau of Labor Statistics. 2013. County Employment and Wages – Second Quarter 2012. January 8, 2013. USDL-13-0013.

to be 5 percent.[18] EIA reports office workers have an average of 387 square feet of space. The average weekly wage for office workers is $1,222 ($63,544 annually) according to BLS. Vacancy is estimated at 15 percent within the office sector.[19, 20] The overall average weekly wage rate in Los Angeles County is $1,006 or $52,312 annually as reported by BLS. The jobs-to-housing ratio in the City of Los Angeles is 1.33.[21] Jobs-to-housing ratio is used as an indicator of how jobs-rich or jobs-poor a community is. Generally, a ratio of less than 1-to-1 indicates a jobs-poor area, and a ratio of more than 1-to-1 indicates a jobs-rich area. It is assumed that the residential redevelopment in the Chinatown-Cornfields opportunity area will maintain this jobs-to-housing ratio. The Los Angeles Housing Department reports a vacancy rate of approximately 4 percent for multi-family individually metered housing units based on data from the Los Angeles Department of Water and Power.[22]

Employment and wage results are shown in the following four tables.

Table 2-43 Chinatown-Cornfields Cumulative Long-Term Employment by Sector

Alternative	Residential	Retail	Office	Manufacturing	Total
Alternatives 10, 13, & 16	287.3	54.9	243.8	41.9	627.9
Alternative 20	1149.1	219.5	975.2	41.9	2385.7

Table 2-44 Chinatown-Cornfields Average Annual Long-Term Employment by Sector

Alternative	Residential	Retail	Office	Manufacturing	Total
Alternatives 10, 13, & 16	146.5	28.0	124.3	21.4	320.2
Alternative 20	586.1	112.0	497.3	21.4	1216.7

Table 2-45 Chinatown-Cornfields Cumulative Long-Term Wages by Sector

Alternative	Residential	Retail	Office	Manufacturing	Total
Alternatives 10, 13, & 16	$383,219,000	$60,108,000	$395,044,000	$59,275,000	$897,646,000
Alternative 20	$1,532,876,000	$240,432,000	$1,580,177,000	$59,275,000	$3,412,759,000

Table 2-46 Chinatown-Cornfields Average Annual Wages by Sector

Alternative	Residential	Retail	Office	Manufacturing	Total
Alternatives 10, 13, & 16	$7,664,000	$1,202,000	$7,901,000	$1,185,000	$17,953,000
Alternative 20	$30,658,000	$4,809,000	$31,604,000	$1,185,000	$68,255,000

[18] Colliers International. 2012. Central Los Angeles Market Report: Retail. 3rd Quarter

[19] Daum Commercial Real Estate Services. 2012. Office Los Angeles County. www.daumcommercial.com. Q3.

[20] Los Angeles Business Journal. 2012. *Special Report Real Estate Quarterly*. April 16, 2012.

[21] City of Los Angeles, City Planning Department. 2011." Jordan Downs Specific Plan Draft EIR." September 2011.

[22] City of Los Angeles, Los Angeles Housing Department. 2012. "City of Los Angeles Vacancy Rates Estimate. "June 11 2012

The net present values of the wage streams over the 50-year redevelopment period are shown in Table 2-47.

Table 2-47 Chinatown-Cornfields NPV of Long-Term Wages by Sector

Alternative	Residential	Retail	Office	Manufacturing	Total
Alternatives 10, 13, & 16	$122,954,000	$19,285,000	$126,748,000	$19,018,000	$288,006,000
Alternative 20	$491,817,000	$77,142,000	$506,994,000	$19,018,000	$1,094,971,000

The sales tax rate for Los Angeles County and the City of Los Angeles is 9 percent. Of this tax rate, 6.5 percent goes to the State and the remaining 2.5 percent is returned to the county and city. Sales taxes generated from employment, assuming 24 percent of wages are taxable expenditures, are shown in Table 2-48.

Table 2-48 Chinatown-Cornfields Long-Term Sales Tax Revenues

	Cumulative			
Alternative	**Sales Tax: State**	**Sales Tax: Local**	**Average Annual: Local**	**NPV: Local**
Alternatives 10, 13, & 16	$14,003,000	$5,386,000	$108,000	$1,728,000
Alternative 20	$53,239,000	$20,477,000	$410,000	$6,570,000

2.9 Regional Economic Development and Economic Impacts Summary

Table 2-49 presents the cumulative regional economic impacts from construction through the study's period of analysis for the alternatives. These results were developed by the study team as reasonable factors, based upon available information, for developing a general estimate of potential redevelopment RED benefits associated with project alternatives.

Table 2-49 Cumulative RED & Economic Impacts of Ecosystem Restoration

Ecosystem Construction Cumulative Impacts				
	10 ART	**13 ACE**	**16A AND**	**20A RIVER**
Jobs	913	1,986	6,491	9,001
Labor Income	$52,560,000	$114,350,000	$373,823,000	$518,341,000
Sales	$125,936,000	$273,986,000	$895,690,000	$1,241,959,000
GRP	$73,445,000	$159,785,000	$522,357,000	$724,297,000
Recreation Construction Cumulative Impacts				
Jobs	74	74	74	74
Labor Income	$4,998,000	$4,998,000	$4,998,000	$4,998,000
Value	$12,958,000	$12,958,000	$12,958,000	$12,958,000
Output	$7,265,000	$7,265,000	$7,265,000	$7,265,000
Redevelopment Construction Cumulative Impacts				
Jobs	1,226	1,281	1,281	5,087
Labor Income	$80,981,000	$84,665,000	$84,665,000	$336,278,000
Value	$111,132,000	$115,791,000	$115,791,000	$460,153,000
Output	$185,630,000	$193,002,000	$193,002,000	$767,247,000
Redevelopment Long-term Economic Activity Cumulative Impacts				
Jobs	628	675	675	2,671
Labor Income	$897,646,000	$964,851,000	$964,851,000	$3,815,989,000
Taxes - Local	$5,386,000	$5,789,000	$5,789,000	$22,896,000

The alternatives are estimated to create 2,200 to 14,100 construction related jobs over the period of analysis. Employment is anticipated to generate labor income ranging from $138 million to $860 million. Regional economic activity from construction is expected to increase by $260 million to nearly $1.5 billion with ecosystem restoration, recreation and redevelopment construction.

The long-term economic impacts of redevelopment are estimated to eventually create permanent employment of 620 to 2,700 jobs. This employment will have a greater impact to the region as these employment opportunities exist throughout the period of analysis. Total labor income from these employment opportunities is estimated to range from nearly $900 million to just under $4 billion depending upon alternative.

The cumulative effects of the construction/redevelopment components over the period of analysis will create between 2,800 to 16,800 jobs with incomes from over $1 billion to nearly $5 billion as shown in Table 2-50.

Table 2-50 Employment and Income Cumulative Impacts

	10 ART	13 ACE	16A AND	20A RIVER
Jobs	2,841	4,016	8,521	16,833
Labor Income	$1,036,185,000	$1,168,864,000	$1,428,337,000	$4,675,606,000

A useful interpretation of the economic impacts is average annual impacts, as construction and redevelopment occur over time. In addition to average annual, net present value is also a method to view impacts that occur over time in current dollars. Ecosystem restoration construction takes place in between 10 and 15 years, whereas the redevelopment components span the 50 years of the analysis. With these time dimensions being so different, combining average annual figures for ecosystem restoration and recreation construction with the redevelopment categories would be misleading. For this reason, the following three tables present average annual impacts separately for ecosystem restoration construction, recreation construction, and redevelopment activities.

Table 2-51 Ecosystem Restoration Construction Impacts – Average Annual

Ecosystem Construction Average Annual Impacts				
	10 ART	13 ACE	16A AND	20A RIVER
Sales	$12,593,600	$27,398,600	$59,712,700	$82,797,300
Jobs	91	199	433	600
Labor Income	$11,435,000	$11,435,000	$24,921,500	$34,556,100
GRP	$7,344,500	$15,978,500	$34,823,800	$48,286,500
Construction Duration	10 years	10 years	15 years	15 years

Table 2-52 Recreation Construction Impacts – Average Annual

Recreation Construction Average Annual Impacts				
	10 ART	13 ACE	16A AND	20A RIVER
Sales	$12,958,000	$12,958,000	$12,958,000	$12,958,000
Jobs	74	74	74	74
Labor Income	$4,998,000	$4,998,000	$4,998,000	$4,998,000
GRP	$7,265,000	$7,265,000	$7,265,000	$7,265,000
Construction Duration	1 year	1 year	1 year	1 year

Table 2-53 Redevelopment Economic Impacts - Average Annual

Redevelopment Construction - Average Annual Impacts				
	10 ART	13 ACE	16A AND	20A RIVER
Jobs	25	26	26	102
Labor Income	$1,620,000	1,693,000	$1,693,000	$6,726,000
Sales	$2,223,000	2,316,000	$2,316,000	$9,203,000
GRP	$3,713,000	3,860,000	$3,860,000	$15,345,000
NPV Income	$36,335,000	$37,988,000	$37,988,000	$150,885,000
Redevelopment Long-term Economic Activity - Average Annual Impacts				
Jobs	320	344	344	1,362
Labor Income	$17,953,000	$19,297,000	$19,297,000	$76,320,000
Taxes	$108,000	$116,000	$116,000	$458,000
NPV Income	$288,006,000	$309,568,000	$309,568,000	$1,224,346,000
Combined Redevelopment Average Annual Impacts				
Jobs	345	370	370	1,464
Labor Income	$19,573,000	$20,990,000	$20,990,000	$83,046,000
NPV Income	$324,341,000	$347,556,000	$347,556,000	$1,375,231,000

3. UPDATED RESULTS FOR THE NATIONAL ECOSYSTEM RESTORATION (NER) AND RECOMMENDED PLAN (LPP)

The analysis documented in previous sections was completed during the alternatives evaluation and comparison phase, based upon planning level alternatives formulation and cost estimates. For consistency with the final NER and recommended plan costs (see Economics Appendix Section 6), the RECONS model was run again to update the estimated RED impacts of construction spending.

Note that redevelopment impacts modeled in IMPLAN were not updated. Because redevelopment effects are a function of the restoration plan components rather than their costs, no substantial changes in the redevelopment effects documented in Section 2.8 are expected. Additionally, the updated NER and Recommended plans aren't expected to result in substantial differences OSE effects compared to those already documented in Section 4.

Updated effects of construction spending are summarized via four tables, as bulleted below:

- Table 3-1: Overall Impacts for NER plan Ecosystem Restoration Construction Spending
- Table 3-2: Overall Impacts for the NER-plan-compatible Recreation Plan
- Table 3-3: Overall Impacts for the Recommended Plan Ecosystem Restoration Construction Spending
- Table 3-4: Overall Impacts for the Recommended-plan-compatible Recreation Plan

These results represent total effect over the duration of construction, not average annual effect. Results are presented in total for quicker comparison to the results shown in Section 2.

3.1 NER Plan

Ecosystem Restoration Construction

The USACE is planning on expending $336,339,000 on the project. Of this total project expenditure $312,413,859 will be captured within the regional impact area. The rest will be leaked out to the state or the nation.

Table 3-1 NER Plan - Ecosystem Construction RED Impacts

Impacts	Impact Areas	Regional	State	National
Total Spending		$336,339,000	$336,339,000	$336,339,000
Direct Impact				
	Output	$312,413,859	$333,770,155	$334,993,047
	Job	2,769.17	3,271.69	3,305.29
	Labor Income	$151,798,611	$168,680,986	$169,647,695
	GRP	$177,116,961	$193,661,261	$194,608,611
Total Impact				
	Output	$659,750,801	$737,860,216	$966,318,565
	Job	4,781.31	5,609.80	6,964.07
	Labor Income	$275,351,761	$307,327,529	$373,034,022
	GRP	$384,759,602	$429,748,303	$540,718,316

Recreation Construction

The USACE is planning on expending $10,377,000 on the project. Of this total project expenditure $10,377,000 will be captured within the regional impact area. The rest will be leaked out to the state or the nation.

Table 3-2 NER Plan - Recreation Construction RED Impacts

Impacts	Impact Areas	Regional	State	National
Total Spending		$10,377,000	$10,377,000	$10,377,000
Direct Impact				
	Output	$10,377,000	$10,377,000	$10,377,000
	Job	58.51	58.51	58.51
	Labor Income	$4,288,202	$4,288,202	$4,288,202
	GRP	$5,368,902	$5,368,902	$5,368,902
Total Impact				
	Output	$21,920,484	$23,023,824	$30,105,589
	Job	125.22	131.57	172.60
	Labor Income	$8,455,129	$8,694,361	$10,741,646
	GRP	$12,289,089	$12,765,131	$16,226,295

3.2 Recommended Plan

Ecosystem Restoration Construction

The USACE is planning on expending $804,017,000 on the project. Of this total project expenditure $746,824,048 will be captured within the regional impact area. The rest will be leaked out to the state or the nation.

Table 3-3 Locally Preferred Plan - Ecosystem Construction RED Impacts

Impact Areas / Impacts		Regional	State	National
Total Spending		$804,017,000	$804,017,000	$804,017,000
Direct Impact				
	Output	$746,824,048	$797,876,186	$800,799,505
	Job	6,619.69	7,820.95	7,901.29
	Labor Income	$362,873,957	$403,231,205	$405,542,119
	GRP	$423,397,369	$462,946,449	$465,211,087
Total Impact				
	Output	$1,577,131,584	$1,763,851,820	$2,309,980,566
	Job	11,429.69	13,410.20	16,647.58
	Labor Income	$658,227,256	$734,665,198	$891,736,300
	GRP	$919,766,251	$1,027,311,555	$1,292,584,917

Recreation Construction

The USACE is planning on expending $18,014,000 on the project. Of this total project expenditure $18,014,000 will be captured within the regional impact area. The rest will be leaked out to the state or the nation.

Table 3-4 Locally Preferred Plan - Recreation Construction RED Impacts

Impact Areas / Impacts		Regional	State	National
Total Spending		$18,014,000	$18,014,000	$18,014,000
Direct Impact				
	Output	$18,014,000	$18,014,000	$18,014,000
	Job	101.57	101.57	101.57
	Labor Income	$7,444,124	$7,444,124	$7,444,124
	GRP	$9,320,169	$9,320,169	$9,320,169
Total Impact				
	Output	$38,052,963	$39,968,311	$52,261,934
	Job	217.37	228.39	299.62
	Labor Income	$14,677,719	$15,093,015	$18,647,009
	GRP	$21,333,299	$22,159,686	$28,168,111

4. OTHER SOCIAL EFFECTS

Since the adoption of the P&G by the Water Resources Council in 1983 and their subsequent incorporation into the USACE water resources policies, there has been a tendency to focus attention on NED and NER benefit/cost procedures. In the last decade, more focus has also been given to the roles and importance of OSE factors in water resources planning. Newer guidance—principally, EC 1105-2-409, “Planning in a Collaborative Environment” from 2005—places much greater emphasis on the importance of including a broad range of considerations in planning that are to be used to develop appropriate water resources solutions. These include social factors addressed in the OSE account, and addressed herein.

The OSE account describes the potential effects of project alternatives in areas that are not dealt with explicitly in the NER and RED accounts. ER 1105-2-409 states, “[a]ny alternative plan may be selected and recommended for implementation if it has, on balance, net beneficial effects after considering all plan effects, beneficial and adverse, in the four Principles and Guidelines evaluation accounts,” of which the OSE is one. The Principles and Guidelines state that the OSE, when included in U.S. Army Corps of Engineers documents, should “display plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others.”

Social effects in a general sense refer to a concern for how the constituents of life that influence personal and group definitions of satisfaction, well-being, and happiness are affected by some condition or proposed intervention. Well-being is an ensemble concept composed of multiple dimensions. While economic factors are very important in characterizing well-being there are many more factors which come into play. In particular the distribution of resources; the character and richness of personal and community associations; the social vulnerability and resilience of individuals, groups, and communities; and the ability to participate in systems of governance are all elements that help define well-being.

This OSE analysis describes the potential social effects of the alternatives under consideration. The OSE account explores the following categories of effects from the implementation of the alternatives considered. In most cases it is not possible to significantly differentiate between the social effects of the restoration alternatives because the scale of the categories on an overall community level exceeds the scale of differences among the alternatives.

- Displacement/Impacts to Population
- Public Health and Safety
- Displacement/Impacts to Minorities and Special Interest Groups
- Displacement/Impacts to Businesses
- Displacement/Impacts to Agriculture
- Displacement/Impacts to Recreational Areas
- Community Growth
- Project Impacts and Connectivity of the Community
- Community Well-being

There is significant interest and activity along the LA River in the form of numerous small efforts to create pocket parks, improve habitat, increase recreation trails, and filter stormwater runoff. Green spaces facilitate hydrological processes in areas where urban development interferes with the movement, distribution, and quality of water. They also provide social, health, environmental, and economic benefits, some of which include the promotion of physical activity, filtration of water pollution, increased control of stormwater runoff and flooding, reduced loading on stormwater systems, improved groundwater recharge, provision of wildlife habitat, and reduced need for pollution prevention measures.[23] Similarly, construction of the ecosystem restoration project under consideration has strong potential to deliver significant and meaningful environmental, economic, and social benefits to the region. The feasibility study includes alternative plans that incorporate a suite of habitat types along and within the Los Angeles River, such as wetlands, riparian areas, pool/riffle complexes, and riparian buffers, as well as appropriate recreation features (e.g., trails, signage).

Indeed, a significant social effect documented herein is the health effect of nearby habitat areas and the associated recreational features of ecosystem restoration projects. And while the primary purpose of an ecosystem restoration project along the Los Angeles River is the creation of habitat value, USACE promotes multipurpose project values in that "collaboration is critically important for achieving the missions of the Corps in the 21st century. Solutions to today's problems require reaching out to those with different authorities, perspectives, and resources to solve the various dimensions of these problems."[24] This is true even though funding of USACE projects along typical missions such as ecosystem restoration "makes it harder to work with small communities that typically value recreation."[25] Further, parks and recreation are critical to any multipurpose project even from an economic perspective, as declared by the Mayor of Indianapolis: "Parks…have a tremendous impact on our cities, from increased tourism to enhanced retail to higher property values to environmental mitigation."[26]

In a recent Environmental Science and Technology article the authors report that there is evidence that urban residents living in greener environments may be significantly healthier than those living in environments with less green space, and the presence of water may create even greater health improvements.[27] Most notably for low-income and minority residents, inequitable urban development and the privatization of natural amenities has contributed to environmental injustices in the distribution of green space and water features. Collectively, this can cause disparities in health-related behaviors and obesity.[28] Given the health benefits related to the contact with or use of green space, disadvantaged populations with green space access may obtain some protection from the effects of poverty-related stress, possibly decreasing their

[23] Heather E. Wright Wendel, Joni A. Downs, and James R. Mihelcic. 2011. "Assessing equitable access to urban green space: the role of engineered water infrastructure". *Environ. Sci. Technol.* 45:6728.

[24] The State of Collaboration in the Corps: A Field Perspective. 2011. From "The Collaborative Capacity Assessment Initiative." Conflict Resolution & Public Participation Center, USACE. 2011-CPC-R-04, May 2011. http://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/2011-CPC-R-04.pdf

[25] Ibid.

[26] Bart Peterson, Mayor of Indianapolis. 2003. In the introduction to "The Excellent City Park System," written by Peter Harnik and published by The Trust for Public Land.

[27] Heather E. Wright Wendel, Joni A. Downs, and James R. Mihelcic. 2011. "Assessing equitable access to urban green space: the role of engineered water infrastructure." *Environ. Sci. Technol.* 45:6728.

[28] Powell, L. M.; Slater, S.; Chaloupka, F. J. 2004. "The relationship between community physical activity settings and race, ethnicity and socioeconomic status." *Evidence-Based Prev. Med*. 1(2), 135–144.

mortality rates relative to similar populations that lack access.[29] For example, people exercising in all types of natural environments experienced enhanced self-esteem and mood, with the presence of water creating the greatest improvements.[30]

This OSE assessment covers not only the standard categories previously mentioned, but it also covers less common areas of social effects as highlighted in the previous paragraph. The primary region of influence (ROI) for the analysis of social effects is the previously defined study area– the approximately 1-mile wide corridor along the River. This ROI area definition extends beyond the potential construction impact area and was chosen based on the assumption that direct social effects associated with the project would be mainly confined to this area.

4.1 Displacement/Impacts to Population

The project location is adjacent to residential, commercial, and industrial land uses that are found along the Los Angeles River channel. The direct effects of construction of the proposed Alternatives 10,13,16, and 20 are not likely to result in any displacement or impacts to population beyond the health and safety concerns outlined below. It is generally assumed that the workers needed for construction will come from the local labor pool. However, labor demands are not anticipated to affect the labor pool as their demands are relatively minor in relation to the labor pool. Thus, construction-related employment is not likely to increase the population to any significant degree within the ROI.

4.2 Public Health and Safety

This section presents a great deal of research literature as evidence of the health costs of obesity and the benefits of exercise at the national, state, and local level. The abundance of information herein is a fraction of the literature that supports the high economic and social health costs of a sedentary lifestyle, and *serves to underline the importance of this facet of OSE benefits related to the project*. Indeed, the challenge of promoting a healthy lifestyle founded on outdoor recreation and the value of natural resources is partly why the America's Great Outdoors (AGO) initiative was begun under President Obama's administration in 2010.[31] A report introducing the AGO initiative states that "[t]he outdoors has increasingly lost its relevance in the lives of our children"…and that "[s]tudies show that access to the outdoors can help reverse the obesity epidemic that has tripled among our children in the last generation. They show that time spent in nature can reduce stress and anxiety, promote learning and personal growth, and foster mental and physical health."[32]

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[29] Mitchell, R.; Popham, F. "Effect of exposure to natural environment on health inequalities: an observational population study." *Lancet*. 2008, 372 (9650), 1655–1660.

[30] Barton, J.; Pretty, J. 2010. "What is the best dose of nature and green exercise for improving mental health? A multi-study analysis." *Environ. Sci. Technol*. 44 (10), 3947–3955.

[31] US Dept. of the Interior, 2011. "America's Great Outdoors: A Promise to Future Generations." A report in collaboration with the USEPA, USDA, and the CEQ. February 2011.

[32] Ibid.

At the current level of analysis, it is impractical to be quantitative about the differences in beneficial effects among the final array primarily because the effects would not greatly vary among the alternatives.

4.2.1 Health Costs

Excessive weight and obesity and their associated health problems have a significant economic impact on the U.S. health care system. Medical costs associated with excessive weight and obesity involve both direct and indirect costs. Direct medical costs may include preventive, diagnostic, and treatment services related to obesity. Indirect costs relate to morbidity and mortality costs. Morbidity costs are defined as the value of income lost from decreased productivity, restricted activity, absenteeism, and bed days. Mortality costs are the value of future income lost by premature death. The medical care costs of obesity in the United States are staggering. In 2008 dollars, these costs totaled about $147 billion.[33] Researchers from the Mayo Clinic, published in the *Journal of Occupational and Environmental Medicine*,[34] found that people who are obese have an extra $1,850 in health costs a year, on average, compared with normal weight people, and for people who are morbidly obese, the costs are even higher: up to $5,500 a year.

The consequences of the country's obesity epidemic expand beyond just personal health. Overweight or obese full-time workers with other chronic health conditions miss 450 million more days of work each year than would healthy workers, costing businesses $153 billion annually in lost productivity, according to a 2011 Gallup poll.[35]

The California Center for Public Health Advocacy (CCPHA) found the total annual estimated cost to California for overweight, obesity and physical inactivity was $41.2 billion – $21.0 billion for overweight and obesity, and $20.2 billion for physical inactivity. Health care costs totaled $20.7 billion and lost productivity costs reached $20.4 billion. Health care costs associated with overweight and obesity were $12.8 billion while health care costs associated with physical inactivity totaled $7.9 billion. Finally, lost productivity costs associated with overweight and obesity were $8.2 billion, and lost productivity costs associated with physical inactivity were $12.3 billion.[36]

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[33] Finkelstein, E., Trogdon, J., Cohen, J. & Dietz, W. 2009. "Annual medical spending attributable to obesity: payer-and service-specific estimates." *Health Affairs* 28(5).

[34] Moriarty, J., Branda M., Olsen, K., Shah, N., Borah, B., Wagie, A., Egginton, J. & Naessens, J. 2012. "The effects of incremental costs of smoking and obesity on health care costs among adults: A 7-year longitudinal study." *Journal of Occupational and Environmental Medicine* Mar; 54(3).

[35] Witters, D. & Agrawal, S. 2011. "Unhealthy U.S. workers' absenteeism costs $153 billion." Internet website: http://www.gallup.com/poll/150026/Unhealthy-Workers-Absenteeism-Costs-153-Billion.aspx.

[36] California Center for Public Health Advocacy. 2006. *"*The Economic Costs of Overweight, Obesity and Physical Inactivity Among California Adults – 2006.*"* Internet website: http://www.publichealthadvocacy.org/costofobesity.html

4.2.2 Physical Activity and Obesity

Physical activity, essential to overall health, can help control weight, reduce the risk of heart disease and some cancers, strengthen bones and muscles, and improve mental health.[37] The American Planning Association reports that proximity to public parks and tree-lined streets appears to have the greatest impact on the length of the lives of study participants, even when taking into account factors known to affect longevity, such as gender, marital status, income and age.[38] The Centers for Disease Control and Prevention's goal of increasing physical activity among all Americans is supported by key strategies such as creating or enhancing access to places for physical activity, enhancing physical education and activity in schools and physical activity in child care settings, and supporting urban design, land use, and transportation policies.[39,40] The proposed alternatives' features fit well within the context of these strategies since all alternatives provide trails, access points, bridges, parking facilities, and restrooms located at strategic locations. All of these serve to provide easier access to recreation along the River as well as to existing, adjacent parks and facilities, thereby encouraging recreation and exercise.

4.2.2.1 National Statistics

Nationwide, more than 35 percent of U.S. men and women were obese in 2009–2010. There was no significant difference in prevalence between men and women at any age. Overall, adults aged 60 and over were more likely to be obese than younger adults. Among men there was no significant difference in obesity prevalence by age. Among women, however, 42.3 percent of those aged 60 and over were obese compared with 31.9 percent of women aged 20–39 (Figure 4.1).[41] The prevalence of obesity was higher among adolescents than among preschool-aged children (Figure 4.2). The prevalence of obesity was higher among boys than girls (18.6 percent of boys and 15.0 percent of girls were obese).

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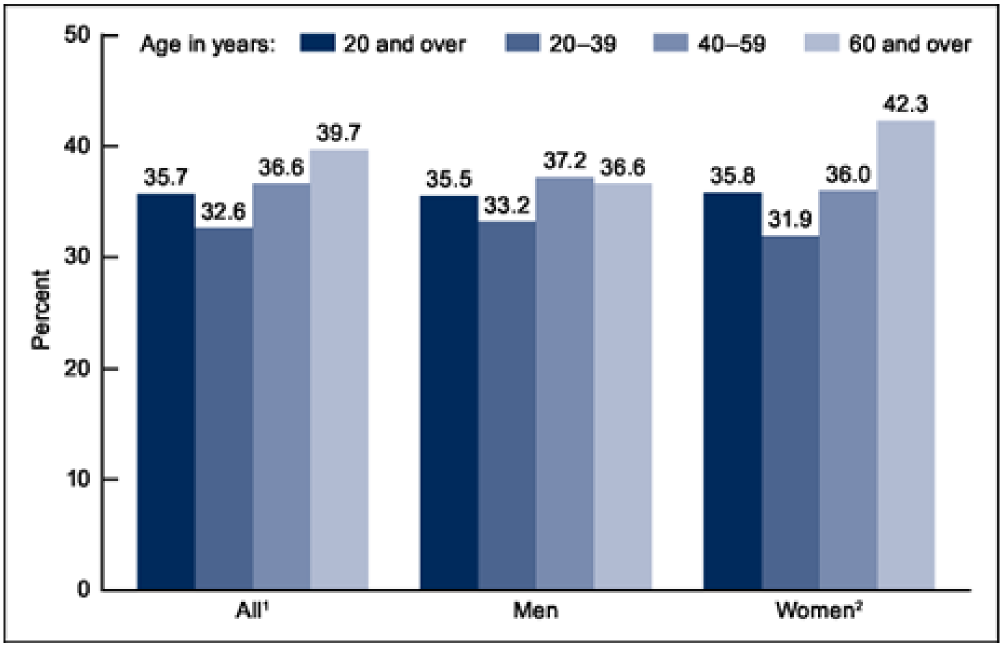
[37] U.S. Department of Health and Human Services. 2008. "Physical activity guidelines for Americans." Hyattsville, MD. U.S. Department of Health and Human Services.

[38] American Planning Association, 2003. "How cities use parks to improve public health, help children learn, create safer neighborhoods." *City Parks Forum Briefing Papers.*

[39] Resources for State and Community Programs. 2010. "CDC's guide to strategies for increasing physical activity in the community." (CD-ROM). Centers for Disease Control and Prevention.

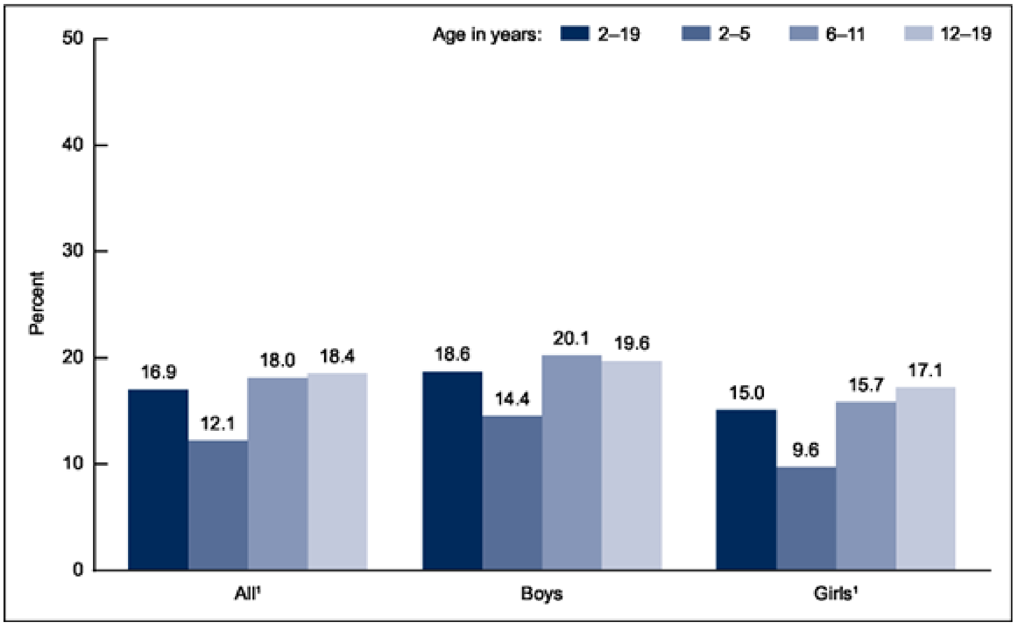
[40] Kahn, E., Ramsey, L., Brownson, R., et al. 2002. "The effectiveness of interventions to increase physical activity: A systematic review." *Am J Prev Med*. 22, (4 suppl).

[41] U.S. Department of Health and Human Services. 2012. "Prevalence of obesity in the United States, 2009-2010." NCHS, Data Brief No. 82. January, 2012.



[1] Significant increasing linear trend by age ($p < 0.01$).
[2] Significant increasing linear trend by age ($p < 0.001$).
NOTE: Estimates were age adjusted by the direct method to the 2000 U.S. Census population using the age groups 20–39, 40–59, and 60 and over.
Source: CDC/NCHS, National Health and Nutrition Examination Survey, 2009–2010

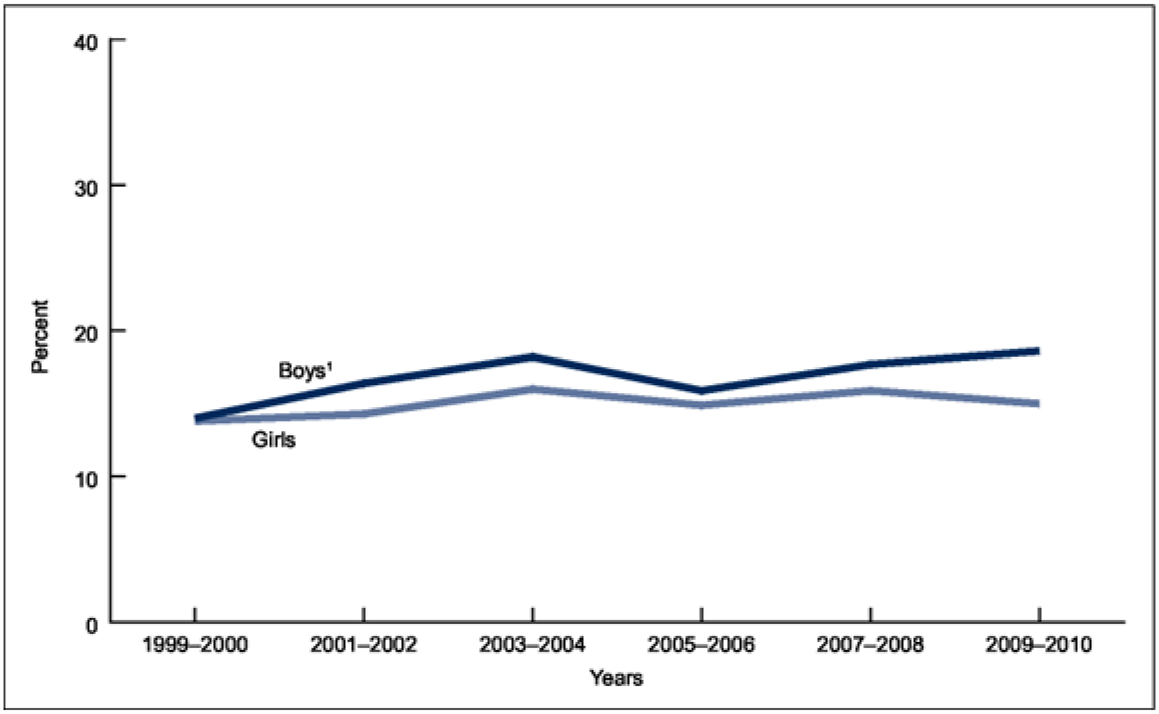
Figure 4.1 Prevalence of Obesity among Adults Aged 20 and Over, by Sex and Age: United States, 2009–2010



[1] Significant increasing linear trend by age ($p < 0.005$).
Source: CDC/NCHS, National Health and Nutrition Examination Survey, 2009–2010.

Figure 4.2 Prevalence of Obesity among Children and Adolescents Aged 2–19, by Sex and Age: United States, 2009–2010

Obesity has been on the rise: In 1999–2000, 27.5 percent of men were obese, and by 2009–2010 the prevalence had increased to 35.5 percent. Among women, 33.4 percent were obese in 1999–2000 with a small change in 2009–2010 (35.8 percent). The prevalence of obesity among boys increased from 14.0 percent in 1999–2000 to 18.6 percent in 2009–2010. There was a small change among girls: the prevalence was 13.8 percent in 1999–2000 and 15.0 percent in 2009–2010 (Figure 4.3).



[1] Significant increasing linear trend 1999–2000 to 2009–2010 ($p < 0.05$).
Source: CDC/NCHS, National Health and Nutrition Examination Survey, 2009–2010.

Figure 4.3 Trends in the Prevalence of Obesity among Children and Adolescents Aged 2–19, by Sex: United States, 1999–2010

The prevalence of these and similar statistics exhibit the growing problem of obesity, nationwide, for which the proposed project features offer beneficial effects regardless of their specific contributory magnitude.

4.2.2.2 California Statistics

In California, despite these now-well-known benefits of physical activity, only 50 percent of California adults engage in the recommended levels of physical activity, and 23.2 percent engage in no leisure-time physical activity, as shown in Table 4-1, according to the Centers for Disease Control and Prevention.

Table 4-1 California: Summary of Physical Activity

	Recommended	Insufficient	Inactive	No-Leisure Time Physical Activity
California	50.0%	37.6%	12.5%	23.2%

Physical activity rates for adults in California by age and gender are shown in Table 4-2.

Table 4-2 California: Recommended Physical Activity - 2007

	18–24	25–34	35–44	45–64	65+
Recommended	64.4%	52.1%	48.7%	47.1%	43.5%
Insufficient	29.8%	37.5%	40.6%	39.5%	36.0%
Inactive	N/A	10.4%	10.7%	13.4%	20.5%
No Leisure-Time Physical Activity*	17.6%	25.2%	25.4%	22.4%	23.9%

	Female	Male
Recommended	48.9%	51.1%
Insufficient	38.6%	36.4%
Inactive	12.5%	12.5%
No Leisure-Time Physical Activity*	24.6%	21.7%

* "Recommended," "Insufficient," and "Inactive" data comprise one measure, and responses should sum to ~100%. "No Leisure-Time Physical Activity" is a separate question, and should not be included with calculations for the recommended, insufficient, or inactive.

Recommended physical activity (meeting the "Healthy People 2010 Objectives") is defined as reported moderate-intensity activities in a usual week (i.e., brisk walking, bicycling, vacuuming, gardening, or anything else that causes small increases in breathing or heart rate) for at least 30 minutes per day, at least 5 days per week; or vigorous-intensity activities in a usual week (i.e., running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate) for at least 20 minutes per day, at least 3 days per week or both. This can be accomplished through lifestyle activities (i.e., household, transportation, or leisure-time activities).

Insufficient physical activity is defined as doing more than 10 minutes total per week of moderate or vigorous-intensity lifestyle activities (i.e., household, transportation, or leisure-time activity), but less than the recommended level of activity.

Inactivity is defined as less than 10 minutes total per week of moderate or vigorous-intensity lifestyle activities (i.e., household, transportation, or leisure-time activity).

No leisure-time physical activity is defined as no reported leisure-time physical activities (i.e., any physical activities or exercises such as running, calisthenics, golf, gardening, or walking) the previous month.

Source: As found in California State Parks. 2005. "The Health and Social Benefits of Recreation." California State Parks. Planning Division. Values updated from the CDC's Behavioral Risk Factor Surveillance System data site: http://www.cdc.gov/brfss/ as accessed in May 2012.

Obesity continues to increase in the state, with a slight dip between 2009 and 2010, as shown in Figure 4.4. Although overall obesity is "down" to roughly 25 percent in 2010 for all Californians, the CDC reports an obesity rate of 30.5 percent for youths between the ages of 10 - 17 in 2007—a rate 7 percent higher than for all Californians.

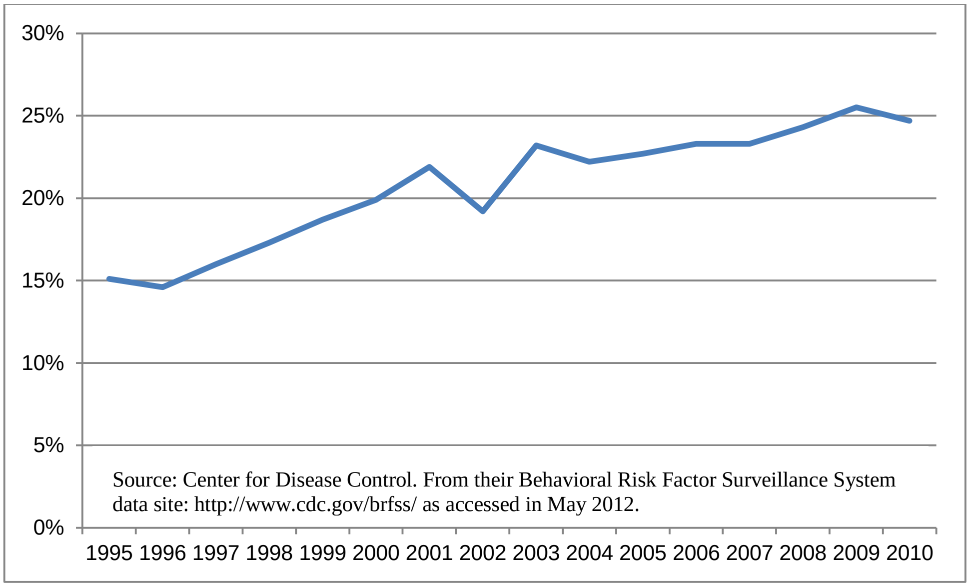


Figure 4.4 California's Overweight and Obesity Annual Rates

More troubling is a recent 2011 report by the UCLA Center for Health Policy Research and California Center for Public Health Advocacy–"*A Patchwork of Progress: Changes in Overweight and Obesity Among California 5th-, 7th-, and 9-th Graders, 2005-2010"*– which indicates 38 percent of 5th, 7th, and 9th graders are overweight or obese. From this report, childhood obesity by ethnicity/race is shown in Figure 4.5 Childhood Obesity.

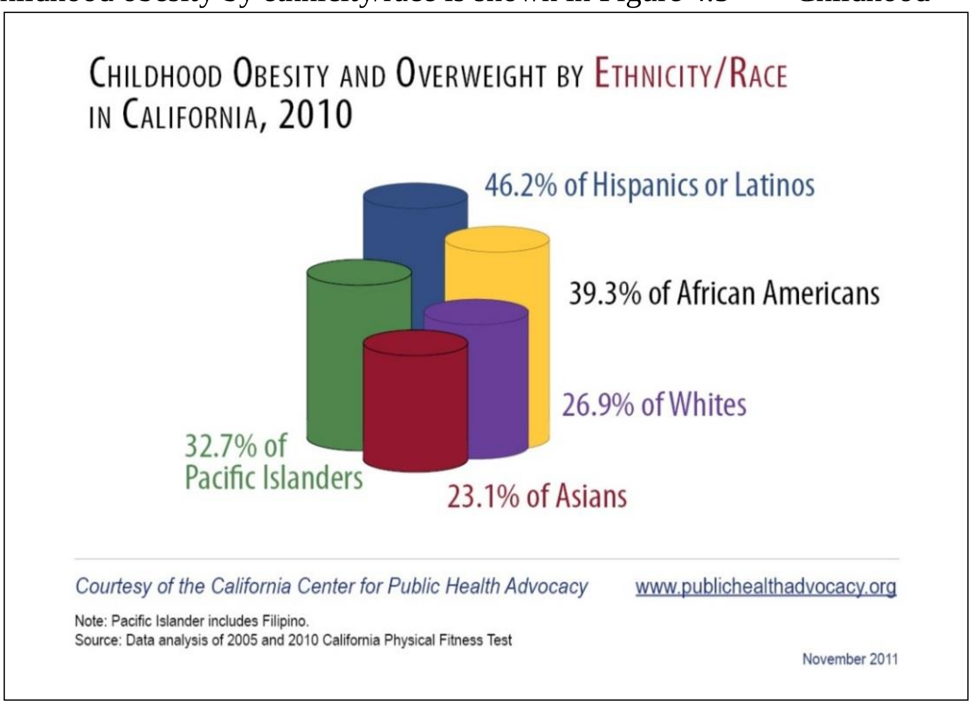


Figure 4.5 Childhood Obesity

The reasons for the correlation between ethnicity and obesity may of course be discussed in the context of culture, income, diet, employment, and a host of environmental justice factors. Among those factors are ample statistics correlating conditions of park-poor neighborhoods within communities that are predominantly Hispanic and African-American. Facilities that provide a greater opportunity and access to recreation opportunities across all of the proposed alternatives, therefore, would serve to help reduce the obesity levels within the ROI.

4.2.2.3 Los Angeles Statistics

The 2005, the CDC's physical activity prevalence statistics for the Los Angeles - Long Beach – Glendale Metropolitan Statistical Area (MSA) indicated that only 45.4 percent of the adult population meets the recommended level of physical activity.

Table 4-3 Physical Activity Prevalence Statistics by Metropolitan Area — SMART BRFSS 2005

	Recommended	Insufficient	Inactive
Los Angeles-Long Beach-Glendale	45.4%	32.4%	13.3%

In a follow-on study in 2008, the CDC reports the level of no leisure-time physical activity for this area's adult population at 25.9 percent.

In 2007 the Department of Public Health and the American Diabetes Association of Los Angeles found that 22 percent of residents suffer from obesity — up from 14.3 percent in 1997.

The issues with overweight/obesity in children are even more severe. After some hope that the obesity/overweight rate with children was stabilizing as evaluated in the Los Angeles County Department of Public Health 2008 report "Los Angeles Health Trends," a subsequent 2010 study conducted by the UCLA Center for Health Policy Research and the California Center for Public Health Advocacy revealed contrary data on the levels of overweight/obesity. The study indicates that while 38 percent of the state's children are overweight or obese, Los Angeles County has both the highest and lowest city rates. City ranges begin as low as 11.3 percent (Manhattan Beach) and climb five-fold to 53 percent for the state's poorest performing city (Huntington Park) with the City of Los Angeles at 45.2 percent and an overall rate for the County at 41.6 percent.

4.2.3 Health Benefits of Exercise Facilities

A landmark report by the U.S. surgeon general found that people who engage in regular physical activity benefit from reduced risk of premature death; reduced risk of coronary heart disease, hypertension, colon cancer, and non-insulin-dependent diabetes; improved maintenance of muscle strength, joint structure, and joint function; reduced body weight and favorable redistribution of body fat; improved physical functioning if they suffer from poor health; and healthier cardiovascular, respiratory, and endocrine systems.[42, 43]

[42] Sherer, Paul M. 2006. "The Benefits of Parks: Why America Needs More City Parks and Open Space." The Trust for Public Land. Reprint of "Parks for People" white paper, published in 2003.

> "Americans can substantially improve their health and quality of life by including moderate amounts of physical activity in their daily lives," the report found. It also found that "health benefits appear to be proportional to the amount of activity; thus, every increase in activity adds some benefit." [44]

The Surgeon General additionally found that physical activity also produces important psychological benefit. It relieves symptoms of depression and anxiety, improves mood, and enhances psychological well-being.[45] Exercise leads to enhanced tranquility and more relief of anxiety and depression when it occurs in natural settings like parks rather than along urban streets.[46]

Exercise significantly reduces the chance for heart problems, according to 43 separate studies conducted by the Centers for Disease Control. Those who do not exercise are twice as likely to have coronary heart disease.[47] A study publishes in the Archives of Internal Medicine indicates the risk of Type II diabetes decreased progressively with increasing levels of physical activity.[48] Women, who exercised regularly in their 20's and had a healthy intake of calcium, decreased by 30 percent their risk of developing osteoporosis in their 70's.[49]

Despite these now well-known benefits of physical activity however only 49 percent of American adults engage in the recommended levels of physical activity, and 24 percent engage in no leisure-time physical activity, according to the Centers for Disease Control and Prevention.[50] The numbers for children and adolescents are similar: only 50 percent of students in grades 9 through 12 engage in moderate to intensive physical activity.[51]

Fortunately, strong evidence shows that people are more likely to exercise when they have access to parks and recreation facilities, thereby reducing obesity and its associated health problems and societal costs. A group of studies reviewed in the American Journal of Preventive

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[43] U.S. Department of Health and Human Services. 1996. "Physical activity and health: A report of the Surgeon General." U.S. Department of Health and Human Services. http://www.cdc.gov/nccdphp/sgr/pdf/sgrfull.pdf.

[44] Ibid.

[45] Ibid.

[46] American Planning Association, 2003. "How Cities Use Parks to Improve Public Health, Help Children Learn, Create Safer Neighborhoods." *City Parks Forum Briefing Papers.*

[47] American Hiking Society (AHS). (n.d.). "A Step in the right direction: The health benefits of hiking and trails." Retrieved from http://atfiles.org/files/pdf/AHShealthben.pdf.

[48] Wannamethee, S.G., Shaper, A.G., & Alberta, K.G.M.M. 2000. "Physical activity, metabolic factors, and the incidence of coronary heart disease and type 2 diabetes." *Archives of Internal Medicine*, *160*(14), 2108-2116.

[49] Gorman, Christine. 2002. "Walk, Don't Run: It's Simple, it's cheap, and studies show that walking may be the best exercise for reducing the risk of heart disease, stroke and diabetes." *Time, 159*(3), 82. June, 2012. http://www.time.com/time/covers/1101020121/walking.html

[50] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. 2012. http://apps.nccd.cdc.gov/PASurveillance/StateSumResult.

[51] U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. 2012. http://apps.nccd.cdc.gov/youthonline/App/Results.

Medicine showed that "creation of or enhanced access to places for physical activity combined with informational outreach" produced a 48.4 percent increase in the frequency of physical activity.[52] The same studies showed that easy access to a place to exercise results in a 5.1 percent median increase in aerobic capacity, along with weight loss, a reduction in body fat, improvements in flexibility, and an increase in perceived energy.[53] Further, a study by the RAND Corporation found that Los Angeles residents who live near parks visit them and exercise more often than people who live greater distances from green spaces.[54] While it may be argued that people with a propensity to exercise will seek to live near parks rather than the proximity to parks *causing* exercise, the fact remains that—either way—more trails, greenways, and parks along the River will result in more exercise among the population.

Unfortunately, residents of many American communities do not have easy access to a park or recreation facility. This is especially true in cities and urban areas, where 80 percent of Americans lived in 2000. Study after study shows that when people cannot reach parks, they often go without exercise. There is a notable scarcity of parks in poor communities. More generally, there is a correlation among poverty, minority status, obesity, ill health, and neighborhood factors that discourage exercise, including the absence of parks and recreation facilities. Indeed, a 2005 University of Southern California study of park access in Los Angeles found that people who live in areas of low income or concentrated poverty and in Latino, African American, and Asian American/Pacific Islander neighborhoods are less likely to have nearby access to parks, playgrounds, and other exercise facilities than people living in largely white neighborhoods.[55,56]

4.2.4 Proposed Alternatives and Public Health

The alternatives' proposed recreational and open space facilities would occur in LA's Council Districts 1, 4, 13 and 14. These districts have some of the lowest parkland to population ratios in the City (Figure 4.6). Note that Council District 4 is third in the ranking due to the inclusion of Griffith Park; however, the current evaluation discounts the recreational use of Griffith Park "on a regular/daily basis" due to its distance from the River and separation by Interstate 5.

Within the principal service territory of the proposed parks, over 11,000 senior citizens (aged 65 and older) and 74,000 adults (aged 18 to 65) reside. The Trust for Public Land in a 2009 study,

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[52] Kahn, E., *et al.* 2002. "The effectiveness of interventions to increase physical activity." *American Journal of Preventive Medicine* 22, no. 4S.

[53] Ibid.

[54] Yañez, E. & Muzzy, W. 2005. "Healthy parks and healthy communities: Addressing health disparities and park inequities through public financing of parks, playgrounds, and other physical activity settings." *The Trust for Public Land*.

[55] Wolch, J., Wilson, J. & Fehrenback, J. 2005. "Parks and park funding in Los Angeles: An equity-mapping analysis," *Urban Geography* 26, no. 1.

[56] Pincetl, S., *et al.* 2003. "Toward a sustainable Los Angeles: A 'nature's services' approach." University of Southern California, Center for Sustainable Cities. March, 2003.

"Measuring the Economic Value of a City Park System," has developed a system ("Parks Health Benefits Calculator") to measure the health value of park usage for exercise by adults.

In their study, after identifying the common types of medical problems that are inversely related to physical activity such as heart disease and diabetes, they created the calculator based on studies in seven different states that show an annual $250 cost difference between those who exercise regularly and those who do not. For people over the age of 65, the value is $500 because seniors typically incur two or more times the medical care costs of younger adults.

The key data input is the number of park users who indulge in a sufficient amount of physical activity (at least 30 minutes of moderate to vigorous activity at least three days per week) to make a difference. If it is assumed that the proposed facilities would impact only 10 percent of the adults in the service territory (1,000 seniors and 7,400 adults) the annual health benefit would be $2,400,000, according to the benefit calculator.

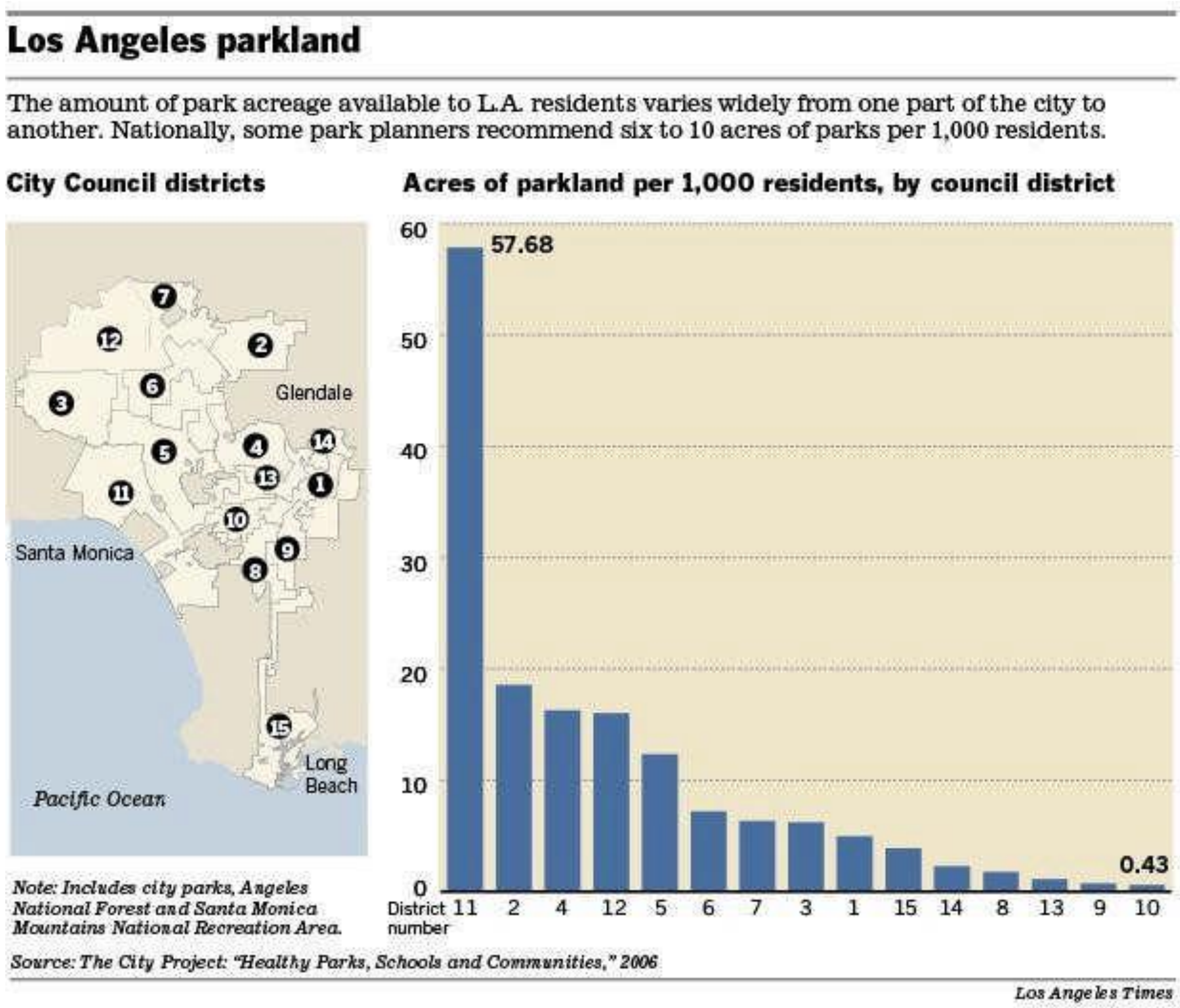

Figure 4.6 Los Angeles Parkland to Population Ratios

As seen in the supporting evidence presented within this section (Section 4.2), inactivity, obesity, and loss of productivity in the workplace contribute to major annual health care cost in California and the Nation, and people who live closer to parks are more likely to participate in physical activity and healthier living. As mentioned above, much of the Los Angeles area is considered to be "park poor" which is defined by California law as any geographic area that provides less than three acres of park per 1,000 residents. [57] Based on this classification, project reaches 7-8 would be considered "park poor" having the lowest amount of parkland per resident in the project area (less than three acres per 1,000 people).

Restoration measures under Alternatives 10, 13, 16A, and 20A would increase accessibility for recreational opportunities in a safe, user-friendly, and accessible setting resulting in a higher frequency of recreation and physical activity use by community members. The recreational facilities common to all alternatives include: trails along the River; bridges that offer accessibility and connectivity to existing, adjacent parks; parking; and access point for trails as well as for kayaking. This is expected to result in a 45% increase in recreation visitation with project, as described in Section 5 and Attachment 1.

Further—beyond the habitat units offered by the restoration measures—the habitat proposed within the alternatives also provide an amenity that would serve to increase the aesthetic enjoyment of recreation along the River by providing an environment conducive to recreation. Linking restoration acreage to public health in this manner results in comparing the acreages of each proposed alternative: Alternative 10 proposes the smallest area of proposed restoration, followed by 13, 16, and 20 with the largest area of proposed restoration. Actual differences in the alternatives based on acreage of restoration may be seen in Table 4-4, indicating increases from one alternative to the next of 13%, 10%, and 4%, respectively.

Table 4-4 Acreage of Habitat Restoration, by Alternative

Alternative			
10	**13**	**16A**	**20a**
528	588	659	719

Restoration measures and associated recreational effects would not only provide obese and at-risk community members with increased opportunities for physical activity and exercise, but would also provide opportunities for healthy and active members of the community who regularly exercise to sustain their health. This would improve the health of the community as a whole by reducing health care costs, increasing productivity, and promoting well-being.

[57] GreenInfo Network. 2010. "Park Poor, Income Poor, and People of Color." Figure presented by the City Project, Los Angeles, CA. Accessed September 2012 at http://www.mapsportal.org/thecityproject/socalmap/LosAngelesCounty.html#.

4.3 Displacement/Impacts to Minorities and Special Interest Groups

Displacements or relocations related to the construction efforts surrounding the project are unlikely due to the construction footprint being on vacant public lands and the limited workforce required for construction.

4.3.1 Proposed Alternatives and Displacement/Impacts to Minorities and Special Interest Groups

Benefits to minorities and special interest groups would be seen in all reaches of the project area post construction. The proposed restoration measures under Alternative 10, 13, 16A, and 20A would provide added trails and linkages to neighboring parks providing recreational activities for hikers, bicycle riders, and equestrian use.

Housing prices would likely appreciate under Alternatives 10, 13, 16A, and 20A, due to the potential of restoration measures to act as a catalyst for the renewal and redevelopment/beautification of adjacent commercial, industrial, business, and residential properties, as discussed above in Section 2.8. Minority and special interest group homeowners would benefit as property values would likely appreciate, while minority renters would be negatively impacted due to rent increases, which could potentially displace minority and special interest group residents.

Alternatives 10, 13, 16A, and 20A vary in the respective implementation acreage of restoration measures; however, each alternative proposes measures in all project reaches (1-8). Therefore, impacts would be similar under each alternative with the slight differences as shown in Table 4-4.

4.4 Displacement/Impacts to Businesses

From an economic perspective, it is assumed that redevelopment would occur in the normal business of free market enterprise. Developers and business owners would agree upon the terms in a free exchange. Existing owners would only transfer ownership if the economic proposition was beneficial. Vacant properties exist throughout the City making relocations possible for the current owner to relocate or build if so desired. The impact areas do not involve residential properties. Thus, the impacts are strictly “business” related.

For Alternative 20, restoration measures and construction staging areas would extend into lands designated as industrial in the Verdugo Wash area of the Northeast Los Angeles Community Plan. Although the construction staging areas represent temporary land uses with less-than significant land use impacts, measures in some alternatives would result in the permanent conversion of industrial uses to a non-industrial use. This would conflict with the designated Industrial Use definition for this site. In addition, active industrial uses are currently in operation within the proposed conversion area. These uses would likely not be able to continue to exist at the site with the restoration measures included in some alternatives, and might require relocation. Further, indirect impacts could occur from the reduction in viable industrial operations adjacent to and in the vicinity of the site. This could result in potentially significant adverse impacts to existing land uses. Still, in the past two decades, the City has supported the conversion of key river-adjacent parcels that have had industrial, public facility, commercial, and other zoning classifications into publicly-accessible open spaces with ecosystem value. Commitment to this process may be seen by the City Council's adoption of the Los Angeles River Revitalization Master Plan in 2007, which calls for acquisition of key industrially-zoned parcels at the Verdugo Wash confluence, Taylor Yard, the Cornfields, and Arroyo Seco.

The LATC site, located within the Boyle Heights Community Plan Area, would convert industrial container rail yard lands to riparian habitat under Alternatives 10, 13, 16A, and 20A with more extensive restoration measures under Alternative 16A and 20A. These include the creation of freshwater marsh, re-grading of channel banks and revegetation, and the relocation of railroad tracks to trestles to provide hydrologic connections to the river. Proposed restoration features would conflict with the Industrial land use designation, and potentially significant impacts to land use could occur as the current container storage/loading facility would be replaced by habitat areas and trails. New industrial uses may not desire to locate to an area if it has decreased availability and viability for industrial operations. In addition, indirect impacts could result from the decreasing availability of industrial land in the Los Angeles area; this could decrease the viability of industrial and manufacturing businesses from remaining in the area if their operations are limited to increasingly small and potentially isolated parcels of land surrounded by restored riparian and wetland habitat and recreational areas.

Conversion of industrial land within the Boyle Heights Community Plan Area to non-industrial uses would conflict with the industrial land use objectives and policies in the Plan; the objectives include preserving industrial lands for industrial uses, and conserving industry to preserve the tax base for the City and to provide jobs. In addition, policies in the Plan state that the industrial uses north of the San Bernardino freeway and west of the Golden State freeway should be preserved since they are near existing transportation facilities. Therefore, implementation of Alternatives 10, 13, 16A, and 20A would result in potentially significant adverse impacts unless community and political desires help develop mutually-agreeable changes in land use designations that include phasing plans. To this end, as mentioned above in this subsection, past actions by the City indicates a willingness and intent to undertake additional rezoning actions to accommodate the River's ecosystem restoration.

4.4.1 Proposed Alternatives and Displacement/Impacts to Businesses

Benefits to businesses due to the implementation of restoration measures post construction may be seen in areas adjacent to the project footprint due to the previously discussed potential increase in economic benefits derived from increased property values and attractive multi-use development. Though the project area is primarily built out and highly urbanized, restoration measures could stimulate redevelopment and urban renewal. Benefits associated with Alternatives 10, 13, 16A, and 20A would be similar in scope since each Alternative covers all eight reaches. However, direct adverse impacts to businesses within the project footprint—primarily in the LATC areas for all alternatives and in the Verdugo Wash area for Alternative 20—would take place in the proposed habitat areas that would displace those businesses.

4.5 Displacement/Impacts to Agriculture

There are no agricultural activities in the area and no impacts are anticipated.

4.6 Displacement/Impacts to Recreational Areas

Generally, construction will take place on vacant public or industrial lands that are not currently used for recreational purposes. Construction traffic may produce a slight impact on existing travel to existing recreational areas outside of the ROI, but these are considered insignificant.

4.6.1 Proposed Alternatives and Displacement/Impacts to Recreational Areas

Post-construction benefits would include the expansion of project area recreation and improved river corridor trail connectivity between these areas, providing the community increased access and recreational opportunities. From the perspective of actual recreational facilities, the alternatives are the same since there is a single recreation plan for the trails, bridges, access points, parking, and other proposed facilities. But in terms of the additional habitat that offers passive respite and aesthetic amenities during recreational activities, the alternatives would differ based on their respective habitat acreage, as shown in Table 4-4, above, which shows that Alternative 20A proposes the largest restoration acreage, followed by16A, 13, and 10 in decreasing order. Specific improvements and associated increases in recreational use are discussed in Chapter 5.

4.7 Community Growth

Generally, a project is expected to promote growth if it contributes substantially to the population or economics of the ROI area. The project is not expected to significantly contribute economically to the ROI during the construction phase in a direct and indirect manner. Employment benefits are expected to occur in the ROI during construction; however, their impacts in relation to the overall employment within the ROI are small.

The plan is not expected to contribute to any rise in area population, directly or indirectly, during the construction. The ROI is essentially a fully developed urban area. Finally, each municipality or county controls growth in their respective areas through land use and growth policies. Other, more powerful economic considerations also directly influence area growth. Thus, plan construction is not expected to affect community growth, either directly or indirectly, during its construction.

4.7.1 Proposed Alternatives and Community Growth

Although an ecosystem restoration construction project is not expected to contribute to community growth during construction, its existence after construction would create a stimulus for redevelopment as discussed above in Section 2.8. Ecosystem restoration measures proposed under Alternatives 10, 13, 16A, and 20A, in increasing magnitude, respectively, are projected to revitalize commercial, industrial, and residential development in several areas along the Los Angeles River as previously detailed in the RED section of this appendix.

4.8 Project Impacts and Connectivity of the Community

Connectivity is generally defined as the degree to which residents feel a sense of belonging to their neighborhood or municipality. Other important measurements include the level of commitment residents feel to the community and the level of attachment residents have to certain neighbors, groups, or institutions. Generally, these levels are higher as a result of continued association over time. Major impacts to community cohesion are generally caused by displacements to important community businesses, centers of community interactions (churches, community centers, recreation areas) or large tracts of residences. Impacts can also occur through a project separating or dividing individual communities. Finally, visual impacts can affect the quality of adjacent communities, which can sometimes affect community connectivity depending on the severity of the impact.

Any institution that promotes this kind of community cohesion adds value to a neighborhood and, by extension, to the whole city. This human web, which Jane Jacobs termed “social capital,”[58] is strengthened in some cities by parks. From playgrounds to sports fields to park benches to flower gardens, parks offer opportunities for people of all ages to interact, communicate, compete, learn, and grow. Perhaps more significantly, the acts of creating, improving, renewing, or even saving a park can build extraordinary levels of social capital. This is particularly true in a neighborhood suffering from alienation partially due to the lack of public spaces.

Parks satisfy needs for interaction by enticing residents into public spaces with trees, greenery, natural settings, and recreational facilities. In a study conducted at a large public housing development in Chicago, vegetated areas were found to be used by significantly more people and those individuals were more likely to be engaged in social activities than similar areas without vegetation.[59] Social interaction and neighborhood spaces have been identified as key facets of healthy communities supporting social networks, social support, and social integration that have been linked to improvements in both physical and mental health.[60] Sociability may alleviate some forms of mental illness and contribute to a sense of belonging and community. A park brings neighbors together, encourages safer, cleaner neighborhoods and creates a livelier community atmosphere. Parks also help improve a community’s image, socioeconomic status and enhance the area’s desirability. Perhaps most importantly, parks become a source of community pride and inspiration for further community improvements and revitalization.

4.8.1 Proposed Alternatives and Connectivity of the Community

Alternatives 10, 13, 16A, and 20A would include the restoration of riparian, in-channel, and overbank wetland habitat, and the greening of impervious surfaces throughout all eight reaches of the project area. Moreover, additional trails, access points, parking areas, and bridges are

[58] Jacobs, J. 1961. *The Death and Life of Great American Cities*. New York: Random House. February 1993 [1961].

[59] Sullivan, W., *et al*. 2004. “The fruit of urban nature: Vital neighborhood spaces.” *Environment and Behavior,* 39.

[60] Berkmana, L., *et al*. 2000. “From social integration to health: Durkheim in the new millennium.”*Social Science and Medicine,* 51.

included in the alternatives. These would provide linkage and connectivity to the restoration areas as well as to existing parks, thereby improving community cohesion. Similar benefits would be seen under all alternatives and would provide a common place for residents of various socio-economic backgrounds to recreate and interact. As shown in the literature cited above, this would help create a sense of community and belonging. In turn, these beneficial social effects would potentially influence the enhancement of surrounding areas to conduct similar activities.

4.9 Community Well-Being

Among the many benefits of nature there are two major mental health benefits that arise from contact with nature. The first is the immediate mental health benefits which help with stress recovery, and the second is the longer-term psychological benefits which help with ongoing health restoration. In terms of immediate mental health benefits, literature shows that stressed individuals often turn to the natural world for relief. Research also shows that trees and woodlands, and contact with nature in general can have a calming effect, helping to reduce stress.[61] Coleman and Iso-Ahola suggest participation in leisure activities provides resources that assist people either to resist the onset of stress reactions or cope with stress before stress has an impact on health.[62] Visual appreciation of natural scenes provides a means to stress recovery. The healing value of hospital gardens or of nature views from hospital windows is a theme present in much literature. Window views of nature have been shown to increase positive feelings, lower stress levels and improve the physical condition of both hospital patients and office employees.[63]

In terms of longer term mental health, nature acts as a restorative environment, providing restoration from mental fatigue. Contact with nature may also help to reduce anger and aggression over the long term. Alternative studies provide a more in depth understanding of how urban nature impacts on psychological well-being. Rhode and Kendle (1994) suggest that urban nature brings emotional benefits (by lowering stress and increasing happiness), cognitive benefits (by reducing mental fatigue) and behavioral benefits (by encouraging adventurous behavior).[64] Contact with urban nature is beneficial to people as it provides an escape from the city, a peaceful retreat to repair emotions and it allows for intellectual learning.

Contact with nature is important for well-being. The benefits that nature brings to human well-being are applicable to both rural and urban settings. The implications of less contact with nature

[61] Palace Road Nature Garden. 2011. "The relationship between nature and human health and well-being in urban areas." Notes on the Royal Commission on Environmental Pollution Study on Urban Environments, Well-being and Health, as found in https://www.facebook.com/notes/palace-road-nature-garden/the-relationship-between-nature-and-human-health-and-well-being-in-urban-areas/158334140891119, March 16, 2011.

[62] Coleman, D. & Iso-Ahola, S. 2001. "Leisure and health: The role of social support and self-determination." *Journal of Leisure Research,* Volume 25, No. 2.

[63] Tarrant, M. 1996. "Attending to past outdoor recreation experiences: Symptom reporting and changes in affect." *Journal of Leisure Research, 28*(1).

[64] Rohde, C. & Kendle, A. 1994. "Report to English nature-human wellbeing, natural landscapes and wildlife in urban areas: A Review." Department of Horticulture and Landscape and the Research Institute for the Care of the Elderly, Bath: University of Reading, UK.

in urban areas are however more significant. A major study, in English Nature, found that people living in built up areas with access to gardens or green open spaces had a lower prevalence of mental disorder than people in built up areas with no such access.[65]

Many studies refer to the social benefits of urban green space. Urban green space contributes significantly to social inclusion because it is free and access is available to all, it provides a neutral ground for all sectors of society, and it can provide many opportunities for social interaction. Urban nature can be a meeting place for people of all classes and backgrounds and can therefore contribute to the health of society. Research suggests that there is value to be found in social participation in shared green spaces. Nature settings allow for different types of social interactions through activities like recreation and picnicking - activities that strengthen social bonding. Evidence therefore clearly suggests that contact with nature is important for well-being.[66]

Studies have shown that the more webs of human relationships a neighborhood has, the stronger, safer, and more successful it is. Institutions that promote this kind of community cohesion add value to a neighborhood. This social capital is strengthened by parks by offering opportunities for people of all ages to interact, communicate, compete, learn, and grow. [67] The acts of improving, renewing, or even saving a park can build extraordinary levels of social capital. This is particularly true in a neighborhood suffering from alienation partially due to the lack of safe public spaces.

City parks make inner-city neighborhoods more livable. They offer opportunities for recreation and exercise to at-risk and low-income children, youth, and families who might not be able to afford them elsewhere. They also provide places in low-income neighborhoods where people can experience a sense of community. Research shows that residents of neighborhoods with greenery in common spaces are more likely to enjoy stronger social ties than those who live surrounded by barren concrete.[68]

Park and recreation opportunities are essential for strengthening and maintaining a healthy community. Positive impacts are evident throughout the community. Recreation brings neighbors together, encourages safer, cleaner neighborhoods and creates a livelier community atmosphere. Parks and recreational facilities also help improve a community's image, socioeconomic status and enhance the area's desirability. When people move they seek a desirable community. When they retire they also look for a community that will accommodate their special needs. Residents

[65] Palace Road Nature Garden. 2011. "The relationship between nature and human health and well-being in urban areas." Notes on the Royal Commission on Environmental Pollution Study on Urban Environments, Well-being and Health, as found in https://www.facebook.com/notes/palace-road-nature-garden/the-relationship-between-nature-and-human-health-and-well-being-in-urban-areas/158334140891119, March 16, 2011.

[66] Tabbush, P. & O'Brien, E. 2003. "Health and well-being: Trees, woodlands and natural spaces." Forestry Commission, Edinburgh.

[67] Harnik, P. & Welle, B. 2009. "Measuring the economic value of a city park system." The Trust for Public Land.

[68] Gies, E. 2006. "The health benefits of parks - how parks help keep Americans and their Communities fit and healthy." The Trust for Public Land.

recognize the numerous benefits that well maintained open spaces and recreation facilities can have for a community.[69]

4.9.1 Crime Reduction

Access to public parks and recreational facilities has been strongly linked to reductions in crime and in particular to reduced juvenile delinquency. Recreational facilities keep at-risk youth off the streets, give them a safe environment to interact with their peers, and fill up time within which they could otherwise get into trouble.

Research supports the widely held belief that community involvement in neighborhood parks is correlated with lower levels of crime. The Project on Human Development in Chicago Neighborhoods studied the impact of "collective efficacy," which it defined as "cohesion among neighborhood residents combined with shared expectations for informal social control of public space." The study found that "in neighborhoods where collective efficacy was strong, rates of violence were low, regardless of socio-demographic composition and the amount of disorder observed. Collective efficacy also appears to deter disorder: Where it was strong, observed levels of physical and social disorder were low."[70]

These benefits may be abstract, but they lead to concrete community improvements such as fewer homicides and other violent crime; fewer property crimes, including graffiti; reduced juvenile delinquency; higher educational achievement; lower rates of asthma and teen pregnancy; and better response to the community's needs by central governments because they see a united front.[71]

Residents who live near outdoor greenery are more familiar with their nearby neighbors, socialize more with them, and expressed greater feelings of community and safety than did residents lacking nearby green spaces.[72]

Well-maintained parks and recreation facilities help reduce crime in a community. The presence of park users in and around the facilities is an excellent deterrent. Low crime rates increase property values and help residents feel secure.

4.9.2 Support of Youths and Seniors

Play is the foundation for children's healthy development. The benefits of outdoor play are maximized when developmentally appropriate equipment and materials provided.[73] Preschool

[69] California State Parks. 2005. "The Health and Social Benefits of Recreation." California State Parks. Planning Division.

[70] Gies, E. 2006. "The health benefits of parks - how parks help keep Americans and their Communities fit and healthy." The Trust for Public Land.

[71] Sherer, Paul. 2004. "Park power land & people." The Trust for Public Land. http://www.tpl.org.

[72] American Planning Association. 2003. "How cities use parks to improve public health, help children learn, create safer neighborhoods." City Parks Forum Briefing Papers.

students exposed to a structured intervention program of a physical education demonstrated significantly higher improvement in fundamental locomotion and object control skills than preschool students who were only allowed to have unstructured physical play with limited equipment.[74] Participation in sports and physical activities is positively associated with psychological maturity and identity development for young women.[75] Environments that are nurturing where youth can have a sense of achievement and recognition as well as opportunities for creative expression, physical activity, and social interaction provides the best settings for them to achieve the five development competencies needed to be successful as adults.[76]

For seniors, recreation can enhance active living, helping limit the onset of disease and impairment normally associated with the aging process. Physical activity help the aging population lead independent and satisfied lives helping them remain mobile, flexible and maintaining their cognitive abilities.[77] Recreation activities provide socialization opportunities and help keep seniors active in the community.

Seniors who live alone are often cut off from the community mainstream, losing their purpose for being and retreating into their homes, thus increasing their health risks. It is generally accepted that the risk of depression increases with age.[78] Seniors involved in recreation programs have reduced feelings of alienation and loneliness and increased intergenerational understanding.[79]

4.9.3 Environmental Health

As referenced by Paul Sherer,[80] the U.S. Forest Service calculated that over a 50-year lifetime, one tree generates $31,250 worth of oxygen, provides $62,000 worth of air pollution control, recycles $37,500 worth of water, and controls $31,250 worth of soil erosion. Further, the research scientists of the Pacific Southwest Research Station of the U.S. Department of Agriculture using the i-Tree Streets program estimate a large tree will provide $3,270 in

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73 Sawyers, Janet K. 1994. "The Preschool Playground." *The Journal of Physical Education, Recreation & Dance*. *65*(6). p.32-33. August, 1994.

74 Ishee, Jimmy H. 2003. "The Influence of Motor Skill Interventions on Disadvantaged Children." *The Journal of Physical Education, Recreation & Dance*. *74*(8), p.14. October, 2003.

75 Shaw, Susan; Klieber, Douglas A.; Caldwell, Linda L. 2001. "Leisure and Identity Formation in Male and Female Adolescents: A Preliminary Examination." *Journal of Leisure Research*, *27*(3), 245- 263,

76 Hudson, Susan D. 1997 "Helping Youth Grow." *The Journal of Physical Education, Recreation & Dance*, *68*(9). pp.16-17. Nov/Dec, 1997.

77 State of California Resources Agency. 2005. "The Health and Social Benefits of Recreation-An Element of the California Outdoor Recreation Planning Program." California State Parks Planning Division.

78 Chodzko-Zajko, W.J. 1998. "Physical activity and aging: Implications for health and quality of life in older persons." *President's Council on Physical Fitness and Sport Research Digest, 3*(4).

79 State of California Resources Agency. 2005. "The Health and Social Benefits of Recreation-An Element of the California Outdoor Recreation Planning Program." California State Parks Planning Division.

80 Sherer, Paul M. 2006. "The Benefits of Parks: Why America Needs More City Parks and Open Space." The Trust for Public Land. Reprint of "Parks for People" white paper, published in 2003.

environmental and other benefits over its lifetime.[81] These researchers also report that 100 large trees will each year remove 7 tons of carbon dioxide, 328 pounds of other air pollutants, and catch 212,000 gallons of rainwater.[82] In addition, they suggest that tree-filled neighborhoods report lower levels of domestic violence, are safer and more sociable, reduce stress of body and mind, and decrease the need for medication, and speed recovery times.[83]

The U.S. Forest Service also completed a relevant study of Los Angeles' existing tree canopy cover for the Million Trees LA Initiative.[84] That study identified locations for additional tree planting and quantified benefits for additional trees. The study found average annual benefits monetized at $38 and $56 per tree planted, depending on tree mortality assumptions. Eighty-one percent of total benefits were aesthetic/other, eight percent were stormwater runoff reduction, six percent energy savings, four percent air quality improvement, and less than one percent atmospheric carbon reduction.

For comparison purposes herein, the assumptions and values from the "Los Angeles 1-Million Tree Canopy Cover Assessment"[85] were applied to the number of potential trees to be planted per alternative. Areas of higher residential densities, commercial, and industrial areas generally have fewer trees and a higher value per tree planted. Therefore, the benefit of $56/tree is used. Table 4-5 includes the annual benefits of trees per alternative.

Table 4-5 Estimated Annual Benefits of Trees per Alternative

	Alt 10-ART	Alt 13-ACE	Alt 16A-AND	Alt 20A-RIVER
Valley Foothills Riparian (acres)	251	273	270	288
Trees/Acre	300	300	300	300
Annual Benefit per Tree	$56	$56	$56	$56
Total Annual Benefit	$4,216,800	$4,586,400	$4,536,000	$4,838,400

4.9.4 Parks and Housing Values

The real estate market consistently demonstrates that many people are willing to pay a larger amount for property located close to parks and open space areas than for a home that does not offer this amenity. The higher value of these residences means that their owners pay higher property taxes. In effect, this represents a "capitalization" of park land into increased property values of proximate land owners.[86] Indeed, parks, greenery, and vegetation in general are

[81] U.S. Department of Agriculture. 2011. "Trees pay us back–in the Southern California Coast Region." May, 2011.

[82] Ibid.

[83] Ibid.

[84] McPherson, E. Gregory; Simpson, James R.; Xiao, Qingfu; Wu, Chunxia.2008. "Los Angeles 1-Million Tree Canopy Cover Assessment." Gen. Tech. Rep. PSW-GTR-207. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 52 p.

[85] Ibid.

[86] Crompton, J. 2004. "The proximate principle: The impact of parks, open space and water features on residential property values and the property tax base." National Recreation and Park Association

typically found associated with higher property values. The researchers from the previous U.S. Forest Study [87] indicate that each large front yard tree adds one percent to the sales price of a house, and large specimen trees can add 10 percent to a property's value. Findings of this type help support the economic development benefits of property located near parkland and trees, and the value placed by society on vegetation, as discussed in the RED section of this appendix.

Repeated studies over the years have confirmed that people prefer to buy homes close to parks, open space, and greenery. One key study looked at the effect of proximity to greenbelts in Boulder, Colorado. The study showed that, other things being equal, there was a $4.20 decrease in the price of residential property for every foot one moved away from the greenbelt, and that the average value of homes next to the greenbelt was 32 percent higher than those 3,200 feet away. A University of Southern California study found that the positive relationship between park proximity and property value holds true in neighborhoods where the residents are mostly immigrants and poor. In a dense urban neighborhood, the value effect of nearby green space can be stronger than lot size itself. The study found that an 11 percent increase in the amount of green space within a radius of 200 to 500 feet from a house leads to an approximate increase of 1.5 percent in the expected sales price of the house, or an additional $3,440 in the median price.[88]

In a 2001 survey conducted for the National Association of Realtors by Public Opinion Strategies, 50 percent of respondents said they would be willing to pay 10 percent more for a house located near a park or other protected open space. In the same survey, 57 percent of respondents said that if they were in the market to buy a new home, they would be more likely to select one neighborhood over another if it was close to parks and open space.[89]

Most people are willing to pay more for a home close to a nice park. Economists call this phenomenon "hedonic value." Hedonic value is affected primarily by two factors: distance from the park and the quality of the park itself. While proximate value can be measured up to 2,000 feet from a large park, most of the value is within the first 500 feet. Moreover, people's desire to live near a park depends on characteristics of the park. Beautiful natural resource parks with great trees, trails, meadows, and gardens are markedly valuable. Other parks with excellent recreational facilities are also desirable. Less attractive or poorly maintained parks are only marginally valuable. Parks with frightening or dangerous aspects can reduce nearby property values.[90] The preponderance of studies has revealed that excellent parks may add 15 percent to

[87] McPherson, E. Gregory; Simpson, James R.; Xiao, Qingfu; Wu, Chunxia.2008. "Los Angeles 1-Million Tree Canopy Cover Assessment." Gen. Tech. Rep. PSW-GTR-207. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 52 p.

[88] Sherer, Paul M. 2006. "The Benefits of Parks: Why America Needs More City Parks and Open Space." The Trust for Public Land. Reprint of "Parks for People" white paper, published in 2003.

[89] *National Association of Realtors*. 2001, (Press release). "NAR survey shows public support for open space depends on use and cost" April, 2001.

[90] Harnik, P. & Welle, B. 2009. "Measuring the economic value of a city park system." The Trust for Public Land.

the value of a proximate dwelling; on the other hand, problematic parks may subtract 5 percent of home value.[91]

4.9.5 Proposed Alternatives and Community Well-being

The discussion in Section 4.9 suggests that the restoration measures and associated recreational facilities as proposed under Alternatives 10, 13, 16, and 20 would have beneficial impacts to community well-being in the following manner:

- Reduction in short term stress and promotion of long term well-being and restorative psychological effects
- Improvements in community social interactions and community health
- Reduction in crime correlated with increased opportunities for youth to participate in recreation activities and increased community involvement and strength
- Support of youth development and senior citizen health
- Increases in housing values

Restoration measures would include the restoration of riparian, in-channel, and overbank wetland habitat, the greening of impervious surfaces throughout all eight reaches of the project area, and associated recreational trails and paths. Recreation measures would provide open space, trails, linkage to neighborhood parks, parking, and access to the River. Because Alternatives 10, 13, 16, and 20 vary in implementation area and proposed features, alternatives would have similar but scaled qualitative benefits, respectively, in increasing community well-being throughout the project area.

[91] Ibid.

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US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Final
Cost Appendix

September 2015

LOS ANGELES RIVER ECOSYSTEM RESTORATION FEASIBILITY STUDY
COST APPENDIX

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1. ALTERNATIVE COST ESTIMATES

1.1 Introduction

Section 1 provides the background information for the Los Angeles River Ecosystem Restoration Feasibility Study spreadsheet construction cost estimates, which have been developed for alternative analysis purposes. This analysis was completed in order to select a preferred plan for further analysis. Sections 2 and 3 of this appendix document the assumptions and work completed for the National Ecosystem Restoration (NER) Plan and Locally Preferred Plan (LPP) which were estimated with Micro-Computer Aided Cost Estimating System (MCACES) cost estimating software.

1.1.1 General

The Los Angeles River Ecosystem Restoration Feasibility Study is evaluating ecosystem restoration opportunities on an 11.5-mile long reach of the Los Angeles River (River) located in southern California. This reach, named the Los Angeles River ARBOR (Area with Restoration Benefits and Opportunities for Revitalization) extends from the Headworks area downstream to First Street in downtown Los Angeles. The ARBOR reach includes the Glendale Narrows—one of the few sections of the study area that does not have a hardened river bed—and contains several distinctive sites and connections including the Headworks, Pollywog Park, Bette Davis Park, the Burbank-Western Channel and Glendale River Walk, Griffith Park, Ferraro Fields, Verdugo Wash, Atwater Village, Taylor Yard and the Rio de Los Angeles State Park, the “Cornfields” (Los Angeles State Historic Park), Arroyo Seco, Elysian Park, “Piggyback Yard” (also known as the “Los Angeles Transportation Center (LATC)” as well as “Mission Yard”), and downtown Los Angeles.

Section 1 of this appendix documents the various unit costs and construction assumptions utilized for the Los Angeles River Ecosystem Restoration project alternative cost estimates. For estimating purposes the ARBOR reach was split into eight sub-reaches, and within these eight sub-reaches various restoration measures were estimated. The restoration measures are intended to solve specific problems or help obtain certain planning objectives[1]. From these measures and sub-reaches, various alternatives have been developed for performing the economic alternatives analysis. A summary matrix of costs for each alternative at each sub-reach can be found in Attachment 1.

1.1.2 Purpose

The purpose of this work is to develop preliminary alternative cost estimates – consistent to the conceptual level of design – for the eight sub-reaches of the project in order to perform

[1] Within this appendix, references to restoration, creation, or improvement of "hydrology" and "geomorphology" are intended to refer to restoration, creation, or improvement of a more natural hydrologic regime and a more natural geomorphic character.

an economic alternatives analysis. The costs within this document are not for budgetary purposes and are subject to change.

1.1.3 Design Features

The design features for the sub-reaches are designed at a conceptual level. Features include those components necessary to implement the measures and sub measures described in the associated Design Appendix and main report. Features include concrete demolition; excavation and fill; riprap; grouted riprap; turf reinforcement mats; fencing; clearing and grubbing; reinforced cast-in-place concrete walls, planters, slabs and piers; detention basins; sub-drainage system; railroad bridges and tunneling.

1.1.4 Design Limitations

Designs are based on preliminary, planning-level conceptual designs, and common engineering practices. The development of the hydraulic and geotechnical reports is currently under way, and thus the preliminary designs of this project were developed without this engineering information. Future design phases would be more integrated with the hydraulic information, geotechnical analyses, and vegetation requirements such that the concepts shown and discussed herein would be modified as necessary.

Also due to the limited hydraulic and geotechnical information diversion and control of water not included as line items within the cost estimates. However, these items are anticipated to be fairly uniform across all the alternatives being considered in the economic analysis. Thus, across all alternatives the costs would be similar and would have no discernible impact on the comparison of alternatives, and ultimately the selection of a recommended plan. Once a recommended plan is selected, and further design information is generated, these items will be incorporated into a more detailed cost estimate.

1.2 Basis of Estimate

1.2.1 Basis of Design

Available design documents of the project elements are listed below

- Los Angeles River Feasibility Study Conceptual Design Drawings, Tetra Tech, April 2013
- Los Angeles River Feasibility Study Design Report, Tetra Tech, April 2013
- Los Angeles River As-Built Drawings, Various Dates, USACE

1.2.2 Quantities

The cost estimate is based on project quantity take-offs that have been calculated in accordance with the documents above. A discussion of the quantity calculation process is provided below, and detailed quantity take-offs can be found in Attachment 2.

1.2.2.1 *Demolition Quantities*

The demolition quantities were developed primarily with the aid of existing typical cross section drawings taken from as-built drawings. Each of the typical cross sections corresponds to a specific length of channel. Thus the typical cross section areas and counts were multiplied into the designated length to calculate the required demolition quantities.

1.2.2.2 *Installation Quantities*

The installation quantities were developed in the same fashion as the demolition quantities. New typical cross sections were created for the various sub-reaches and side channels. These cross sections along with the length of the given sub-reaches were used to calculate the construction items required for revitalizing the channel.

1.3 Unit Costs and Assumptions

1.3.1 <u>Unit Cost Development</u>

Unit prices were developed with detailed labor, equipment and material pricing data. Recent vendor quotes for materials and placement were utilized in the development of several unit costs.

1.3.1.1 *Borrow/Disposal Areas and Materials*

Borrow materials are assumed to be available in the greater Los Angeles area. Any borrow material required is assumed to be trucked into the project site.

Any excess earthen material is assumed to be hauled off-site by the contractor to a disposal location. Three landfills that accept clean soils have been located within a 20-mile radius of the project location. These landfills are the Puente Hills Landfill, Scholl Canyon Landfill and Savage Canyon Landfill. Thus, the estimate includes costs for transporting the excess material 20-miles as well as a tipping fee for disposal at the landfills.

1.3.2 <u>Cost Item Assumptions</u>

1.3.2.1 *Excavation Grade Control (All Material Haul)*

This construction cost item accounts for the excavation of material in the existing channel bed. The unit cost includes excavating with the use of hydraulic excavators and assumes all (100%) the material excavated would be hauled off-site for disposal. Front end loaders are assumed to load the trucks for hauling. The trucks are then assumed to travel 20-miles (one way) to a landfill for disposal of the material. A tipping fee is included in the cost as well.

1.3.2.2 *Excavation Grade Control (Medium Material Haul)*

This construction cost item accounts for the excavation of material in the existing channel bed. The unit cost includes excavating with the use of hydraulic excavators and assumes half (50%) the material excavated would be hauled off-site for disposal. Front end loaders are assumed to load the trucks for hauling. The trucks are then assumed to travel 20-miles (one way) to a landfill for disposal of the material. A tipping fee is included in the cost as well.

1.3.2.3 *Excavation Grade Control (Limited Material Haul)*

This construction cost item accounts for the excavation of material in the existing channel bed. The unit cost includes excavating with the use of hydraulic excavators and assumes a limited amount (15%) of the material excavated would be hauled off-site for disposal. Front end loaders are assumed to load the trucks for hauling. The trucks are then assumed to travel 20-miles (one way) to a landfill for disposal of the material. A tipping fee is included in the cost as well.

1.3.2.4 *Grouted Riprap*

This construction cost accounts for the placement of the grouted riprap grade control structures that would be placed within the channel. The unit cost includes all materials (stone and concrete), transportation, and placement required for the structures.

1.3.2.5 *Excavation Embankment Control (All Material Haul)*

This construction cost item accounts for the excavation of materials on the existing slopes of the channel. The unit cost includes excavating with the use of conventional scrapers. The scrapers would also transport the excavated material to a stockpile site and assumes all (100%) the material excavated would be hauled off-site for disposal. Front end loaders are assumed to be used at the stockpile location to load the trucks for hauling. The trucks are then assumed to travel 20-miles (one way) to a landfill for disposal of the material. A tipping fee is included in the cost as well.

1.3.2.6 *Excavation Embankment Control (Medium Material Haul)*

This construction cost item accounts for the excavation of materials on the existing slopes of the channel. The unit cost includes excavating with the use of conventional scrapers. The scrapers would also transport the excavated material to a stockpile site and assumes half (50%) the material would be hauled off-site for disposal. Front end loaders are assumed to be used at the stockpile location. The trucks are then assumed to travel 20-miles (one way) to a landfill for disposal of the material. A tipping fee is included in the cost as well.

1.3.2.7 *Excavation Embankment Control (Limited Material Haul)*

This construction cost item accounts for the excavation of materials on the existing slopes of the channel. The unit cost includes excavating with the use of conventional scrapers. The scrapers would also transport the excavated material to a stockpile site and assumes a limited amount (15%) of the material excavated would be hauled off-site for disposal. Front end loaders are assumed to be used at the stockpile location to load the trucks for hauling. The trucks are then assumed to travel 20-miles (one way) to a landfill for disposal of the material. A tipping fee is included in the cost as well.

1.3.2.8 *Riprap*

This construction cost item accounts for the all the riprap to be placed as erosion protection along the revitalized channel. The unit cost accounts for the purchase of the stone material, transporting the material a distance of approximately 40-miles, and placing the stone with the use of hydraulic excavators.

1.3.2.9 *Grading*

This construction cost item accounts for grading of newly constructed slopes. The unit cost assumes utilizing grader and equipment operator.

1.3.2.10 *Turf Reinforcement Mat*

This construction cost item accounts for the material and placement of the reinforcement mats along designated slopes of the newly constructed channel. The cost for material and placement was provided by capable vendors. This quoted price was used as a sub-contractor bid in the estimate, and thus accrued appropriate sub-bid mark-ups.

1.3.2.11 *Rock at Reinforcement Mat Tie-In*

This construction cost item accounts for the rock required at the tie-in to the slope. The stone for this item is assumed to be purchased from a quarry in the greater Los Angeles region and trucked to the project site. The material would be placed with front end loaders.

1.3.2.12 *Top Soil*

This construction cost item accounts for the top soil that would be placed on top of the turf reinforcement mats. The soil is assumed to be all borrow material, and would need to be trucked to the site. The material is assumed to be placed with front end loaders and compacted.

1.3.2.13 *Vegetation*

This construction item accounts for the placement of vegetation along the channel where necessary. The unit cost accounts for all materials and labor required to place the vegetation. The cost is based on recent estimates of planting costs along channel ways.

1.3.2.14 *Concrete Demolition*

This construction cost item accounts for the demolition of existing concrete slabs, slopes and walls found within the channel. The concrete is assumed to be demolished with the use of a concrete pulverizer and hydraulic excavator. The concrete would then be loaded onto trucks for hauling to a concrete recycling facility. The cost includes the disposal fee at the recycle plant and a 10-mile (one way) haul distance.

1.3.2.15 *Subdrainage System Demolition*

This construction cost item accounts for the demolition of existing subdrainage piping. The excavation required to access the subdrains is assumed to be accounted for in the other excavation items in the estimate. The piping to be removed is assumed to be 12” in diameter.

1.3.2.16 *Chain Link Fence Demolition*

This construction item accounts for the removal of existing fencing that runs along the channel. The fence is assumed to be chain link and would require hauling off site for disposal.

1.3.2.17 *Clearing and Grubbing*

This construction cost item accounts for the clearing and grubbing of the existing channel slopes prior to any earthwork being performed. The crew includes the use of a hydraulic excavator and trucks for removal of material.

1.3.2.18 *6' Chain Link Fence*

This construction cost item accounts for the placement of a 6-foot high chain link fence. The unit cost accounts for all labor, equipment, and material costs required placing the fence.

1.3.2.19 *Aggregate Base Course*

This construction cost item accounts for the placement of an aggregate base layer beneath the required asphalt pavement. The base material is assumed to be purchased and then hauled to the project site from the greater Los Angeles area. The base layer is assumed to be 6-inches in depth, and would be placed with front end loaders and then compacted.

1.3.2.20 *Asphalt Pavement*

This construction cost item accounts for the placement of asphalt roadways. The asphalt layer is assumed to be 6-inches thick, and would be placed on an aggregate base layer, which is accounted for in another unit cost.

1.3.2.21 *Asphalt Demolition*

This construction cost item accounts for the demolition of existing asphalt roadways throughout the project. The asphalt would be demolished, and then loaded onto trucks for hauling off-site. A tipping fee is also included in the unit cost of this item.

1.3.2.22 *Utility Pole Relocations*

An assessment of the utilities within the project extent and the sub-measures for the study area have identified various reaches as having facility/utility relocations. There are numerous high voltage transmission line towers within the study area. The transmission towers are required to be relocated in order to complete many of the construction measures which include planned channel widening, creation of marsh lands and planting of riparian habitat, freshwater marsh creation, railroad trestling, and for removal of existing channel walls for connectivity.

According to the Real Estate Appendix, a preliminary real estate assessment following the guidelines set forth in Real Estate Policy Guidance Letter No. 31 was completed for the transmission tower relocations. Based on the real estate assessment, the transmission towers are of the type eligible for compensation and Los Angeles Department of Water and Power (LADWP) has been identified with a compensable interest in the property in the cases where the LADWP has been identified as the fee owner of the right of way. Further real estate analysis will need to be completed to determine whether LADWP has a compensable interest in the property in reaches 7 and 8. If LADWP is determined to have a compensable interest in the property the cost to relocate the identified utilities should be captured as a LERRD cost and not cost shared under the construction feature accounts.

This cost item accounts for the moving of the large steel transmission towers found throughout the project area. The unit cost was developed based on research into similar construction activities on recent projects. The costs and methodologies from these other projects were incorporated into this unit cost. This utility tower work is considered a relocation component and therefore the costs for these relocations are included under the 02 – Relocations feature account.

The above assumptions were further refined as alternatives were analyzed. Those utility relocations are described in 2.10.2 and 3.10.2.

1.3.2.23 *Compacted Fill (All Borrow Material)*

This construction cost item accounts for fill material to be placed for various structures throughout the project. The unit cost assumes the entire fill amount required (100%) would come from borrow material. Thus, the cost includes the price of the fill material delivered and stockpiled at the project site. It is assumed that the fill would be moved from a stockpile location, placed with a front end loader, and then compacted with a vibratory roller.

1.3.2.24 *Compacted Fill (Medium Borrow Material)*

This construction cost item accounts for fill material to be placed for various structures throughout the project. The unit cost assumes that half the fill amount required (50%) would come from borrow material, and the rest would come from on-site excavated material. The borrow material would need to be purchased, delivered and stockpiled at the project location. It is assumed that the fill would be moved from a stockpile location, placed with a front end loader, and then compacted with a vibratory roller.

1.3.2.25 *Compacted Fill (Limited Borrow Material)*

This construction cost item accounts for fill material to be placed for various structures throughout the project. The unit cost assumes that a portion of the fill amount required (15%) would come from borrow material, and the rest would come from on-site excavated material. The borrow material would need to be purchased, delivered and stockpiled at the project location. It is assumed that the fill would be moved from a stockpile location, placed with a front end loader, and then compacted with a vibratory roller.

1.3.2.26 *Compacted Fill (No Borrow Material)*

This construction cost item accounts for fill material to be placed for various structures throughout the project. The unit cost assumes the entire fill amount required would come from on-site material that has previously been excavated. It is assumed that the fill would be moved from a stockpile location, placed with a front end loader, and then compacted with a vibratory roller.

1.3.2.27 *Sub Drainage System*

This construction item accounts for the placement of the sub drainage system for the reinforced concrete walls. The unit cost includes several items. The drainage piping is assumed to be 12-inch diameter perforated PVC piping. This piping would be placed in the middle of a gravel packing, which would all be encased by geotextile fabric. Weep holes are assumed to be placed approximately every 10-feet along the drainage system.

1.3.2.28 *Demo Grouted Riprap*

This construction item accounts for the removal of the existing grouted riprap found along the channel. The unit cost includes demolishing the grouted stone and loading the material onto trucks. The trucks would transport the material to a proper disposal location.

1.3.2.29 *Riprap Demolition*

This construction item accounts for the removal of the existing riprap found along the current channel. The material would be removed with hydraulic excavators. The removed stone is then assumed to be crushed prior to being loaded and hauled off-site for disposal.

1.3.2.30 *Remove Spalls*

This construction item accounts for the removal of the spalls found in the current channel. The spalls would be removed with the use of hydraulic excavators. The spalls would then be loaded onto trucks for disposal off-site.

1.3.2.31 *Sheet Pile Wall Demolition*

This construction item accounts for the removal of existing sheet pile walls found in several sub-reaches. The sheet piles would be removed with the use of a hydraulic crane crew. No tipping fee has been included as the sheet piles are assumed to provide some salvage value.

1.3.2.32 *Reinforced Concrete Retaining Wall*

This construction item accounts for the placement of a reinforced concrete wall in the locations noted in the typical sections. The unit cost for this item includes costs for the formwork, concrete material, and concrete placement. The concrete is assumed to be pumped into place. An assumption of 150-lbs of reinforcing steel per cubic yard of concrete has been included as well.

1.3.2.33 *Retaining Wall Gravel*

This construction item accounts for the placement of the base material required beneath the retaining wall structures. The unit cost accounts for material and delivery of the gravel, as well as placement with front end loaders.

1.3.2.34 *Reinforced Concrete Planters*

This construction item accounts for the placement of the concrete planters along the channel slope in designated sub-reaches. The planters would be terraced up the slopes and consist of slab portions and vertical wall portions. The unit cost accounts for all formwork, concrete material, placement by pumping, and reinforcing steel required for the planters' construction.

1.3.2.35 *Railroad Bridge*

This construction item accounts for the placement of a new railroad bridge that would be constructed within the channel. The bridges are assumed to be placed on top of concrete caissons. A concrete deck would then be placed prior to installation of the rail line. It is assumed that the bridges are for single rail lines only. The unit cost for this item accounts for all labor, equipment and materials required to place the aforementioned items. The costs for this item are included under the 02 – Relocations feature account.

1.3.2.36 *Impermeable Liner*

This construction item accounts for the placement of the liner in order to create a flood control basin. The unit cost includes all material and placement costs of the liner.

1.3.2.37 *Reinforced Concrete Elevated Slab*

This construction item accounts for the placement of a reinforced concrete elevated slab in the locations noted in the typical sections. The unit cost for this item includes costs for the formwork, concrete material, and concrete placement. The concrete is assumed to be pumped into place. An assumption of 150-lbs of reinforcing steel per cubic yard of concrete has been included as well.

1.3.2.38 *Reinforced Concrete Slab*

This construction item accounts for the placement of a reinforced concrete slab in the locations noted in the typical sections. The unit cost for this item includes costs for the formwork, concrete material, and concrete placement. The concrete is assumed to be pumped into place. An assumption of 150-lbs of reinforcing steel per cubic yard of concrete has been included as well.

1.3.2.39 *Reinforced Concrete Piers*

This construction item accounts for the placement of a reinforced concrete piers in the locations noted in the typical sections. The unit cost for this item includes costs for the formwork, concrete material, and concrete placement. The concrete is assumed to be pumped into place. An assumption of 150-lbs of reinforcing steel per cubic yard of concrete has been included as well.

1.3.2.40 *Underground Basins*

This construction item accounts for the creation of underground basins for water storage. The basins are assumed to be constructed of metal piping. The unit cost includes all material and labor to install the pipes for basin creation.

1.3.2.41 *Storm Drain Daylighting*

This construction item accounts for the placement of a new storm drain, associated piping and 1-acre of vegetation. The unit cost includes purchasing and placing a precast concrete storm drain that has a splitter sending low flows out a 24-inch pipe that would output flows into a wetland area, while high flows would exit the storm drain through a 36” pipe that outputs the flows into the river. The wetland area would be vegetated as well. Costs for the storm drain and piping were provided by vendor quotes.

1.3.2.42 *Four 24’ Diameter Tunnels*

This construction item accounts for the drilling and commissioning of four 24-foot diameter tunnels along an 8.2-mile stretch. The unit cost for this item was calculated from a quote provided by capable contractors, whom provided a cost for drilling and constructing one tunnel.

1.4 Price Level

The effective price level date for the alternatives estimates are April 2013. This date applies to all elements of the alternative cost estimates.

1.5 Project Markups and Functional Costs

1.5.1 Escalation

No escalation has been included in the alternative estimates.

1.5.2 Preliminary Alternative Estimates Contingency

Contingencies represent allowances to cover unknowns, uncertainties and/or unanticipated conditions that are not possible to adequately evaluate from the data on hand at the time the cost estimate is prepared but must be represented by a sufficient cost to cover the identified risks. An overall contingency of 25% has been used to cover design changes and uncertainties in quantities and unit prices for the preliminary alternatives analysis.

1.5.3 Real Estate Costs

The costs for this feature were developed by the City of Los Angeles and USACE in August 2013. Costs were developed for each alternative in each sub-reach, and applied appropriately within the alternatives matrix.

1.5.4 Relocation Costs

The total costs for this feature include other costs developed by the USACE in August 2013 as well as the railroad bridge costs estimated within this document. Costs prepared by the USACE were developed in accordance with P.L. 91-646 for businesses that would require relocation and more detailed discussion of the relocation costs is provided in the Real Estate Plan.

1.5.5 Mobilization and Demobilization

Costs for this item were estimated to be 7.5% of construction costs. This item accounts for transporting equipment and crews to the project site, setting up site facilities and staging areas, as well as demobilizing all equipment and crews, removal of staging areas and disassembly of all other field facilities after construction is complete.

1.5.6 Planning, Engineering and Design

Costs for this account were estimated at 11% of construction costs. This account covers the preparation of plans, specifications, and engineering during construction.

1.5.7 Construction Management

Costs for this account were estimated to be 6.5% of construction costs. This account covers construction management during the construction phase.

1.5.8 Operations and Maintenance (O&M)

Costs for this item account for the routine work that is expected to occur each year over the life cycle of the project. Costs were developed for this by using percentages of the original installation cost for each item. A table the overall O&M costs for each sub-reach can be found in Attachment 4.

1.6 Interest During Construction

Interest during construction (IDC) is the opportunity cost of capital, which is an economic cost incurred while construction funds are expended but benefits have not yet begun to accrue. This value is calculated from the overall costs, the construction duration, and the Federal discount rate (at time of calculation the rate was 3.75%). The IDC values can be found in the alternatives matrix in Attachment 1.

1.7 Annualized Costs

Annualized construction and O&M costs have been calculated within the alternatives matrix spreadsheet. These costs have been annualized over the 50-year life cycle of the project. The assumed Federal discount rate at time of the calculations was 3.75% and this value was used in the computing of the annualized costs.

1.8 Spreadsheet Estimates

Alternative cost estimates have been developed that contain all sub-measures found in each sub-reach. These estimates can be found in Attachment 3. The spreadsheet estimates are split into the eight sub-reaches. Each sub-reach in turn has estimates of each restoration measure that may be constructed in the sub-reach. These spreadsheet estimates are construction costs only and do not contain any of the project markups or functional cost items referenced above.

1.9 Final Array of Alternatives

The nineteen restoration alternatives, listed in Attachment 1, were analyzed as described in the Economics and Plan Formulation Appendix to identify the final array of alternatives. The final array consists of four alternatives that have been renamed to identify the recombination of restoration components. Each of the final array alternatives include a mixture of components taken from the initial nineteen alternatives and the table below includes the alternatives and reaches that compose the final array. The right hand column of the Table 1.1 includes the reaches and lists the preliminary array of nineteen alternatives from which the measures included in the final array originated.

Table 1.1 Final Array of Alternatives Summarized

Final Array Name	Reaches and Alternatives	
10 **ARBOR Riparian Transitions (ART)**	Reach 1 - A11 Reach 2 - A11 Reach 3 - A17 Reach 4 - A16	Reach 5 - A16 Reach 6 - A14 Reach 7 - A9 Reach 8 - A15
13 **ARBOR Corridor Extension (ACE)**	Reach 1 - A11 Reach 2 - A11 Reach 3 - A16 Reach 4 - A16	Reach 5 - A16 Reach 6 - A13 Reach 7 - A12 Reach 8 - A15

16 **ARBOR Narrows to Downtown (AND)**	Reach 1 - A11 Reach 5 - A5 Reach 2 - A11 Reach 6 – A13 Reach 3 - A16 Reach 7 - A12 Reach 4 - A16 Reach 8 - A3
20 **ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER)**	Reach 1 - A11 Reach 5 - A5 Reach 2 - A13 Reach 6 - A13 Reach 3 - A18 Reach 7 - A16 Reach 4 - A16 Reach 8 - A3

Total first costs (not including O&M, interest during construction, or escalation) for the final array of alternatives are summarized in Table 1.2, and a detailed breakdown of costs can be found in Attachment 5.

1.9.1 Recreation Costs

Recreation costs that were developed for the final array of alternatives are included in Table 1.2. The recreation plan includes modifications, upgrades, and creation of multi-use trails and amenities (access points, wildlife viewpoints, parking lots, restrooms and signage). The plan also includes several non-motorized multi-use bridges that span the river and tributaries.

A detailed discussion of the Recreation plan can be found in Appendix B (Economic Appendix), and detailed cost estimates of the Recreation items can be found in Attachment 6 here within. As described in the Appendix B the recreation plan was refined for Alternatives 13 and 20. The costs for those two recreation plans have been developed in MCACES.

1.9.2 Abbreviated Risk Analysis

An Abbreviated Risk Analysis (ARA) was completed in order to develop the contingencies for the Channels; Planning, Engineering and Design; and Construction Management feature accounts of the four final array alternatives. A single risk register was developed due to the similarity of the construction components between each of the four alternatives. The individual construction element contingencies calculated from the risk register were then pulled out and applied to each alternative's construction costs to generate the weighted construction contingencies seen in Table 1.2. The ARA and the calculated construction contingency spreadsheet can be found in Attachment 7.

Table 1.2 Final Array of Alternatives Cost Estimates by Work Breakdown Structure

Alt 10 - ARBOR Riparian Transitions (ART)

WBS No.	Feature Account	First Costs	Contingency (%)	Total Costs
01	Lands and Damages	$247,425,237	20.00%	$296,910,284
02	Relocations[1]	$11,392,360	20.00%	$13,670,832
09	Channels	$39,947,368	38.83%	$55,456,944
14	Recreation	$4,543,482	35.00%	$6,133,701
30	Planning, Engineering and Design	$6,147,153	24.40%	$7,647,058
31	Construction Management	$3,632,409	26.25%	$4,585,916
			Total Project Cost:	**$384,404,735**

1) Relocation cost and contingency provided by USACE.

Alt 13 - ARBOR Corridor Extension (ACE)

WBS No.	Feature Account	First Costs	Contingency (%)	Total Costs
01	Lands and Damages	$250,048,826	20.00%	$300,058,591
02	Relocations[1]	$11,392,360	20.00%	$13,670,832
09	Channels	$88,459,438	36.01%	$120,312,641
14	Recreation	$4,543,482	35.00%	$6,133,701
30	Planning, Engineering and Design	$11,483,481	24.40%	$14,285,450
31	Construction Management	$6,785,693	26.25%	$8,566,938
			Total Project Cost:	**$463,028,152**

1) Relocation cost and contingency provided by USACE.

Alt 16 - ARBOR Narrows to Downtown (AND)

WBS No.	Feature Account	First Costs	Contingency (%)	Total Costs
01	Lands and Damages	$278,031,210	20.00%	$333,637,452
02	Relocations[1]	$35,422,360	32.14%	$46,805,411
09	Channels	$261,753,170	37.89%	$360,927,221
14	Recreation	$4,543,482	35.00%	$6,133,701
30	Planning, Engineering and Design	$33,189,091	24.40%	$41,287,230
31	Construction Management	$19,611,736	26.25%	$24,759,816
			Total Project Cost:	**$813,550,831**

1) Relocation cost includes costs provided by the USACE and Railroad Bridge construction. Contingency is weighted average of contingencies provided by the USACE and calculated contingency from ARA.

Alt 20 - ARBOR Riparian Integration Via Varied Ecological Reintroduction (RIVER)

WBS No.	Feature Account	First Costs	Contingency (%)	Total Costs
01	Lands and Damages	$352,858,303	20.00%	$423,429,964
02	Relocations[1]	$49,072,002	31.46%	$64,511,752
09	Channels	$363,575,556	39.38%	$506,743,287
14	Recreation	$4,543,482	35.00%	$6,133,701
30	Planning, Engineering and Design	$45,891,014	24.40%	$57,088,422
31	Construction Management	$27,117,418	26.25%	$34,235,740
			Total Project Cost:	**$1,092,142,864**

1) Relocation cost includes costs provided by the USACE and Railroad Bridge construction. Contingency is weighted average of contingencies provided by the USACE and calculated contingency from ARA.

1.10 Alternatives Modification Addendum

Following public review, further analysis was performed that included a more detailed cost analysis using MCACES software, real estate cost updates, and further modified contingencies based upon a full cost risk summary analysis. This analysis identified a more cost effective variation on Alternative 13 (referred to throughout the IFR and Appendices as “Alternative 13v”) that is identical to Alternative 13 except for Reach 7, where it includes the reach plan included in Alternative 20 that provides 10 acres of marsh and a connection to the Los Angeles State Historic Park. As described in the IFR, the previously identified NER Plan has been modified to include the substitution of the Reach 7 plan on the basis of the analysis referenced above; Alt 13v is the NER Plan. Because the analysis in this Appendix included analysis of all of the components of Alt 13v, no separate or additional analysis is necessary. For the assessment of Alt 13v for Reaches 1-6 and 8, see the Alternative 13 analysis included in this Appendix. For the assessment of Alt 13v for Reach 7, see the Alternative 20 analysis included in this Appendix.

Subsequent sections of this appendix are based upon Alternative 13v as the NER Plan.

2. MCACES (MII) CONSTRUCTION COST ESTIMATE – NATIONAL ECOSYSTEM RESTORATION PLAN

2.1 Introduction

2.1.1 General

Section 2 of this appendix documents the various unit costs and construction assumptions utilized for the Los Angeles River Ecosystem Restoration project's National Ecosystem Restoration (NER) Plan cost estimate. The NER Plan is Alternative 13v. This alternative incorporates various construction features as discussed below.

2.1.2 Purpose

The purpose of this work is to develop a detailed cost estimate for the Los Angeles River Ecosystem Restoration Project – consistent to the level of design – for the cost and quantities of the project features using Micro-Computer Aided Cost Estimating System (MCACES).

2.1.3 Design Features

The design features for the sub-reaches are designed at a conceptual level. Features for the NER Plan include concrete demolition; excavation and fill; riprap; grouted riprap; turf reinforcement mats; fencing; clearing and grubbing; reinforced cast-in-place concrete; sub-drainage system; asphalt; multi-use trail; trail access points; pedestrian bridges and other recreation components.

2.1.4 Design Limitations

As noted in Section 1 of this appendix, the current designs are based on preliminary, planning-level conceptual designs, and common engineering practices. The design level used to complete the MCACES construction cost estimate has not progressed beyond the level used at the alternatives analysis stage. More detailed assumptions have been developed for key construction items that were not included in the alternatives analysis, which primarily includes diversion and control of water elements.

2.2 Basis of Estimate

2.2.1 Basis of Design

Available design documents of the project elements are listed below

- Los Angeles River Feasibility Study Conceptual Design Drawings, Tetra Tech
- Los Angeles River Feasibility Study Design Report, Tetra Tech
- Los Angeles River As-Built Drawings, Various Dates, USACE

2.2.2 Basis of Quantities

The NER Plan cost estimate is based on the project quantity take-offs that have been calculated in accordance with the documents above. A quantity summary and detailed quantity take-offs that correspond to the MCACES cost estimate are found in Attachment 8, which is for official use only and available upon request.

2.3 Project Schedule

It is estimated that the overall project would take approximately 129 months. The durations used in the NER Plan estimate to determine costs for the contractor to maintain field facilities and provide construction supervision have been taken from the tentative project schedule's construction durations. A simplified tentative project schedule, that includes PED, is presented in Attachment 9. This schedule was developed with the following assumptions:

- Assumed durations for PED and all activities leading up to construction.
- Assumes construction starts at reach 6 and proceeds upstream. Reaches 7 and 8 would be constructed last in order to allow sufficient time for the LATC Relocation work.
- Assumes no in-channel construction from October 15th through April 15th.
- Assumes recreational items in a reach will be completed after all other construction activities are finished at that reach.

2.4 Acquisition Plan

The NER Plan cost estimate is based on five contracts being awarded to separate prime contractors with subcontractors for landscaping, asphalt, fencing and recreation item construction. Four of the contracts would consist of the primary ecosystem restoration construction activities, while the fifth contract would be for the LATC relocation efforts. The prime contractors would be responsible for all the preparatory work, and placing all associated site work as well as overseeing the subcontractors' work. The estimate currently assumes that the project would be let out in an unrestricted bid process and is expected to have a competitive bidding market. Also, no small business contracts are assumed due to the overall size of the project.

2.5 Project Construction

2.5.1 Mobilization/Demobilization

Mobilization and demobilization costs account for the transportation of all construction equipment and personnel to and from the project site. All equipment and labor is assumed to be available in the Los Angeles area.

2.5.2 Staging and Site Access

The project would require multiple staging and access roads throughout the reaches. The cost estimate assumes at least one staging area would be constructed in each reach along with at least one stretch of access road. The staging areas and access roads are assumed to be cleared and grubbed, graded and have a gravel layer placed over them.

2.5.3 Borrow/Disposal Areas and Materials

All required construction materials are assumed to be available from the greater Los Angeles area. All material quotes include estimated deliver prices to the general project area.

All demolished materials are assumed to be hauled off-site for disposal. Excavated earth material is assumed to be hauled to a disposal site within 20-miles of the project. All asphalt and concrete materials are also assumed to be hauled within 20-miles of the site and disposed at a recycle plant or landfill.

2.5.4 Construction Methodology

- Contract 1 – Reach 6
    - Reach 6: Prior to the construction of the primary restoration measures, several utility towers would be relocated outside of the project footprint. Construction activities in this reach assume placing approximately 2,000-lf of inflatable cofferdams for water control. The inflatable dams are assumed to be used on the natural bottom sections of the channel. This length of cofferdam would require to be moved multiple times in order to complete construction. The construction work would include four restoration measures from the alternatives analysis, as well as construction of recreation components. These items are described below:
        - Measure 21/22 – The existing embankments would be excavated. Once complete a new asphalt access road and chain link fencing would be constructed.
        - Measure 16 – Bioengineering Channel Walls: This would require the placement of turf reinforcement mats along the banks. These mats would require a gravel tie-in section as well as installation of a chain link fence in certain sections to keep the public off the mats.
        - Measure 19 – Bioengineering Channel Walls: This would require the placement of turf reinforcement mats along the banks. These mats would require a gravel tie-in section as well.
        - Measure 17 – Habitat Corridors/Riparian Planting on Banks: The new banks would be vegetated after the other restoration measures are completed. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.
        - Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include new unpaved trails, trail access points, restroom facilities, parking lot, a pedestrian tunnel and a pedestrian bridge.

- Contract 2 – Reaches 3, 4 and 5
    - Reach 5: Construction activities in this reach assume placing an inflatable cofferdam as required for the storm drain construction. This type of cofferdam is assumed to be used due to the natural bottom channel section found in this reach. The construction work would include one restoration measure from the alternatives analysis, as well as construction of recreation components. These items are described below:
        - Measure 2 – Daylight Streams: This work would involve taking the low flow from the existing storm drain into a wetland and return to the river through the storm drain system. Excavation would be required to access the existing storm drain components. The placing of a precast concrete storm drain that has a splitter that would send low flows out a 24-inch pipe that would outlet into a wetland area, while high flows from the existing drain would exit the storm drain through a 36-inch pipe that outlets into the river. The wetland area would be vegetated.
        - Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include trail access points and wildlife viewpoints.
    - Reach 4: Construction activities in this reach assume placing small k-rail cofferdams for the side channel work and inflatable cofferdams for the in-channel work. The construction activities would include four restoration measures from the alternatives analysis, as well as construction of recreation components. These items are described below:
        - Measure 4 – Grade Adjacent Areas to Lower Elevation Side Channel (G): The existing slopes at side channel G would require excavation. It is assumed that all materials would be hauled off-site for disposal.
        - Measure 10 – Divert Tributary & River Flow into Side Channels (F): The banks alongside channel F would require excavation and riprap placement. It is assumed that all excavated materials would be hauled off-site for disposal.
        - Measure 3/5 – Create Geomorphology and Plant for Freshwater Marsh: This work requires the construction of grade control structures within the existing channel. These grade controls would require excavation, grouted riprap placement and compacted backfill. It is assumed that all the backfill material would come from the excavation work, and any excess material would be hauled off-site for disposal.
        - Measure 2 – Daylight Streams: This work would involve taking the low flow from the existing storm drain into a wetland and return to the river through the storm drain system. Excavation would be required to access the existing storm drain components. The placing of a precast concrete storm drain that has a splitter that would send low flows out a 24-inch pipe that

would outlet into a wetland area, while high flows from the existing drain would exit the storm drain through a 36-inch pipe that outlets into the river. The wetland area would be vegetated.

- Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include conversion of existing access roads to un-paved multi-use trails, trail access points, and wildlife viewpoints.

- Reach 3: Construction activities in this reach assume placing small k-rail cofferdams for the side channel work and k-rail cofferdam down the center of the channel for the main channel work. The construction activities would include four restoration measures from the alternatives analysis, as well as construction of recreation components. These items are described below:

  - Measure 10 – Divert Tributary & River Flow into Side Channels (E): The banks alongside channel E would require excavation and riprap placement. It is assumed that excavated material required for compacted fill (in measure 3/5) will be stockpiled, and any excess hauled off-site.

  - Measure 3/5 – Create Geomorphology and Plant for Freshwater Marsh: This work requires the construction of grade control structures within the existing channel. These grade controls would require riprap and compacted backfill. It is assumed that all the backfill material would come from the excavation work at this reach, and any excess material would be hauled off-site for disposal.

  - Measure 2 – Daylight Streams: This work would involve taking the low flow from the existing storm drain into a wetland and return to the river through the storm drain system. Excavation would be required to access the existing storm drain components. The placing of a precast concrete storm drain that has a splitter that would send low flows out a 24-inch pipe that would outlet into a wetland area, while high flows from the existing drain would exit the storm drain through a 36-inch pipe that outlets into the river. The wetland area would be vegetated.

  - Measure 17 – Habitat Corridors/Riparian Planting on Banks: This reach would require new vegetation after the other restoration measures are completed. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.

  - Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include conversion of existing access roads to un-paved multi-use trails, new unpaved trails and wildlife viewpoints.

- Contract 3 – Reaches 1 and 2
    - Reach 2: Construction activities in this reach assume all work is outside of the water levels and therefore do not require any dewatering efforts. The construction work would include one restoration measure from the alternatives analysis, as well as construction of recreation components. These items are described below:
        - Measure 17 – Habitat Corridors/Riparian Planting on Banks: This reach would require new vegetation to be placed along the existing banks. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.
        - Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include existing trail improvements, new unpaved trails, trail access points, restroom facilities, and wildlife viewpoints.
    - Reach 1: Construction activities in this reach assume all work is outside of the water levels and therefore do not require any dewatering efforts. The construction work would include one restoration measure from the alternatives analysis, as well as construction of recreation components. These items are described below:
        - Measure 17 – Habitat Corridors/Riparian Planting on Banks: This reach would require new vegetation to be placed along the existing banks. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.
        - Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include existing trail improvements, new unpaved trails and trail access points.
- Contract 4 – Reaches 7 and 8
    - Reach 8: Construction activities in this reach assume placing two k-rail cofferdams. These cofferdams would be used to control flows at the entrance and exit of the side channel into LATC. The construction work would include two restoration measures from the alternatives analysis, as well as construction of recreation components. These items are described below:
        - Measure 6 – Rebuild Geomorphology for Historic Wash (LATC): This area would require excavation and riprap placement. It is assumed that all excavated materials would be hauled off-site for disposal.
        - Measure 17 – Habitat Corridors/Riparian Planting on Banks: The LATC area would be re-vegetated after construction. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.

- Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include new unpaved trails, trail access points, restroom facilities, parking lot and a pedestrian bridge.

- Reach 7: Prior to the construction of the primary restoration measures, several utility towers would be relocated outside of the project footprint. The primary construction activities in this reach assume placing a k-rail cofferdam down the middle of the channel for approximately half the length. One side of the channel would be constructed then, the cofferdam would be shifted such that the other side could be constructed. Then the cofferdam would be moved to the second half of the channel length to complete the work. The construction activities would include five restoration measures from the alternatives analysis, as well as construction of recreation components. These items are described below:

  - Measure 1 – Railroad Trestle: This work would involve the construction of a railroad trestle through this reach. The trestle work assumes only installing items directly associated with the trestle structure and the railroad track components (rails, ballast, ties, etc.). It is assumed that the trestle would be a concrete structure with pilings or caissons constructed to support the elevated deck and rails. This work is considered a relocation effort, and is therefore included under the 02 Account.

  - Measure 27 – Tributary Channels/Widen Channel (Arroyo Seco): The existing reinforced concrete channel wall and chain link fencing would be demolished. The embankment would be excavated as shown in the typical sections. It is assumed that all excavated materials would be hauled off-site for disposal. Once completed, turf reinforcement mats, a new asphalt access road, and chain link fencing would be constructed. Also, the area would be re-vegetated to include the placement of shrubs, trees and seeding. It is assumed that this area would require temporary irrigation.

  - Measure 8 – Corn Field: This area would require excavation. It is assumed that all excavated materials would be hauled off-site for disposal. Once completed, a new impermeable liner, asphalt access road, and chain link fencing would be constructed. Also, this area would be re-vegetated to include the placement of shrubs, trees and seeding. It is assumed that this area would require temporary irrigation.

  - Measure 26 – Terrace Banks: The existing reinforced concrete along the right bank would be demolished. This would involve removing the concrete and chain link fencing. Once completed, reinforced concrete planters, a new asphalt access road, and chain link fencing would be constructed. Also, the area would be re-vegetated to include the placement of shrubs, trees and seeding. It is assumed that this area would require temporary irrigation.

  - Measure 17 – Habitat Corridors/Riparian Planting on Banks: The new banks would be vegetated after all measure work is complete. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.

        - Measure 2 – Daylight Streams: This work would involve taking the low flow from the existing storm drain into a wetland and return to the river through the storm drain system. Excavation would be required to access the existing storm drain components. The placing of a precast concrete storm drain that has a splitter that would send low flows out a 24-inch pipe that would outlet into a wetland area, while high flows from the existing drain would exit the storm drain through a 36-inch pipe that outlets into the river. The wetland area would be vegetated.

- Contract 5- LATC Reach 8
    - Construction activities assume that the LATC Intermodal Facility would be replaced in kind at another location. The LATC is located in Reach 8 but the costs for this work are assumed to be under a separate contract that would be completed prior to Reach 8 being constructed. Costs for this work include providing similar infrastructure and operations to rail lines, replacing or removing rubber tires gantry cranes, reconstructing facilities at the new location, which would also include all new structures and security facilities. It is assumed that the NFS would provide this site as part of the LERRDs for the project.

2.5.5 Unusual Conditions

None anticipated to significantly impact the estimate.

2.5.6 Unique Construction Techniques

No unique construction techniques are anticipated to be required.

2.5.7 Equipment/Labor Availability and Distance Traveled

All equipment and labor is assumed to be available in the greater Los Angeles area.

2.6 Effective Dates for Labor, Equipment and Material Pricing

The labor, equipment, and material pricing were developed using the MCACES 2012 English Unit Cost Library, 2014 Los Angeles County Labor Library (see Attachment 10), and the 2011 Equipment Library (Region VII) for the base cost estimates. The index pricing data has been prepared in October 2014 dollars.

The cost estimate has been updated with current quoted fuel prices of $3.36/gal for off-road diesel, $4.11/gal for on-road diesel and $4.01/gal for gasoline in the Los Angeles area.

2.7 Estimated Production Rates

The estimate contains many user created cost items that were developed outside of the MCACES Unit Cost Library. These developed cost items have had crews and production rates created in order to accurately calculate unit costs. See Attachment 11 for the Estimated Production Rate Calculations for these construction items.

2.8 Direct and Contractor Markups

2.8.1 Direct Markups

The cost estimate includes a 9% sales tax on all material cost items.

2.8.2 Contractor Markups

The prime contractor Job Office Overhead (JOOH) markups are based on calculated percentages currently within MCACES. The JOOH calculations are based on the estimated duration for all construction components. A running percentage has been used in the estimated for the prime contractor Home Office Overhead (HOOH) markup for all contracts. Profit is included for the prime contractors and is calculated using the profit weighted guideline calculation within MCACES. Bonding has also been included for all prime and sub-contractors.

2.9 Project Markups

2.9.1 Escalation

Price levels have been escalated from effective price levels of the construction cost estimate for October 2014 (1Q15) to the mid-points of construction for each contract. The appropriate escalation cost factors for each date and for each feature account have been calculated within the Total Project Cost Summary.

2.9.2 Contingency

An overall 33.8% contingency has been included in the estimate for all the feature accounts except for Lands and Damages and the LATC relocation contract. A separate contingency was developed for these two items, which was based on the incremental costs and general contingencies developed by the entity that completed the cost estimates for those components. A Cost and Schedule Risk Analysis (CSRA) has been performed to support the construction contingency listed above. See Attachment 12 for the full CSRA report for the NER Plan.

2.10 Functional Costs

2.10.1 01 Account – Lands and Damages

The current estimated cost for this account comes from the Real Estate Plan found in Appendix G of the main report. The costs include the real estate required to be purchased as well as business relocation costs. This account also includes incremental costs and other contingencies that have been used as the total contingency for this account within the TPCS.

2.10.2 02 Account – Relocations

The cost for this account includes costs for the relocation of existing utility towers, construction of the railroad trestles, and the relocation of the LATC Intermodal Facility. Only the costs for the utility towers, trestles, and pipe lines were estimated in MCACES. The LATC facility was estimated as a Class IV estimate outside of MCACES, but input as a lump sum into the estimate for reference. The LATC facility is assumed to be replaced in kind at another location within the Los Angeles basin. The relocation costs for this facility is assumed to be a separate construction contract.

An assessment of the utilities within the project extent and the sub-measures for the study area have identified Reaches 6 and 7 as having facility/utility relocations. In Reach 6 there are five high voltage transmission line towers within the study area where there is planned channel widening, creation of marsh lands and planting of riparian habitat. In order to accomplish the sub-measures the area would need to be graded to a lower elevation and banks would need to be sloped back. In Reach 7, two transmission line towers have been identified as utility relocations. In this reach, the freshwater marsh would be restored and connected under a railroad trestle with the right bank of the river channel terraced.

According to the Real Estate Appendix, a preliminary real estate assessment following the guidelines set forth in Real Estate Policy Guidance Letter No. 31 was completed for the transmission towers in Reach 6 and 7. Based on the real estate assessment, the transmission towers are of the type eligible for compensation and Los Angeles Department of Water and Power (LADWP) has been identified with a compensable interest in the property in the cases where the LADWP has been identified as the fee owner of the right of way. Further real estate analysis will need to be completed to determine whether LADWP has a compensable interest in the property in reach 7. If LADWP is determined to have a compensable interest in the property the cost to relocate the identified utilities should be captured as a LERRD cost and not cost shared under the construction feature accounts.

The cost of relocating the large steel transmission towers found in Reaches 6 and 7 of the project area was developed based on research into similar construction activities on recent projects. The costs and methodologies from these other projects were incorporated into this unit cost. This utility tower work is considered a relocation component and therefore the costs for these relocations are included under the 02 – Relocations feature account.

2.10.3 06 Account – Fish and Wildlife Facilities

Costs for this account are based on the estimated construction costs for all construction activities referenced above that are not accounted for in the 02 or 14 feature accounts. This account was estimated within MCACES software.

2.10.4 06 Account – Fish and Wildlife Facilities (Monitoring & Adaptive Management)

Costs for this account are based on estimated costs for monitoring and adaptive management that has been provided by the Environmental Resource Branch of the Los Angeles District.

2.10.5 14 Account – Recreation

Costs for this account are based on the estimated construction costs for the recreation plan. These components were estimated with the MCACES program.

2.10.6 30 Account – Planning, Engineering and Design

Costs for this account were estimated as percentages of the construction costs for the various feature accounts. This account covers the preparation of plans, specifications, and engineering during construction. The percentages used for contracts one through four were provided and verified by the Los Angeles District's Cost Engineering & Specifications Section, while the PED percentage for the LATC work was estimated by the sub-contractor whom completed the relocation estimate. Table 2.1 provides the various PED percentages used for each feature account within each contract.

Table 2.1 PED Percentages by Contract

Contract	Reaches	WBS Items	PED Percent
1	Reach 6	02, 06, 14	14.5%
2	Reaches 3, 4 & 5	02, 06, 14	14.5%
3	Reaches 1 & 2	02, 06, 14	14.5%
4	Reaches 7 & 8	02, 06, 14	14.5%
5	LATC Relocation	02	3.5%

2.10.7 31 Account – Construction Management

Costs for this account were estimated as percentages of construction costs of the various feature accounts. This cost is assumed to cover construction management during construction. This percentage used for contracts one through seven was provided and verified by the Los Angeles District's Cost Engineering & Specifications Section, while the CM percentage for the LATC work was estimated by the sub-contractor whom completed the relocation estimate. Table 2.2 provides the various CM percentages used for each feature account within each contract.

Table 2.2 CM Percentages by Contract

Contract	Reaches	WBS Items	CM Percent
1	Reach 6	02, 06, 14	6.5%
2	Reaches 3, 4 & 5	02, 06, 14	6.5%
3	Reaches 1 & 2	02, 06, 14	6.5%
4	Reaches 7 & 8	02, 06, 14	6.5%
5	LATC Relocation	02	2.2%

2.11 MCACES Construction Cost Estimate

The construction cost estimate was developed using MCACES 2nd Generation (MII) cost estimating software in accordance with guidance contained in ER 1110-2-1302, Civil Works Cost Engineering. See Attachment 13 for the MCACES construction cost estimate summary output report.

2.12 Total Project Cost Summary (TPCS)

The TPCS was prepared using the latest TPCS Excel spreadsheet provided by the USACE, Walla Walla District. The TPCS incorporates the construction costs developed in the MII, the project markups, and the functional costs. See Attachment 14 for the TPCS spreadsheet.

The TPCS also contains the proposed cost share agreement between the Federal and Non-Federal agencies. The proposed cost share is atypical and more information on the cost share can be found in Chapter 7 of the Integrated Feasibility Report. The cost share agreement shown on the TPCS is estimated based on the following assumptions:

Table 2.3 NER Plan Proposed Cost Share

Feature Account	Federal Percent (%)	Non-Federal Percent (%)
01 – Lands and Damages[1]	0%	100%
02 – Relocations[1]	0%	100%
06 – Fish and Wildlife Facilities[2]	100%	0%
14 – Recreation	50%	50%
30 – Planning, Engineering, & Design (Ecosystem Restoration Only)	100%	0%
30 – Planning, Engineering, & Design (Recreation Only)	50%	50%
31 – Construction Management (Ecosystem Restoration Only)	100%	0%
31 – Construction Management (Recreation Only)	50%	50%

Notes:
1) Non-Federal PED and Construction Management Costs for Ecosystem Restoration are for Relocations and therefore considered part of LERRD's.
2) Federal Administration Cost – Federal administrative costs of LERRD acquisition oversight.

3. MCACES (MII) CONSTRUCTION COST ESTIMATE – LOCALLY PREFERRED PLAN

3.1 Introduction

3.1.1 General

Section 3 of this appendix documents the various unit costs and construction assumptions utilized for the Los Angeles River Ecosystem Restoration project's locally preferred plan (LPP) cost estimate. The LPP is Alternative 20, ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER). This alternative incorporates various construction items from each of the eight reaches of the project.

3.1.2 Purpose

The purpose of this work is to develop a detailed cost estimate for the Los Angeles River Ecosystem Restoration Project – consistent to the level of design – for the cost and quantities of the project features using Micro-Computer Aided Cost Estimating System (MCACES).

3.1.3 Design Features

The design features for the sub-reaches are designed at a conceptual level (refer to section 1.3 of this appendix for discussion of individual design feature assumptions). Features for the LPP include concrete demolition; excavation and fill; riprap; grouted riprap; turf reinforcement mats; fencing; clearing and grubbing; reinforced cast-in-place concrete; sub-drainage system; asphalt; multi-use trail; trail access points; railroad trestles; pedestrian bridges and other recreation components.

3.1.4 Design Limitations

As noted in Section 1 of this appendix, the current designs are based on preliminary, planning-level conceptual designs, and common engineering practices. The design level used to complete the MCACES construction cost estimate has not progressed beyond the level used at the alternatives analysis stage. More detailed assumptions have been developed for key construction items that were not included in the alternatives analysis, which primarily includes diversion and control of water elements.

3.2 Basis of Estimate

3.2.1 Basis of Design

Available design documents of the project elements are listed below

- Los Angeles River Feasibility Study Conceptual Design Drawings, Tetra Tech
- Los Angeles River Feasibility Study Design Report, Tetra Tech
- Los Angeles River As-Built Drawings, Various Dates, USACE

3.2.2 Basis of Quantities

The LPP cost estimate is based on the project quantity take-offs that have been calculated in accordance with the documents above. A quantity summary and detailed quantity take-offs that correspond to the LPP MCACES cost estimate are found in Attachment 8.

3.3 Project Schedule

It is estimated that the overall project would take approximately 192 months. The durations used in the LPP estimate to determine costs for the contractor to maintain field facilities and provide construction supervision have been taken from the tentative project schedule's construction durations. A simplified tentative project schedule, that includes PED, is presented in Attachment 9. This schedule was developed with the following assumptions:

- Assumed durations for PED and all activities leading up to construction.
- Assumes no in-channel construction from October 15th through April 15th.
- Assumes recreational items in a reach will be completed after all other construction activities are finished at that reach.

3.4 Acquisition Plan

The LPP cost estimate is based on eight contracts being awarded to separate prime contractors with subcontractors for landscaping, asphalt, fencing, utilities, railroads and recreation item construction. Seven of the contracts would consist of the primary ecosystem restoration construction activities, while the eighth contract would be for the LATC relocation efforts. The prime contractors would be responsible for all the preparatory work, and placing all associated site work as well as overseeing the subcontractors' work. The estimate currently assumes that the project would be let out in an unrestricted bid process and is expected to have a competitive bidding market. Also, no small business contracts are assumed due to the overall size of the project.

3.5 Project Construction

3.5.1 Mobilization/Demobilization

Mobilization and demobilization costs account for the transportation of all construction equipment and personnel to and from the project site. All equipment and labor is assumed to be available in the Los Angeles area.

3.5.2 Staging and Site Access

The project would require multiple staging and access roads throughout the reaches. The cost estimate assumes at least one staging area would be constructed in each reach along with at least one stretch of access road. The staging areas and access roads are assumed to be cleared and grubbed, graded and have a gravel layer placed over them.

3.5.3 Borrow/Disposal Areas and Materials

All required construction materials are assumed to be available from the greater Los Angeles area. All material quotes include estimated deliver prices to the general project area.

All demolished materials are assumed to be hauled off-site for disposal. Excavated earth material is assumed to be hauled to a disposal site within 20-miles of the project. All asphalt and concrete materials are also assumed to be hauled within 20-miles of the site and disposed at a recycle plant or landfill.

3.5.4 Construction Methodology

- Contract 1 – Reach 6
    - Reach 6: Prior to the construction of the primary restoration measures, several utility towers would be relocated outside of the project footprint. The primary construction activities in this reach assume placing approximately 2,000-lf of inflatable cofferdams for water control. The inflatable dams are assumed to be used on the natural bottom sections of the channel. This length of cofferdam would be required to be moved multiple times in order to complete construction. The construction work would include four restoration measures from the alternatives analysis, as well as construction of recreation components. These items are described below:
        - Measure 21/22 – The existing embankments would be excavated. Once completed, a new asphalt access road and chain link fencing would be constructed.
        - Measure 16 – Bioengineering Channel Walls: This would require the placement of turf reinforcement mats along the banks. These mats would require a gravel tie-in section as well as installation of a chain link fence in certain sections to keep the public off the mats.
        - Measure 19 – Bioengineering Channel Walls: This would require the placement of turf reinforcement mats along the banks. These mats would require a gravel tie-in section as well.
        - Measure 17 – Habitat Corridors/Riparian Planting on Banks: The new banks would be vegetated after the other restoration measures are completed. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.
        - Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include new unpaved trails, trail access points, restroom facilities, parking lot, a pedestrian tunnel, a pedestrian bridge, new paved trails, and wildlife viewpoints.

- Contract 2 – Reach 5
  - Reach 5: Construction activities in this reach assume placing an inflatable cofferdam as required for the storm drain construction. This type of cofferdam is assumed to be used due to the natural bottom channel section found in this reach. The construction work would include four restoration measures from the alternatives analysis, as well as construction of recreation components. These items are described below:
    - Measure 2 – Daylight Streams: This work would involve taking the low flow from the existing storm drain into a wetland and return to the river through the storm drain system. Excavation would be required to access the existing storm drain components. The placing of a precast concrete storm drain that has a splitter that would send low flows out a 24-inch pipe that would outlet into a wetland area, while high flows from the existing drain would exit the storm drain through a 36-inch pipe that outlets into the river. The wetland area would be vegetated.
    - Measure 26 – Terrace Banks: The existing reinforced concrete channel slope paving on the left bank would be demolished. This would involve removing the concrete, grouted riprap, spalls, chain link fencing, sheet piles, and asphalt-concrete access road. In addition, the left bank would require excavation as shown in the typical sections. Once completed, a new asphalt access road and concrete planters would be constructed.
    - Measure 27 – Modify Trapezoidal Channel to Vertical Sides: The existing reinforced concrete channel slope paving on the right bank would be demolished. This would involve removing the concrete, grouted riprap, spalls, sheet piles, chain link fencing, and asphalt-concrete access road. In addition, the right bank would require excavation as shown in the typical sections, riprap placement, retaining walls, and compacted backfill. Once completed, a new asphalt access road and chain link fencing would be constructed.
    - Measure 16 – Bioengineer Channel Walls – This reach would require new vegetation to be placed along the existing banks. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.
    - Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include trail access points, wildlife viewpoints, and bridge underpasses.
- Contract 3 – Reach 4
  - Reach 4: Construction activities in this reach assume placing small k-rail cofferdams for the side channel work and inflatable cofferdams for the in-channel work. The construction activities would include four restoration measures from the

alternatives analysis, as well as construction of recreation components. These items are described below:

- Measure 4 – Grade Adjacent Areas to Lower Elevation Side Channel (G): The existing slopes at side channel G would require excavation. It is assumed that all materials would be hauled off-site for disposal.

- Measure 10 – Divert Tributary & River Flow into Side Channels (F): The banks alongside channel F would require excavation and riprap placement. It is assumed that all excavated materials would be hauled off-site for disposal.

- Measure 3/5 – Create Geomorphology and Plant for Freshwater Marsh: This work requires the construction of grade control structures within the existing channel. These grade controls would require excavation, grouted riprap placement and compacted backfill. It is assumed that all the backfill material would come from the excavation work, and any excess material would be hauled off-site for disposal.

- Measure 2 – Daylight Streams: This work would involve taking the low flow from the existing storm drain into a wetland and return to the river through the storm drain system. Excavation would be required to access the existing storm drain components. The placing of a precast concrete storm drain that has a splitter that would send low flows out a 24-inch pipe that would outlet into a wetland area, while high flows from the existing drain would exit the storm drain through a 36-inch pipe that outlets into the river. The wetland area would be vegetated.

- Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include new unpaved trails, conversion of existing access roads to un-paved multi-use trails, trail access points, wildlife viewpoints, and a bridge underpass.

- Contract 4 – Reach 7

  - Reach 7: Prior to the construction of the primary restoration measures, several utility towers would be relocated outside of the project footprint. The primary construction activities in this reach assume placing a k-rail cofferdam down the middle of the channel for approximately half the length. One side of the channel would be constructed then, the cofferdam would be shifted such that the other side could be constructed. Then the cofferdam would be moved to the second half of the channel length to complete the work. The construction activities would include five restoration measures from the alternatives analysis, as well as construction of recreation components. These items are described below:

    - Measure 1 – Railroad Trestle: This work would involve the construction of a railroad trestle through this reach. The trestle work assumes only installing items directly associated with the trestle structure and the railroad track components (rails, ballast, ties, etc.). It is assumed that the trestle would be a concrete structure with pilings or caissons constructed to support the elevated deck and rails. This work is considered a relocation effort, and is therefore included under the 02 Account.

- Measure 27 – Tributary Channels/Widen Channel (Arroyo Seco): The existing reinforced concrete channel wall and chain link fencing would be demolished. The embankment would be excavated as shown in the typical sections. It is assumed that all excavated materials would be hauled off-site for disposal. Once completed, turf reinforcement mats, a new asphalt access road, and chain link fencing would be constructed. Also, the area would be re-vegetated to include the placement of shrubs, trees and seeding. It is assumed that this area would require temporary irrigation.

- Measure 8 – Corn Field: This area would require excavation. It is assumed that all excavated materials would be hauled off-site for disposal. Once completed, a new impermeable liner, asphalt access road, and chain link fencing would be constructed. Also, this area would be re-vegetated to include the placement of shrubs, trees and seeding. It is assumed that this area would require temporary irrigation. Baker Street would also be reconstructed to have a precast concrete box culvert placed underneath it.

- Measure 26 – Terrace Banks: The existing reinforced concrete along the right bank would be demolished. This would involve removing the concrete and chain link fencing. Once completed, reinforced concrete planters, a new asphalt access road, and chain link fencing would be constructed. Also, the area would be re-vegetated to include the placement of shrubs, trees and seeding. It is assumed that this area would require temporary irrigation.

- Measure 17 – Habitat Corridors/Riparian Planting on Banks: The new banks would be vegetated after all measure 17 work is complete. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.

- Measure 2 – Daylight Streams: This work would involve taking the low flow from the existing storm drain into a wetland and return to the river through the storm drain system. Excavation would be required to access the existing storm drain components. The placing of a precast concrete storm drain that has a splitter that would send low flows out a 24-inch pipe that would outlet into a wetland area, while high flows from the existing drain would exit the storm drain through a 36-inch pipe that outlets into the river. The wetland area would be vegetated.

- Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include existing trail improvements, new unpaved trails, trail access points, wildlife viewpoints, bridge underpasses, and new paved trails.

- Contract 5 – Reach 3
  - Reach 3: Construction activities in this reach assume placing small k-rail cofferdams for the side channel work and k-rail cofferdam down the center of the channel for the main channel work. The construction activities would include four restoration measures from the alternatives analysis, as well as construction of recreation components. These items are described below:
    - Measure 10 – Divert Tributary & River Flow into Side Channels (E): The banks alongside channel E would require excavation and riprap placement. It is assumed that excavated material required for compacted fill (in measure 3/5) will be stockpiled, and any excess hauled off-site.
    - Measure 3/5 – Create Geomorphology and Plant for Freshwater Marsh: This work requires the construction of grade control structures within the existing channel. These grade controls would require riprap and compacted backfill. It is assumed that all the backfill material would come from the excavation work at this reach, and any excess material would be hauled off-site for disposal.
    - Measure 25 – Tributary Channels – Verdugo Wash: The existing reinforced concrete channel walls would be demolished. This would involve removing the concrete, sub-drainage system, and chain link fencing. The embankment would be excavated as shown in the typical sections. It is assumed that all excavated materials would be hauled off-site for disposal. Once completed, riprap, turf reinforcement mats with gravel tie-in section, a new asphalt access road, topsoil, vegetation and chain link fencing would be constructed.
    - Measure 17 – Habitat Corridors/Riparian Planting on Banks: This reach would require new vegetation after the other restoration measures are completed. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.
    - Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include new unpaved trails, conversion of existing access roads to un-paved multi-use trails, wildlife viewpoints, trail improvements, trail access points, a bridge underpass, and a pedestrian bridge.
- Contract 6 – Reaches 1 and 2
  - Reach 2: Construction activities in this reach assume placing an inflatable cofferdam as required for the storm drain construction. This type of cofferdam is assumed to be used due to the natural bottom channel section found in this reach. The construction work would include three restoration measure from the alternatives analysis, as well as construction of recreation components. These items are described below:

        - Measure 27 – Modify Trapezoidal Channel to Vertical Sides: The existing reinforced concrete channel slope paving along the right bank would be demolished. This would involve removing the concrete, grouted riprap, spalls, sheet piles, chain link fencing, and asphalt-concrete access road. In addition, this work requires riprap placement and compacted backfill. A new asphalt access road, retaining walls, sub-drainage system pipe, and chain link fencing would be constructed.

        - Measure 16 – Bioengineer Channel Walls: This would require the placement of turf reinforcement mats along the banks. These mats would require a gravel tie-in section as well as installation of a chain link fence in certain sections to keep the public off the mats.

        - Measure 17 – Habitat Corridors/Riparian Planting on Banks: This reach would require new vegetation to be placed along the existing banks. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.

        - Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include existing trail improvements, new unpaved trails, and restroom facilities.

    - Reach 1: Construction activities in this reach assume all work is outside of the water levels and therefore do not require any dewatering efforts. The construction work would include one restoration measure from the alternatives analysis, as well as construction of recreation components. These items are described below:

        - Measure 17 – Habitat Corridors/Riparian Planting on Banks: This reach would require new vegetation to be placed along the existing banks. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.

        - Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include existing trail improvements, new unpaved trails, and trail access points.

- Contract 7 – Reach 8

    - Reach 8: Prior to the primary restoration measures, several utility towers, a 24” VCP line and a 54” concrete sewer line would require relocation. Primary construction activities in this reach assume placing two k-rail cofferdams. These cofferdams would be used to control flows at the entrance and exit of the side channel into LATC. The construction work would include seven restoration measures from the alternatives analysis, as well as construction of recreation components. These items are described below:

        - Measure 1 – Railroad Trestle: This work would involve the construction of a railroad trestle through this reach. The trestle work assumes only installing items directly associated with the trestle structure and the railroad track components (rails, ballast, ties, etc.). It is assumed that the trestle would be a concrete structure with pilings or caissons constructed to support the elevated deck and rails. This work is considered a relocation effort, and is therefore included under the 02 Account.

- Measure 3 – Create Geomorphology and Plant for Freshwater Marsh: This work requires the construction of grade control structures within the existing channel. These grade controls would require excavation, grouted riprap placement, and compacted backfill. It is assumed that all the backfill material would come from the excavation work, and any excess material would be hauled off-site for disposal. Also, a portion of the channel would be re-vegetated after construction to include the placement of shrubs, trees and seeding. It is assumed that this area would require temporary irrigation.

- Measure 6 – Rebuild Geomorphology for Historic Wash (LATC): This area would require excavation and riprap placement. It is assumed that all excavated materials would be hauled off-site for disposal.

- Measure 10 – Divert Tributary & River Flow into Side Channels (LATC): The banks along the channels would require excavation and riprap placement. It is assumed that all excavated materials would be hauled off-site for disposal.

- Measure 17 – Habitat Corridors/Riparian Planting on Banks: The LATC area would be re-vegetated after construction. This work is assumed to include placement of shrubs, trees and seeding. The area is also assumed to require temporary irrigation.

- Measure 21 – Lower Channel Banks and Provide Setback Levees or Berms: This work requires excavation of the existing embankments and riprap placement. Once completed, a new asphalt access road and chain link fencing would be constructed.

- Measure 26 – Terrace Banks: The existing reinforced concrete channel slope paving and parapet would be demolished along both banks. This would involve removing the concrete, spalls, and chain link fencing. In addition, the embankments would be excavated and riprap would be placed as shown in the typical sections.

- Recreation: This work is assumed to be completed after all restoration measures are in place. The items in this reach would include new unpaved trails, trail access points, restroom facilities, parking lot, pedestrian bridges, and wildlife viewpoints.

- Contract 8- LATC Relocation Contract

  - Construction activities assume that the LATC Intermodal Facility would be replaced in kind at another location. The LATC is located in Reach 8 but the costs for this work are assumed to be under a separate contract that would be completed prior to Reach 8 being constructed. Costs for this work include providing similar infrastructure and operations to rail lines, replacing or removing rubber tires gantry cranes, reconstructing facilities at the new location, which would also include all new structures and security facilities. It is assumed that the NFS would provide this site as part of the LERRDs for the project.

3.5.5 Unusual Conditions

None anticipated to significantly impact the estimate.

3.5.6 Unique Construction Techniques

No unique construction techniques are anticipated to be required.

3.5.7 Equipment/Labor Availability and Distance Traveled

All equipment and labor is assumed to be available in the greater Los Angeles area.

3.6 Effective Dates for Labor, Equipment and Material Pricing

The labor, equipment, and material pricing were developed using the MCACES 2012 English Unit Cost Library, 2014 Los Angeles County Labor Library (see Attachment 10), and the 2011 Equipment Library (Region VII) for the base cost estimates. The index pricing data has been prepared in October 2014 dollars.

The cost estimate has been updated with current quoted fuel prices of $3.36/gal for off-road diesel, $4.11/gal for on-road diesel and $4.01/gal for gasoline in the Los Angeles area.

3.7 Estimated Production Rates

The estimate contains many user created cost items that were developed outside of the MCACES Unit Cost Library. These developed cost items have had crews and production rates created in order to accurately calculate unit costs. See Attachment 11 for the Estimated Production Rate Calculations for these construction items.

3.8 Direct and Contractor Markups

3.8.1 Direct Markups

The cost estimate includes a 9% sales tax on all material cost items.

3.8.2 Contractor Markups

The prime contractor Job Office Overhead (JOOH) markups are based on calculated percentages currently within MCACES. The JOOH calculations are based on the estimated duration for all construction components. A running percentage has been used in the estimated for the prime contractor Home Office Overhead (HOOH) markup for all contracts. Profit is included for the prime contractors and is calculated using the profit weighted guideline calculation within MCACES. Bonding has also been included for all prime and sub-contractors.

3.9 Project Markups

3.9.1 Escalation

Price levels have been escalated from effective price levels of the construction cost estimate for October 2014 (1Q15) to the mid-points of construction for each contract. The appropriate escalation cost factors for each date and for each feature account have been calculated within the Total Project Cost Summary.

3.9.2 Contingency

An overall 36.8% contingency has been included in the estimate for all the feature accounts except for Lands and Damages and the LATC relocation contract. A separate contingency was developed for these two items, which was based on the incremental costs and general contingencies developed by the entity that completed the cost estimates for those components. A Cost and Schedule Risk Analysis (CSRA) has been performed to support the construction contingency listed above. See Attachment 12 for the full CSRA report for the LPP.

3.10 Functional Costs

3.10.1 01 Account – Lands and Damages

The current estimated cost for this account comes from the Real Estate Plan found in Appendix G of the main report. The costs include the real estate required to be purchased as well as business relocation costs. This account also includes incremental costs and other contingencies that have been used as the total contingency for this account within the TPCS.

3.10.2 02 Account – Relocations

The cost for this account includes costs for the relocation of existing utility towers, construction of the railroad trestles, the relocation of several pipe lines running through the project footprint and the relocation of the LATC Intermodal Facility. Only the costs for the utility towers, trestles, and pipe lines were estimated in MCACES. The LATC facility was estimated as a Class IV estimate outside of MCACES, but input as a lump sum into the estimate for reference. The LATC facility is assumed to be replaced in kind at another location within the Los Angeles basin. The relocation costs for this facility is assumed to be a separate construction contract.

An assessment of the utilities within the project extent and the sub-measures for the study area have identified Reaches 6, 7 and 8 as having facility/utility relocations. In Reach 6 there are five high voltage transmission line towers within the study area where there is planned channel widening, creation of marsh lands and planting of riparian habitat. In order to accomplish the sub-measures the area would need to be graded to a lower elevation and banks would need to be sloped back. In Reach 7, two transmission line towers have been identified as utility relocations. In this reach, the freshwater marsh would be restored and connected under a railroad trestle with the right bank of the river channel terraced. Lastly in Reach 8, five transmission towers have been identified for relocation in order to trestle the rail road tracks and remove the channel wall creating connectivity between the river and the marsh land that would be created at the LATC site.

According to the Real Estate Appendix, a preliminary real estate assessment following the guidelines set forth in Real Estate Policy Guidance Letter No. 31 was completed for the transmission tower in Reach 6, 7 and 8. Based on the real estate assessment, the transmission towers are of the type eligible for compensation and Los Angeles Department of Water and Power (LADWP) has been identified with a compensable interest in the property in the cases where the LADWP has been identified as the fee owner of the right of way. Further real estate analysis will need to be completed to determine whether LADWP has a compensable interest in the property in reaches 7 and 8. If LADWP is determined to have a compensable interest in the property the cost to relocate the identified utilities should be captured as a LERRD cost and not cost shared under the construction feature accounts.

The cost of relocating the large steel transmission towers found in Reaches 6 and 7 of the project area was developed based on research into similar construction activities on recent projects. The costs and methodologies from these other projects were incorporated into the unit cost. This utility tower work is considered a relocation component and therefore the costs for these relocations are included under the 02 – Relocations feature account.

3.10.3 30 Account – Planning, Engineering and Design

Costs for this account were estimated as percentages of the construction costs for the various feature accounts. This account covers the preparation of plans, specifications, and engineering during construction. The percentages used for contracts one through seven were provided and verified by the Los Angeles District's Cost Engineering & Specifications Section, while the PED percentage for the LATC work was estimated by the sub-contractor whom completed the relocation estimate. Table 3.1 provides the various PED percentages used for each feature account within each contract.

Table 3.1 PED Percentages by Contract

Contract	Reaches	WBS Items	PED Percent
1	Reach 6	02, 06, 14	14.5%
2	Reach 5	02, 06, 14	14.5%
3	Reach 4	02, 06, 14	14.5%
4	Reach 7	02, 06, 14	14.5%
5	Reach 3	02, 06, 14	14.5%
6	Reaches 1 & 2	02, 06, 14	14.5%
7	Reach 8	02, 06, 14	14.5%
8	LATC Relocation	02	3.5%

3.10.4 31 Account – Construction Management

Costs for this account were estimated as percentages of construction costs of the various feature accounts. This cost is assumed to cover construction management during construction. This percentage used for contracts one through seven was provided and verified by the Los Angeles District's Cost Engineering & Specifications Section, while the CM percentage for the LATC work was estimated by the sub-contractor whom completed the relocation estimate. Table 3.2 provides the various CM percentages used for each feature account within each contract.

Table 3.2 CM Percentages by Contract

Contract	Reaches	WBS Items	CM Percent
1	Reach 6	02, 06, 14	6.5%
2	Reach 5	02, 06, 14	6.5%
3	Reach 4	02, 06, 14	6.5%
4	Reach 7	02, 06, 14	6.5%
5	Reach 3	02, 06, 14	6.5%
6	Reaches 1 & 2	02, 06, 14	6.5%
7	Reach 8	02, 06, 14	6.5%
8	LATC Relocation	02	2.2%

3.11 MCACES Construction Cost Estimate

The construction cost estimate was developed using MCACES 2nd Generation (MII) cost estimating software in accordance with guidance contained in ER 1110-2-1302, Civil Works Cost Engineering. See Attachment 13 for the MCACES construction cost estimate summary output report for the LPP.

3.12 Total Project Cost Summary (TPCS)

The TPCS was prepared using the latest TPCS Excel spreadsheet provided by the USACE, Walla Walla District. The TPCS incorporates the construction costs developed in the MII, the project markups, and the functional costs. See Attachment 14 for the TPCS spreadsheet for the LPP.

The TPCS also contains the proposed cost share agreement between the Federal and Non-Federal agencies. Per CECW memorandum dated 3 July 2014 it was directed that the reporting officers present two cost sharing options for the LPP. Those cost sharing options are described in detail in Chapter 7 of the Integrated Feasibility Report. The report does not provide a recommendation for cost sharing, any recommendation to deviate from standard cost sharing percentages will require specific statutory language to be authorized.

The Lands and Damages costs shown under the LERRDs in the TPCS include some costs for federal administration, which are not part of LERRDs. Also, a portion of the PED and Construction Management costs relate to Relocations, and are therefore a LERRDs costs. The IFR identifies these specific costs and categorizes them appropriately in cost apportionment tables.

The following tables provide the basis for the two cost sharing options shown on the TPCS.

Table 3.3 LPP Proposed Cost Share – OPTION 1

Feature Account	Federal Percent (%)	Non-Federal Percent (%)
01 – Lands and Damages	0%	100%
01 – Federal Administrative Costs	100%	0%
02 – Relocations	0%	100%
06 – Fish and Wildlife Facilities	NER*	LPP – NER**
14 – Recreation	50%	50%
30 – Planning, Engineering, & Design (Ecosystem Restoration Only)	NER*	LPP – NER**
30 – Planning, Engineering, & Design (Relocations)	0%	100%
30 – Planning, Engineering, & Design (Recreation Only)	50%	50%
31 – Construction Management (Ecosystem Restoration Only)	NER*	LPP – NER**
31 – Construction Management (Relocations)	0%	100%
31 – Construction Management (Recreation Only)	50%	50%
Notes: * Federal sponsors would pay for the cost of the feature account from the NER Plan. ** The Non-Federal sponsors would pay the difference of the current LPP costs minus the NER cost for the given feature account.		

Table 3.4 LPP Proposed Cost Share – OPTION 2

Feature Account	Federal Percent (%)	Non-Federal Percent (%)
01 – Lands and Damages	0%	100%
01 – Federal Administrative Costs	100%	0%
02 – Relocations	0%	100%
06 – Fish and Wildlife Facilities	100%	0%
14 – Recreation	50%	50%
30 – Planning, Engineering, & Design (Ecosystem Restoration Only)	100%	0%
30 – Planning, Engineering, & Design (Relocations)	0%	100%
30 – Planning, Engineering, & Design (Recreation Only)	50%	50%
31 – Construction Management (Ecosystem Restoration Only)	100%	0%
31 – Construction Management (Relocations)	0%	100%
31 – Construction Management (Recreation Only)	50%	50%
Adjustment to Cost Sharing, per Option 2	- 15% of Total Project First Cost for Ecosystem Restoration	+ 15% of Total Project First Cost for Ecosystem Restoration
Notes: For the ecosystem restoration component of the project, the Non-Federal sponsor would be required to provide a cash contribution of 15% of the total project first cost of the LPP ecosystem restoration plan, in addition to providing all LERRDs (including PED and Construction Management costs for Relocations).		

4. REFERENCES

- U.S. Army Corps of Engineers, 1993, *Engineering and Design Cost Engineering Policy and General Requirements*, *Engineering Regulation 1110-1-1300,* Department of the Army, Washington D.C., 26 March 1993.

- U.S. Army Corps of Engineers, 1999, *Engineering and Design For Civil Works Projects*, *Engineering Regulation 1110-2-1150*, Department of the Army, Washington D.C., 31 August 1999.

- U.S. Army Corps of Engineers, 2008a, *Civil Works Cost Engineering*, *Engineering Regulation 1110-2-1302,* Department of the Army, Washington D.C., 15 September 2008.

- U.S. Army Corps of Engineers, 2008b, *Construction Cost Estimating Guide For Civil Works*, *Engineering Technical Letter 1110-2-573,* Department of the Army, Washington D.C., 30 September 2008.

- U.S. Army Corps of Engineers, 2010, *Civil Works Construction Cost Index System, Engineering Manual 1110-2-1304,* Department of the Army, Washington D.C., 31 March 2014

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Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 1

Alternatives Matrix of Construction Costs

April 2015

LOS ANGELES RIVER COST ESTIMATE
ALTERNATIVES MATRIX

Reach	Measure Type	Submeasure	1 Comprehensive	2 City: Atwater to Cornfields	3 Banks & Tribs Only	4 Highest Scoring Objectives (over 3)	5 City: Los Feliz to Arroyo Seco	6 Corps Team	7 highest objectives (over 5)	8 Charette Team 1	9 Soft Bottom & Channl associated banks	10 Highest Other Criteria (over 11)	11 Charette Team 4	12 Charette Team 3	13 Charette Team 6	14 Charette Team 5	15 Charette Team 2	16 Side Channels Only	17 Charette Team 7	18 Comprehensive Pockets	19 Taylor Yard
1. Pollywog Park/Headworks to Midpoint of Betty Davis Park	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x		x	x					x	x				x	x	x	x		
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x		x			x			x	x				x		x			
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat)	x		x			x		x	x	x						x			
		7. Create underground basin for attenuation at equestrian center - continue current use	y		y			y			y					y		y		y	
		9. culverts & or underground basins to divert flood flows	y		y	y		y	y	y	y						y		y		
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x							x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x		x	x		x		x	x	x	x	x	x	x	x	x	x	x	
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	21/22. channel banks mainstem/widen channel (implies erosion control)	x													x					
		23. channel bed (implies deepening or attenuation)	x			x		x		x	x	x		x		x					
		25. tributary channels/widen channel (implies erosion control)	x		x			x			x										
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x		x			x		x	x	x		x	x	x			x		
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x			x			x						x						
		Construction	71,138,775	-	50,790,568	22,707,817	-	63,895,827	936,944	59,532,012	67,498,547	60,731,449	1,460,173	39,056,801	25,989,049	42,959,521	5,062,893	23,134,820	25,951,542	1,460,173	-
		Mobilization (7.5%)	5,335,408	-	3,809,293	1,703,086	-	4,792,187	70,271	4,464,901	5,062,391	4,554,859	109,513	2,929,260	1,949,179	3,221,964	379,717	1,735,112	1,946,366	109,513	-
		Construction Subtotal	76,474,183	-	54,599,860	24,410,903	-	68,688,014	1,007,215	63,996,913	72,560,938	65,286,307	1,569,686	41,986,061	27,938,228	46,181,485	5,442,610	24,869,932	27,897,907	1,569,686	-
		Contingency (25%)	19,118,546	-	13,649,965	6,102,726	-	17,172,004	251,804	15,999,228	18,140,235	16,321,577	392,421	10,496,515	6,984,557	11,545,371	1,360,653	6,217,483	6,974,477	392,421	-
		PED/EDC (11%)	8,412,160	-	6,005,985	2,685,199	-	7,555,682	110,794	7,039,660	7,981,703	7,181,494	172,665	4,618,467	3,073,205	5,079,963	598,687	2,735,693	3,068,770	172,665	-
		S&A (6.5%)	4,970,822	-	3,548,991	1,586,709	-	4,464,721	65,469	4,159,799	4,716,461	4,243,610	102,030	2,729,094	1,815,985	3,001,797	353,770	1,616,546	1,813,364	102,030	-
		Construction Period (Months)	32	-	24	16	-	26	9	22	27	23	8	16	15	21	11	16	15	9	-
		IDC	5,532,329	-	2,931,039	875,221	-	3,983,847	20,568	3,243,568	4,510,035	3,334,547	27,908	1,484,615	950,985	2,225,551	133,558	895,086	949,278	32,312	-
		LERRDS	5,449,862	-	5,443,610	5,315,390	-	5,443,610	8,813	5,440,071	4,921,692	5,443,610	4,784,304	5,440,071	5,448,854	5,443,610	5,306,609	4,788,223	5,440,071	4,784,304	-
		Total Cost Subtotal	119,957,902	-	86,179,450	40,976,148	-	107,307,878	1,464,662	99,879,239	112,831,065	101,811,145	7,049,014	66,754,823	46,211,814	73,477,778	13,195,886	41,122,963	46,143,867	7,053,419	-
		Annualized Construction Costs	5,347,030	-	3,841,382	1,826,480	-	4,783,165	65,286	4,452,039	5,029,357	4,538,152	314,204	2,975,544	2,059,855	3,275,215	588,196	1,833,024	2,056,827	314,401	-
		Annualized O&M Costs	410,062	-	369,512	92,889	-	339,033	163,400	348,864	369,512	341,794	62,410	199,535	240,085	233,014	92,889	204,669	230,014	62,410	-
		Total Annualized Costs	5,757,091	-	4,210,894	1,919,369	-	5,122,198	228,686	4,800,903	5,398,869	4,879,946	376,615	3,175,079	2,299,940	3,508,229	681,086	2,037,693	2,286,841	376,811	-
2. Midpoint Betty Davis Park to upstream end of Ferraro Fields	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x		x	x					x	x				x	x	x	x		
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x		x			x			x	x						x			
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat)	x		x			x		x	x	x						x			
		9. culverts & or underground basins to divert flood flows	y		y	y		y	y	y	y						y		y		
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x							x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x		x	x		x	x	x	x	x	x	x	x	x	x	x			
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	23. channel bed (implies deepening or attenuation)				x			x												
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x					x		x	x	x		x							
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x			x			x						x						
		Construction	37,354,526	-	7,633,672	28,184,790	-	9,657,836	24,852,325	10,293,099	12,990,301	12,990,301	41,962	5,398,591	24,406,187	3,374,427	3,374,427	7,633,672	3,332,465	-	-
		Mobilization (7.5%)	2,801,589	-	572,525	2,113,859	-	724,338	1,863,924	771,982	974,273	974,273	3,147	404,894	1,830,464	253,082	253,082	572,525	249,935	-	-
		Construction Subtotal	40,156,115	-	8,206,198	30,298,649	-	10,382,173	26,716,249	11,065,081	13,964,573	13,964,573	45,109	5,803,485	26,236,651	3,627,509	3,627,509	8,206,198	3,582,400	-	-
		Contingency (25%)	10,039,029	-	2,051,549	7,574,662	-	2,595,543	6,679,062	2,766,270	3,491,143	3,491,143	11,277	1,450,871	6,559,163	906,877	906,877	2,051,549	895,600	-	-
		PED/EDC (11%)	4,417,173	-	902,682	3,332,851	-	1,142,039	2,938,787	1,217,159	1,536,103	1,536,103	4,962	638,383	2,886,032	399,026	399,026	902,682	394,064	-	-
		S&A (6.5%)	2,610,147	-	533,403	1,969,412	-	674,841	1,736,556	719,230	907,697	907,697	2,932	377,227	1,705,382	235,788	235,788	533,403	232,856	-	-
		Construction Period (Months)	18	-	10	13	-	11	12	11	12	11	4	6	10	6	7	9	6	-	-
		IDC	1,650,016	-	189,053	895,239	-	245,812	685,316	264,200	384,884	345,329	428	80,831	595,199	48,238	58,354	165,950	47,591	-	-
		LERRDS	2,257,456	-	2,093,163	2,230,703	-	2,116,844	2,230,703	2,254,384	2,119,884	2,116,844	2,091,559	2,112,199	2,257,423	2,088,519	2,091,559	2,093,163	-	-	-
		Total Cost Subtotal	61,129,936	-	13,976,048	46,301,517	-	17,157,253	40,986,674	18,286,325	22,404,286	22,361,690	2,156,267	10,462,996	40,239,850	7,305,958	7,319,113	13,952,945	5,152,511	-	-
		Annualized Construction Costs	2,724,819	-	622,971	2,063,854	-	764,771	1,826,949	815,099	998,654	996,755	96,114	466,380	1,793,660	325,657	326,244	621,942	229,669	-	-
		Annualized O&M Costs	215,441	-	114,267	175,662	-	87,201	147,892	87,409	114,970	114,970	50,629	51,333	151,100	78,399	78,399	114,267	77,769	-	-
		Total Annualized Costs	2,940,260	-	737,238	2,239,516	-	851,972	1,974,841	902,507	1,113,624	1,111,725	146,743	517,713	1,944,760	404,056	404,643	736,209	307,439	-	-
3. Ferraro Fields to Brazil St	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x		x	x					x	x			x	x		x		x	
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x	x	x			x		x	x							x	x		
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat) ro recreate channel braiding	x		x	x				x	x		x	x				x		x	
		9. culverts & or underground basins to divert flood flows	y	y	y	y		y	y	y	y				y		y		y		
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x	x						x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x	x	x	x		x	x	x	x	x	x	x	x	x		x		x	
		18. open water	x								x								x		
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	21/22 widenchannel, provide erosion control may lower channel banks and provide setback levees or vegetated berms			x						x		x		x					x	
		23. channel bed (implies deepening or attenuation)		x		x			x												
		25. tributary channels/widen channel (implies erosion control)	x					x		x	x		x	x	x	x	x			x	
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x		x			x			x		x		x						
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x	x		x			x					x	x						
		Construction	133,829,933	78,314,553	15,005,741	91,985,315	-	48,319,416	77,714,553	54,559,229	62,590,178	14,405,741	53,959,229	125,198,984	126,990,121	55,750,366	47,584,437	15,005,741	600,000	61,990,178	-
		Mobilization (7.5%)	10,037,245	5,873,591	1,125,431	6,898,899	-	3,623,956	5,828,591	4,091,942	4,694,263	1,080,431	4,046,942	9,389,924	9,524,259	4,181,277	3,568,833	1,125,431	45,000	4,649,263	-
		Construction Subtotal	143,867,178	84,188,144	16,131,171	98,884,213	-	51,943,372	83,543,144	58,651,171	67,284,442	15,486,171	58,006,171	134,588,908	136,514,380	59,931,643	51,153,270	16,131,171	645,000	66,639,442	-
		Contingency (25%)	35,966,795	21,047,036	4,032,793	24,721,053	-	12,985,843	20,885,786	14,662,793	16,821,110	3,871,543	14,501,543	33,647,227	34,128,595	14,982,911	12,788,318	4,032,793	161,250	16,659,860	-
		PED/EDC (11%)	15,825,390	9,260,696	1,774,429	10,877,263	-	5,713,771	9,189,746	6,451,629	7,401,289	1,703,479	6,380,679	14,804,780	15,016,582	6,592,481	5,626,860	1,774,429	70,950	7,330,339	-
		S&A (6.5%)	9,351,367	5,472,229	1,048,526	6,427,474	-	3,376,319	5,430,304	3,812,326	4,373,489	1,006,601	3,770,401	8,748,279	8,873,435	3,895,557	3,324,963	1,048,526	41,925	4,331,564	-
		Construction Period (Months)	34	23	14	23	-	17	20	19	23	9	18	27	31	14	13	10	8	18	-
		IDC	11,321,958	4,314,733	496,838	5,221,108	-	2,005,347	3,777,896	2,552,033	3,496,115	298,837	2,344,885	8,183,631	9,604,241	1,940,841	1,523,395	359,688	11,464	2,674,234	-
		LERRDS	12,244,960	12,015,063	108,626,715	1,748,027	-	11,948,150	1,343,274	11,026,690	107,384,686	1,696,095	107,368,440	10,950,933	108,448,474	10,721,071	10,449,278	502,284	174,856	107,366,428	-
		Total Cost Subtotal	228,577,647	136,297,902	132,110,473	147,879,138	-	87,972,803	124,170,150	97,156,641	206,761,130	24,062,726	192,372,119	210,923,757	312,585,706	98,064,504	84,866,083	23,848,891	1,105,445	205,001,867	-
		Annualized Construction Costs	10,188,670	6,075,372	5,888,721	6,591,597	-	3,921,319	5,534,787	4,330,681	9,216,216	1,072,577	8,574,837	9,401,762	13,933,264	4,371,149	3,782,839	1,063,046	49,274	9,137,798	-
		Annualized O&M Costs	430,160	251,093	237,092	366,896	-	115,289	245,093	103,064	237,092	173,827	154,329	290,133	379,121	128,788	50,000	179,827	56,000	173,827	-
		Total Annualized Costs	10,618,830	6,326,466	6,125,813	6,958,493	-	4,036,608	5,779,881	4,433,746	9,453,308	1,246,405	8,729,166	9,691,894	14,312,384	4,499,936	3,832,839	1,242,873	105,274	9,311,625	-

X: Indicates that the measure is included in the alternative.

y: Prelminary array included culverts or basins.

LOS ANGELES RIVER COST ESTIMATE
ALTERNATIVES MATRIX

Reach	Measure Type	Submeasure	1 Comprehensive	2 City: Atwater to Cornfields	3 Banks & Tribs Only	4 Highest Scoring Objectives (over 3)	5 City: Los Feliz to Arroyo Seco	6 Corps Team	7 highest objectives (over 5)	8 Charette Team 1	9 Soft Bottom & Channl associated banks	10 Highest Other Criteria (over 11)	11 Charette Team 4	12 Charette Team 3	13 Charette Team 6	14 Charette Team 5	15 Charette Team 2	16 Side Channels Only	17 Charette Team 7	18 Comprehensive Pockets	19 Taylor Yard
4. Brazil to Los Feliz Blvd	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x	x	x	x			x	x		x						x	x		
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x	x	x	x	x	x	x	x	x	x		x			x	x	x		
		4. grade adjacent areas to a lower elevation for habitat & offline retention	x	x	x	x		x	x			x		x				x			
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat)	x	x	x	x	x	x	x	x		x			x			x			
		7. Create underground basins for attenuation - continue current use	y		y					y				y	y			y			
		9. culverts & or underground basins to divert flood flows	y	y	y	y	y	y	y	y	y						y		y		
	III. Wildlife Access (formerly other)	12. bridge undercrossings for wildlife	x	x													x				
		15. wildlife passage/tunnels	x	x	x			x							x		x				
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x	x			x			x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x	x		x	x	x	x	x			x	x	x			x			
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	21/22 widenchannel, provide erosion control may lower channel banks and provide setback levees or vegetated berms	x	x		x		x	x					x		x					
		23. channel bed (implies deepening or attenuation)		x		x	x		x												
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x	x	x	x		x	x	x	x	x	x		x	x					
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x	x		x	x		x						x						
		Construction	137,219,364	138,376,364	127,488,009	137,874,958	7,848,819	131,040,351	137,874,958	126,011,065	114,541,639	127,488,009	113,641,639	12,108,299	119,433,459	122,871,588	900,000	13,846,370	6,577,607	-	-
		Mobilization (7.5%)	10,291,452	10,378,227	9,561,601	10,340,622	588,661	9,828,026	10,340,622	9,450,830	8,590,623	9,561,601	8,523,123	908,122	8,957,509	9,215,369	67,500	1,038,478	493,321	-	-
		Construction Subtotal	147,510,816	148,754,591	137,049,610	148,215,580	8,437,481	140,868,377	148,215,580	135,461,895	123,132,262	137,049,610	122,164,762	13,016,421	128,390,968	132,086,957	967,500	14,884,848	7,070,927	-	-
		Contingency (25%)	36,877,704	37,188,648	34,262,402	37,053,895	2,109,370	35,217,094	37,053,895	33,865,474	30,783,066	34,262,402	30,541,191	3,254,105	32,097,742	33,021,739	241,875	3,721,212	1,767,732	-	-
		PED/EDC (11%)	16,226,190	16,363,005	15,075,457	16,303,714	928,123	15,495,522	16,303,714	14,900,808	13,544,549	15,075,457	13,438,124	1,431,806	14,123,006	14,529,565	106,425	1,637,333	777,802	-	-
		S&A (6.5%)	9,588,203	9,669,048	8,908,225	9,634,013	548,436	9,156,445	9,634,013	8,805,023	8,003,597	8,908,225	7,940,710	846,067	8,345,413	8,585,652	62,888	967,515	459,610	-	-
		Construction Period (Months)	43	43	35	39	17	36	39	35	27	32	26	15	33	27	13	17	12	-	-
		IDC	14,782,451	14,967,077	11,163,895	13,508,715	328,001	11,645,434	13,508,715	10,966,480	7,642,732	9,919,258	7,184,143	449,021	9,718,354	8,171,589	27,158	564,516	191,153	-	-
		LERRDS	19,830,552	19,830,552	19,001,697	19,792,938	19,756,075	19,820,195	19,792,938	18,802,694	17,300,599	18,974,422	17,578,612	17,548,694	18,353,356	16,799,997	634,224	17,993,208	562,014	-	-
		Total Cost Subtotal	244,815,916	246,772,921	225,461,286	244,508,854	32,107,486	232,203,067	244,508,854	222,802,375	200,406,804	224,189,374	198,847,541	36,546,115	211,028,839	213,195,499	2,040,069	39,768,632	10,829,238	-	-
		Annualized Construction Costs	10,912,478	10,999,710	10,049,761	10,898,791	1,431,166	10,350,270	10,898,791	9,931,242	8,932,977	9,993,066	8,863,474	1,629,015	9,406,446	9,503,023	90,935	1,772,656	482,705	-	-
		Annualized O&M Costs	554,898	554,898	545,049	547,377	102,772	500,101	547,377	552,570	461,521	545,049	452,521	61,329	496,293	454,849	59,000	142,528	106,277	-	-
		Total Annualized Costs	11,467,377	11,554,609	10,594,809	11,446,168	1,533,939	10,850,371	11,446,168	10,483,811	9,394,497	10,538,115	9,315,994	1,690,343	9,902,739	9,957,872	149,935	1,915,184	588,982	-	-
5. Los Feliz to Glendale Fwy (2)	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x	x	x		x			x		x	x		x						
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x	x			x	x			x							x			
	II. Attenuation	9. culverts & or underground basins to divert flood flows	y	y	y	y	y	y	y	y	y						y		y		
	III. Wildlife Access (formerly other)	14. wildlife access from river to bank (in daylighted storm drain)	x	x			x	x		x		x					x				
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x	x			x			x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x	x		x	x	x	x	x			x		x			x			
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	23. channel bed (implies deepening or attenuation)		x		x	x		x												
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x	x	x		x						x								
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x	x		x	x		x						x						
		Construction	87,401,820	87,401,820	31,784,946	55,367,624	87,401,820	100,000	55,367,624	149,250	100,000	-	31,784,946	-	55,516,874	-	-	100,000	-	-	-
		Mobilization (7.5%)	6,555,137	6,555,137	2,383,871	4,152,572	6,555,137	7,500	4,152,572	11,194	7,500	-	2,383,871	-	4,163,766	-	-	7,500	-	-	-
		Construction Subtotal	93,956,957	93,956,957	34,168,817	59,520,196	93,956,957	107,500	59,520,196	160,444	107,500	-	34,168,817	-	59,680,640	-	-	107,500	-	-	-
		Contingency (25%)	23,489,239	23,489,239	8,542,204	14,880,049	23,489,239	26,875	14,880,049	40,111	26,875	-	8,542,204	-	14,920,160	-	-	26,875	-	-	-
		PED/EDC (11%)	10,335,265	10,335,265	3,758,570	6,547,222	10,335,265	11,825	6,547,222	17,649	11,825	-	3,758,570	-	6,564,870	-	-	11,825	-	-	-
		S&A (6.5%)	6,107,202	6,107,202	2,220,973	3,868,813	6,107,202	6,988	3,868,813	10,429	6,988	-	2,220,973	-	3,879,242	-	-	6,988	-	-	-
		Construction Period (Months)	29	30	15	20	30	12	20	13	10	-	15	-	20	-	-	10	-	-	-
		IDC	6,278,039	6,559,371	1,161,876	2,647,887	6,559,371	2,877	2,647,887	4,752	2,270	-	1,161,876	-	2,657,915	-	-	2,270	-	-	-
		LERRDS	1,755,929	1,755,929	1,569,855	1,353,694	1,755,929	1,330,646	1,353,694	1,741,935	59,726	-	1,562,483	-	1,686,421	-	-	59,726	-	-	-
		Total Cost Subtotal	141,922,632	142,203,963	51,422,296	88,817,861	142,203,963	1,486,711	88,817,861	1,975,319	215,183	-	51,414,923	-	89,389,248	-	-	215,183	-	-	-
		Annualized Construction Costs	6,326,090	6,338,631	2,292,109	3,958,987	6,338,631	66,269	3,958,987	88,048	9,592	-	2,291,780	-	3,984,456	-	-	9,592	-	-	-
		Annualized O&M Costs	532,619	532,619	320,008	259,372	532,619	51,000	259,372	52,239	51,000	-	320,008	-	261,611	-	-	51,000	-	-	-
		Total Annualized Costs	6,858,709	6,871,249	2,612,116	4,218,359	6,871,249	117,269	4,218,359	140,287	60,592	-	2,611,788	-	4,246,067	-	-	60,592	-	-	-
6. Glendale Fwy (2) to I-5	I. Adjacent or off channel modifications	3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x	x	x	x	x	x			x	x		x	x	x	x	x	x	x	x
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x	x	x	x	x	x			x							x		x	x
		4. grade adjacent areas to a lower elevation for habitat & offline retention	x	x	x	x	x	x	x		x			x				x			x
	II. Attenuation	9. culverts & or underground basins to divert flood flows	y	y	y	y	y	y	y	y	y						y		y		
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x	x			x			x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x
		19. Planting built into channel walls (reshape concrete walls to accommodate vegetation or add hanging boxes (native vines, small shrubs, etc)	x	x			x					x	x	x	x					x	
		20. bring concrete down to channel level; reconfigure as soft bottom channel	x	x	x	x	x	x			x				x		x			x	x
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	21/22 widenchannel, provide erosion control may lower channel banks and provide setback levees or vegetated berms	x	x	x	x	x	x	x		x		x	x	x	x	x		x	x	x
		23. channel bed (implies deepening or attenuation)		x		x	x		x												
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x	x	x		x	x		x	x	x	x	x			x		x	x	x
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x	x		x	x		x						x						
		Construction	87,357,210	87,357,210	79,398,773	35,964,291	87,357,210	77,497,106	35,864,291	50,416,020	77,497,106	44,359,249	51,974,577	79,298,773	18,400,200	8,540,096	50,072,911	27,424,195	49,148,143	52,074,577	77,497,106
		Mobilization (7.5%)	6,551,791	6,551,791	5,954,908	2,697,322	6,551,791	5,812,283	2,689,822	3,781,201	5,812,283	3,326,944	3,898,093	5,947,408	1,380,015	640,507	3,755,468	2,056,815	3,686,111	3,905,593	5,812,283
		Construction Subtotal	93,909,001	93,909,001	85,353,680	38,661,613	93,909,001	83,309,389	38,554,113	54,197,221	83,309,389	47,686,193	55,872,671	85,246,180	19,780,215	9,180,603	53,828,379	29,481,010	52,834,254	55,980,171	83,309,389
		Contingency (25%)	23,477,250	23,477,250	21,338,420	9,665,403	23,477,250	20,827,347	9,638,528	13,549,305	20,827,347	11,921,548	13,968,168	21,311,545	4,945,054	2,295,151	13,457,095	7,370,252	13,208,563	13,995,043	20,827,347
		PED/EDC (11%)	10,329,990	10,329,990	9,388,905	4,252,777	10,329,990	9,164,033	4,240,952	5,961,694	9,164,033	5,245,481	6,145,994	9,377,080	2,175,824	1,009,866	5,921,122	3,242,911	5,811,768	6,157,819	9,164,033
		S&A (6.5%)	6,104,085	6,104,085	5,547,989	2,513,005	6,104,085	5,415,110	2,506,017	3,522,819	5,415,110	3,099,603	3,631,724	5,541,002	1,285,714	596,739	3,498,845	1,916,266	3,434,226	3,638,711	5,415,110
		Construction Period (Months)	36	37	33	26	37	31	23	22	31	21	22	29	22	16	25	18	22	26	30
		IDC	7,849,100	8,136,336	6,385,208	2,330,657	8,136,336	5,927,984	1,982,117	2,727,153	5,927,984	2,305,189	2,839,949	5,606,629	961,836	337,351	3,018,641	1,177,639	2,636,668	3,341,702	5,678,106
		LERRDS	109,570,708	109,570,708	109,570,708	87,070,619	109,570,708	87,123,187	87,026,198	109,537,664	87,123,522	109,562,270	109,562,270	109,562,270	109,561,619	87,061,796	87,114,364	30,788,481	29,722,759	109,570,373	87,123,522
		Total Cost Subtotal	251,240,133	251,527,370	237,584,910	144,494,074	251,527,370	211,767,050	143,947,927	189,495,858	211,767,386	179,820,284	192,020,775	236,644,707	138,710,261	100,481,506	166,838,445	73,976,559	107,648,239	192,683,818	211,517,507
		Annualized Construction Costs	11,198,833	11,211,636	10,590,162	6,440,710	11,211,636	9,439,351	6,416,366	8,446,630	9,439,366	8,015,349	8,559,176	10,548,253	6,182,901	4,478,885	7,436,693	3,297,447	4,798,336	8,588,731	9,428,228
		Annualized O&M Costs	797,650	797,650	674,616	420,437	797,650	646,091	419,437	412,559	646,091	318,050	332,361	673,616	229,742	78,183	303,836	392,255	289,965	333,361	646,091
		Total Annualized Costs	11,996,483	12,009,286	11,264,778	6,861,148	12,009,286	10,085,442	6,835,804	8,859,189	10,085,457	8,333,399	8,891,537	11,221,869	6,412,643	4,557,067	7,740,529	3,689,702	5,088,301	8,922,092	10,074,318

X: Indicates that the measure is included in the alternative.

y: Prelminary array included culverts or basins.

LOS ANGELES RIVER COST ESTIMATE
ALTERNATIVES MATRIX

Reach	Measure Type	Submeasure	1 Comprehensive	2 City: Atwater to Cornfields	3 Banks & Tribs Only	4 Highest Scoring Objectives (over 3)	5 City: Los Feliz to Arroyo Seco	6 Corps Team	7 highest objectives (over 5)	8 Charette Team 1	9 Soft Bottom & Channl associated banks	10 Highest Other Criteria (over 11)	11 Charette Team 4	12 Charette Team 3	13 Charette Team 6	14 Charette Team 5	15 Charette Team 2	16 Side Channels Only	17 Charette Team 7	18 Comprehensive Pockets	19 Taylor Yard
7. I-5 to Main	I. Adjacent or off channel modifications	1. elevate railroads on trestles (consider other locations when necessary - is this an "all alts" measure?)	x	x	x	x		x		x		x	x		x			x	x	x	
		2. expose existing storm drains & gravity flow through DWP to LAR with terracing into the river	x	x	x			x		x		x	x				x			x	
		3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x	x	x	x	x	x		x		x	x		x		x	x	x		
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x	x			x	x			x							x			
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat)	x	x	x										x			x			
		8. creation of wetlands flood control basin (assumes culvert under Baker St)	x	x	x			x					x							x	
		9. culverts & or underground basins to divert flood flows	y	y	y	y	y	y	y	y	y						y		y		
	III. Wildlife Access (formerly other)	15. wildlife passage/tunnels	x	x				x									x				
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x	x			x			x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x		x	
		19. Planting built into channel walls (reshape concrete walls to accommodate vegetation or add hanging boxes (native vines, small shrubs, etc)	x	x	x		x					x	x	x	x					x	
		21/22 widenchannel, provide erosion control may lower channel banks and provide setback levees or vegetated berms	x	x	x	x	x	x				x	x	x	x	x	x		x	x	
		23. channel bed (implies deepening or attenuation)	x	x		x	x		x			x	x		x	x				x	
		25. tributary channels/widen channel (implies erosion control)		x	x	x	x	x	x	x		x	x				x				
		26. terrace banks (check for connectivity vs too small once mapping is completed)	x	x	x		x	x		x		x	x		x						
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x	x		x	x		x						x						
		Construction	79,429,472	79,429,472	72,919,284	75,353,714	70,653,714	72,919,284	6,704,487	48,176,162	300,000	72,993,007	76,768,766	21,161,663	75,353,714	25,011,145	64,143,526	48,176,162	68,649,227	34,086,903	-
		Mobilization (7.5%)	5,957,210	5,957,210	5,468,946	5,651,529	5,299,029	5,468,946	502,837	3,613,212	22,500	5,474,476	5,757,657	1,587,125	5,651,529	1,875,836	4,810,764	3,613,212	5,148,692	2,556,518	-
		Construction Subtotal	85,386,683	85,386,683	78,388,231	81,005,242	75,952,742	78,388,231	7,207,324	51,789,374	322,500	78,467,483	82,526,423	22,748,788	81,005,242	26,886,980	68,954,290	51,789,374	73,797,919	36,643,421	-
		Contingency (25%)	21,346,671	21,346,671	19,597,058	20,251,311	18,988,186	19,597,058	1,801,831	12,947,343	80,625	19,616,871	20,631,606	5,687,197	20,251,311	6,721,745	17,238,573	12,947,343	18,449,480	9,160,855	-
		PED/EDC (11%)	9,392,535	9,392,535	8,622,705	8,910,577	8,354,802	8,622,705	792,806	5,696,831	35,475	8,631,423	9,077,907	2,502,367	8,910,577	2,957,568	7,584,972	5,696,831	8,117,771	4,030,776	-
		S&A (6.5%)	5,550,134	5,550,134	5,095,235	5,265,341	4,936,928	5,095,235	468,476	3,366,309	20,963	5,100,386	5,364,218	1,478,671	5,265,341	1,747,654	4,482,029	3,366,309	4,796,865	2,381,822	-
		Construction Period (Months)	33	35	27	24	27	27	11	20	6	25	27	10	27	11	21	17	18	17	-
		IDC	6,558,718	6,817,666	4,909,491	4,419,999	4,699,799	4,909,491	171,517	2,365,663	4,315	4,451,664	5,029,087	516,740	4,898,390	643,390	3,307,376	1,916,525	3,005,039	1,400,811	-
		LERRDS	47,061,897	47,061,897	31,372,890	31,282,450	22,658,568	47,057,422	5,869,762	45,153,206	2,324,206	31,372,890	31,372,890	5,749,795	45,237,420	5,653,606	25,045,660	33,285,601	25,628,633	31,372,890	-
		Total Cost Subtotal	175,296,639	175,555,587	147,985,610	151,134,919	135,591,024	163,670,142	16,311,716	121,318,726	2,788,084	147,640,717	154,002,130	38,683,557	165,568,280	44,610,943	126,612,900	109,001,984	133,795,707	84,990,576	-
		Annualized Construction Costs	7,813,711	7,825,253	6,596,343	6,736,721	6,043,864	7,295,469	727,082	5,407,687	124,277	6,580,970	6,864,525	1,724,289	7,380,077	1,988,498	5,643,671	4,858,678	5,963,839	3,788,388	-
		Annualized O&M Costs	277,496	277,496	263,119	320,002	267,002	263,119	120,291	237,622	53,000	255,626	263,119	70,918	267,002	70,918	255,626	234,622	249,711	81,412	-
		Total Annualized Costs	8,091,207	8,102,749	6,859,462	7,056,723	6,310,866	7,558,588	847,373	5,645,310	177,277	6,836,595	7,127,644	1,795,207	7,647,079	2,059,416	5,899,297	5,093,300	6,213,550	3,869,800	-
8. Main to First	I. Adjacent or off channel modifications	1. elevate railroads on trestles (consider other locations when necessary - is this an "all alts" measure?)	x		x	x		x	x	x		x	x	x		x		x	x		
		3/5. create geomorphology and plant for freshwater marsh, open water le pool/riffle system	x		x	x		x		x		x				x		x			
		2. expose stormdrain outlets; convert to natural stream confluence, & divert to water quality ponds as needed (put in adjacent channel etc)	x					x			x							x			
		6. rebuild geomorphology for historic wash	x		x	x				x			x				x				
	II. Attenuation	10. divert tributary & river flow into side channels on both sides (minimize impacts to existing use in parks & plant ripairan/marsh habitat) to recreate channel braiding	x		x	x		x							x			x	x		
		9. culverts & or underground basins to divert flood flows	y		y	y		y	y	y	y						y		y		
	III. Wildlife Access (formerly other)	15. wildlife passage/tunnels	x		x			x					x				x				
	IV. Planting/ implies soil amendments and geomorphic restructuring as needed	16. bioengineer channel walls (vines, vegetated notching near top of vertical walls)	x							x					x						
		17. habitat corridors/ riparian planting on banks (assume easiest method)	x		x	x		x	x	x		x	x	x	x	x	x	x			
	V. Remove concrete (implies required erosion control such as grade control,planting and geomorphic restructuring, etc)	21/22 widenchannel, provide erosion control may lower channel banks and provide setback levees or vegetated berms	x		x			x					x	x		x					
		23. channel bed (implies deepening or attenuation)	x			x			x			x	x			x					
		26. terrace banks (check for connectivity vs too small once mapping is completed)			x			x					x								
	VI Reshape Channel	27. modify trap channel to vertical sides to gain width (adds capacity)	x			x			x						x						
		Construction	141,779,824	-	109,533,381	90,353,761	-	98,659,287	53,192,364	57,775,550	200,000	50,858,186	99,560,232	64,496,286	40,570,055	90,126,824	12,271,741	51,514,951	40,600,920	-	-
		Mobilization (7.5%)	10,633,487	-	8,215,004	6,776,532	-	7,399,447	3,989,427	4,333,166	15,000	3,814,364	7,467,017	4,837,221	3,042,754	6,759,512	920,381	3,863,621	3,045,069	-	-
		Construction Subtotal	152,413,311	-	117,748,384	97,130,293	-	106,058,734	57,181,791	62,108,716	215,000	54,672,550	107,027,249	69,333,507	43,612,809	96,886,335	13,192,122	55,378,573	43,645,989	-	-
		Contingency (25%)	38,103,328	-	29,437,096	24,282,573	-	26,514,683	14,295,448	15,527,179	53,750	13,668,137	26,756,812	17,333,377	10,903,202	24,221,584	3,298,030	13,844,643	10,911,497	-	-
		PED/EDC (11%)	16,765,464	-	12,952,322	10,684,332	-	11,666,461	6,289,997	6,831,959	23,650	6,013,980	11,772,997	7,626,686	4,797,409	10,657,497	1,451,133	6,091,643	4,801,059	-	-
		S&A (6.5%)	9,906,865	-	7,653,645	6,313,469	-	6,893,818	3,716,816	4,037,067	13,975	3,553,716	6,956,771	4,506,678	2,834,833	6,297,612	857,488	3,599,607	2,836,989	-	-
		Construction Period (Months)	41	-	33	29	-	31	20	22	9	18	29	19	17	25	13	19	15	-	-
		IDC	14,501,299	-	8,824,577	6,362,679	-	7,560,057	2,541,787	3,034,250	4,081	2,230,617	7,020,346	2,933,981	1,634,792	5,477,239	375,186	2,431,497	1,511,180	-	-
		LERRDS	237,461,453	-	240,495,921	236,884,419	-	231,497,843	207,951,590	221,139,121	873,030	207,420,256	225,903,761	207,420,256	77,997,019	207,420,256	178,965,949	226,609,830	61,310,966	-	-
		Total Cost Subtotal	469,151,720	-	417,111,945	381,657,765	-	390,191,596	291,977,430	312,678,291	1,183,487	287,559,255	385,437,938	309,154,484	141,780,064	350,960,522	198,139,908	307,955,793	125,017,681	-	-
		Annualized Construction Costs	20,912,071	-	18,592,439	17,012,097	-	17,392,485	13,014,666	13,937,390	52,753	12,817,729	17,180,595	13,780,320	6,319,736	15,643,791	8,831,932	13,726,889	5,572,565	-	-
		Annualized O&M Costs	860,700	-	805,724	552,159	-	775,200	181,136	235,166	52,000	136,509	467,224	293,275	502,127	376,916	85,391	393,367	304,858	-	-
		Total Annualized Costs	21,772,771	-	19,398,163	17,564,255	-	18,167,686	13,195,801	14,172,556	104,753	12,954,238	17,647,819	14,073,594	6,821,863	16,020,707	8,917,322	14,120,256	5,877,423	-	-
Alternative Totals		**Construction**	775,510,925	470,879,419	494,554,373	537,792,269	253,261,563	502,089,107	392,507,546	406,912,386	335,717,771	383,825,941	429,191,524	346,719,395	486,659,658	348,633,966	183,409,935	186,835,912	194,859,903	149,611,832	77,497,106
		Mobilization (7.5%)	58,163,319	35,315,956	37,091,578	40,334,420	18,994,617	37,656,683	29,438,066	30,518,429	25,178,833	28,786,946	32,189,364	26,003,955	36,499,474	26,147,547	13,755,745	14,012,693	14,614,493	11,220,887	5,812,283
		Tunneling Costs	1,524,019,200	1,524,019,200	-	1,524,019,200	1,524,019,200	1,524,019,200	1,524,019,200	1,524,019,200	-	1,524,019,200	-	-	1,524,019,200	1,524,019,200	1,524,019,200	-	-	-	-
		Construction Subtotal	2,357,693,444	2,030,214,576	531,645,951	2,102,145,890	1,796,275,381	2,063,764,991	1,945,964,812	1,961,450,015	360,896,604	1,936,632,087	461,380,888	372,723,350	2,047,178,333	1,898,800,713	1,721,184,880	200,848,605	209,474,396	160,832,719	83,309,389
		Contingency (25%)	589,423,361	507,553,644	132,911,488	525,536,472	449,068,845	515,941,248	486,491,203	490,362,504	90,224,151	484,158,022	115,345,222	93,180,837	511,794,583	474,700,178	430,296,220	50,212,151	52,368,599	40,208,180	20,827,347
		PED/EDC (11%)	259,346,279	223,323,603	58,481,055	231,236,048	197,590,292	227,014,149	214,056,129	215,759,502	39,698,626	213,029,530	50,751,898	40,999,568	225,189,617	208,868,078	189,330,337	22,093,347	23,042,184	17,691,599	9,164,033
		S&A (6.5%)	153,250,074	131,963,947	34,556,987	136,639,483	116,757,900	134,144,724	126,487,713	127,494,251	23,458,279	125,881,086	29,989,758	24,227,018	133,066,592	123,422,046	111,877,017	13,055,159	13,615,836	10,454,127	5,415,110
		IDC	68,473,911	40,795,183	36,061,977	36,261,503	19,723,507	36,280,851	25,335,802	25,158,099	21,972,417	22,885,440	25,608,622	19,255,448	31,021,711	18,844,199	8,443,668	7,513,171	8,352,374	7,449,059	5,678,106
		LERRDS	435,632,817	190,234,150	518,174,560	385,678,240	153,741,279	406,337,897	325,576,973	415,095,764	222,107,346	376,586,386	500,224,319	358,784,218	368,990,587	335,188,854	309,607,642	316,120,517	122,839,298	253,093,996	87,123,522
		Total Cost Subtotal	3,863,819,886	3,124,085,103	1,311,832,017	1,245,770,276	561,429,843	1,211,756,500	952,185,273	1,063,592,774	758,357,424	987,445,190	1,183,300,707	909,170,440	1,145,514,062	888,096,709	599,012,404	609,842,950	429,692,687	489,729,679	211,517,507
		Annualized Construction Costs	179,861,590	145,426,788	61,066,043	57,990,856	26,134,672	56,407,508	44,324,415	49,510,457	35,301,690	45,965,772	55,082,885	42,322,066	53,323,909	41,341,080	27,884,147	28,388,312	20,002,281	22,797,015	9,846,182
		Annualized O&M Costs	4,079,026	2,413,757	3,329,386	2,734,795	1,700,044	2,777,035	2,084,000	2,029,493	1,985,186	1,885,825	2,102,601	1,640,138	2,527,081	1,421,067	925,140	1,712,535	1,314,594	651,010	646,091
		Total Annualized Costs	183,940,616	147,840,544	64,395,430	60,725,651	27,834,715	59,184,543	46,408,415	51,539,950	37,286,876	47,851,596	57,185,486	43,962,204	55,850,991	42,762,147	28,809,288	30,100,847	21,316,875	23,448,025	10,492,273

X: Indicates that the measure is included in the alternative.

y: Prelminary array included culverts or basins.

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Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 2
Quantity Take-Offs

April 2015

(Attachment is for Official Use Only)

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Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 3
Spreadsheet Estimate Summaries

April 2015

LOS ANGELES RIVER FEASIBILITY

Date: 24-Apr-13

SUMMARY OF CONSTRUCTION COSTS

REACH NO.		REACH / SUB-MEASURE DESCRIPTION	UOM	QUANTITY		ANNUAL O&M COST
1		**Pollywog Park/Headworks to Midpoint of Betty Davis Park**				
		Mobilization / Demobilization	LS	1	$	13,840,408
	2	Expose Storm Drain Outlets	LS	1	$	300,000
	3	Create Geomorphology and Plant Freshwater Marsh	LS	1	$	3,602,720
	7	Create Underground Basins for Attenuation	LS	1	$	113,400,000
	10	Divert Tributary & River Flow Into Side Channels (A, B, & C)	LS	1	$	17,771,927
	16	Bioengineer Channel Walls	LS	1	$	2,703,283
	17	Habitat Corridors/Riparian Planting on Banks	LS	1	$	1,460,173
	23	Channel Bed	LS	1	$	16,707,980
	25	Tributary Channels - Burbank Channel	LS	1	$	6,767,099
	26	Terrace Banks	LS	1	$	20,888,649
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$	936,944
				Total Cost Reach 1:	*$*	*198,379,183*
2		**Midpoint Betty Davis Park to upstream end of Ferraro Fields**				
		Mobilization / Demobilization	LS	1	$	3,694,944
	2	Expose Storm Drain Outlets	LS	1	$	300,000
	3	Create Geomorphology and Plant Freshwater Marsh	LS	1	$	3,332,465
	9	Culverts or Underground Basins	LS	1	$	10,530,000
	10	Divert Tributary & River Flow Into Side Channels (A, B, & C)	LS	1	$	3,959,245
	16	Bioengineer Channel Walls	LS	1	$	935,263
	17	Habitat Corridors/Riparian Planting on Banks	LS	1	$	41,962
	23	Channel Bed	LS	1	$	1,381,401
	26	Terrace Banks	LS	1	$	5,356,628
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$	23,428,962
				Total Cost Reach 2:	*$*	*52,960,871*
3		**Ferraro Fields to Brazil St**				
		Mobilization / Demobilization	LS	1	$	16,182,731
	2	Expose Storm Drain Outlets	LS	1	$	600,000
	3	Create Geomorphology and Plant Freshwater Marsh	LS	1	$	8,030,949
	9	Culverts or Underground Basins	LS	1	$	75,600,000
	10	Divert Tributary & River Flow Into Side Channels (E)	LS	1	$	6,239,813
	17	Habitat Corridors/Riparian Planting on Banks	LS	1	$	134,979
	23	Channel Bed	LS	1	$	6,339,819
	25	Tribuary Channels - Verdugo Wash	LS	1	$	47,584,437
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$	71,239,755
				Total Cost Reach 3:	*$*	*231,952,484*

LOS ANGELES RIVER FEASIBILITY

SUMMARY OF CONSTRUCTION COSTS

Date: 24-Apr-13

REACH NO.	REACH / SUB-MEASURE DESCRIPTION		UOM	QUANTITY	ANNUAL O&M COST	
4	**Brazil to Los Feliz Blvd**					
		Mobilization / Demobilization	LS	1	$	30,304,227
	2	Expose Storm Drain Outlets	LS	1	$	900,000
	3	Create Geomorphology and Plant Freshwater Marsh	LS	1	$	5,677,607
	4	Grade Adjacent Areas to Lower Elevation (G)	LS	1	$	1,978,350
	9	Culverts or Underground Basins	LS	1	$	265,680,000
	10	Divert Tributary & River Flow Into Side Channels (A, B, & C)	LS	1	$	5,290,413
	16	Bioengineer Channel Walls	LS	1	$	501,406
	22	Channel Banks Mainstem/Widen Channel	LS	1	$	9,229,949
	23	Channel Bed	LS	1	$	1,157,000
	26	Terrace Banks	LS	1	$	113,641,639
				Total Cost Reach 4:	*$*	*434,360,591*
5	**Los Feliz to Glendale Fwy (2)**					
		Mobilization / Demobilization	LS	1	$	6,555,137
	2	Expose Storm Drain Outlets	LS	1	$	100,000
	16	Bioengineer Channel Walls	LS	1	$	149,250
	26	Terrace Banks	LS	1	$	31,784,946
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$	55,367,624
				Total Cost Reach 5:	*$*	*93,956,957*
6	**Glendale Fwy (2) to I-5**					
		Mobilization / Demobilization	LS	1	$	7,645,291
	2	Expose Storm Drain Outlets	LS	1	$	100,000
	4	Grade Adjacent Areas to Lower Elevation (G)	LS	1	$	27,324,195
	9	Culverts or Underground Basins	LS	1	$	14,580,000
	16	Bioengineer Channel Walls	LS	1	$	7,958,437
	17	Habitat Corridors/Riparian Planting on Banks	LS	1	$	924,768
	19	Bioengineer Channel Walls	LS	1	$	1,901,667
	21	Lower Channel Banks and Provide Setback Levees or Berms	LS	1	$	7,615,328
	26	Terrace Banks	LS	1	$	41,532,815
				Total Cost Reach 6:	*$*	*109,582,501*

LOS ANGELES RIVER FEASIBILITY

SUMMARY OF CONSTRUCTION COSTS

Date: 24-Apr-13

REACH NO.		REACH / SUB-MEASURE DESCRIPTION	UOM	QUANTITY		ANNUAL O&M COST
7		**I-5 to Main**				
		Mobilization / Demobilization	LS	1	$	12,560,232
	1	Elevate Railroads on Trestles	LS	1	$	5,000,000
	2	Expose Storm Drain Outlets	LS	1	$	300,000
	3	Create Geomorphology and Plant Freshwater Marsh	LS	1	$	42,681,863
	8	Creation of Wetlands Flood Control Basin (Corn Field)	LS	1	$	3,775,759
	17	Habitat Corridors/Riparian Planting on Banks	LS	1	$	194,299
	21	Lower Channel Banks and Provide Setback Levees or Berms	LS	1	$	20,967,364
	23	Channel Bed	LS	1	$	3,849,481
	27	Tributary Channels/Widen Channel (Arroyo Seco)	LS	1	$	2,660,707
	28	Widen Channel/Cantilever Channel Bank.	LS	1	$	88,040,283
				Total Cost Reach 7:	*$*	*180,029,987*
8		**Main to First**				
		Mobilization / Demobilization	LS	1	$	27,545,045
	1	Elevate Railroads on Trestles	LS	1	$	24,030,000
	2	Expose Storm Drain Outlets	LS	1	$	200,000
	3	Create Geomorphology and Plant Freshwater Marsh	LS	1	$	9,516,383
	6	Rebuild Geomorphology for Historic Wash (Piggyback Yard)	LS	1	$	11,074,093
	9	Culverts or Undergound Basins	LS	1	$	172,800,000
	10	Divert Tributary & River Flow Into Side Channels (Piggyback Yard)	LS	1	$	16,570,920
	16	Bioengineer Channel Walls	LS	1	$	11,957,425
	17	Habitat Corridors/Riparian Planting on Banks	LS	1	$	191,148
	17	Habitat Corridors/Riparian Planting on Banks	LS	1	$	1,006,500
	21	Lower Channel Banks and Provide Setback Levees or Berms	LS	1	$	39,268,638
	23	Channel Bed	LS	1	$	16,114,155
	26	Terrace Banks	LS	1	$	7,875,698
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$	11,850,562
	28	Widen Channel/Cantilever Channel Bank.	LS	1	$	45,818,249
				Total Cost Reach 8:	*$*	*395,818,817*

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Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 4
Operation and Maintenance Costs

April 2015

ANNUAL O&M COSTS FOR FINAL ARRAY OF ALTERNATIVES

10 **ARBOR RIPARIAN TRANSITIONS (ART)**

R/A	Sub Measure	Item Description	UOM	Quantity	Unit Cost	Total O&M Cost
R1A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 12,410	$ 12,410
R2A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 629	$ 629
R3A17	2	Expose Storm Drain Outlets	LS	1	$ 6,000	$ 6,000
R4A16	2	Expose Storm Drain Outlets	LS	1	$ 9,000	$ 9,000
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 47,277	$ 47,277
	4	Grade Adjacent Areas to Lower Elevation (G)	LS	1	$ -	$ -
	10	Divert Tributary & River Flow Into Side Channels (F)	LS	1	$ 36,251	$ 36,251
R5A16	2	Expose Storm Drain Outlets	LS	1	$ 1,000	$ 1,000
R6A14	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 13,872	$ 13,872
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 14,311	$ 14,311
R7A9	2	Expose Storm Drain Outlets	LS	1	$ 3,000	$ 3,000
R8A15	6	Rebuild Geomorphology for Historic Wash (Piggyback Yard)	LS	1	$ 32,523	$ 32,523
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 15,098	$ 15,098
					O&M Subtotal (1):	$ 191,371
					Annual Misc. Inspection and Maintenance per Reach:	$ 50,000
					Total Inspection and Maintenance:	$ 400,000
					Invasive Species Management:	$ 84,000
					O&M Subtotal (2):	$ 675,371
					Contingency:	$ 236,380
					Total Annual O&M Cost:	$ 911,751

13 **ARBOR Corridor Extension (ACE)**

R/A	Sub Measure	Item Description	UOM	Quantity	Unit Cost	Total Cost
R1A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 12,410	$ 12,410
R2A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 629	$ 629
R3A16	2	Expose Storm Drain Outlets	LS	1	$ 6,000	$ 6,000
	3/5	Riprap	LS	1	$ 76,763	$ 76,763
	10	Excavation Embankment - Med. Haul Off	LS	1	$ 45,040	$ 45,040
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 2,025	$ 2,025
R4A16	2	Expose Storm Drain Outlets	LS	1	$ 9,000	$ 9,000
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 47,277	$ 47,277
	4	Grade Adjacent Areas to Lower Elevation (G)	LS	1	$ -	$ -
	10	Divert Tributary & River Flow Into Side Channels (F)	LS	1	$ 36,251	$ 36,251
R5A16	2	Expose Storm Drain Outlets	LS	1	$ 1,000	$ 1,000
R6A13	16	Bioengineer Channel Walls	LS	1	$ 123,034	$ 123,034
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 13,872	$ 13,872
	19	Bioengineer Channel Walls	LS	1	$ 28,525	$ 28,525
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 14,311	$ 14,311
R7A12	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 2,914	$ 2,914
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 18,003	$ 18,003
R8A15	6	Rebuild Geomorphology for Historic Wash (Piggyback Yard)	LS	1	$ 32,523	$ 32,523
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 15,098	$ 15,098
					O&M Subtotal (1):	$ 484,676
					Annual Misc. Inspection and Maintenance per Reach:	$ 50,000
					Total Inspection and Maintenance:	$ 400,000
					Invasive Species Management:	$ 84,000
					O&M Subtotal (2):	$ 968,676
					Contingency:	$ 339,037
					Total Annual O&M Cost:	$ 1,307,712

COSTS FOR FINAL ARRAY OF ALTERNATIVES

16 **ARBOR Narrows to Downtown (AND)**

R/A	Sub Measure	Item Description	UOM	Quantity	Unit Cost	Total Cost
R1A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 12,410	$ 12,410
R2A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 629	$ 629
R3A16	2	Expose Storm Drain Outlets	LS	1	$ 6,000	$ 6,000
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 76,763	$ 76,763
	10	Divert Tributary & River Flow Into Side Channels (E)	LS	1	$ 45,040	$ 45,040
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 2,025	$ 2,025
R4A16	2	Expose Storm Drain Outlets	LS	1	$ 9,000	$ 9,000
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 47,277	$ 47,277
	4	Excavation Embankment - All Haul Off	LS	1	$ -	$ -
	10	Divert Tributary & River Flow Into Side Channels (F)	LS	1	$ 36,251	$ 36,251
R5A5	2	Expose Storm Drain Outlets	LS	1	$ 1,000	$ 1,000
	16	Bioengineer Channel Walls	LS	1	$ 2,239	$ 2,239
	26	Terrace Banks	LS	1	$ 270,008	$ 270,008
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$ 209,372	$ 209,372
R6A13	16	Bioengineer Channel Walls	LS	1	$ 123,034	$ 123,034
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 13,872	$ 13,872
	19	Bioengineer Channel Walls	LS	1	$ 28,525	$ 28,525
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 14,311	$ 14,311
R7A12	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 2,914	$ 2,914
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 18,003	$ 18,003
R8A3	1	Railroad Trestle	LS	1	$ -	$ -
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 83,642	$ 83,642
	6	Rebuild Geomorphology for Historic Wash (Piggyback Yard)	LS	1	$ 32,523	$ 32,523
	10	Divert Tributary & River Flow Into Side Channels (Piggyback Yard)	LS	1	$ 127,429	$ 127,429
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 15,098	$ 15,098
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 67,293	$ 67,293
	26	Terrace Banks	LS	1	$ 32,253	$ 32,253
					O&M Subtotal (1):	$ 1,077,767
					Annual Misc. Inspection and Maintenance per Reach:	$ 50,000
					Total Inspection and Maintenance:	$ 400,000
					Invasive Species Management:	$ 84,000
					O&M Subtotal (2):	$ 1,561,767
					Contingency:	$ 546,618
					Total Annual O&M Cost:	$ 2,108,385

COSTS FOR FINAL ARRAY OF ALTERNATIVES

20 ARBOR RIPARIAN INTEGRATION VIA VARIED ECOLOGICAL REINTRODUCTION (RIVER)

R/A	Sub Measure	Item Description	UOM	Quantity	Unit Cost	Total Cost
R1A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 12,410	$ 12,410
R2A13	16	Bioengineer Channel Walls	LS	1	$ 3,208	$ 3,208
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 629	$ 629
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$ 97,263	$ 97,263
R3A18	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 76,763	$ 76,763
	10	Divert Tributary & River Flow Into Side Channels (E)	LS	1	$ 45,040	$ 45,040
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 2,025	$ 2,025
	25	Tributary Channels - Verdugo Wash	LS	1	$ 57,265	$ 57,265
R4A16	2	Expose Storm Drain Outlets	LS	1	$ 9,000	$ 9,000
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 47,277	$ 47,277
	4	Excavation Embankment - All Haul Off	LS	1	$ -	$ -
	10	Divert Tributary & River Flow Into Side Channels (F)	LS	1	$ 36,251	$ 36,251
R5A5	2	Expose Storm Drain Outlets	LS	1	$ 1,000	$ 1,000
	16	Bioengineer Channel Walls	LS	1	$ 2,239	$ 2,239
	26	Terrace Banks	LS	1	$ 270,008	$ 270,008
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$ 209,372	$ 209,372
R6A13	16	Bioengineer Channel Walls	LS	1	$ 123,034	$ 123,034
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 13,872	$ 13,872
	19	Bioengineer Channel Walls	LS	1	$ 28,525	$ 28,525
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 14,311	$ 14,311
R7A16	1	Railroad Trestle	LS	1	$ -	$ -
	2	Expose Storm Drain Outlets	LS	1	$ 3,000	$ 3,000
	3	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 181,708	$ 181,708
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 2,914	$ 2,914
R8A3	1	Railroad Trestle	LS	1	$ -	$ -
	3	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 83,642	$ 83,642
	6	Rebuild Geomorphology for Historic Wash (Piggyback Yard)	LS	1	$ 32,523	$ 32,523
	10	Divert Tributary & River Flow Into Side Channels (Piggyback Yard)	LS	1	$ 127,429	$ 127,429
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 15,098	$ 15,098
	21	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 67,293	$ 67,293
	26	Terrace Banks	LS	1	$ 32,253	$ 32,253
					O&M Subtotal (1):	$ 1,595,350
					Annual Misc. Inspection and Maintenance per Reach:	$ 50,000
					Total Inspection and Maintenance:	$ 400,000
					Invasive Species Management:	$ 84,000
					O&M Subtotal (2):	$ 2,079,350
					Contingency:	$ 727,773
					Total Annual O&M Cost:	$ 2,807,123

O&M COSTS FOR NER AND LPP COST ESTIMATES (BASED ON MCACES CONSTRUCTION COSTS)

13 **ARBOR Corridor Extension (ACE)**

R/A	Sub Measure	Item Description	UOM	Quantity	Unit Cost	Total Cost
R1A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 24,381	$ 24,381
R2A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 647	$ 647
R3A16	2	Expose Storm Drain Outlets	LS	1	$ 8,219	$ 8,219
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 70,355	$ 70,355
	10	Divert Tributary & River Flow Into Side Channels	LS	1	$ 41,227	$ 41,227
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 2,328	$ 2,328
R4A16	2	Expose Storm Drain Outlets	LS	1	$ 14,113	$ 14,113
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 43,303	$ 43,303
	4	Grade Adjacent Areas to Lower Elevation (G)	LS	1	$ -	$ -
	10	Divert Tributary & River Flow Into Side Channels (F)	LS	1	$ 33,516	$ 33,516
R5A16	2	Expose Storm Drain Outlets	LS	1	$ 1,370	$ 1,370
R6A13	16	Bioengineer Channel Walls	LS	1	$ 139,605	$ 139,605
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 15,776	$ 15,776
	19	Bioengineer Channel Walls	LS	1	$ 31,593	$ 31,593
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 18,783	$ 18,783
R7A16	2	Expose Storm Drain Outlets	LS	1	$ 3,938	$ 3,938
	8	Corn Field	LS	1	$ 13,168	$ 13,168
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 197	$ 197
	26	Terrace Banks	LS	1	$ 3,215	$ 3,215
	27	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 15,621	$ 15,621
R8A15	6	Rebuild Geomorphology for Historic Wash (Piggyback Yard)	LS	1	$ 31,054	$ 31,054
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 19,477	$ 19,477

O&M Subtotal (1):	$ 531,887
Annual Misc. Inspection and Maintenance per Reach:	$ 49,500
Total Inspection and Maintenance:	$ 396,000
Invasive Species Management:	$ 84,000
O&M Subtotal (2):	$ 1,011,887
Contingency:	$ 354,160
Total Annual O&M Cost:	$ 1,366,047

20 **ARBOR RIPARIAN INTEGRATION VIA VARIED ECOLOGICAL REINTRODUCTION (RIVER)**

R/A	Sub Measure	Item Description	UOM	Quantity	Unit Cost	Total Cost
R1A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 24,381	$ 24,381
R2A13	16	Bioengineer Channel Walls	LS	1	$ 15,067	$ 15,067
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 654	$ 654
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$ 84,442	$ 84,442
R3A18	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 69,136	$ 69,136
	10	Divert Tributary & River Flow Into Side Channels (E)	LS	1	$ 40,513	$ 40,513
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 2,196	$ 2,196
	25	Tributary Channels - Verdugo Wash	LS	1	$ 58,106	$ 58,106
R4A16	2	Expose Storm Drain Outlets	LS	1	$ 14,113	$ 14,113
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 43,303	$ 43,303
	4	Excavation Embankment - All Haul Off	LS	1	$ -	$ -
	10	Divert Tributary & River Flow Into Side Channels (F)	LS	1	$ 33,516	$ 33,516
R5A5	2	Expose Storm Drain Outlets	LS	1	$ 1,320	$ 1,320
	16	Bioengineer Channel Walls	LS	1	$ 2,440	$ 2,440
	26	Terrace Banks	LS	1	$ 61,817	$ 61,817
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$ 204,623	$ 204,623
R6A13	16	Bioengineer Channel Walls	LS	1	$ 139,605	$ 139,605
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 15,776	$ 15,776
	19	Bioengineer Channel Walls	LS	1	$ 31,593	$ 31,593
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 18,783	$ 18,783
R7A16	2	Expose Storm Drain Outlets	LS	1	$ 3,938	$ 3,938
	8	Corn Fileds	LS	1	$ 13,168	$ 13,168
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 197	$ 197
	26	Terrace Banks	LS	1	$ 3,215	$ 3,215
	27	Tributary Channels/Widen Channel	LS	1	$ 15,621	$ 15,621
R8A3		Utility Relocations	LS	1	$ 24,241	$ 24,241
	3	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 74,442	$ 74,442
	6	Rebuild Geomorphology for Historic Wash (Piggyback Yard)	LS	1	$ 28,310	$ 28,310
	10	Divert Tributary & River Flow Into Side Channels (Piggyback Yard)	LS	1	$ 110,923	$ 110,923
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 19,438	$ 19,438
	21	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 67,828	$ 67,828
	26	Terrace Banks	LS	1	$ 5,727	$ 5,727

O&M Subtotal (1):	$ 1,228,434
Annual Misc. Inspection and Maintenance per Reach:	$ 49,500
Total Inspection and Maintenance:	$ 396,000
Invasive Species Management:	$ 84,000
O&M Subtotal (2):	$ 1,708,434
Contingency:	$ 597,952
Total Annual O&M Cost:	$ 2,306,385

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Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 5
Cost Breakdown for Final Array of Alternatives

April 2015

COSTS FOR FINAL ARRAY OF ALTERNATIVES

10 **ARBOR RIPARIAN TRANSITIONS (ART)**

R/A	Sub Measure	Item Description	UOM	Quantity	Unit Cost	Total Cost
R1A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 1,460,173	$ 1,460,173
R2A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 41,962	$ 41,962
R3A17	2	Expose Storm Drain Outlets	LS	1	$ 600,000	$ 600,000
R4A16	2	Expose Storm Drain Outlets	LS	1	$ 900,000	$ 900,000
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 5,677,607	$ 5,677,607
	4	Grade Adjacent Areas to Lower Elevation (G)	LS	1	$ 1,978,350	$ 1,978,350
	10	Divert Tributary & River Flow Into Side Channels (F)	LS	1	$ 5,290,413	$ 5,290,413
R5A16	2	Expose Storm Drain Outlets	LS	1	$ 100,000	$ 100,000
R6A14	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 924,768	$ 924,768
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 7,615,328	$ 7,615,328
R7A9	2	Expose Storm Drain Outlets	LS	1	$ 300,000	$ 300,000
R8A15	6	Rebuild Geomorphology for Historic Wash (Piggyback Yard)	LS	1	$ 11,074,093	$ 11,074,093
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 1,197,648	$ 1,197,648
					Total Construction Cost:	$ 37,160,342
					Mobilization (7.5%):	$ 2,787,026
					Construction Subtotal:	$ 39,947,368

13 **ARBOR Corridor Extension (ACE)**

R/A	Sub Measure	Item Description	UOM	Quantity	Unit Cost	Total Cost
R1A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 1,460,173	$ 1,460,173
R2A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 41,962	$ 41,962
R3A16	2	Expose Storm Drain Outlets	LS	1	$ 600,000	$ 600,000
	3/5	Riprap	LS	1	$ 8,030,949	$ 8,030,949
	10	Excavation Embankment - Med. Haul Off	LS	1	$ 6,239,813	$ 6,239,813
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 134,979	$ 134,979
R4A16	2	Expose Storm Drain Outlets	LS	1	$ 900,000	$ 900,000
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 5,677,607	$ 5,677,607
	4	Grade Adjacent Areas to Lower Elevation (G)	LS	1	$ 1,978,350	$ 1,978,350
	10	Divert Tributary & River Flow Into Side Channels (F)	LS	1	$ 5,290,413	$ 5,290,413
R5A16	2	Expose Storm Drain Outlets	LS	1	$ 100,000	$ 100,000
R6A13	16	Bioengineer Channel Walls	LS	1	$ 7,958,437	$ 7,958,437
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 924,768	$ 924,768
	19	Bioengineer Channel Walls	LS	1	$ 1,901,667	$ 1,901,667
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 7,615,328	$ 7,615,328
R7A12	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 194,299	$ 194,299
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 20,967,364	$ 20,967,364
R8A15	6	Rebuild Geomorphology for Historic Wash (Piggyback Yard)	LS	1	$ 11,074,093	$ 11,074,093
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 1,197,648	$ 1,197,648
					Total Construction Cost:	$ 82,287,850
					Mobilization (7.5%):	$ 6,171,589
					Construction Subtotal:	$ 88,459,438

COSTS FOR FINAL ARRAY OF ALTERNATIVES

16 **ARBOR Narrows to Downtown (AND)**

R/A	Sub Measure	Item Description	UOM	Quantity	Unit Cost	Total Cost
R1A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 1,460,173	$ 1,460,173
R2A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 41,962	$ 41,962
R3A16	2	Expose Storm Drain Outlets	LS	1	$ 600,000	$ 600,000
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 8,030,949	$ 8,030,949
	10	Divert Tributary & River Flow Into Side Channels (E)	LS	1	$ 6,239,813	$ 6,239,813
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 134,979	$ 134,979
R4A16	2	Expose Storm Drain Outlets	LS	1	$ 900,000	$ 900,000
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 5,677,607	$ 5,677,607
	4	Excavation Embankment - All Haul Off	LS	1	$ 1,978,350	$ 1,978,350
	10	Divert Tributary & River Flow Into Side Channels (F)	LS	1	$ 5,290,413	$ 5,290,413
R5A5	2	Expose Storm Drain Outlets	LS	1	$ 100,000	$ 100,000
	16	Bioengineer Channel Walls	LS	1	$ 149,250	$ 149,250
	26	Terrace Banks	LS	1	$ 31,784,946	$ 31,784,946
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$ 55,367,624	$ 55,367,624
R6A13	16	Bioengineer Channel Walls	LS	1	$ 7,958,437	$ 7,958,437
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 924,768	$ 924,768
	19	Bioengineer Channel Walls	LS	1	$ 1,901,667	$ 1,901,667
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 7,615,328	$ 7,615,328
R7A12	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 194,299	$ 194,299
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 20,967,364	$ 20,967,364
R8A3	1	Railroad Trestle	LS	1	$ 24,030,000	$ 24,030,000
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 9,516,383	$ 9,516,383
	6	Rebuild Geomorphology for Historic Wash (Piggyback Yard)	LS	1	$ 11,074,093	$ 11,074,093
	10	Divert Tributary & River Flow Into Side Channels (Piggyback Yard)	LS	1	$ 16,570,920	$ 16,570,920
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 191,148	$ 191,148
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 39,268,638	$ 39,268,638
	26	Terrace Banks	LS	1	$ 7,875,698	$ 7,875,698
					Total Construction Cost:	$ 265,844,810
					Mobilization (7.5%):	$ 19,938,361
					Construction Subtotal:	$ 285,783,170

COSTS FOR FINAL ARRAY OF ALTERNATIVES

20 **ARBOR RIPARIAN INTEGRATION VIA VARIED ECOLOGICAL REINTRODUCTION (RIVER)**

R/A	Sub Measure	Item Description	UOM	Quantity	Unit Cost	Total Cost
R1A11	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 1,460,173	$ 1,460,173
R2A13	16	Bioengineer Channel Walls	LS	1	$ 935,263.33	$ 935,263
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 41,962.12	$ 41,962
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$ 23,428,961.66	$ 23,428,962
R3A18	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 8,030,949.27	$ 8,030,949
	10	Divert Tributary & River Flow Into Side Channels (E)	LS	1	$ 6,239,812.78	$ 6,239,813
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 134,978.79	$ 134,979
	25	Tributary Channels - Verdugo Wash	LS	1	$ 47,584,437.48	$ 47,584,437
R4A16	2	Expose Storm Drain Outlets	LS	1	$ 900,000.00	$ 900,000
	3/5	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 5,677,606.67	$ 5,677,607
	4	Excavation Embankment - All Haul Off	LS	1	$ 1,978,350.00	$ 1,978,350
	10	Divert Tributary & River Flow Into Side Channels (F)	LS	1	$ 5,290,413.33	$ 5,290,413
R5A5	2	Expose Storm Drain Outlets	LS	1	$ 100,000.00	$ 100,000
	16	Bioengineer Channel Walls	LS	1	$ 149,250.00	$ 149,250
	26	Terrace Banks	LS	1	$ 31,784,945.96	$ 31,784,946
	27	Modify Trapezoidal Channel to Vertical Sides	LS	1	$ 55,367,624.42	$ 55,367,624
R6A13	16	Bioengineer Channel Walls	LS	1	$ 7,958,437.33	$ 7,958,437
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 924,767.70	$ 924,768
	19	Bioengineer Channel Walls	LS	1	$ 1,901,666.67	$ 1,901,667
	21/22	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 7,615,328.19	$ 7,615,328
R7A16	1	Railroad Trestle	LS	1	$ 5,000,000.00	$ 5,000,000
	2	Expose Storm Drain Outlets	LS	1	$ 300,000.00	$ 300,000
	3	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 42,681,862.55	$ 42,681,863
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 194,299.05	$ 194,299
R8A3	1	Railroad Trestle	LS	1	$ 24,030,000.00	$ 24,030,000
	3	Create Geomorphology and Plant Freshwater Marsh	LS	1	$ 9,516,383.39	$ 9,516,383
	6	Rebuild Geomorphology for Historic Wash (Piggyback Yard)	LS	1	$ 11,074,093.26	$ 11,074,093
	10	Divert Tributary & River Flow Into Side Channels (Piggyback Yard)	LS	1	$ 16,570,920.19	$ 16,570,920
	17	Habitat/Corridors Riparian Planting on Banks	LS	1	$ 1,197,647.73	$ 1,197,648
	21	Lower Channel Banks and Provide Setback Levee or Berms	LS	1	$ 39,268,637.85	$ 39,268,638
	26	Terrace Banks	LS	1	$ 7,875,698.17	$ 7,875,698
					Total Construction Cost:	$ 365,214,471
					Mobilization (7.5%):	$ 27,391,085
					Construction Subtotal:	$ 392,605,556

Note: The above tables summarize all construction componenets estimated within this report. These summary tables include the railroad trestles, even though they are classified as a relocation, because they were developed with the other construction components. Therefore these tables differ from Table 6-1 in the Feasibility Report.

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Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 6
Recreation Cost Estimates

April 2015

LOS ANGELES RIVER FEASIBILITY
RECREATION COMPONENTS

Date: 23-Jul-13

CONSTRUCTION COST SUMMARY PAGE

ITEM #	ITEM DESCRIPTION	UOM	QUANTITY	UNIT COST		CONTINGENCY	TOTAL CONSTRUCTION COST	
REC	**Recreation Construction Costs**							
MOB	Mobilization / Demobilization	LS	1	$	316,987	35.00%	**$**	**427,933**
1	Existing Acces Road to Un-Paved Multi Use Trail	LS	1	$	395,536	35.00%	**$**	**533,974**
2	Trail Improvement	LS	1	$	342,258	35.00%	**$**	**462,049**
3	New Unpaved Trail	LS	1	$	861,902	35.00%	**$**	**1,163,568**
4	Parking Lot 1	LS	1	$	97,400	35.00%	**$**	**131,490**
5	Parking Lot 2	LS	1	$	110,288	35.00%	**$**	**148,888**
6	Restrooms	LS	1	$	210,000	35.00%	**$**	**283,500**
7	Trail Access Point	LS	1	$	95,000	35.00%	**$**	**128,250**
8	Pedestrian Tunnel	LS	1	$	107,111	35.00%	**$**	**144,600**
9	Wildlife Viewpoint	LS	1	$	57,000	35.00%	**$**	**76,950**
10	Bridges	LS	1	$	1,950,000	35.00%	**$**	**2,632,500**
					Total Construction Cost:		**$**	**6,133,701**

O&M COST SUMMARY PAGE

ITEM #	ITEM DESCRIPTION	UOM	QUANTITY	UNIT COST		CONTINGENCY	ANNUAL O&M COSTS	
REC	**Recreation Construction Costs**							
MOB	Mobilization / Demobilization	YR	1	$	-	35.00%	**$**	**-**
1	Existing Acces Road to Un-Paved Multi Use Trail	YR	1	$	1,077.36	35.00%	**$**	**1,454**
2	Trail Improvement	YR	1	$	3,191.00	35.00%	**$**	**4,308**
3	New Unpaved Trail	YR	1	$	8,903.65	35.00%	**$**	**12,020**
4	Parking Lot 1	YR	1	$	1,043.00	35.00%	**$**	**1,408**
5	Parking Lot 2	YR	1	$	1,181.00	35.00%	**$**	**1,594**
6	Restrooms	YR	1	$	3,150.00	35.00%	**$**	**4,253**
7	Trail Access Point	YR	1	$	674.50	35.00%	**$**	**911**
8	Pedestrian Tunnel	YR	1	$	1,226.67	35.00%	**$**	**1,656**
9	Wildlife Viewpoint	YR	1	$	1,066.25	35.00%	**$**	**1,439**
10	Bridges	YR	1	$	9,750.00	35.00%	**$**	**13,163**
					ANNUAL O&M:		**$**	**42,206**

**US Army Corps
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Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 7
Abbreviated Risk Analysis

April 2015

Abbreviated Risk Analysis

Los Angeles River
Feasibility (Alternatives)

Meeting Date: 6-Jun-13

PDT Members
Note: PDT involvement is commensurate with project size and involvement.

Lead Planner:	Kathy Bergmann (SPL)
Cost Engineering:	Arnecia Williams (SPL)
Hydrology:	Van Crisostomo (SPL)
Soils, Design, Materials:	Chris Spitzer (SPL)
Geology & Investigations:	Mark McLarty (SPL)
Project Manager:	Ira Artz (Tetra Tech)
Planner:	Scott Estergard (Tetra Tech)
Cost Engineering:	Scott Vose (Tetra Tech)

Abbreviated Risk Analysis

Project (less than $40M): **Los Angeles River**
Project Development Stage: **Feasibility (Alternatives)**
Risk Category: **Moderate Risk: Typical Project or Possible Life Safety**

Total Construction Contract Cost = $ 9,000,000

	CWWBS	Feature of Work	Contract Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ 1,000,000		20.00%	$ 200,000	$ 1,200,000.00
1	09 01 CHANNELS	Mobilization - Demobilization	$ 1,000,000		26.44%	$ 264,381	$ 1,264,381.41
2	09 01 CHANNELS	Earthwork	$ 1,000,000		45.78%	$ 457,767	$ 1,457,767.09
3	09 01 CHANNELS	Vegetation & Topsoil	$ 1,000,000		22.80%	$ 228,012	$ 1,228,011.58
4	09 01 CHANNELS	Demolition	$ 1,000,000		24.56%	$ 245,596	$ 1,245,595.58
5	09 01 CHANNELS	Riprap & Grouted Riprap	$ 1,000,000		38.88%	$ 388,781	$ 1,388,780.61
6	09 01 CHANNELS	Turf Reinforcement Mat	$ 1,000,000		24.13%	$ 241,337	$ 1,241,336.55
7	09 01 CHANNELS	Concrete (Walls & Planters)	$ 1,000,000		47.10%	$ 471,045	$ 1,471,045.08
8	09 01 CHANNELS	Asphalt Paving (Inc. Base Course, Fence)	$ 1,000,000		13.44%	$ 134,371	$ 1,134,370.70
9			$ -		0.00%	$ -	$ -
12		**Remaining Construction Items**	$ 1,000,000	*12.5%*	32.86%	$ 328,649	$ 1,328,648.56
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	$ 1,000,000		24.40%	$ 244,020	$ 1,244,019.73
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 1,000,000		26.25%	$ 262,529	$ 1,262,529.13

Totals				
Real Estate	$ 1,000,000	20.00%	$ 200,000	$ 1,200,000.00
Total Construction Estimate	$ 9,000,000	30.67%	$ 2,759,937	$ 11,759,937
Total Planning, Engineering & Design	$ 1,000,000	24.40%	$ 244,020	$ 1,244,020
Total Construction Management	$ 1,000,000	26.25%	$ 262,529	$ 1,262,529
Total	$ 12,000,000		$ 3,466,486	$ 15,466,486

Los Angeles River
Feasibility (Alternatives)
Abbreviated Risk Analysis

Meeting Date: 6-Jun-13

Risk Level

	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Element	Feature of Work	Concerns Pull Down Tab (ENABLE MACROS THRU TRUST CENTER) (Choose ALL that apply)	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Likelihood	Impact	Risk Level
Project Scope Growth							
					Max Potential Cost Growth		75%
PS-1	Mobilization - Demobilization	• Design confidence?	• Potential for scope growth, added features and quantities? • Design confidence?	Due to low level of design, many aspects in regards to staging areas and site constraints have not been fully developed. These assumptions utilized currently could differ significantly as design progresses and staging/constraints are analyzed in detail.	Likely	Significant	3
PS-2	Earthwork	• Water care and diversion fully understood, planned?	• Potential for scope growth, added features and quantities? • Project accomplish intent? • Investigations sufficient to support design assumptions? • Design confidence? • Water care and diversion fully understood, planned?	Primary concerns are that this project is at a low level of design, investigations remain to be completed to finalize design, encountering HTRWs, and no fully developed water control plan has been developed. Based on all these risks, it is likely that at least a few of them could impact the costs, and these risks would significantly impact costs.	Likely	Significant	3
PS-3	Vegetation & Topsoil	• Water care and diversion fully understood, planned?	• Design confidence? • Potential for scope growth, added features and quantities? • Water care and diversion fully understood, planned?	Low level of design is an inherent risk, and there is some chance for the scope to increase. However, the likelihood and impacts are both small as current assumptions are conservative and not likely to incur significant growth.	Possible	Marginal	1
PS-4	Demolition	• Water care and diversion fully understood, planned?	• Investigations sufficient to support design assumptions? • Design confidence? • Water care and diversion fully understood, planned?	Design level is low, and some investigations remain to determine the extent of demolition required. Also, the diversion and care of water has not been analyzed in detail. The likelihood of the demo work being affected by scope growth is small, but any increases could add significant costs.	Likely	Marginal	2
PS-5	Riprap & Grouted Riprap	• Water care and diversion fully understood, planned?	• Design confidence? • Potential for scope growth, added features and quantities? • Investigations sufficient to support design assumptions? • Water care and diversion fully understood, planned?	Primary concerns are the low level of design, and the need for additional hydraulic modeling to be completed to finalize design. The modeling could change the current riprap assumptions significantly.	Likely	Significant	3
PS-6	Turf Reinforcement Mat	• Water care and diversion fully understood, planned?	• Design confidence? • Potential for scope growth, added features and quantities? • Project accomplish intent? • Investigations sufficient to support design assumptions? • Water care and diversion fully understood, planned?	Further investigation into capabilities and reasonableness of utilizing the Turf Reinforcement Mats need to be completed. There is a risk that the mat is only for low velocity and small area surface run-off, and that it may be unsuitable for use in this project. Different material could be required, by overall impact to cost of this item is estimated to be marginal.	Likely	Marginal	2
PS-7	Concrete (Walls & Planters)	• Water care and diversion fully understood, planned?	• Potential for scope growth, added features and quantities? • Project accomplish intent? • Investigations sufficient to support design assumptions? • Design confidence? • Water care and diversion fully understood, planned?	The concrete structures require further investigations, require further easement and ROW analysis, and are based on conceptual designs. These risks are likely to cause some changes as the project progresses, and impacts to costs could be significant.	Likely	Significant	3
PS-8	Asphalt Paving (Inc. Base Course, Fence)	• Design confidence?	• Potential for scope growth, added features and quantities? • Project accomplish intent? • Investigations sufficient to support design assumptions? • Design confidence?	The level of design is low, but the risks to these items is anticipated to be minor. Scope is not anticpated to grow to an extent that would significantly impact these items.	Possible	Marginal	1
PS-9	0	• Potential for scope growth, added features and quantities?			Unlikely	Negligible	0
PS-10	0	• Investigations sufficient to support design assumptions?			Unlikely	Negligible	0
PS-11	0	• Potential for scope growth, added features and quantities?			Unlikely	Negligible	0
PS-12	Remaining Construction Items	• Design confidence?	• Design confidence?	No design currently for the storm drains or the new railroad trestles. Scope for these not anticipated to grow, but if it did costs would increase significantly.	Unlikely	Significant	1
PS-13	Planning, Engineering, & Design	• Water care and diversion fully understood, planned?	• Potential for scope growth, added features and quantities? • Project accomplish intent? • Investigations sufficient to support design assumptions? • Design confidence? • Water care and diversion fully understood, planned?	Many investigations remain to be completed in order to finalize the design. If the scope grows in extent then the cost to complete the PED phase would grow as well. However, current assumptions on cost of PED have generated large PED costs, thus impacts of future unaccounted for investigations would be marginal.	Very LIKELY	Marginal	3
PS-14	Construction Management	• Water care and diversion fully understood, planned?	• Potential for scope growth, added features and quantities? • Project accomplish intent? • Investigations sufficient to support design assumptions? • Design confidence? • Water care and diversion fully understood, planned?	The primary concern for construction management, is the possible encountering of a large area of HTRW. This would create a significant impact on the management costs.	Possible	Significant	2

Acquisition Strategy

						Max Potential Cost Growth	30%
AS-1	Mobilization - Demobilization	• Bid schedule developed to reduce quantity risks?	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Bid schedule developed to reduce quantity risks?	At this stage of the project no contracting plan has been established. Unit costs take into account use of some sub-contracting for certain aspects of construction. There may be some requirements of 8a/small business, but they probably would not be the prime. Some in channel work may need to be accelerated to avoid rainy seasons, but not a huge risk as many contractors would be capable of working through winter. There is no bid schedule, but detailed quantity take-offs have been developed for current design. So, PDT has concluded that these are all risks, but they are not likely to all occur and impact the costs. The overall impact on costs would be small as well due to the esitmate already containing unit costs that account for subs.	Possible	Marginal	1
AS-2	Earthwork	• Contracting plan firmly established?	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Bid schedule developed to reduce quantity risks?	See discussion in first box above.	Possible	Marginal	1
AS-3	Vegetation & Topsoil	• Contracting plan firmly established?	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Bid schedule developed to reduce quantity risks?	See discussion in first box above.	Possible	Marginal	1
AS-4	Demolition	• Contracting plan firmly established?	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Bid schedule developed to reduce quantity risks?	See discussion in first box above.	Possible	Marginal	1
AS-5	Riprap & Grouted Riprap	• Contracting plan firmly established?	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Bid schedule developed to reduce quantity risks?	See discussion in first box above.	Possible	Marginal	1
AS-6	Turf Reinforcement Mat	• Contracting plan firmly established?	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Bid schedule developed to reduce quantity risks?	See discussion in first box above.	Possible	Marginal	1
AS-7	Concrete (Walls & Planters)	• Contracting plan firmly established?	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Bid schedule developed to reduce quantity risks?	See discussion in first box above.	Possible	Marginal	1
AS-8	Asphalt Paving (Inc. Base Course, Fence)	• Contracting plan firmly established?	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Bid schedule developed to reduce quantity risks?	See discussion in first box above.	Possible	Marginal	1
AS-9	0	• Contracting plan firmly established?			Unlikely	Negligible	0
AS-10	0	• Contracting plan firmly established?			Unlikely	Negligible	0
AS-11	0	• Contracting plan firmly established?			Unlikely	Negligible	0
AS-12	Remaining Construction Items	• Contracting plan firmly established?	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Bid schedule developed to reduce quantity risks?	See discussion in first box above.	Possible	Marginal	1
AS-13	Planning, Engineering, & Design	• Contracting plan firmly established?	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Bid schedule developed to reduce quantity risks?	See discussion in first box above.	Possible	Marginal	1
AS-14	Construction Management	• Contracting plan firmly established?	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Bid schedule developed to reduce quantity risks?	See discussion in first box above.	Possible	Marginal	1

Construction Elements

						Max Potential Cost Growth	25%
CE-1	Mobilization - Demobilization	• Potential for construction modification and claims?	No significant risks anticipated.	No specialty equipment or contractors should be required for this project.	Unlikely	Negligible	0
CE-2	Earthwork	• Potential for construction modification and claims?	• Accelerated schedule or harsh weather schedule? • High risk or complex construction elements, site access, in-water? • Water care and diversion plan? • Potential for construction modification and claims?	The primary risks concerning the earthwork are the unanticipated groundwater occurrence, re-use of excavated material for structure foundations (must have good materials for re-use), lack of water care plan and encountering HTRWs. These risks are likely to occur at some point during the construction of this project, and the cost impact would be significant.	Likely	Significant	3
CE-3	Vegetation & Topsoil	• Water care and diversion plan?	• Accelerated schedule or harsh weather schedule? • Water care and diversion plan?	These construction items are not risky themselves. The lack of a water care plan, or possible accelerated schedule could pose a small risk. Cost impacts would not be significant those as these are pretty typical items with accurate unit costs being used.	Possible	Marginal	1
CE-4	Demolition	• Potential for construction modification and claims?	• High risk or complex construction elements, site access, in-water? • Water care and diversion plan? • Potential for construction modification and claims?	Site accessibility could be difficult as no detailed analysis has been done into this aspect. The same can be said about the water care and diversion. Also, unanticipated structures could be found during construction or in further design phases. These risks are possible to occur, but due to use of as-builts in quantity development, current costs/quantities, are not anticipated to be imacted greatly.	Possible	Marginal	1
CE-5	Riprap & Grouted Riprap	• Water care and diversion plan?	• High risk or complex construction elements, site access, in-water? • Water care and diversion plan?	Site accessibility could be difficult as no detailed analysis has been completed. Also the water care and diversion plan has not been determined either. These risks would most likely impact other areas of construction prior to the start of the riprap placement. Thus it is unlikely that the risks would occur, and impacts would be negligible.	Unlikely	Negligible	0
CE-6	Turf Reinforcement Mat	• Potential for construction modification and claims?	• High risk or complex construction elements, site access, in-water? • Special equipment or subcontractors needed? • Potential for construction modification and claims?	Turf reinforcement mat placement would probably be performed by company providing the material. Lack of expertise with material may lead to problems during design, which in turn could lead to mods. Risk is likely, and impact to cost should not be large, as material quote was provided by supplier for project.	Possible	Negligible	0
CE-7	Concrete (Walls & Planters)	• Potential for construction modification and claims?	• High risk or complex construction elements, site access, in-water? • Water care and diversion plan? • Potential for construction modification and claims?	This work requires the large scale placement of large concrete retaining walls and concrete planter boxes. A project of this scale has not really been completed for these items. Thus any design errors could lead to construction mods. The placement could be risky as well, due to the size, and need for everything to line up properly. These risks are likely to occur at some point throughout the project, and costs for this would be significantly impacted.	Likely	Significant	3
CE-8	Asphalt Paving (Inc. Base Course, Fence)	• Accelerated schedule or harsh weather schedule?	No significant risks anticipated.	This work is all very straight forward and no risks are expected to occur or impact costs in a significant way.	Unlikely	Negligible	0
CE-9	0	• Accelerated schedule or harsh weather schedule?			Unlikely	Negligible	0
CE-10	0	• Accelerated schedule or harsh weather schedule?			Unlikely	Negligible	0
CE-11	0	• Accelerated schedule or harsh weather schedule?			Unlikely	Negligible	0
CE-12	Remaining Construction Items	• Special equipment or subcontractors needed?	• High risk or complex construction elements, site access, in-water? • Unique construction methods? • Special equipment or subcontractors needed?	Construction of the railroad trestles is a more difficult construction task. The railroad companies would need to be heavily involved and special contractor would be likely. Cost estimate assumed a sub- for this work, and has conservative unit cost. Therfore impact would be marginal, but risk is still high of something not going as planned.	Likely	Marginal	2
CE-13	Planning, Engineering, & Design	• Potential for construction modification and claims?	• High risk or complex construction elements, site access, in-water? • Water care and diversion plan? • Potential for construction modification and claims?	Designs will need to be very detailed in order for the large scale structures to be constructed properly. Extra time and oversight may be required, but current PED cost should be more than adequate to complete the design work. Thus no impacts to costs are assumed.	Unlikely	Negligible	0
CE-14	Construction Management	• Potential for construction modification and claims?	• High risk or complex construction elements, site access, in-water? • Water care and diversion plan? • Potential for construction modification and claims?	Assumed CM costs could differ from actual if some of the risks noted above occur. Primarily if there are mods to the contract, there could be need for more management costs. However, the risk would not be significant to overall CM costs as current CM costs are quite high.	Possible	Marginal	1

Quantities for Current Scope

							Max Potential Cost Growth: 20%
Q-1	Mobilization - Demobilization	• Quality control check applied?	No significant risks anticipated.	Mob/Demob costs are not based on any quantity calculations, and therefore have no liklihood of risks and no impacts to costs.	Unlikely	Negligible	0
Q-2	Earthwork	• Sufficient investigations to develop quantities?	• Level of confidence based on design and assumptions? • Sufficient investigations to develop quantities?	Earthwork quantities were calculated based on using one typical cross section per reach. This allows for plenty of room for changes as design progresses and more details are available. Also, investigations remain that could alter the quantity development as well. Changes to these quantities are likely to occur, and any growth in quantities would cause significant changes to costs.	Likely	Significant	3
Q-3	Vegetation & Topsoil	• Sufficient investigations to develop quantities?	• Level of confidence based on design and assumptions? • Sufficient investigations to develop quantities?	Vegetation areas were calculated based on using one typical cross section per reach. The areas are likley to change as design is refined. However, the areas are not anticipated to increase much and thus impact is assumed to be marginal.	Likely	Marginal	2
Q-4	Demolition	• Sufficient investigations to develop quantities?	• Level of confidence based on design and assumptions? • Sufficient investigations to develop quantities?	Demo quantities were calculated based on typical cross sections found in the as-built drawings. These cross sections were compared with aerials to determine lengths for quantity development. As design progresses quantities are not anticipated to increase greatly since current quantities were conservatively calculated. Thus impacts would be marginal.	Possible	Marginal	1
Q-5	Riprap & Grouted Riprap	• Sufficient investigations to develop quantities?	• Level of confidence based on design and assumptions? • Sufficient investigations to develop quantities?	The hydraulic modeling has not been finalized for this project, and thus the quantity of riprap currently assumed could change once the modeling is completed. There is a chance that more rock could be needed, and increases in this quantity would cause significant increases in costs.	Likely	Significant	3
Q-6	Turf Reinforcement Mat	• Level of confidence based on design and assumptions?	• Level of confidence based on design and assumptions?	Due to the low level of design, a single cross section per reach was used to calculate quantiteis for this. Increases to the amount of mats required is not anticipated to occur as conservative assumptions were already used. Any increases in quantity would impact the overall cost of this item significantly though.	Unlikely	Significant	1
Q-7	Concrete (Walls & Planters)	• Sufficient investigations to develop quantities?	• Level of confidence based on design and assumptions? • Sufficient investigations to develop quantities?	The current quantity calculations were based off one cross section per reach. Once further detailed designs are completed, and hydraulic modeling finished, the quantities would likely change. However, quantities are anticipated to change as the project progresses. Impacts to costs would be significant if the quantities increased.	Likely	Significant	3
Q-8	Asphalt Paving (Inc. Base Course, Fence)	• Sufficient investigations to develop quantities?	• Level of confidence based on design and assumptions?	Changes to the quantities for these items are not anticipated to change significantly. If they did change, costs would only be affected marginally.	Unlikely	Marginal	0
Q-9	0	• Level of confidence based on design and assumptions?			Unlikely	Negligible	0
Q-10	0	• Level of confidence based on design and assumptions?			Unlikely	Negligible	0
Q-11	0	• Level of confidence based on design and assumptions?			Unlikely	Negligible	0
Q-12	Remaining Construction Items	• Appropriate methods applied to calculate quantities?	• Level of confidence based on design and assumptions? • Appropriate methods applied to calculate quantities?	Detailed quantity take-offs have not been developed for the the storm drains or the railroad trestles as no design exists currently. General assumptions were used and are likely to change, which could have a significant impact on costs.	Likely	Significant	3
Q-13	Planning, Engineering, & Design	• Sufficient investigations to develop quantities?	• Appropriate methods applied to calculate quantities? • Level of confidence based on design and assumptions? • Sufficient investigations to develop quantities?	Design level is very low at this time. Many investigations still remain to be order to accurately calculate quantities. However, current PED value should have adequate funds to account for any issues that arise for quantity development. Thus no impact to costs is assumed to occur either.	Unlikely	Negligible	0
Q-14	Construction Management	• Level of confidence based on design and assumptions?	No significant risks anticipated.	CM is not anticipated to affected by risks to the quantities of the project.	Unlikely	Negligible	0

Specialty Fabrication or Equipment

							Max Potential Cost Growth	75%
FE-1	Mobilization - Demobilization	• Risk of specialty equipment functioning first time? Test?	No significant risks anticipated.	This construction feature does no require specialty fabrication or equipment and thus no risks are anticipated.	Unlikely	Negligible		0
FE-2	Earthwork	• Unusual parts, material or equipment manufactured or installed?	No significant risks anticipated.	This construction feature does no require specialty fabrication or equipment and thus no risks are anticipated.	Unlikely	Negligible		0
FE-3	Vegetation & Topsoil	• Unusual parts, material or equipment manufactured or installed?	No significant risks anticipated.	This construction feature does no require specialty fabrication or equipment and thus no risks are anticipated.	Unlikely	Negligible		0
FE-4	Demolition	• Unusual parts, material or equipment manufactured or installed?	No significant risks anticipated.	This construction feature does no require specialty fabrication or equipment and thus no risks are anticipated.	Unlikely	Negligible		0
FE-5	Riprap & Grouted Riprap	• Unusual parts, material or equipment manufactured or installed?	No significant risks anticipated.	This construction feature does no require specialty fabrication or equipment and thus no risks are anticipated.	Unlikely	Negligible		0
FE-6	Turf Reinforcement Mat	• Risk of specialty equipment functioning first time? Test?	• Unusual parts, material or equipment manufactured or installed? • Confidence in suppliers' ability? • Risk of specialty equipment functioning first time? Test?	There is a risk of the turf reinforcement not being sufficient to withstand the flows that may occur in the channel. Also, the supplier would most likely be a sub to the prime for installation of the material, which may be a risk in terms of methodologies. The supplier has been involved throughout this project so far, and has assured that the material is adequate for this project, so currently not likely to occur. But significant cost impacts could be accrued if is shown that the material is not adequate.	Possible	Significant		2
FE-7	Concrete (Walls & Planters)	• Ability to reasonably transport?	• Unusual parts, material or equipment manufactured or installed? • Confidence in suppliers' ability? • Ability to reasonably transport?	Precast planters may have some risks. These structures will be very large and may have difficulty in being manufactured and transported to project site. Also, each piece would need to be approved for placement. The region should have a supplier capable, but risk remains possible, and impact would be significant if no supplier is found and/or transportation becomes a problem.	Possible	Significant		2
FE-8	Asphalt Paving (Inc. Base Course, Fence)	• Unusual parts, material or equipment manufactured or installed?	No significant risks anticipated.	This construction feature does no require specialty fabrication or equipment and thus no risks are anticipated.	Unlikely	Negligible		0
FE-9	0	• Unusual parts, material or equipment manufactured or installed?			Unlikely	Negligible		0
FE-10	0	• Unusual parts, material or equipment manufactured or installed?			Unlikely	Negligible		0
FE-11	0	• Unusual parts, material or equipment manufactured or installed?			Unlikely	Negligible		0
FE-12	Remaining Construction Items	• Ability to reasonably transport?	• Unusual parts, material or equipment manufactured or installed? • Confidence in contractor's ability to install? • Ability to reasonably transport?	Some prefabricated items may be required for the railroad trestle installation. The trestles are large structures and a risk could be the difficulty in making sure the materials arrive on site on schedule. Sub-contractor used should be capable of handling this and thus the risk is not likely but the impact could be large if things get delayed or fabrication can't be completed on time.	Possible	Significant		2
FE-13	Planning, Engineering, & Design	• Unusual parts, material or equipment manufactured or installed?	• Unusual parts, material or equipment manufactured or installed?	New and different types of materials and construction elements, such as the Pyramat and planter boxes, can cause difficulty during the PED phase. There is a possible chance of these increasing PED costs, however that cost is assumed to be negligible due to the amount of the PED value being used.	Possible	Negligible		0
FE-14	Construction Management	• Ability to reasonably transport?	• Unusual parts, material or equipment manufactured or installed? • Ability to reasonably transport?	Primary risk is the capability of the contractors to keep the transporation of the materials to the site on schedule (especially the planters). If materials are not provided on schedule significant impact to costs may be accrued.	Possible	Significant		2

Cost Estimate Assumptions

						Max Potential Cost Growth	35%
CT-1	Mobilization - Demobilization	• Site accessibility, transport delays, congestion?	• Site accessibility, transport delays, congestion?	Site accessibility and staging areas have not been fully developed. However, current mob/demob assumption results in large mob/demob costs as it is a percentage of construction. Therefore mob/demob is not anticipated to have much of an impact even if further analysis results in accessibility problems.	Possible	Marginal	1
CT-2	Earthwork	• Site accessibility, transport delays, congestion?	• Reliability and number of key quotes? • Assumptions regarding crew, productivity, overtime? • Site accessibility, transport delays, congestion?	Large volumes of excavated material will be required to be disposed of off-site. The capability of the contractor to be able to find adequate disposal locations that would accept the large volumes could be difficult. Also, traffic could be a major risk to trucks transporting the material. These risks were factored in some for unit cost development, but at time of construction could vary significantly.	Likely	Significant	3
CT-3	Vegetation & Topsoil	• Lack confidence on critical cost items?	• Lack confidence on critical cost items?	No vegetation plan has been developed. Thus, the unit cost used was developed from analyzing other local projects' cost estimates. Actual cost for vegetation could be different depending on future design. Also, amounts of irrigation required could cause cost increases. However, conservative unit cost was used and assumptions are likely to change but impact would be marginal.	Likely	Marginal	2
CT-4	Demolition	• Reliability and number of key quotes?	• Assumptions regarding crew, productivity, overtime? • Site accessibility, transport delays, congestion? • Reliability and number of key quotes?	With no site access plan, demolition of existing structures could be more difficult to access than assumed. Tipping fees were obtained for materials being demolished, but these could be different at time of construction. These risks are not anticipated to be likely, but could have significant impacts.	Possible	Significant	2
CT-5	Riprap & Grouted Riprap	• Site accessibility, transport delays, congestion?	• Reliability and number of key quotes? • Assumptions regarding crew, productivity, overtime? • Site accessibility, transport delays, congestion?	Large volumes of stone would be required, and thus would heavily depend on the material and trucking costs. If these costs are different at time of construction, which is likely, then there would be significant impacts to costs.	Likely	Significant	3
CT-6	Turf Reinforcement Mat	• Reliability and number of key quotes?	• Reliability and number of key quotes?	Cost quote for material and placement of the material was obtained. Sub-contractor mark-ups were applied as well, due to the assumption that the material supplier would also install. Quote used was in line with other projects the material was used, and therefore is unlikely to change.	Unlikely	Marginal	0
CT-7	Concrete (Walls & Planters)	• Site accessibility, transport delays, congestion?	• Site accessibility, transport delays, congestion?	Transporting the concrete material, and planter boxes could be problematic due to traffic concerns. This shouldn't cause to many delays but could be significant if it does occur.	Possible	Significant	2
CT-8	Asphalt Paving (Inc. Base Course, Fence)	• Reliability and number of key quotes?	No significant risks anticipated.	This work is very typical in this area, and no significant risks are likely to occur. Unit costs are in line with this work in the area and not anticipated to change.	Unlikely	Negligible	0
CT-9	0	• Reliability and number of key quotes?			Unlikely	Negligible	0
CT-10	0	• Reliability and number of key quotes?			Unlikely	Negligible	0
CT-11	0	• Reliability and number of key quotes?			Unlikely	Negligible	0
CT-12	Remaining Construction Items	• Lack confidence on critical cost items?	• Lack confidence on critical cost items?	No design exists for the storm drain daylighting or the railroad tressles. Conservative unit costs were used for each of these items however. Costs are likely to be different, but due to the conservative unit costs used impacts would be marginal.	Likely	Marginal	2
CT-13	Planning, Engineering, & Design	• Lack confidence on critical cost items?	• Lack confidence on critical cost items?	Current percentage used for PED is probably conservative due the overall project costs, which generate large PED costs. Thus the likelihood of it increasing is minimal, and the impact would be marginal if it did increase.	Unlikely	Marginal	0
CT-14	Construction Management	• Lack confidence on critical cost items?	• Lack confidence on critical cost items?	Current CM percentage used is conservative due to the overall project costs, which generates large CM costs. However, some of the risks outlined above may cause increases to CM. These risks are not likely to occur and could cause marginal increases here.	Possible	Marginal	1

External Project Risks

							Max Potential Cost Growth	40%
EX-1	Mobilization - Demobilization	• Potential for market volatility impacting competition, pricing?	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	There are several external risks that could delay the project and/or impact the overall costs. One risk is in regard to the interactions between all the agencies that would be involved in this project. Getting all the agencies on the same page could be a cause for concern moving forward. Also dealing with the overall scale of the project and all the multiple stakholders is a risk as well. Weather is not anticipated to be a likely risk, but could impact the costs if something drastic occurred. Lastly, inflation in fuel and some materials would impact costs. Overall, these are not likely to occur, but most likely would be an impact to schedule and only marginal to costs.	Possible	Marginal	1
EX-2	Earthwork	• Potential for severe adverse weather?	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	See discussion in first box above.	Possible	Marginal	1
EX-3	Vegetation & Topsoil	• Potential for severe adverse weather?	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	See discussion in first box above.	Possible	Marginal	1
EX-4	Demolition	• Potential for severe adverse weather?	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	See discussion in first box above.	Possible	Marginal	1
EX-5	Riprap & Grouted Riprap	• Potential for severe adverse weather?	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	See discussion in first box above.	Possible	Marginal	1
EX-6	Turf Reinforcement Mat	• Potential for severe adverse weather?	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	See discussion in first box above.	Possible	Marginal	1
EX-7	Concrete (Walls & Planters)	• Potential for severe adverse weather?	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	See discussion in first box above.	Possible	Marginal	1
EX-8	Asphalt Paving (Inc. Base Course, Fence)	• Potential for severe adverse weather?	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	See discussion in first box above.	Possible	Marginal	1
EX-9	0	• Potential for severe adverse weather?			Unlikely	Negligible	0
EX-10	0	• Potential for severe adverse weather?			Unlikely	Negligible	0
EX-11	0	• Potential for severe adverse weather?			Unlikely	Negligible	0
EX-12	Remaining Construction Items	• Potential for severe adverse weather?	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	See discussion in first box above.	Possible	Marginal	1
EX-13	Planning, Engineering, & Design	• Potential for severe adverse weather?	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	See discussion in first box above.	Possible	Marginal	1
EX-14	Construction Management	• Potential for severe adverse weather?	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	See discussion in first box above.	Possible	Marginal	1

Los Angeles River
Feasibility (Alternatives)
Abbreviated Risk Analysis

Typical Risk Elements	Mobilization - Demobilization	Earthwork	Vegetation & Topsoil	Demolition	Riprap & Grouted Riprap	Turf Reinforcement Mat	Concrete (Walls & Planters)	Asphalt Paving (Inc. Base Course, Fen	0	0	0	Remaining Construction Item	Planning, Engineering, & Design	Construction Management
	Potential Risk Areas													
Project Scope Growth	3	3	1	2	3	2	3	1	-	-	-	1	3	2
Acquisition Strategy	1	1	1	1	1	1	1	1	-	-	-	1	1	1
Construction Elements	-	3	1	1	-	-	3	-	-	-	-	2	-	1
Quantities for Current Scope	-	3	2	1	3	1	3	-	-	-	-	3	-	-
Specialty Fabrication or Equipment	-	-	-	-	-	2	2	-	-	-	-	2	-	2
Cost Estimate Assumptions	1	3	2	2	3	-	2	-	-	-	-	2	-	1
External Project Risks	1	1	1	1	1	1	1	1	-	-	-	1	1	1

Construction Contingencies by Alternative

ALT 10 - ARBOR Riparian Transitions (ART)

Features	Construction Cost		Contingency	Total Cost	
Mobilization - Demobilization	$	2,787,026	26.44%	$	3,523,915
Earthwork	$	19,169,720	45.78%	$	27,945,617
Vegetation & Topsoil	$	3,624,550	22.80%	$	4,450,948
Demolition	$	-	24.56%	$	-
Riprap & Grouted Riprap	$	11,283,850	38.88%	$	15,671,010
Turf Reinforcement Mat	$	-	24.13%	$	-
Concrete (Walls & Planters)	$	-	47.10%	$	-
Asphalt Paving (Inc. Base Course, Fence)	$	1,182,222	13.44%	$	1,341,113
Remaining Construction Items	$	1,900,000	32.86%	$	2,524,340
Total Construction Costs	***$***	***39,947,368***	***38.83%***	***$***	***55,456,944***

ALT 13 - ARBOR Corridor Extension (ACE)

Features	Construction Cost		Contingency	Total Cost	
Mobilization - Demobilization	$	6,171,589	26.44%	$	7,803,357
Earthwork	$	32,734,957	45.78%	$	47,721,020
Vegetation & Topsoil	$	3,953,828	22.80%	$	4,855,301
Demolition	$	8,360,013	24.56%	$	10,413,232
Riprap & Grouted Riprap	$	23,109,490	38.88%	$	32,094,459
Turf Reinforcement Mat	$	9,494,344	24.13%	$	11,785,329
Concrete (Walls & Planters)	$	-	47.10%	$	-
Asphalt Paving (Inc. Base Course, Fence)	$	2,669,458	13.44%	$	3,028,233
Remaining Construction Items	$	1,965,760	32.86%	$	2,611,709
Total Construction Costs	***$***	***88,459,438***	***36.01%***	***$***	***120,312,641***

ALT 16 - ARBOR Narrows to Downtown (AND)

Features	Construction Cost		Contingency	Total Cost	
Mobilization - Demobilization	$	19,938,361	26.44%	$	25,210,063
Earthwork	$	81,865,448	45.78%	$	119,343,449
Vegetation & Topsoil	$	3,872,911	22.80%	$	4,755,935
Demolition	$	30,050,117	24.56%	$	37,430,426
Riprap & Grouted Riprap	$	60,223,646	38.88%	$	83,638,599
Turf Reinforcement Mat	$	9,494,344	24.13%	$	11,785,329
Concrete (Walls & Planters)	$	46,625,927	47.10%	$	68,586,739
Asphalt Paving (Inc. Base Course, Fence)	$	7,616,160	13.44%	$	8,639,772
Remaining Construction Items	$	26,096,257	32.86%	$	34,671,487
Total Construction Costs	***$***	***285,783,170***	***37.89%***	***$***	***394,061,800***

ALT 20 - ARBOR Riparian Integration Via Varied Ecol. Reintroduction (RIVER)

Features	Construction Cost		Contingency	Total Cost	
Mobilization - Demobilization	$	27,391,085	26.44%	$	34,633,288
Earthwork	$	113,775,573	45.78%	$	165,862,031
Vegetation & Topsoil	$	5,603,018	22.80%	$	6,880,507
Demolition	$	25,234,156	24.56%	$	31,431,665
Riprap & Grouted Riprap	$	76,784,594	38.88%	$	106,638,445
Turf Reinforcement Mat	$	11,815,774	24.13%	$	14,666,920
Concrete (Walls & Planters)	$	93,075,780	47.10%	$	136,914,473
Asphalt Paving (Inc. Base Course, Fence)	$	7,925,902	13.44%	$	8,991,143
Remaining Construction Items	$	30,999,672	32.86%	$	41,186,164
Total Construction Costs	***$***	***392,605,556***	***39.38%***	***$***	***547,204,636***

PED Contingency: 24.40%

CM Contingency: 26.25%

US Army Corps
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Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 8
MCACES Cost Estimate
Detailed Quantity Take-Offs

April 2015

(Attachment is for Official Use Only)

(Available upon request)

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

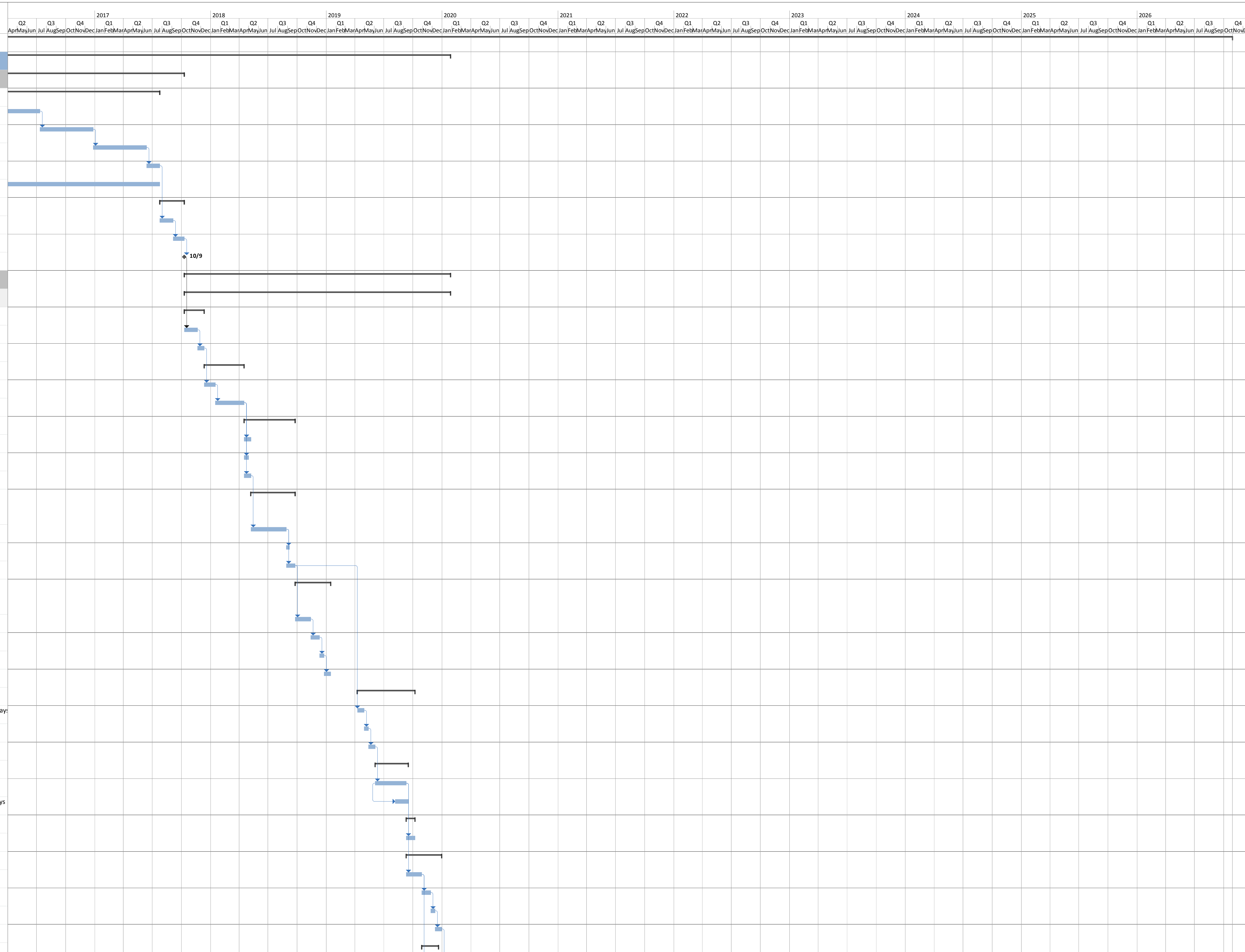
Attachment 9
Tentative Project Schedule

April 2015

NATIONAL ECOSYSTEM RESTORATION PLAN – ALTERNATIVE 13v

TENTATIVE PROJECT SCHEDULE

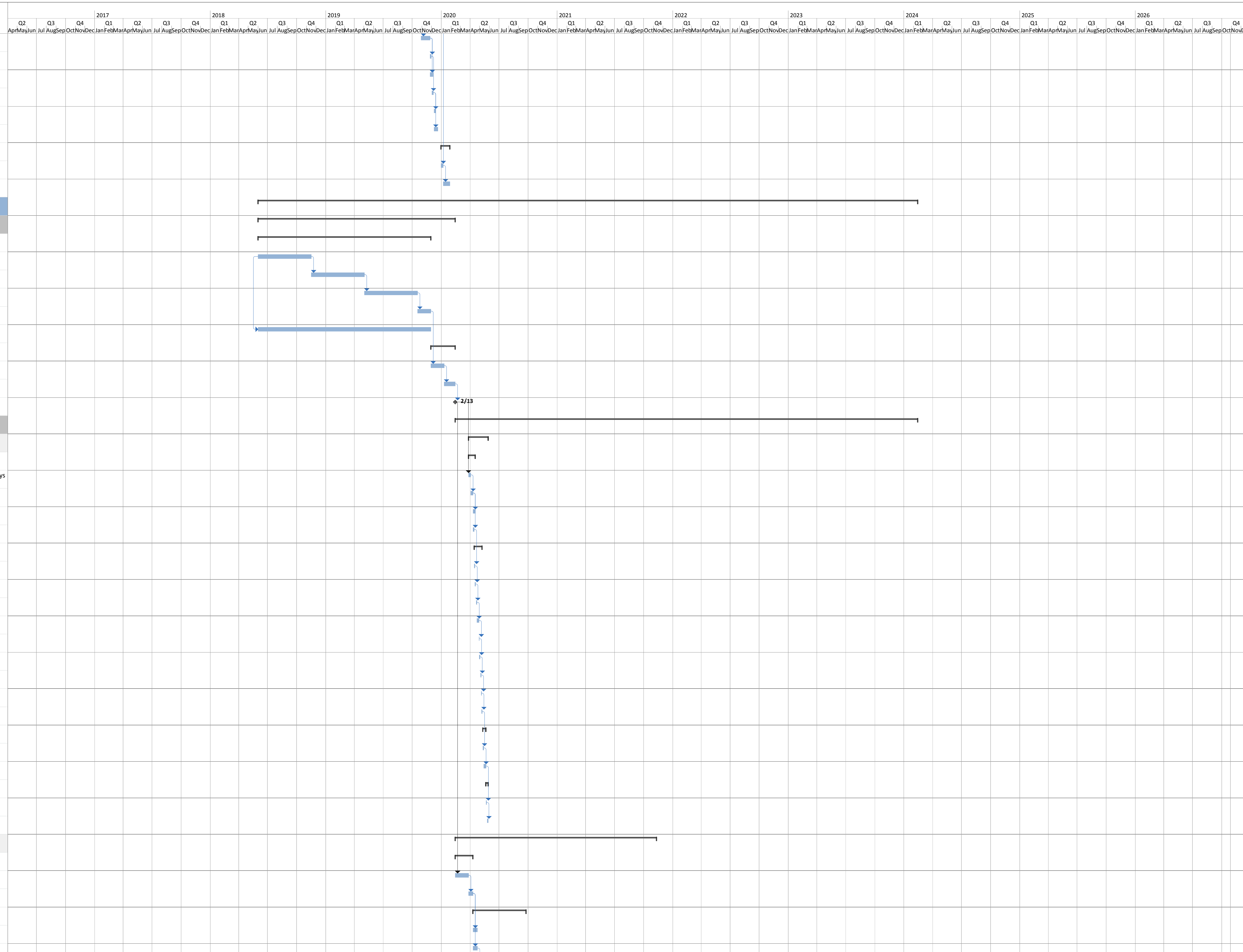
ID	Task Name	Duration	Start	Finish	Predecessors
1	**LOS ANGELES RIVER ECOSYSTEM RESTORATION PROJECT SCHE**	**2807 days**	**Tue 1/26/16**	**Wed 10/28/2**	
2	**CONTRACT 1 (REACH 6)**	**1045 days**	**Tue 1/26/16**	**Mon 1/27/20**	
3	**PRE-CONSTRUCTION AWARD**	**445 days**	**Tue 1/26/16**	**Mon 10/9/17**	
4	**Plans & Specifications**	**390 days**	**Tue 1/26/16**	**Mon 7/24/17**	
5	30% Design	120 days	Tue 1/26/16	Mon 7/11/16	
6	60% Design	120 days	Tue 7/12/16	Mon 12/26/1	5
7	90% Design	120 days	Tue 12/27/16	Mon 6/12/17	6
8	BCOE	30 days	Tue 6/13/17	Mon 7/24/17	7
9	LERRDs Procurement	390 days	Tue 1/26/16	Mon 7/24/17	5SS
10	**Procurement & Award**	**55 days**	**Tue 7/25/17**	**Mon 10/9/17**	
11	Advertise	30 days	Tue 7/25/17	Mon 9/4/17	8
12	Award	25 days	Tue 9/5/17	Mon 10/9/17	11
13	NTP	0 days	Mon 10/9/17	Mon 10/9/17	12
14	**CONSTRUCTION**	**600 days**	**Tue 10/10/17**	**Mon 1/27/20**	
15	**Reach 6 - Glendale Freeway to I-5**	**600 days**	**Tue 10/10/17**	**Mon 1/27/20**	
16	**Mobilization and Preparatory Work**	**45 days**	**Tue 10/10/17**	**Mon 12/11/1**	
17	Mobilization	30 days	Tue 10/10/17	Mon 11/20/1	13
18	Site Access and Staging	15 days	Tue 11/21/17	Mon 12/11/1	17
19	**Utility Tower Relocations**	**90 days**	**Tue 12/12/17**	**Mon 4/16/18**	
20	Demolish Existing Towers	25 days	Tue 12/12/17	Mon 1/15/18	18
21	Construct New Towers	65 days	Tue 1/16/18	Mon 4/16/18	20
22	**In-Channel Work Period I**	**115 days**	**Tue 4/17/18**	**Mon 9/24/18**	
23	Temporary Cofferdam Installation	15 days	Tue 4/17/18	Mon 5/7/18	21
24	Erosion Control	10 days	Tue 4/17/18	Mon 4/30/18	21
25	Clearing and Grubbing	15 days	Tue 4/17/18	Mon 5/7/18	21
26	**Measure 21/22 - Lower Channel Banks and Provide Setback Levees or Berms**	**100 days**	**Tue 5/8/18**	**Mon 9/24/18**	
27	Excavation, Embankments	80 days	Tue 5/8/18	Mon 8/27/18	25
28	Aggregate Base and Asphalt Installation	8 days	Tue 8/28/18	Thu 9/6/18	27
29	Chain Link Fence Installation	20 days	Tue 8/28/18	Mon 9/24/18	27
30	**Measure 17 - Habitat Corridors/Riparain Planting on Banks**	**80 days**	**Tue 9/25/18**	**Mon 1/14/19**	
31	Planting, Shrubs	35 days	Tue 9/25/18	Mon 11/12/1	29
32	Planting, Trees	20 days	Tue 11/13/18	Mon 12/10/1	31
33	Fertilize and Seed	10 days	Tue 12/11/18	Mon 12/24/1	32
34	Temporary Irrigation	15 days	Tue 12/25/18	Mon 1/14/19	33
35	**In-Channel Work Period II**	**130 days**	**Tue 4/9/19**	**Mon 10/7/19**	
36	Temporary Cofferdam Installation	15 days	Tue 4/9/19	Mon 4/29/19	29FS+140 days
37	Erosion Control	10 days	Tue 4/30/19	Mon 5/13/19	36
38	Clearing and Grubbing	15 days	Tue 5/14/19	Mon 6/3/19	37
39	**Measure 16 - Bioengineering Channel Walls**	**75 days**	**Tue 6/4/19**	**Mon 9/16/19**	
40	Turf Reinforcement Mat Installation w/ Rock at 1	70 days	Tue 6/4/19	Mon 9/9/19	38
41	Chain Link Fence Installation	30 days	Tue 8/6/19	Mon 9/16/19	40SS+45 days
42	**Measure 19 - Bioengineer Channel Walls**	**20 days**	**Tue 9/10/19**	**Mon 10/7/19**	
43	Turf Reinforcement Mat Installation w/ Rock at 1	20 days	Tue 9/10/19	Mon 10/7/19	40
44	**Measure 17 - Habitat Corridors/Riparain Planting on**	**80 days**	**Tue 9/10/19**	**Mon 12/30/1**	
45	Planting, Shrubs	35 days	Tue 9/10/19	Mon 10/28/1	40
46	Planting, Trees	20 days	Tue 10/29/19	Mon 11/25/1	45
47	Fertilize and Seed	10 days	Tue 11/26/19	Mon 12/9/19	46
48	Temporary Irrigation	15 days	Tue 12/10/19	Mon 12/30/1	47
49	Recreation	39 days	Tue 10/29/19	Fri 12/20/19	



Project: LA River_Project Schedule
Date: Thu 3/5/15

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Deadline | Progress | Manual Progress

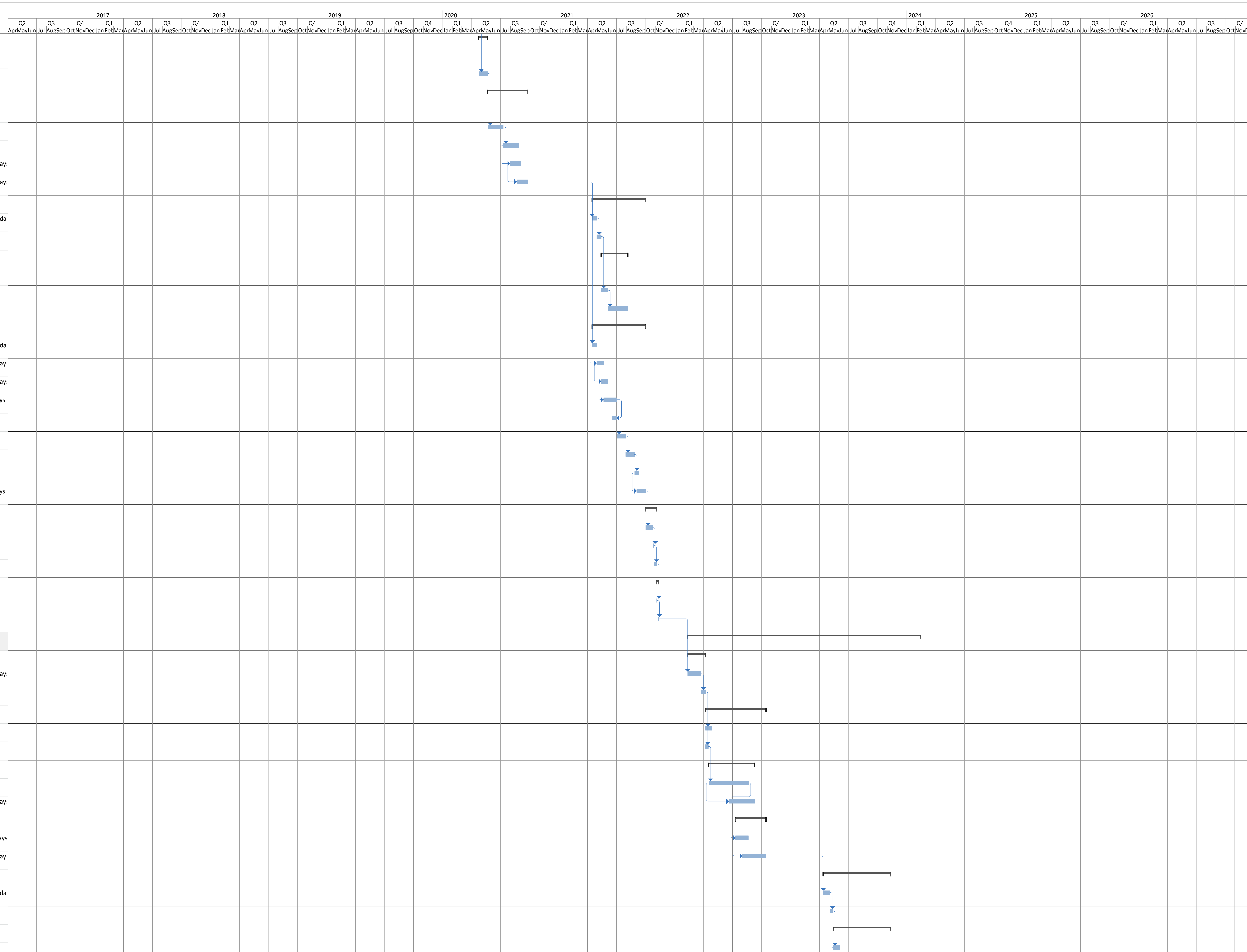
ID	Task Name	Duration	Start	Finish	Predecessors
50	New Unpaved Trail	20 days	Tue 10/29/1	Mon 11/25/1	45
51	Trail Access Points	4 days	Tue 11/26/1	Fri 11/29/19	50
52	Restrooms	8 days	Tue 11/26/1	Thu 12/5/19	50
53	Parking Lot	5 days	Mon 12/2/19	Fri 12/6/19	51
54	Pedestrian Tunnel	5 days	Mon 12/9/19	Fri 12/13/19	53
55	Pedestrian Bridge	10 days	Mon 12/9/19	Fri 12/20/19	53
56	Demobilization and Restoration	20 days	Tue 12/31/1	Mon 1/27/20	
57	Site Clean Up and Removals	5 days	Tue 12/31/1	Mon 1/6/20	48
58	**Demobilization**	**15 days**	**Tue 1/7/20**	**Mon 1/27/2**	**57**
59	**CONTRACT 2 (REACHES 3, 4 and 5)**	**1488 days**	**Fri 6/1/18**	**Tue 2/13/24**	
60	**PRE-CONSTRUCTION AWARD**	**445 days**	**Fri 6/1/18**	**Thu 2/13/20**	
61	**Plans & Specifications**	**390 days**	**Fri 6/1/18**	**Thu 11/28/1**	
62	30% Design	120 days	Fri 6/1/18	Thu 11/15/1	
63	60% Design	120 days	Fri 11/16/18	Thu 5/2/19	62
64	90% Design	120 days	Fri 5/3/19	Thu 10/17/1	63
65	BCOE	30 days	Fri 10/18/19	Thu 11/28/1	64
66	LERRDs Procurement	390 days	Fri 6/1/18	Thu 11/28/1	62SS
67	**Procurement & Award**	**55 days**	**Fri 11/29/19**	**Thu 2/13/20**	
68	Advertise	30 days	Fri 11/29/19	Thu 1/9/20	65
69	Award	25 days	Fri 1/10/20	Thu 2/13/20	68
70	NTP	0 days	Thu 2/13/20	Thu 2/13/20	69
71	**CONSTRUCTION**	**1043 days**	**Fri 2/14/20**	**Tue 2/13/24**	
72	**Reach 5 - Los Feliz Blvd. to Glendale Freeway**	**44 days**	**Fri 3/27/20**	**Wed 5/27/2**	
73	**Mobilization and Preparatory Work**	**15 days**	**Fri 3/27/20**	**Thu 4/16/20**	
74	Mobilization	5 days	Fri 3/27/20	Thu 4/2/20	70FS+30 days
75	Site Access and Staging	5 days	Fri 4/3/20	Thu 4/9/20	74
76	Temporary Cofferdam Installation	5 days	Fri 4/10/20	Thu 4/16/20	75
77	Erosion Control	2 days	Fri 4/10/20	Mon 4/13/20	75
78	**Measure 2 - Expose Storm Drain Outlets**	**19 days**	**Tue 4/14/20**	**Fri 5/8/20**	
79	Clearing and Grubbing	2 days	Tue 4/14/20	Wed 4/15/20	77
80	Excavation, Structural	2 days	Thu 4/16/20	Fri 4/17/20	79
81	Demo Existing Stormdrain	2 days	Mon 4/20/20	Tue 4/21/20	80
82	Install New Storm Drain, Piping, and Splitter Box	5 days	Wed 4/22/20	Tue 4/28/20	81
83	Backfill	1 day	Wed 4/29/20	Wed 4/29/20	82
84	Planting, Shrubs	2 days	Thu 4/30/20	Fri 5/1/20	83
85	Planting, Trees	2 days	Mon 5/4/20	Tue 5/5/20	84
86	Fertilize and Seed	1 day	Wed 5/6/20	Wed 5/6/20	85
87	Temporary Irrigation	2 days	Thu 5/7/20	Fri 5/8/20	86
88	**Recreation**	**8 days**	**Mon 5/11/2**	**Wed 5/20/2**	
89	Trail Access Points	3 days	Mon 5/11/20	Wed 5/13/20	87
90	Wildlife Viewpoint	5 days	Thu 5/14/20	Wed 5/20/20	89
91	**Demobilization and Restoration**	**5 days**	**Thu 5/21/20**	**Wed 5/27/2**	
92	Site Clean Up and Removals	2 days	Thu 5/21/20	Fri 5/22/20	90
93	Demobilization	3 days	Mon 5/25/20	Wed 5/27/20	92
94	**Reach 4 - Brazil St. to Los Feliz Blvd**	**454 days**	**Fri 2/14/20**	**Wed 11/10/2**	
95	**Mobilization and Preparatory Work**	**40 days**	**Fri 2/14/20**	**Thu 4/9/20**	
96	Mobilization	30 days	Fri 2/14/20	Thu 3/26/20	70
97	Site Access and Staging	10 days	Fri 3/27/20	Thu 4/9/20	96
98	**In-Channel Work Period I**	**120 days**	**Fri 4/10/20**	**Thu 9/24/20**	
99	Temporary Cofferdam Installation	10 days	Fri 4/10/20	Thu 4/23/20	97
100	Erosion Control	10 days	Fri 4/10/20	Thu 4/23/20	97



Project: LA River_Project Schedule
Date: Thu 3/5/15

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Deadline | Progress | Manual Progress

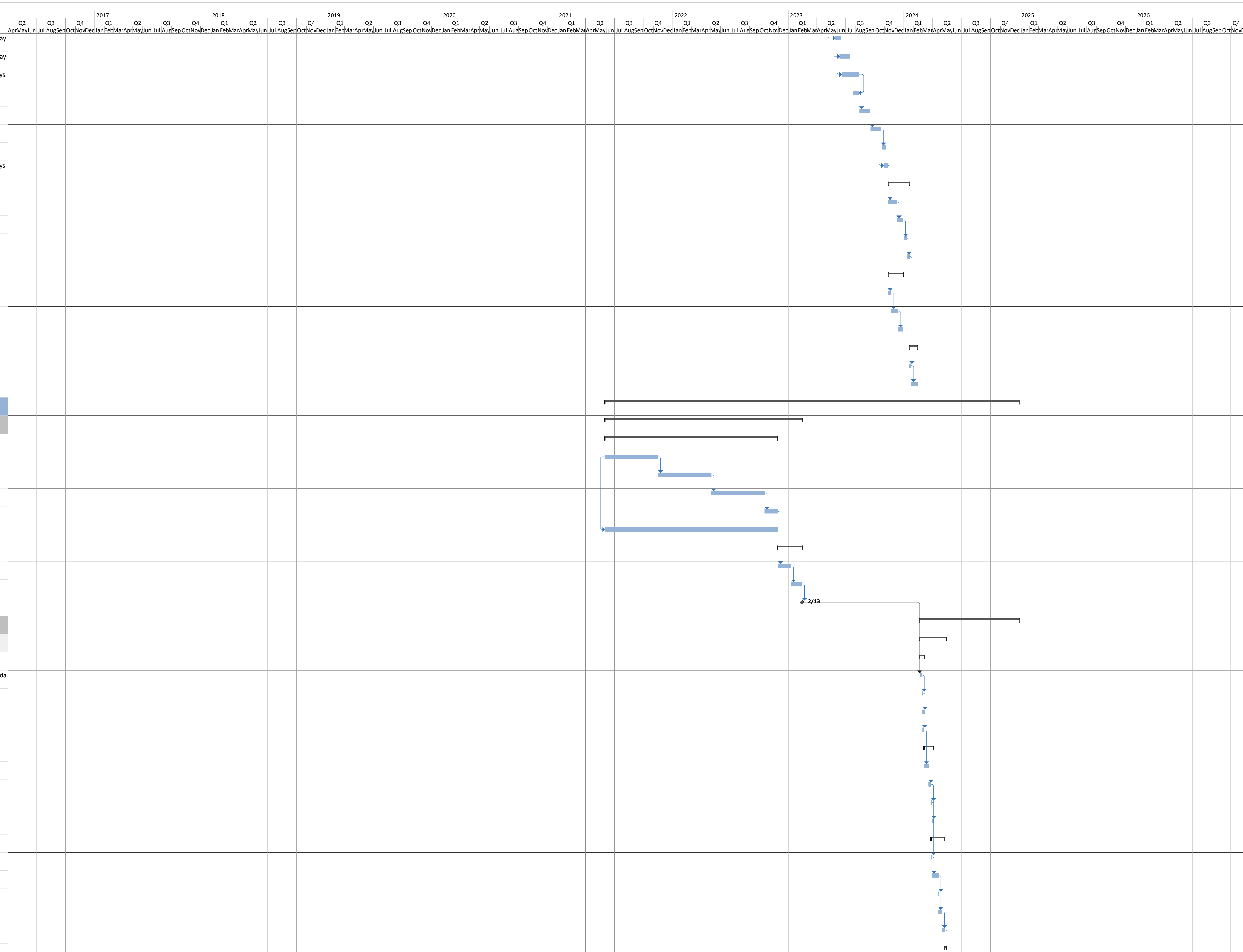
ID	Task Name	Duration	Start	Finish	Predecessors
101	**Measure 4 - Grade Adjacent Areas to Lower Elevation (G)**	**20 days**	**Fri 4/24/20**	**Thu 5/21/20**	
102	Excavation, Embankment	20 days	Fri 4/24/20	Thu 5/21/20	100
103	**Measure 3/5 - Create Geomorphology and Plant for Freshwater Marsh**	**90 days**	**Fri 5/22/20**	**Thu 9/24/20**	
104	Excavation, Grade Control	35 days	Fri 5/22/20	Thu 7/9/20	102
105	Grouted Riprap, Stone Placement	35 days	Fri 7/10/20	Thu 8/27/20	104
106	Grouted Riprap, Grout Placement	25 days	Fri 7/31/20	Thu 9/3/20	105SS+15 days
107	Compacted Fill	25 days	Fri 8/21/20	Thu 9/24/20	106SS+15 days
108	**In-Channel Work Period II**	**120 days**	**Fri 4/16/21**	**Thu 9/30/21**	
109	Temporary Cofferdam Installation	10 days	Fri 4/16/21	Thu 4/29/21	107FS+145 da
110	Erosion Control	10 days	Fri 4/30/21	Thu 5/13/21	109
111	**Measure 10 - Divert Tributary & River Flow Into Side Channels (F)**	**60 days**	**Fri 5/14/21**	**Thu 8/5/21**	
112	Excavation, Embankment	15 days	Fri 5/14/21	Thu 6/3/21	110
113	Riprap Placement	45 days	Fri 6/4/21	Thu 8/5/21	112
114	**Measure 2 - Expose Storm Drain Outlets**	**120 days**	**Fri 4/16/21**	**Thu 9/30/21**	
115	Clearing and Grubbing	10 days	Fri 4/16/21	Thu 4/29/21	107FS+145 da
116	Excavation, Structural	15 days	Fri 4/30/21	Thu 5/20/21	115SS+10 days
117	Demo Existing Stormdrain	15 days	Fri 5/14/21	Thu 6/3/21	116SS+10 days
118	Install New Storm Drain, Piping, and Splitter Box	30 days	Fri 5/21/21	Thu 7/1/21	117SS+5 days
119	Backfill	10 days	Fri 6/18/21	Thu 7/1/21	118FF
120	Planting, Shrubs	20 days	Fri 7/2/21	Thu 7/29/21	119
121	Planting, Trees	20 days	Fri 7/30/21	Thu 8/26/21	120
122	Fertilize and Seed	10 days	Fri 8/27/21	Thu 9/9/21	121
123	Temporary Irrigation	20 days	Fri 9/3/21	Thu 9/30/21	122SS+5 days
124	**Recreation**	**24 days**	**Fri 10/1/21**	**Wed 11/3/21**	
125	Existing Access Road Converstion to Multi-Use Trail	16 days	Fri 10/1/21	Fri 10/22/21	123
126	Trail Access Points	2 days	Mon 10/25/2	Tue 10/26/21	125
127	Wildlife Viewpoint	6 days	Wed 10/27/2	Wed 11/3/21	126
128	**Demobilization and Restoration**	**5 days**	**Thu 11/4/21**	**Wed 11/10/2**	
129	Site Clean Up and Removals	2 days	Thu 11/4/21	Fri 11/5/21	127
130	Demobilization	3 days	Mon 11/8/21	Wed 11/10/2	129
131	**Reach 3 - Ferraro Fields to Brazil St.**	**524 days**	**Thu 2/10/22**	**Tue 2/13/24**	
132	**Mobilization and Preparatory Work**	**40 days**	**Thu 2/10/22**	**Wed 4/6/22**	
133	Mobilization	30 days	Thu 2/10/22	Wed 3/23/22	130FS+65 days
134	Site Access and Staging	10 days	Thu 3/24/22	Wed 4/6/22	133
135	**In-Channel Work Period I**	**137 days**	**Thu 4/7/22**	**Fri 10/14/22**	
136	Temporary Cofferdam Installation	15 days	Thu 4/7/22	Wed 4/27/22	134
137	Erosion Control	7 days	Thu 4/7/22	Fri 4/15/22	134
138	**Measure 3/5 - Create Geomorphology and Plant fc**	**105 days**	**Mon 4/18/22**	**Fri 9/9/22**	
139	Riprap Placement	90 days	Mon 4/18/22	Fri 8/19/22	137
140	Compacted Fill	60 days	Mon 6/20/22	Fri 9/9/22	139SS+45 days
141	**Measure 10 - Divert Tributary & River Flow Into Si**	**70 days**	**Mon 7/11/22**	**Fri 10/14/22**	
142	Excavation, Embankment	30 days	Mon 7/11/22	Fri 8/19/22	139FS-30 days
143	Riprap Placement	55 days	Mon 8/1/22	Fri 10/14/22	142SS+15 days
144	**In-Channel Work Period II**	**152 days**	**Thu 4/13/23**	**Fri 11/10/23**	
145	Temporary Cofferdam Installation	15 days	Thu 4/13/23	Wed 5/3/23	143FS+128 da
146	Erosion Control	7 days	Thu 5/4/23	Fri 5/12/23	145
147	**Measure 2 - Expose Storm Drain Outlets**	**130 days**	**Mon 5/15/23**	**Fri 11/10/23**	
148	Clearing and Grubbing	15 days	Mon 5/15/23	Fri 6/2/23	146



Project: LA River_Project Schedule
Date: Thu 3/5/15

Task	Milestone	Project Summary	External Milestone	Inactive Milestone	Duration-only	Manual Summary	Finish-only	Progress	
Split	Summary	External Tasks	Inactive Task	Inactive Summary	Manual Summary Rollup	Start-only	Deadline	Manual Progress	

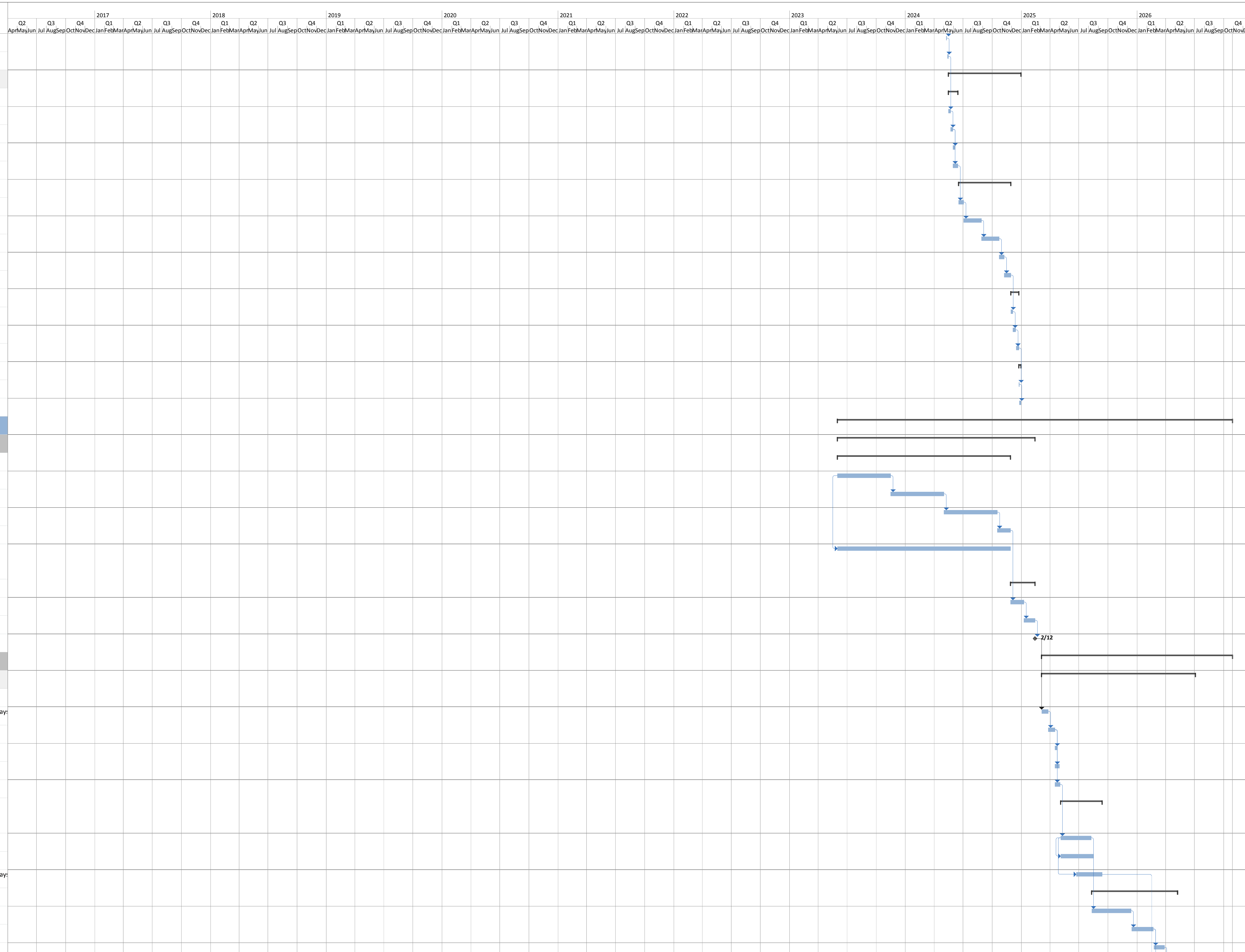
ID	Task Name	Duration	Start	Finish	Predecessors
149	Excavation, Structural	15 days	Mon 5/29/23	Fri 6/16/23	148SS+10 days
150	Demo Existing Stormdrain	25 days	Mon 6/12/23	Fri 7/14/23	149SS+10 days
151	Install New Storm Drain, Piping, and Splitter Box	40 days	Mon 6/19/23	Fri 8/11/23	150SS+5 days
152	Backfill	15 days	Mon 7/24/23	Fri 8/11/23	151FF
153	Planting, Shrubs	25 days	Mon 8/14/23	Fri 9/15/23	152
154	Planting, Trees	25 days	Mon 9/18/23	Fri 10/20/23	153
155	Fertilize and Seed	10 days	Mon 10/23/2	Fri 11/3/23	154
156	Temporary Irrigation	10 days	Mon 10/30/2	Fri 11/10/23	155SS+5 days
157	**Measure 17 - Habitat Corridors/Riparain Planting on**	**49 days**	**Mon 11/13/2**	**Thu 1/18/24**	
158	Planting, Shrubs	20 days	Mon 11/13/2	Fri 12/8/23	156
159	Planting, Trees	15 days	Mon 12/11/2	Fri 12/29/23	158
160	Fertilize and Seed	7 days	Mon 1/1/24	Tue 1/9/24	159
161	Temporary Irrigation	7 days	Wed 1/10/24	Thu 1/18/24	160
162	**Recreation**	**35 days**	**Mon 11/13/2**	**Fri 12/29/23**	
163	New Unpaved Trail	7 days	Mon 11/13/2	Tue 11/21/23	156
164	Existing Access Road Converstion to Multi-Use Trail	16 days	Wed 11/22/2	Wed 12/13/2	163
165	Wildlife Viewpoint	12 days	Thu 12/14/23	Fri 12/29/23	164
166	**Demobilization and Restoration**	**18 days**	**Fri 1/19/24**	**Tue 2/13/24**	
167	Site Clean Up and Removals	3 days	Fri 1/19/24	Tue 1/23/24	161
168	Demobilization	15 days	Wed 1/24/24	Tue 2/13/24	167
169	**CONTRACT 3 (REACHES 1 and 2)**	**935 days**	**Tue 6/1/21**	**Mon 12/30/2**	
170	**PRE-CONSTRUCTION AWARD**	**445 days**	**Tue 6/1/21**	**Mon 2/13/23**	
171	**Plans & Specifications**	**390 days**	**Tue 6/1/21**	**Mon 11/28/2**	
172	30% Design	120 days	Tue 6/1/21	Mon 11/15/2	
173	60% Design	120 days	Tue 11/16/21	Mon 5/2/22	172
174	90% Design	120 days	Tue 5/3/22	Mon 10/17/2	173
175	BCOE	30 days	Tue 10/18/22	Mon 11/28/2	174
176	LERRDs Procurement	390 days	Tue 6/1/21	Mon 11/28/2	172SS
177	**Procurement & Award**	**55 days**	**Tue 11/29/2**	**Mon 2/13/23**	
178	Advertise	30 days	Tue 11/29/22	Mon 1/9/23	175
179	Award	25 days	Tue 1/10/23	Mon 2/13/23	178
180	NTP	0 days	Mon 2/13/23	Mon 2/13/23	179
181	**CONSTRUCTION**	**225 days**	**Tue 2/20/24**	**Mon 12/30/2**	
182	**Reach 2 - Glendale Freeway to I-5**	**62 days**	**Tue 2/20/24**	**Wed 5/15/24**	
183	**Mobilization and Preparatory Work**	**12 days**	**Tue 2/20/24**	**Wed 3/6/24**	
184	Mobilization	5 days	Tue 2/20/24	Mon 2/26/24	180FS+265 da
185	Site Access and Staging	2 days	Tue 2/27/24	Wed 2/28/24	184
186	Temporary Cofferdam Installation	5 days	Thu 2/29/24	Wed 3/6/24	185
187	Clearing and Grubbing	3 days	Thu 2/29/24	Mon 3/4/24	185
188	**Measure 17 - Habitat Corridors/Riparain Planting on**	**23 days**	**Tue 3/5/24**	**Thu 4/4/24**	
189	Planting, Shrubs	10 days	Tue 3/5/24	Mon 3/18/24	187
190	Planting, Trees	6 days	Tue 3/19/24	Tue 3/26/24	189
191	Fertilize and Seed	2 days	Wed 3/27/24	Thu 3/28/24	190
192	Temporary Irrigation	5 days	Fri 3/29/24	Thu 4/4/24	191
193	**Recreation**	**31 days**	**Wed 3/27/24**	**Wed 5/8/24**	
194	Trail Improvements	2 days	Wed 3/27/24	Thu 3/28/24	190
195	New Unpaved Trail	15 days	Fri 3/29/24	Thu 4/18/24	194
196	Trail Access Points	1 day	Fri 4/19/24	Fri 4/19/24	195
197	Restrooms	8 days	Fri 4/19/24	Tue 4/30/24	195
198	Wildlife Viewpoint	6 days	Wed 5/1/24	Wed 5/8/24	197
199	**Demobilization and Restoration**	**5 days**	**Thu 5/9/24**	**Wed 5/15/24**	



Project: LA River_Project Schedule
Date: Thu 3/5/15

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Deadline | Progress | Manual Progress

ID	Task Name	Duration	Start	Finish	Predecessors
200	Site Clean Up and Removals	2 days	Thu 5/9/24	Fri 5/10/24	198
201	Demobilization	3 days	Mon 5/13/24	Wed 5/15/24	200
202	**Reach 1 - Pollywog Park / Headworks to Midpoint of Be**	**163 days**	**Thu 5/16/24**	**Mon 12/30/2**	
203	**Mobilization and Preparatory Work**	**22 days**	**Thu 5/16/24**	**Fri 6/14/24**	
204	Mobilization	5 days	Thu 5/16/24	Wed 5/22/24	201
205	Site Access and Staging	5 days	Thu 5/23/24	Wed 5/29/24	204
206	Temporary Cofferdam Installation	5 days	Thu 5/30/24	Wed 6/5/24	205
207	Clearing and Grubbing	12 days	Thu 5/30/24	Fri 6/14/24	205
208	**Measure 17 - Habitat Corridors/Riparain Planting on**	**119 days**	**Mon 6/17/24**	**Thu 11/28/2**	
209	Top Soil Placement	12 days	Mon 6/17/24	Tue 7/2/24	207
210	Planting, Shrubs	40 days	Wed 7/3/24	Tue 8/27/24	209
211	Planting, Trees	40 days	Wed 8/28/24	Tue 10/22/24	210
212	Fertilize and Seed	12 days	Wed 10/23/2	Thu 11/7/24	211
213	Temporary Irrigation	15 days	Fri 11/8/24	Thu 11/28/24	212
214	**Recreation**	**17 days**	**Fri 11/29/24**	**Mon 12/23/2**	
215	Trail Improvements	4 days	Fri 11/29/24	Wed 12/4/24	213
216	New Unpaved Trail	7 days	Thu 12/5/24	Fri 12/13/24	215
217	Trail Access Points	6 days	Mon 12/16/2	Mon 12/23/2	216
218	**Demobilization and Restoration**	**5 days**	**Tue 12/24/2**	**Mon 12/30/2**	
219	Site Clean Up and Removals	2 days	Tue 12/24/24	Wed 12/25/2	217
220	Demobilization	3 days	Thu 12/26/24	Mon 12/30/2	219
221	**CONTRACT 4 (REACHES 7 and 8) and LATC RELOCATION**	**890 days**	**Thu 6/1/23**	**Wed 10/28/2**	
222	**PRE-CONSTRUCTION AWARD**	**445 days**	**Thu 6/1/23**	**Wed 2/12/25**	
223	**Plans & Specifications**	**390 days**	**Thu 6/1/23**	**Wed 11/27/2**	
224	30% Design	120 days	Thu 6/1/23	Wed 11/15/2	
225	60% Design	120 days	Thu 11/16/23	Wed 5/1/24	224
226	90% Design	120 days	Thu 5/2/24	Wed 10/16/2	225
227	BCOE	30 days	Thu 10/17/24	Wed 11/27/2	226
228	LERRDs Procurement, LATC Relocation and Utility Tower Relocations	390 days	Thu 6/1/23	Wed 11/27/24	224SS
229	**Procurement & Award**	**55 days**	**Thu 11/28/2**	**Wed 2/12/25**	
230	Advertise	30 days	Thu 11/28/24	Wed 1/8/25	227
231	Award	25 days	Thu 1/9/25	Wed 2/12/25	230
232	NTP	0 days	Wed 2/12/25	Wed 2/12/25	231
233	**CONSTRUCTION**	**430 days**	**Thu 3/6/25**	**Wed 10/28/2**	
234	**Reach 8 - Main St. to 1st St.**	**347 days**	**Thu 3/6/25**	**Fri 7/3/26**	
235	**Mobilization and Preparatory Work**	**42 days**	**Thu 3/6/25**	**Fri 5/2/25**	
236	Mobilization	15 days	Thu 3/6/25	Wed 3/26/25	232FS+15 days
237	Site Access and Staging	15 days	Thu 3/27/25	Wed 4/16/25	236
238	Temporary Cofferdam Installation	5 days	Thu 4/17/25	Wed 4/23/25	237
239	Erosion Control	10 days	Thu 4/17/25	Wed 4/30/25	237
240	Clearing and Grubbing	12 days	Thu 4/17/25	Fri 5/2/25	237
241	**Measure 6 - Rebuild Geomorphology for Historic Wash (Piggyback Yard)**	**95 days**	**Mon 5/5/25**	**Fri 9/12/25**	
242	Excavation, Embankments	70 days	Mon 5/5/25	Fri 8/8/25	240
243	Load and Haul to Disposal	75 days	Mon 5/5/25	Fri 8/15/25	242SS
244	Riprap Placement	60 days	Mon 6/23/25	Fri 9/12/25	242SS+35 days
245	**Measure 17 - Habitat Corridors/Riparian Planting on**	**195 days**	**Mon 8/11/25**	**Fri 5/8/26**	
246	Planting, Shrubs	90 days	Mon 8/11/25	Fri 12/12/25	242
247	Planting, Trees	50 days	Mon 12/15/2	Fri 2/20/26	246
248	Fertilize and Seed	25 days	Mon 2/23/26	Fri 3/27/26	247



Project: LA River_Project Schedule
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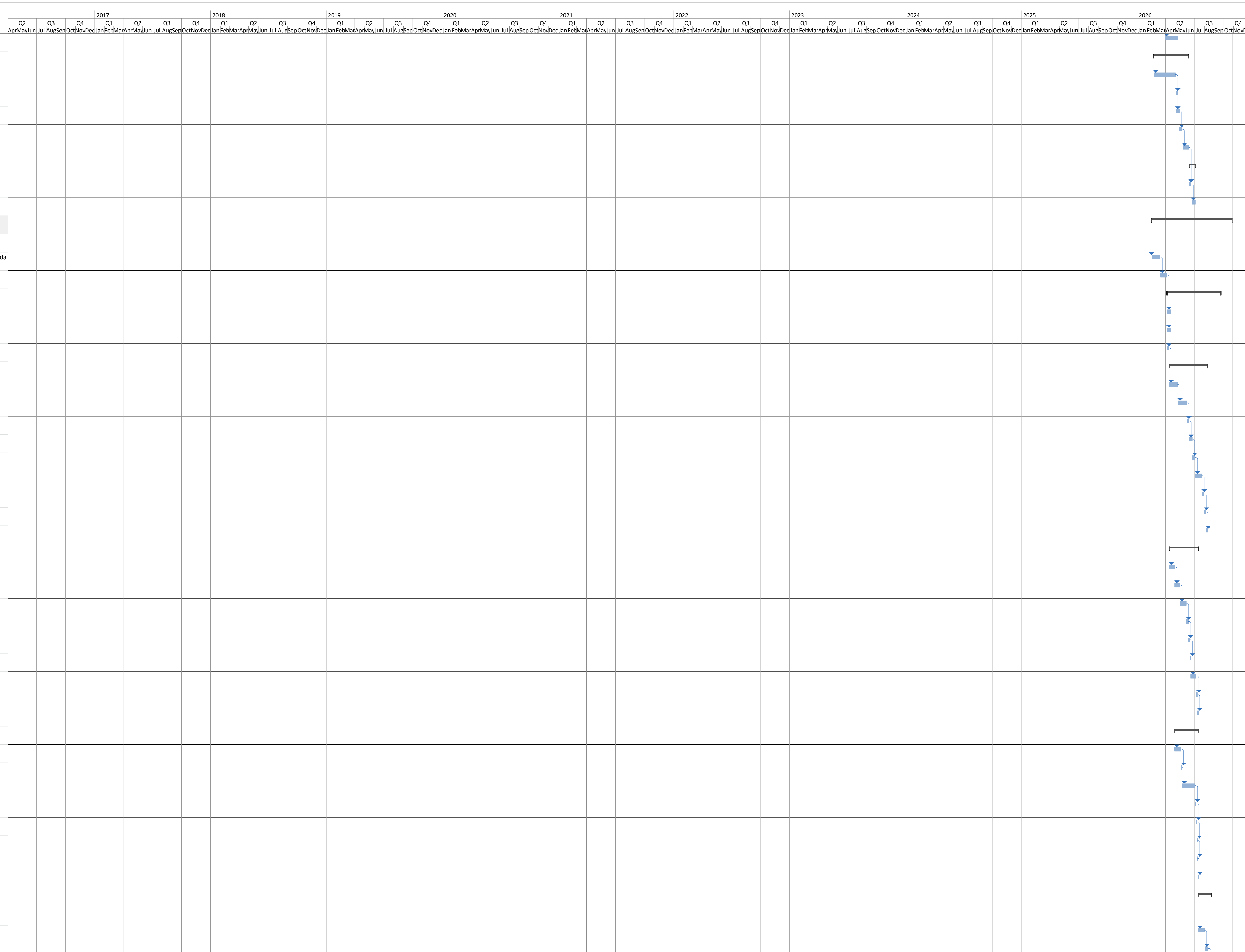
Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Deadline | Progress | Manual Progress

ID	Task Name	Duration	Start	Finish	Predecessors
249	Temporary Irrigation	30 days	Mon 3/30/26	Fri 5/8/26	248
250	**Recreation**	**80 days**	**Mon 2/23/26**	**Fri 6/12/26**	
251	New Unpaved Trail	50 days	Mon 2/23/26	Fri 5/1/26	247
252	Trail Access Points	5 days	Mon 5/4/26	Fri 5/8/26	251
253	Restrooms	8 days	Mon 5/4/26	Wed 5/13/26	251
254	Parking Lot	7 days	Thu 5/14/26	Fri 5/22/26	253
255	Pedestrian Bridge	15 days	Mon 5/25/26	Fri 6/12/26	254
256	**Demobilization and Restoration**	**15 days**	**Mon 6/15/26**	**Fri 7/3/26**	
257	Site Clean Up and Removals	5 days	Mon 6/15/26	Fri 6/19/26	255
258	Demobilization	10 days	Mon 6/22/26	Fri 7/3/26	257
259	**Reach 7 - I-5 to Main St.**	**183 days**	**Mon 2/16/26**	**Wed 10/28/2**	
260	**Mobilization and Preparatory Work**	**35 days**	**Mon 2/16/26**	**Fri 4/3/26**	
261	Mobilization	20 days	Mon 2/16/26	Fri 3/13/26	244FS+110 da
262	Site Access and Staging	15 days	Mon 3/16/26	Fri 4/3/26	261
263	**In-Channel Work Period I**	**121 days**	**Mon 4/6/26**	**Mon 9/21/26**	
264	Temporary Cofferdam Installation	10 days	Mon 4/6/26	Fri 4/17/26	262
265	Erosion Control	10 days	Mon 4/6/26	Fri 4/17/26	262
266	Clearing and Grubbing	5 days	Mon 4/6/26	Fri 4/10/26	262
267	**Measure 8 - Creation of Wetlands Flood Control B**	**87 days**	**Mon 4/13/26**	**Tue 8/11/26**	
268	Excavation, Embankment	20 days	Mon 4/13/26	Fri 5/8/26	266
269	Impermeable Layer	20 days	Mon 5/11/26	Fri 6/5/26	268
270	Chain Link Fence Installation	5 days	Mon 6/8/26	Fri 6/12/26	269
271	Aggregate Base and Asphalt Installation	7 days	Mon 6/15/26	Tue 6/23/26	270
272	Top Soil Placement	7 days	Wed 6/24/26	Thu 7/2/26	271
273	Planting, Shrubs	15 days	Fri 7/3/26	Thu 7/23/26	272
274	Planting, Trees	5 days	Fri 7/24/26	Thu 7/30/26	273
275	Fertilize and Seed	4 days	Fri 7/31/26	Wed 8/5/26	274
276	Temporary Irrigation	4 days	Thu 8/6/26	Tue 8/11/26	275
277	**Measure 27 - Tributary Channels/Widen Channel (**	**67 days**	**Mon 4/13/26**	**Tue 7/14/26**	
278	Concrete Demolition	12 days	Mon 4/13/26	Tue 4/28/26	266
279	Excavation, Embankment	12 days	Wed 4/29/26	Thu 5/14/26	278
280	Turf Reinforcement Mat Installation	15 days	Fri 5/15/26	Thu 6/4/26	279
281	Chain Link Fence Installation	5 days	Fri 6/5/26	Thu 6/11/26	280
282	Aggregate Base and Asphalt Installation	3 days	Fri 6/12/26	Tue 6/16/26	281
283	Top Soil Placement	2 days	Wed 6/17/26	Thu 6/18/26	282
284	Planting, Trees	12 days	Fri 6/19/26	Mon 7/6/26	283
285	Fertilize and Seed	3 days	Tue 7/7/26	Thu 7/9/26	284
286	Temporary Irrigation	3 days	Fri 7/10/26	Tue 7/14/26	285
287	**Measure 26 - Terrace Banks**	**54 days**	**Wed 4/29/26**	**Mon 7/13/26**	
288	Concrete Demolition	15 days	Wed 4/29/26	Tue 5/19/26	278
289	Excavation, Embankment	2 days	Wed 5/20/26	Thu 5/21/26	288
290	Reinforced Concrete Planters	30 days	Fri 5/22/26	Thu 7/2/26	289
291	Top Soil Placement	2 days	Fri 7/3/26	Mon 7/6/26	290
292	Planting, Shrubs	2 days	Tue 7/7/26	Wed 7/8/26	291
293	Planting, Trees	1 day	Thu 7/9/26	Thu 7/9/26	292
294	Fertilize and Seed	1 day	Fri 7/10/26	Fri 7/10/26	293
295	Temporary Irrigation	1 day	Mon 7/13/26	Mon 7/13/26	294
296	**Measure 17 - Habitat Corridors/Riparian Planting on Banks**	**31 days**	**Mon 7/13/26**	**Mon 8/24/26**	
297	Planting, Shrubs	15 days	Mon 7/13/26	Fri 7/31/26	294
298	Planting, Trees	9 days	Mon 8/3/26	Thu 8/13/26	297



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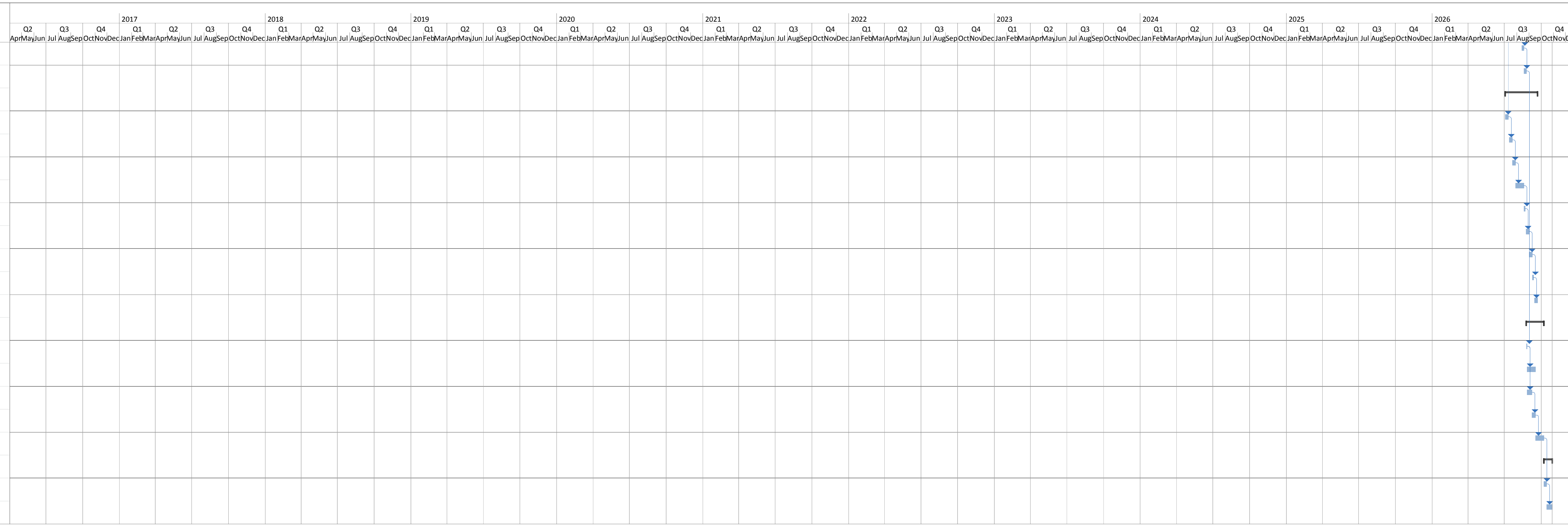
ID	Task Name	Duration	Start	Finish	Predecessors
299	Fertilize and Seed	3 days	Fri 8/14/26	Tue 8/18/26	298
300	Temporary Irrigation	4 days	Wed 8/19/26	Mon 8/24/26	299
301	**Measure 2 - Expose Storm Drain Outlets**	**57 days**	**Fri 7/3/26**	**Mon 9/21/2**	
302	Clearing and Grubbing	6 days	Fri 7/3/26	Fri 7/10/26	290
303	Excavation, Structural	6 days	Mon 7/13/26	Mon 7/20/26	302
304	Demo Existing Stormdrain	6 days	Tue 7/21/26	Tue 7/28/26	303
305	Install New Storm Drain, Piping, and Splitter Box	15 days	Wed 7/29/26	Tue 8/18/26	304
306	Backfill	3 days	Wed 8/19/26	Fri 8/21/26	305
307	Planting, Shrubs	6 days	Mon 8/24/26	Mon 8/31/26	306
308	Planting, Trees	6 days	Tue 9/1/26	Tue 9/8/26	307
309	Fertilize and Seed	3 days	Wed 9/9/26	Fri 9/11/26	308
310	Temporary Irrigation	6 days	Mon 9/14/26	Mon 9/21/26	309
311	**Recreation**	**32 days**	**Tue 8/25/26**	**Wed 10/7/2**	
312	Trail Improvements	2 days	Tue 8/25/26	Wed 8/26/26	300
313	New Unpaved Trail	15 days	Thu 8/27/26	Wed 9/16/26	312
314	Restrooms	8 days	Thu 8/27/26	Mon 9/7/26	312
315	Parking Lot	7 days	Tue 9/8/26	Wed 9/16/26	314
316	Pedestrian Bridge	15 days	Thu 9/17/26	Wed 10/7/26	315
317	**Demobilization and Restoration**	**15 days**	**Thu 10/8/26**	**Wed 10/28/2**	
318	Site Clean Up and Removals	5 days	Thu 10/8/26	Wed 10/14/2	316
319	Demobilization	10 days	Thu 10/15/2	Wed 10/28/2	318



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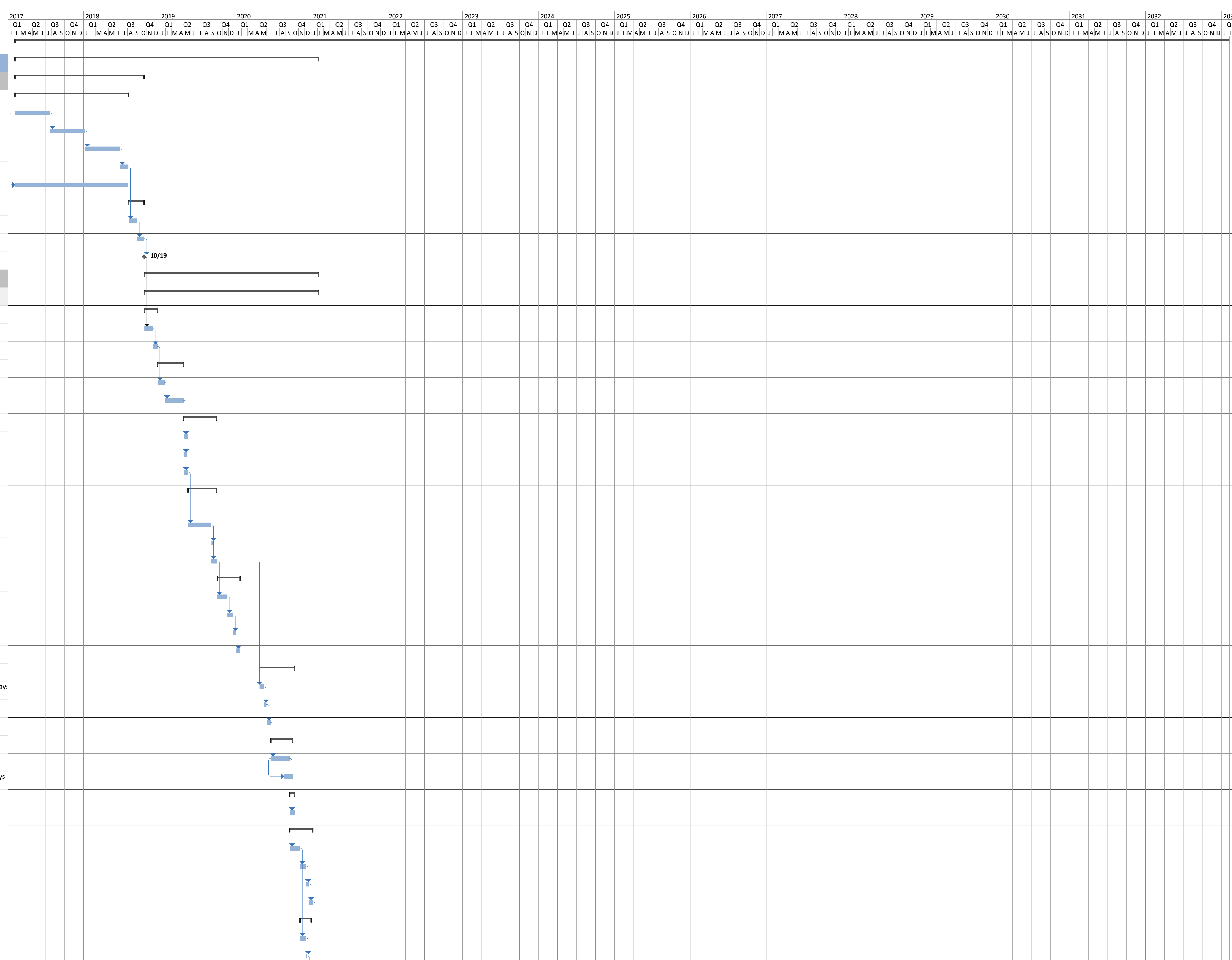
LOCALLY PREFERRED PLAN – ALTERNATIVE 20

TENTATIVE PROJECT SCHEDULE

ID	Task Name	Duration	Start	Finish	Predecessors
1	**LOS ANGELES RIVER ECOSYSTEM RESTORATION PROJECT SCHE**	**4177 days**	**Mon 2/6/17**	**Tue 2/8/33**	
2	**CONTRACT 1 (REACH 6)**	**1045 days**	**Mon 2/6/17**	**Fri 2/5/21**	
3	**PRE-CONSTRUCTION AWARD**	**445 days**	**Mon 2/6/17**	**Fri 10/19/18**	
4	**Plans & Specifications**	**390 days**	**Mon 2/6/17**	**Fri 8/3/18**	
5	30% Design	120 days	Mon 2/6/17	Fri 7/21/17	
6	60% Design	120 days	Mon 7/24/17	Fri 1/5/18	5
7	90% Design	120 days	Mon 1/8/18	Fri 6/22/18	6
8	BCOE	30 days	Mon 6/25/18	Fri 8/3/18	7
9	LERRDs Procurement and Utility Relocations	390 days	Mon 2/6/17	Fri 8/3/18	5SS
10	**Procurement & Award**	**55 days**	**Mon 8/6/18**	**Fri 10/19/18**	
11	Advertise	30 days	Mon 8/6/18	Fri 9/14/18	8
12	Award	25 days	Mon 9/17/18	Fri 10/19/18	11
13	NTP	0 days	Fri 10/19/18	Fri 10/19/18	12
14	**CONSTRUCTION**	**600 days**	**Mon 10/22/1**	**Fri 2/5/21**	
15	**Reach 6 - Glendale Freeway to I-5**	**600 days**	**Mon 10/22/1**	**Fri 2/5/21**	
16	**Mobilization and Preparatory Work**	**45 days**	**Mon 10/22/1**	**Fri 12/21/18**	
17	Mobilization	30 days	Mon 10/22/1	Fri 11/30/18	13
18	Site Access and Staging	15 days	Mon 12/3/18	Fri 12/21/18	17
19	**Utility Tower Relocations**	**90 days**	**Mon 12/24/1**	**Fri 4/26/19**	
20	Demolish Existing Towers	25 days	Mon 12/24/1	Fri 1/25/19	18
21	Construct New Towers	65 days	Mon 1/28/19	Fri 4/26/19	20
22	**In-Channel Work Period I**	**115 days**	**Mon 4/29/1**	**Fri 10/4/19**	
23	Temporary Cofferdam Installation	15 days	Mon 4/29/19	Fri 5/17/19	21
24	Erosion Control	10 days	Mon 4/29/19	Fri 5/10/19	21
25	Clearing and Grubbing	15 days	Mon 4/29/19	Fri 5/17/19	21
26	**Measure 21/22 - Lower Channel Banks and Provide Setback Levees or Berms**	**100 days**	**Mon 5/20/19**	**Fri 10/4/19**	
27	Excavation, Embankments	80 days	Mon 5/20/19	Fri 9/6/19	25
28	Aggregate Base and Asphalt Installation	8 days	Mon 9/9/19	Wed 9/18/19	27
29	Chain Link Fence Installation	20 days	Mon 9/9/19	Fri 10/4/19	27
30	**Measure 17 - Habitat Corridors/Riparain Planting on**	**80 days**	**Mon 10/7/1**	**Fri 1/24/20**	
31	Planting, Shrubs	35 days	Mon 10/7/19	Fri 11/22/19	29
32	Planting, Trees	20 days	Mon 11/25/1	Fri 12/20/19	31
33	Fertilize and Seed	10 days	Mon 12/23/1	Fri 1/3/20	32
34	Temporary Irrigation	15 days	Mon 1/6/20	Fri 1/24/20	33
35	**In-Channel Work Period II**	**121 days**	**Mon 4/27/2**	**Mon 10/12/2**	
36	Temporary Cofferdam Installation	15 days	Mon 4/27/20	Fri 5/15/20	29FS+145 days
37	Erosion Control	10 days	Mon 5/18/20	Fri 5/29/20	36
38	Clearing and Grubbing	15 days	Mon 6/1/20	Fri 6/19/20	37
39	**Measure 16 - Bioengineering Channel Walls**	**75 days**	**Mon 6/22/2**	**Fri 10/2/20**	
40	Turf Reinforcement Mat Installation w/ Rock at T	65 days	Mon 6/22/20	Fri 9/18/20	38
41	Chain Link Fence Installation	30 days	Mon 8/24/20	Fri 10/2/20	40SS+45 days
42	**Measure 19 - Bioengineer Channel Walls**	**16 days**	**Mon 9/21/2**	**Mon 10/12/2**	
43	Turf Reinforcement Mat Installation w/ Rock at T	16 days	Mon 9/21/20	Mon 10/12/2	40
44	**Measure 17 - Habitat Corridors/Riparain Planting on**	**80 days**	**Mon 9/21/2**	**Fri 1/8/21**	
45	Planting, Shrubs	35 days	Mon 9/21/20	Fri 11/6/20	40
46	Planting, Trees	20 days	Mon 11/9/20	Fri 12/4/20	45
47	Fertilize and Seed	10 days	Mon 12/7/20	Fri 12/18/20	46
48	Temporary Irrigation	15 days	Mon 12/21/2	Fri 1/8/21	47
49	**Recreation**	**39 days**	**Mon 11/9/2**	**Thu 12/31/2**	
50	New Unpaved Trail	20 days	Mon 11/9/20	Fri 12/4/20	45
51	Trail Access Points	4 days	Mon 12/7/20	Thu 12/10/2	50



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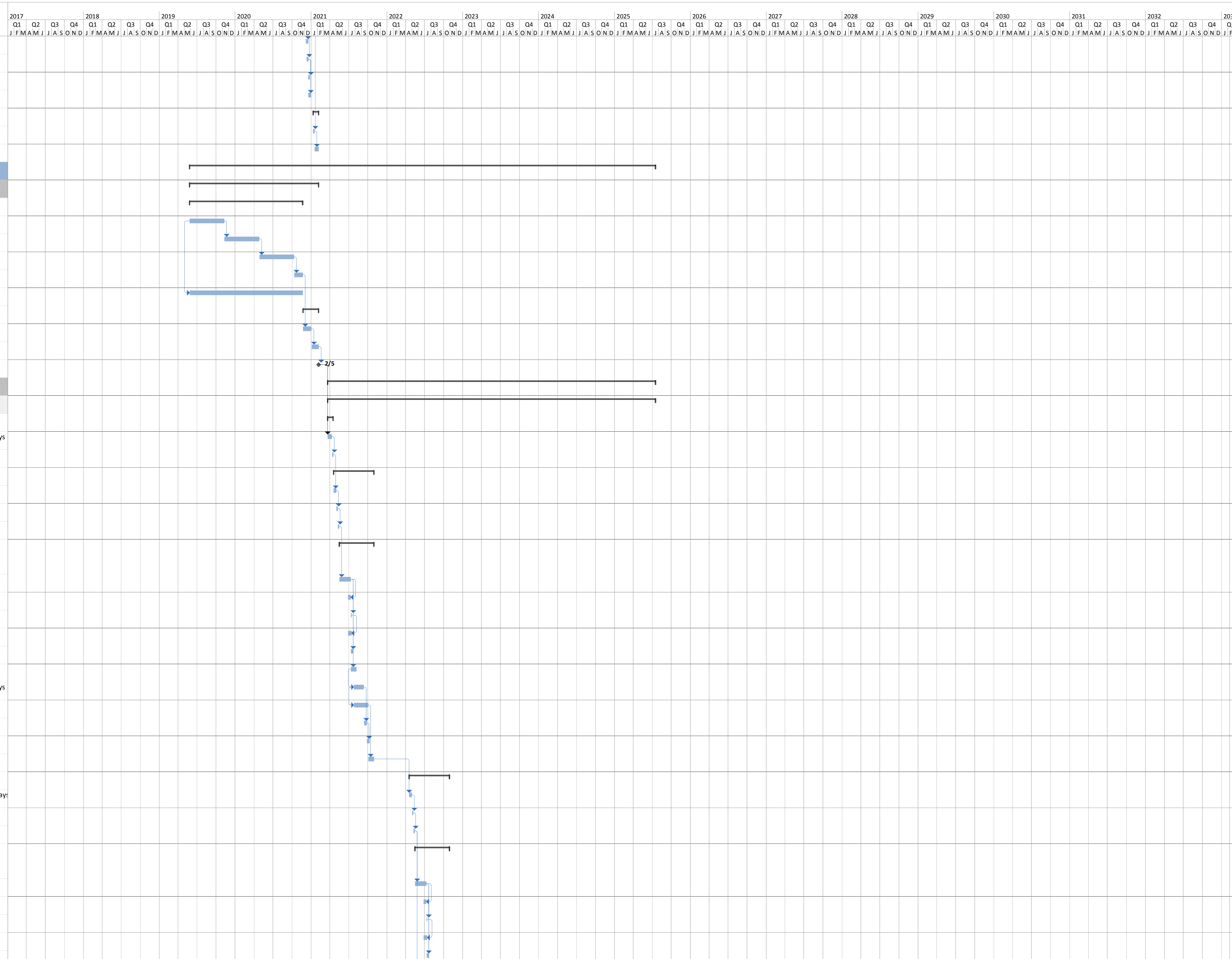
ID	Task Name	Duration	Start	Finish	Predecessors
52	Restrooms	8 days	Mon 12/7/20	Wed 12/16/2	50
53	Parking Lot	5 days	Fri 12/11/20	Thu 12/17/2	51
54	Pedestrian Tunnel	5 days	Fri 12/18/20	Thu 12/24/2	53
55	Pedestrian Bridge	10 days	Fri 12/18/20	Thu 12/31/2	53
56	**Demobilization and Restoration**	**20 days**	**Mon 1/11/21**	**Fri 2/5/21**	
57	Site Clean Up and Removals	5 days	Mon 1/11/21	Fri 1/15/21	48
58	Demobilization	15 days	Mon 1/18/21	Fri 2/5/21	57
59	**CONTRACT 2 (REACH 5)**	**1603 days**	**Mon 5/27/1**	**Wed 7/16/2**	
60	**PRE-CONSTRUCTION AWARD**	**445 days**	**Mon 5/27/1**	**Fri 2/5/21**	
61	**Plans & Specifications**	**390 days**	**Mon 5/27/1**	**Fri 11/20/20**	
62	30% Design	120 days	Mon 5/27/19	Fri 11/8/19	
63	60% Design	120 days	Mon 11/11/1	Fri 4/24/20	62
64	90% Design	120 days	Mon 4/27/20	Fri 10/9/20	63
65	BCOE	30 days	Mon 10/12/2	Fri 11/20/20	64
66	LERRDs Procurement	390 days	Mon 5/27/19	Fri 11/20/20	62SS
67	**Procurement & Award**	**55 days**	**Mon 11/23/2**	**Fri 2/5/21**	
68	Advertise	30 days	Mon 11/23/2	Fri 1/1/21	65
69	Award	25 days	Mon 1/4/21	Fri 2/5/21	68
70	NTP	0 days	Fri 2/5/21	Fri 2/5/21	69
71	**CONSTRUCTION**	**1128 days**	**Mon 3/22/21**	**Wed 7/16/2**	
72	**Reach 5 - Los Feliz Blvd. to Glendale Freeway**	**1128 days**	**Mon 3/22/21**	**Wed 7/16/2**	
73	**Mobilization and Preparatory Work**	**20 days**	**Mon 3/22/21**	**Fri 4/16/21**	
74	Mobilization	15 days	Mon 3/22/21	Fri 4/9/21	70FS+30 days
75	Site Access and Staging	5 days	Mon 4/12/21	Fri 4/16/21	74
76	**In-Channel Work Period I**	**140 days**	**Mon 4/19/21**	**Fri 10/29/21**	
77	Temporary Cofferdam Installation	10 days	Mon 4/19/21	Fri 4/30/21	75
78	Erosion Control	5 days	Mon 5/3/21	Fri 5/7/21	77
79	Clearing and Grubbing	5 days	Mon 5/10/21	Fri 5/14/21	78
80	**Measure 27 - Modify Trapezoidal Channel to Vertical Sides**	**120 days**	**Mon 5/17/21**	**Fri 10/29/21**	
81	Concrete Demolition	40 days	Mon 5/17/21	Fri 7/9/21	79
82	Grouted Riprap Demolition	10 days	Mon 6/28/21	Fri 7/9/21	81FF
83	Riprap Demolition	2 days	Mon 7/12/21	Tue 7/13/21	82
84	Sheet Pile Wall Demoition	12 days	Mon 6/28/21	Tue 7/13/21	83FF
85	Asphalt Demolition	8 days	Mon 7/12/21	Wed 7/21/21	81
86	Excavation, Embankments	20 days	Mon 7/12/21	Fri 8/6/21	81
87	Riprap Placement	35 days	Mon 7/26/21	Fri 9/10/21	86SS+10 days
88	Reinforced Concrete Planters	50 days	Mon 7/26/21	Fri 10/1/21	87SS
89	Chain Link Fence Installation	10 days	Mon 9/13/21	Fri 9/24/21	87
90	Aggregate Base and Asphalt Installation	10 days	Mon 9/27/21	Fri 10/8/21	89
91	Topsoil	20 days	Mon 10/4/21	Fri 10/29/21	88
92	**In-Channel Work Period II**	**140 days**	**Mon 4/18/2**	**Fri 10/28/22**	
93	Temporary Cofferdam Installation	10 days	Mon 4/18/22	Fri 4/29/22	91FS+120 days
94	Erosion Control	5 days	Mon 5/2/22	Fri 5/6/22	93
95	Clearing and Grubbing	5 days	Mon 5/9/22	Fri 5/13/22	94
96	**Measure 27 - Modify Trapezoidal Channel to Vertical Sides**	**120 days**	**Mon 5/16/22**	**Fri 10/28/22**	
97	Concrete Demolition	40 days	Mon 5/16/22	Fri 7/8/22	95
98	Grouted Riprap Demolition	10 days	Mon 6/27/22	Fri 7/8/22	97FF
99	Riprap Demolition	2 days	Mon 7/11/22	Tue 7/12/22	98
100	Sheet Pile Wall Demoition	12 days	Mon 6/27/22	Tue 7/12/22	99FF
101	Asphalt Demolition	8 days	Mon 7/11/22	Wed 7/20/22	97



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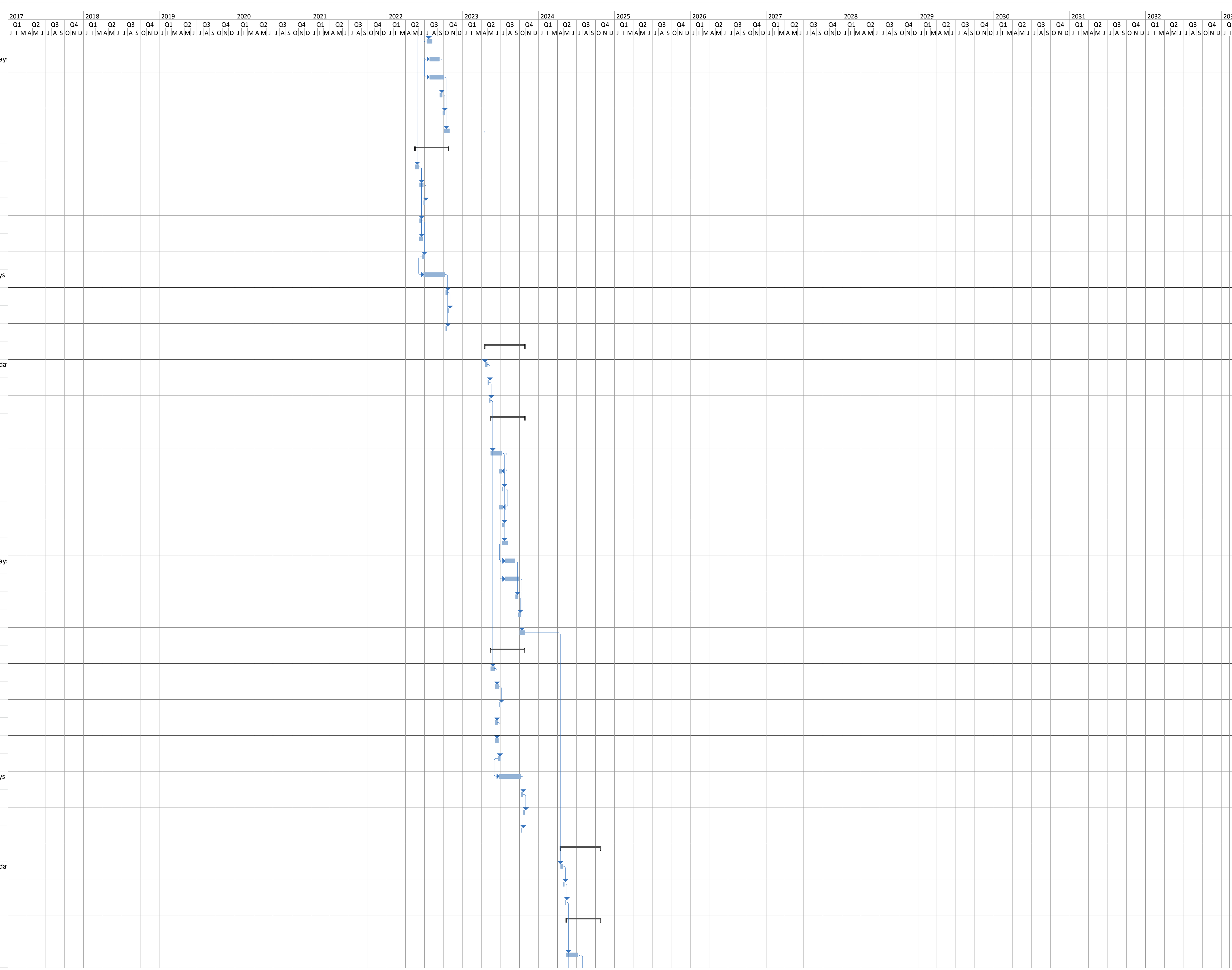
ID	Task Name	Duration	Start	Finish	Predecessors
102	Excavation, Embankments	20 days	Mon 7/11/22	Fri 8/5/22	97
103	Riprap Placement	35 days	Mon 7/25/22	Fri 9/9/22	102SS+10 days
104	Reinforced Concrete Planters	50 days	Mon 7/25/22	Fri 9/30/22	103SS
105	Chain Link Fence Installation	10 days	Mon 9/12/22	Fri 9/23/22	103
106	Aggregate Base and Asphalt Installation	10 days	Mon 9/26/22	Fri 10/7/22	105
107	Topsoil	20 days	Mon 10/3/22	Fri 10/28/22	104
108	**Measure 26 - Terrace Banks**	**117 days**	**Mon 5/16/22**	**Tue 10/25/2**	
109	Concrete Demolition	15 days	Mon 5/16/22	Fri 6/3/22	95
110	Grouted Riprap Demolition	15 days	Mon 6/6/22	Fri 6/24/22	109
111	Riprap Demolition	4 days	Mon 6/27/22	Thu 6/30/22	110
112	Sheet Pile Wall Demoition	10 days	Mon 6/6/22	Fri 6/17/22	109
113	Asphalt Demolition	12 days	Mon 6/6/22	Tue 6/21/22	109
114	Excavation, Embankments	10 days	Mon 6/20/22	Fri 7/1/22	112
115	Reinforced Concrete Planters	75 days	Mon 6/27/22	Fri 10/7/22	114SS+5 days
116	Chain Link Fence Installation	8 days	Mon 10/10/2	Wed 10/19/2	115
117	Aggregate Base and Asphalt Installation	4 days	Thu 10/20/2	Tue 10/25/2	116
118	Topsoil	4 days	Mon 10/10/2	Thu 10/13/2	115
119	**In-Channel Work Period III**	**140 days**	**Mon 4/17/23**	**Fri 10/27/23**	
120	Temporary Cofferdam Installation	10 days	Mon 4/17/23	Fri 4/28/23	107FS+120 day
121	Erosion Control	5 days	Mon 5/1/23	Fri 5/5/23	120
122	Clearing and Grubbing	5 days	Mon 5/8/23	Fri 5/12/23	121
123	**Measure 27 - Modify Trapezoidal Channel to Vertical Sides**	**120 days**	**Mon 5/15/23**	**Fri 10/27/23**	
124	Concrete Demolition	40 days	Mon 5/15/23	Fri 7/7/23	122
125	Grouted Riprap Demolition	10 days	Mon 6/26/23	Fri 7/7/23	124FF
126	Riprap Demolition	2 days	Mon 7/10/23	Tue 7/11/23	125
127	Sheet Pile Wall Demoition	12 days	Mon 6/26/23	Tue 7/11/23	126FF
128	Asphalt Demolition	8 days	Mon 7/10/23	Wed 7/19/23	124
129	Excavation, Embankments	20 days	Mon 7/10/23	Fri 8/4/23	124
130	Riprap Placement	35 days	Mon 7/24/23	Fri 9/8/23	129SS+10 days
131	Reinforced Concrete Planters	50 days	Mon 7/24/23	Fri 9/29/23	130SS
132	Chain Link Fence Installation	10 days	Mon 9/11/23	Fri 9/22/23	130
133	Aggregate Base and Asphalt Installation	10 days	Mon 9/25/23	Fri 10/6/23	132
134	Topsoil	20 days	Mon 10/2/23	Fri 10/27/23	131
135	**Measure 26 - Terrace Banks**	**117 days**	**Mon 5/15/2**	**Tue 10/24/2**	
136	Concrete Demolition	15 days	Mon 5/15/23	Fri 6/2/23	122
137	Grouted Riprap Demolition	15 days	Mon 6/5/23	Fri 6/23/23	136
138	Riprap Demolition	4 days	Mon 6/26/23	Thu 6/29/23	137
139	Sheet Pile Wall Demoition	10 days	Mon 6/5/23	Fri 6/16/23	136
140	Asphalt Demolition	12 days	Mon 6/5/23	Tue 6/20/23	136
141	Excavation, Embankments	10 days	Mon 6/19/23	Fri 6/30/23	139
142	Reinforced Concrete Planters	75 days	Mon 6/26/23	Fri 10/6/23	141SS+5 days
143	Chain Link Fence Installation	8 days	Mon 10/9/23	Wed 10/18/2	142
144	Aggregate Base and Asphalt Installation	4 days	Thu 10/19/2	Tue 10/24/2	143
145	Topsoil	4 days	Mon 10/9/23	Thu 10/12/2	142
146	**In-Channel Work Period IV**	**140 days**	**Mon 4/15/24**	**Fri 10/25/24**	
147	Temporary Cofferdam Installation	10 days	Mon 4/15/24	Fri 4/26/24	134FS+120 day
148	Erosion Control	5 days	Mon 4/29/24	Fri 5/3/24	147
149	Clearing and Grubbing	5 days	Mon 5/6/24	Fri 5/10/24	148
150	**Measure 27 - Modify Trapezoidal Channel to Vertical Sides**	**120 days**	**Mon 5/13/24**	**Fri 10/25/24**	
151	Concrete Demolition	40 days	Mon 5/13/24	Fri 7/5/24	149



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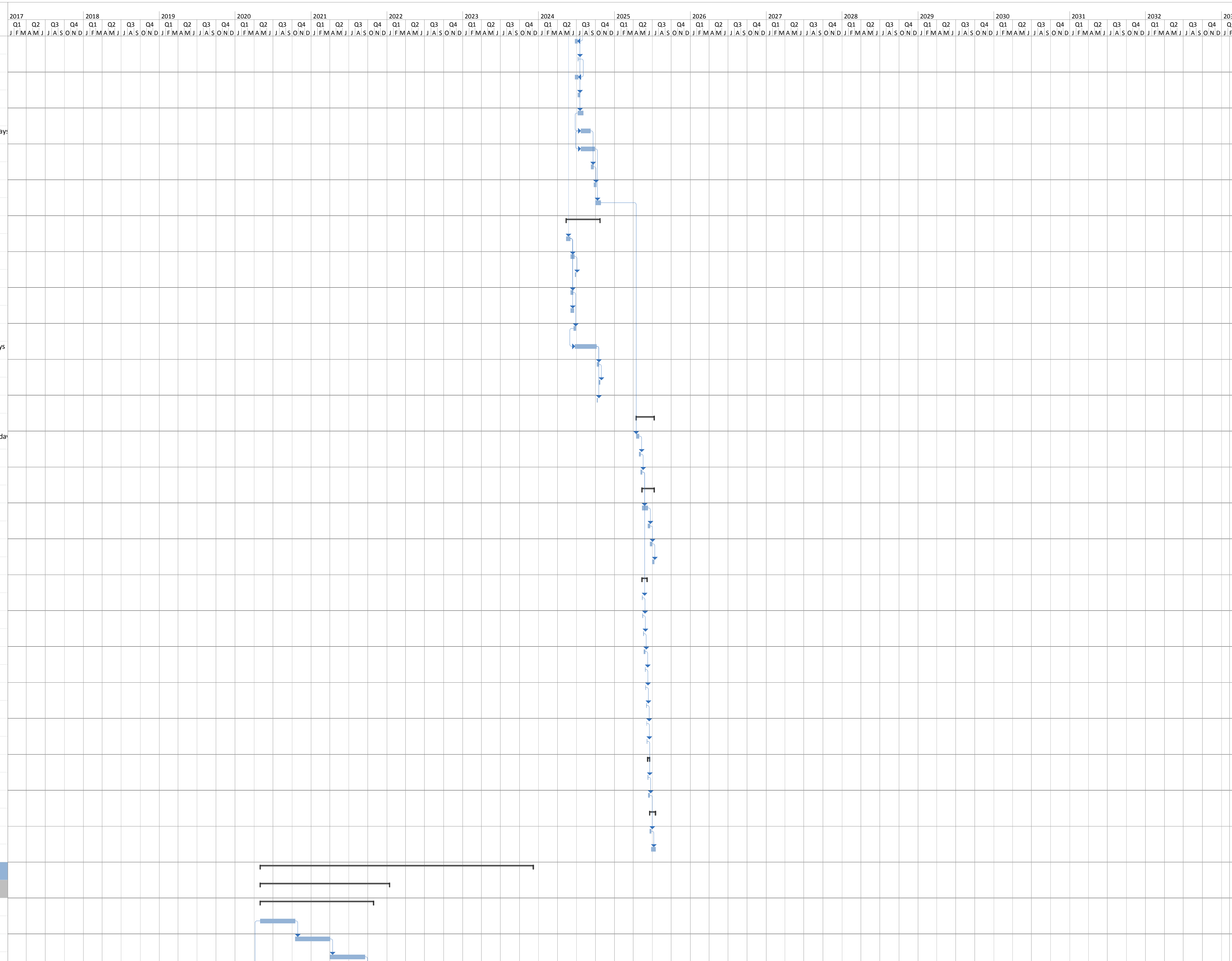
Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Deadline | Progress | Manual Progress

ID	Task Name	Duration	Start	Finish	Predecessors
152	Grouted Riprap Demolition	10 days	Mon 6/24/24	Fri 7/5/24	151FF
153	Riprap Demolition	2 days	Mon 7/8/24	Tue 7/9/24	152
154	Sheet Pile Wall Demoition	12 days	Mon 6/24/24	Tue 7/9/24	153FF
155	Asphalt Demolition	8 days	Mon 7/8/24	Wed 7/17/24	151
156	Excavation, Embankments	20 days	Mon 7/8/24	Fri 8/2/24	151
157	Riprap Placement	35 days	Mon 7/22/24	Fri 9/6/24	156SS+10 days
158	Reinforced Concrete Planters	50 days	Mon 7/22/24	Fri 9/27/24	157SS
159	Chain Link Fence Installation	10 days	Mon 9/9/24	Fri 9/20/24	157
160	Aggregate Base and Asphalt Installation	10 days	Mon 9/23/24	Fri 10/4/24	159
161	Topsoil	20 days	Mon 9/30/24	Fri 10/25/24	158
162	**Measure 26 - Terrace Banks**	**117 days**	**Mon 5/13/2**	**Tue 10/22/2**	
163	Concrete Demolition	15 days	Mon 5/13/24	Fri 5/31/24	149
164	Grouted Riprap Demolition	15 days	Mon 6/3/24	Fri 6/21/24	163
165	Riprap Demolition	4 days	Mon 6/24/24	Thu 6/27/24	164
166	Sheet Pile Wall Demoition	10 days	Mon 6/3/24	Fri 6/14/24	163
167	Asphalt Demolition	12 days	Mon 6/3/24	Tue 6/18/24	163
168	Excavation, Embankments	10 days	Mon 6/17/24	Fri 6/28/24	166
169	Reinforced Concrete Planters	75 days	Mon 6/24/24	Fri 10/4/24	168SS+5 days
170	Chain Link Fence Installation	8 days	Mon 10/7/24	Wed 10/16/2	169
171	Aggregate Base and Asphalt Installation	4 days	Thu 10/17/2	Tue 10/22/2	170
172	Topsoil	4 days	Mon 10/7/24	Thu 10/10/2	169
173	**In-Channel Work Period V**	**63 days**	**Tue 4/15/25**	**Thu 7/10/25**	
174	Temporary Cofferdam Installation	10 days	Tue 4/15/25	Mon 4/28/25	161FS+121 da
175	Erosion Control	5 days	Tue 4/29/25	Mon 5/5/25	174
176	Clearing and Grubbing	5 days	Tue 5/6/25	Mon 5/12/25	175
177	**Measure 16 - Bioengineer Channel Walls**	**43 days**	**Tue 5/13/25**	**Thu 7/10/25**	
178	Planting, Shrubs	20 days	Tue 5/13/25	Mon 6/9/25	176
179	Planting, Trees	8 days	Tue 6/10/25	Thu 6/19/25	178
180	Fertilize and Seed	7 days	Fri 6/20/25	Mon 6/30/25	179
181	Temporary Irrigation	8 days	Tue 7/1/25	Thu 7/10/25	180
182	**Measure 2 - Expose Storm Drain Outlets**	**19 days**	**Tue 5/13/25**	**Fri 6/6/25**	
183	Clearing and Grubbing	2 days	Tue 5/13/25	Wed 5/14/25	176
184	Excavation, Structural	2 days	Thu 5/15/25	Fri 5/16/25	183
185	Demo Existing Stormdrain	2 days	Mon 5/19/25	Tue 5/20/25	184
186	Install New Storm Drain, Piping, and Splitter Box	5 days	Wed 5/21/25	Tue 5/27/25	185
187	Backfill	1 day	Wed 5/28/25	Wed 5/28/25	186
188	Planting, Shrubs	2 days	Thu 5/29/25	Fri 5/30/25	187
189	Planting, Trees	2 days	Mon 6/2/25	Tue 6/3/25	188
190	Fertilize and Seed	1 day	Wed 6/4/25	Wed 6/4/25	189
191	Temporary Irrigation	2 days	Thu 6/5/25	Fri 6/6/25	190
192	**Recreation**	**8 days**	**Mon 6/9/25**	**Wed 6/18/2**	
193	Trail Access Points	2 days	Mon 6/9/25	Tue 6/10/25	191
194	Wildlife Viewpoint	6 days	Wed 6/11/25	Wed 6/18/25	193
195	**Demobilization and Restoration**	**20 days**	**Thu 6/19/25**	**Wed 7/16/2**	
196	Site Clean Up and Removals	5 days	Thu 6/19/25	Wed 6/25/25	194
197	Demobilization	15 days	Thu 6/26/25	Wed 7/16/25	196
198	**CONTRACT 3 (REACH 4)**	**939 days**	**Fri 5/1/20**	**Wed 12/6/2**	
199	**PRE-CONSTRUCTION AWARD**	**445 days**	**Fri 5/1/20**	**Thu 1/13/22**	
200	**Plans & Specifications**	**390 days**	**Fri 5/1/20**	**Thu 10/28/2**	
201	30% Design	120 days	Fri 5/1/20	Thu 10/15/2	
202	60% Design	120 days	Fri 10/16/20	Thu 4/1/21	201
203	90% Design	120 days	Fri 4/2/21	Thu 9/16/21	202



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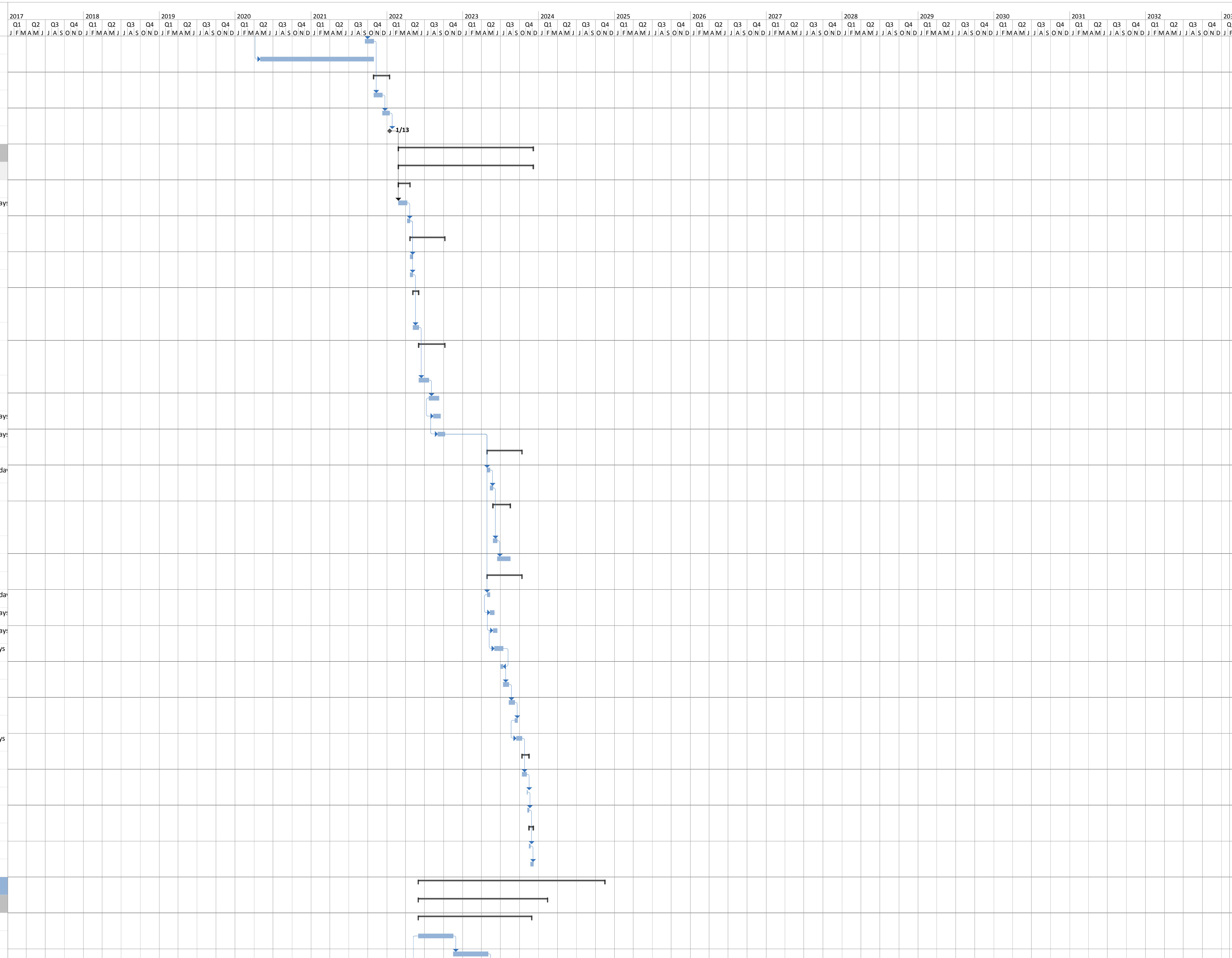
Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Deadline | Progress | Manual Progress

ID	Task Name	Duration	Start	Finish	Predecessors
204	BCOE	30 days	Fri 9/17/21	Thu 10/28/21	203
205	LERRDs Procurement	390 days	Fri 5/1/20	Thu 10/28/21	201SS
206	**Procurement & Award**	**55 days**	**Fri 10/29/21**	**Thu 1/13/22**	
207	Advertise	30 days	Fri 10/29/21	Thu 12/9/21	204
208	Award	25 days	Fri 12/10/21	Thu 1/13/22	207
209	NTP	0 days	Thu 1/13/22	Thu 1/13/22	208
210	**CONSTRUCTION**	**464 days**	**Fri 2/25/22**	**Wed 12/6/23**	
211	**Reach 4 - Brazil St. to Los Feliz Blvd**	**464 days**	**Fri 2/25/22**	**Wed 12/6/23**	
212	**Mobilization and Preparatory Work**	**40 days**	**Fri 2/25/22**	**Thu 4/21/22**	
213	Mobilization	30 days	Fri 2/25/22	Thu 4/7/22	209FS+30 days
214	Site Access and Staging	10 days	Fri 4/8/22	Thu 4/21/22	213
215	**In-Channel Work Period I**	**120 days**	**Fri 4/22/22**	**Thu 10/6/22**	
216	Temporary Cofferdam Installation	10 days	Fri 4/22/22	Thu 5/5/22	214
217	Erosion Control	10 days	Fri 4/22/22	Thu 5/5/22	214
218	**Measure 4 - Grade Adjacent Areas to Lower Elevation (G)**	**20 days**	**Fri 5/6/22**	**Thu 6/2/22**	
219	Excavation, Embankment	20 days	Fri 5/6/22	Thu 6/2/22	217
220	**Measure 3/5 - Create Geomorphology and Plant for Freshwater Marsh**	**90 days**	**Fri 6/3/22**	**Thu 10/6/22**	
221	Excavation, Grade Control	35 days	Fri 6/3/22	Thu 7/21/22	219
222	Grouted Riprap, Stone Placement	35 days	Fri 7/22/22	Thu 9/8/22	221
223	Grouted Riprap, Grout Placement	25 days	Fri 8/12/22	Thu 9/15/22	222SS+15 days
224	Compacted Fill	25 days	Fri 9/2/22	Thu 10/6/22	223SS+15 days
225	**In-Channel Work Period II**	**120 days**	**Fri 4/28/23**	**Thu 10/12/23**	
226	Temporary Cofferdam Installation	10 days	Fri 4/28/23	Thu 5/11/23	224FS+145 days
227	Erosion Control	10 days	Fri 5/12/23	Thu 5/25/23	226
228	**Measure 10 - Divert Tributary & River Flow Into Side Channels (F)**	**60 days**	**Fri 5/26/23**	**Thu 8/17/23**	
229	Excavation, Embankment	15 days	Fri 5/26/23	Thu 6/15/23	227
230	Riprap Placement	45 days	Fri 6/16/23	Thu 8/17/23	229
231	**Measure 2 - Expose Storm Drain Outlets**	**120 days**	**Fri 4/28/23**	**Thu 10/12/23**	
232	Clearing and Grubbing	10 days	Fri 4/28/23	Thu 5/11/23	224FS+145 days
233	Excavation, Structural	15 days	Fri 5/12/23	Thu 6/1/23	232SS+10 days
234	Demo Existing Stormdrain	15 days	Fri 5/26/23	Thu 6/15/23	233SS+10 days
235	Install New Storm Drain, Piping, and Splitter Box	30 days	Fri 6/2/23	Thu 7/13/23	234SS+5 days
236	Backfill	10 days	Fri 6/30/23	Thu 7/13/23	235FF
237	Planting, Shrubs	20 days	Fri 7/14/23	Thu 8/10/23	236
238	Planting, Trees	20 days	Fri 8/11/23	Thu 9/7/23	237
239	Fertilize and Seed	10 days	Fri 9/8/23	Thu 9/21/23	238
240	Temporary Irrigation	20 days	Fri 9/15/23	Thu 10/12/23	239SS+5 days
241	**Recreation**	**24 days**	**Fri 10/13/23**	**Wed 11/15/23**	
242	Existing Access Road Converstion to Multi-Use Trail	16 days	Fri 10/13/23	Fri 11/3/23	240
243	Trail Access Points	2 days	Mon 11/6/23	Tue 11/7/23	242
244	Wildlife Viewpoint	6 days	Wed 11/8/23	Wed 11/15/23	243
245	**Demobilization and Restoration**	**15 days**	**Thu 11/16/23**	**Wed 12/6/23**	
246	Site Clean Up and Removals	5 days	Thu 11/16/23	Wed 11/22/23	244
247	Demobilization	10 days	Thu 11/23/23	Wed 12/6/23	246
248	**CONTRACT 4 (REACH 7)**	**643 days**	**Wed 6/1/22**	**Fri 11/15/24**	
249	**PRE-CONSTRUCTION AWARD**	**445 days**	**Wed 6/1/22**	**Tue 2/13/24**	
250	**Plans & Specifications**	**390 days**	**Wed 6/1/22**	**Tue 11/28/23**	
251	30% Design	120 days	Wed 6/1/22	Tue 11/15/22	
252	60% Design	120 days	Wed 11/16/22	Tue 5/2/23	251



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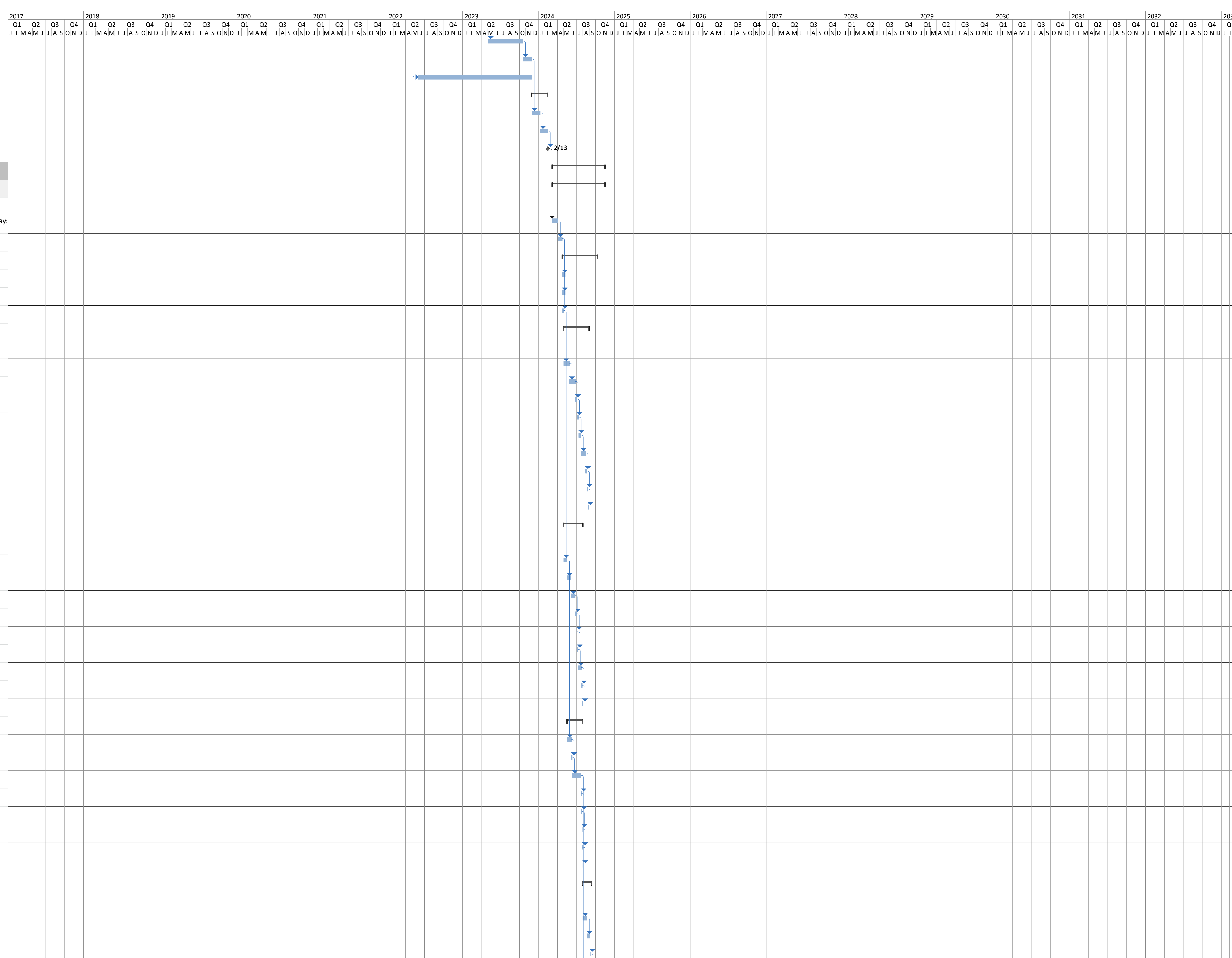
ID	Task Name	Duration	Start	Finish	Predecessors
253	90% Design	120 days	Wed 5/3/23	Tue 10/17/23	252
254	BCOE	30 days	Wed 10/18/2	Tue 11/28/23	253
255	LERRDs Procurement and Utility Relocations	390 days	Wed 6/1/22	Tue 11/28/23	251SS
256	**Procurement & Award**	**55 days**	**Wed 11/29/2**	**Tue 2/13/24**	
257	Advertise	30 days	Wed 11/29/2	Tue 1/9/24	254
258	Award	25 days	Wed 1/10/24	Tue 2/13/24	257
259	NTP	0 days	Tue 2/13/24	Tue 2/13/24	258
260	**CONSTRUCTION**	**183 days**	**Wed 3/6/24**	**Fri 11/15/24**	
261	**Reach 7 - I-5 to Main St.**	**183 days**	**Wed 3/6/24**	**Fri 11/15/24**	
262	**Mobilization and Preparatory Work**	**35 days**	**Wed 3/6/24**	**Tue 4/23/24**	
263	Mobilization	20 days	Wed 3/6/24	Tue 4/2/24	259FS+15 days
264	Site Access and Staging	15 days	Wed 4/3/24	Tue 4/23/24	263
265	**In-Channel Work Period I**	**121 days**	**Wed 4/24/24**	**Wed 10/9/24**	
266	Temporary Cofferdam Installation	10 days	Wed 4/24/24	Tue 5/7/24	264
267	Erosion Control	10 days	Wed 4/24/24	Tue 5/7/24	264
268	Clearing and Grubbing	5 days	Wed 4/24/24	Tue 4/30/24	264
269	**Measure 8 - Creation of Wetlands Flood Control Basin (Corn Field)**	**87 days**	**Wed 5/1/24**	**Thu 8/29/24**	
270	Excavation, Embankment	20 days	Wed 5/1/24	Tue 5/28/24	268
271	Impermeable Layer	20 days	Wed 5/29/24	Tue 6/25/24	270
272	Chain Link Fence Installation	5 days	Wed 6/26/24	Tue 7/2/24	271
273	Aggregate Base and Asphalt Installation	7 days	Wed 7/3/24	Thu 7/11/24	272
274	Top Soil Placement	7 days	Fri 7/12/24	Mon 7/22/24	273
275	Planting, Shrubs	15 days	Tue 7/23/24	Mon 8/12/24	274
276	Planting, Trees	5 days	Tue 8/13/24	Mon 8/19/24	275
277	Fertilize and Seed	4 days	Tue 8/20/24	Fri 8/23/24	276
278	Temporary Irrigation	4 days	Mon 8/26/24	Thu 8/29/24	277
279	**Measure 27 - Tributary Channels/Widen Channel (Arroyo Seco)**	**67 days**	**Wed 5/1/24**	**Thu 8/1/24**	
280	Concrete Demolition	12 days	Wed 5/1/24	Thu 5/16/24	268
281	Excavation, Embankment	12 days	Fri 5/17/24	Mon 6/3/24	280
282	Turf Reinforcement Mat Installation	15 days	Tue 6/4/24	Mon 6/24/24	281
283	Chain Link Fence Installation	5 days	Tue 6/25/24	Mon 7/1/24	282
284	Aggregate Base and Asphalt Installation	3 days	Tue 7/2/24	Thu 7/4/24	283
285	Top Soil Placement	2 days	Fri 7/5/24	Mon 7/8/24	284
286	Planting, Trees	12 days	Tue 7/9/24	Wed 7/24/24	285
287	Fertilize and Seed	3 days	Thu 7/25/24	Mon 7/29/24	286
288	Temporary Irrigation	3 days	Tue 7/30/24	Thu 8/1/24	287
289	**Measure 26 - Terrace Banks**	**54 days**	**Fri 5/17/24**	**Wed 7/31/24**	
290	Concrete Demolition	15 days	Fri 5/17/24	Thu 6/6/24	280
291	Excavation, Embankment	2 days	Fri 6/7/24	Mon 6/10/24	290
292	Reinforced Concrete Planters	30 days	Tue 6/11/24	Mon 7/22/24	291
293	Top Soil Placement	2 days	Tue 7/23/24	Wed 7/24/24	292
294	Planting, Shrubs	2 days	Thu 7/25/24	Fri 7/26/24	293
295	Planting, Trees	1 day	Mon 7/29/24	Mon 7/29/24	294
296	Fertilize and Seed	1 day	Tue 7/30/24	Tue 7/30/24	295
297	Temporary Irrigation	1 day	Wed 7/31/24	Wed 7/31/24	296
298	**Measure 17 - Habitat Corridors/Riparian Planting on Banks**	**31 days**	**Wed 7/31/24**	**Wed 9/11/24**	
299	Planting, Shrubs	15 days	Wed 7/31/24	Tue 8/20/24	296
300	Planting, Trees	9 days	Wed 8/21/24	Mon 9/2/24	299
301	Fertilize and Seed	3 days	Tue 9/3/24	Thu 9/5/24	300



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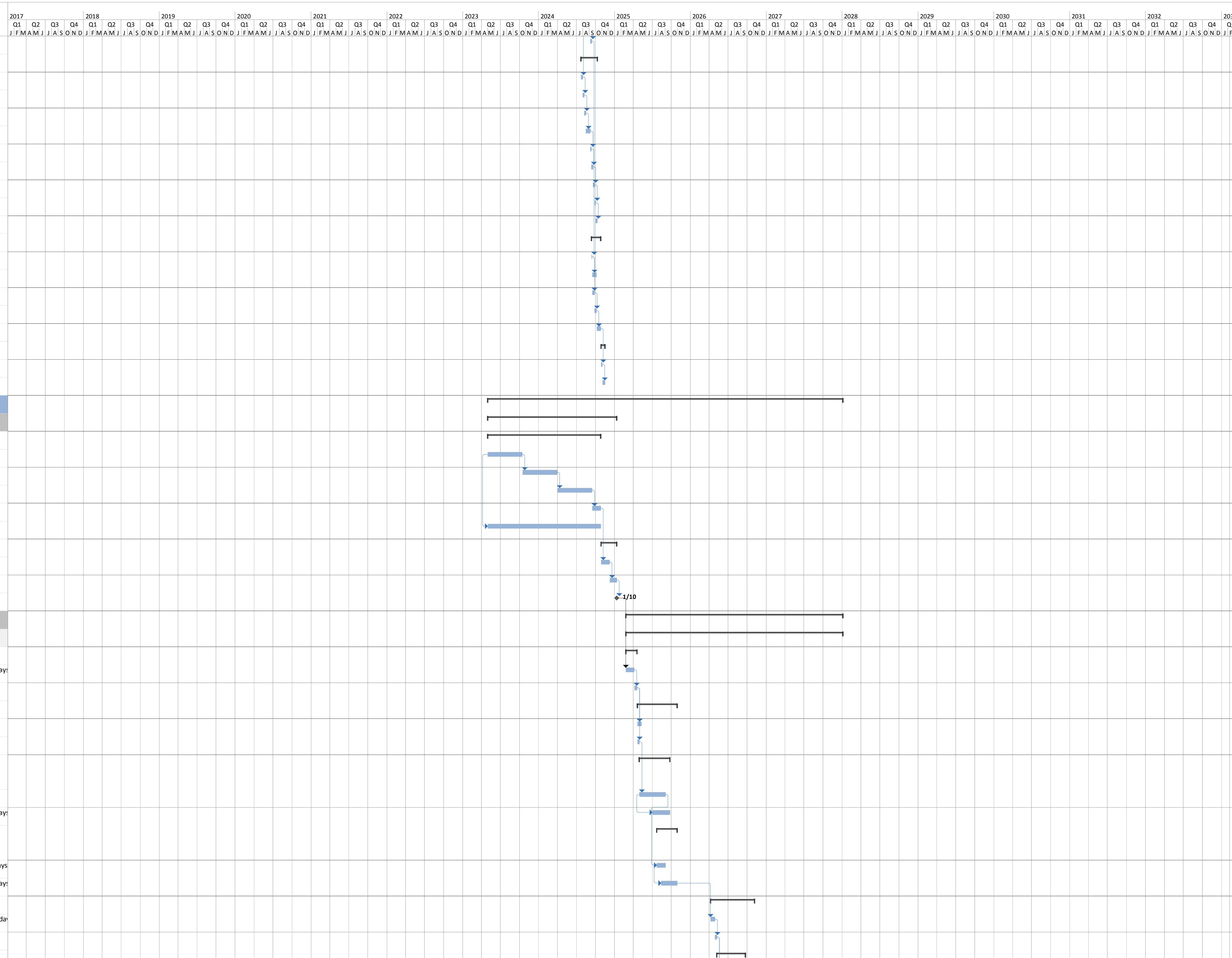
- Inactive Milestone
- Inactive Summary
- Duration-only
- Manual Summary Rollup
- Manual Summary
- Start-only
- Finish-only
- Deadline
- Progress
- Manual Progress

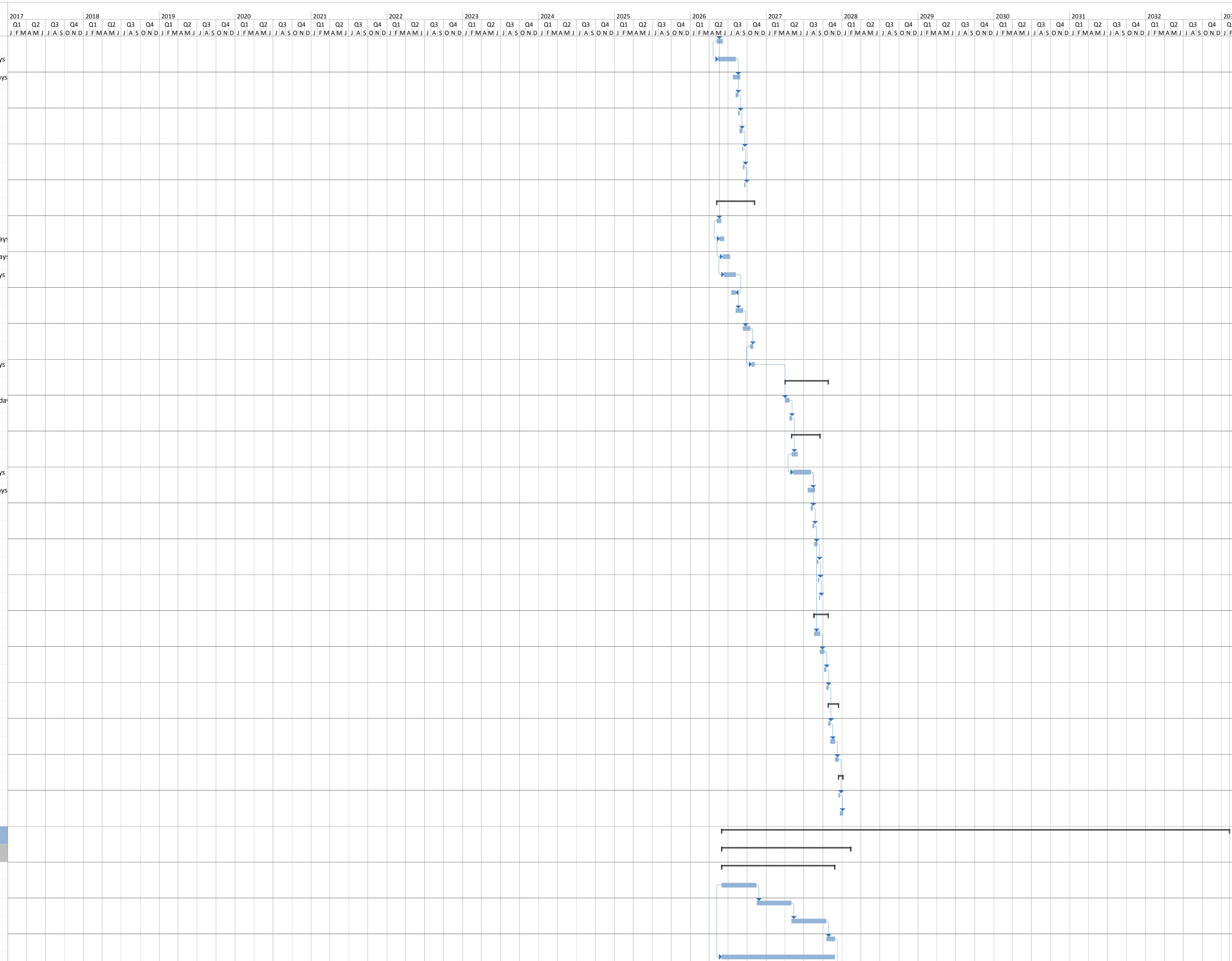
ID	Task Name	Duration	Start	Finish	Predecessors
302	Temporary Irrigation	4 days	Fri 9/6/24	Wed 9/11/24	301
303	**Measure 2 - Expose Storm Drain Outlets**	**57 days**	**Tue 7/23/24**	**Wed 10/9/2**	
304	Clearing and Grubbing	6 days	Tue 7/23/24	Tue 7/30/24	292
305	Excavation, Structural	6 days	Wed 7/31/24	Wed 8/7/24	304
306	Demo Existing Stormdrain	6 days	Thu 8/8/24	Thu 8/15/24	305
307	Install New Storm Drain, Piping, and Splitter Box	15 days	Fri 8/16/24	Thu 9/5/24	306
308	Backfill	3 days	Fri 9/6/24	Tue 9/10/24	307
309	Planting, Shrubs	6 days	Wed 9/11/24	Wed 9/18/24	308
310	Planting, Trees	6 days	Thu 9/19/24	Thu 9/26/24	309
311	Fertilize and Seed	3 days	Fri 9/27/24	Tue 10/1/24	310
312	Temporary Irrigation	6 days	Wed 10/2/24	Wed 10/9/24	311
313	**Recreation**	**32 days**	**Thu 9/12/24**	**Fri 10/25/24**	
314	Trail Improvements	2 days	Thu 9/12/24	Fri 9/13/24	302
315	New Unpaved Trail	15 days	Mon 9/16/24	Fri 10/4/24	314
316	Restrooms	8 days	Mon 9/16/24	Wed 9/25/24	314
317	Parking Lot	7 days	Thu 9/26/24	Fri 10/4/24	316
318	Pedestrian Bridge	15 days	Mon 10/7/24	Fri 10/25/24	317
319	**Demobilization and Restoration**	**15 days**	**Mon 10/28/2**	**Fri 11/15/24**	
320	Site Clean Up and Removals	5 days	Mon 10/28/2	Fri 11/1/24	318
321	Demobilization	10 days	Mon 11/4/24	Fri 11/15/24	320
322	**CONTRACT 5 (REACH 3)**	**1222 days**	**Mon 5/1/23**	**Tue 1/4/28**	
323	**PRE-CONSTRUCTION AWARD**	**445 days**	**Mon 5/1/23**	**Fri 1/10/25**	
324	**Plans & Specifications**	**390 days**	**Mon 5/1/23**	**Fri 10/25/24**	
325	30% Design	120 days	Mon 5/1/23	Fri 10/13/23	
326	60% Design	120 days	Mon 10/16/2	Fri 3/29/24	325
327	90% Design	120 days	Mon 4/1/24	Fri 9/13/24	326
328	BCOE	30 days	Mon 9/16/24	Fri 10/25/24	327
329	LERRDs Procurement	390 days	Mon 5/1/23	Fri 10/25/24	325SS
330	**Procurement & Award**	**55 days**	**Mon 10/28/2**	**Fri 1/10/25**	
331	Advertise	30 days	Mon 10/28/2	Fri 12/6/24	328
332	Award	25 days	Mon 12/9/24	Fri 1/10/25	331
333	NTP	0 days	Fri 1/10/25	Fri 1/10/25	332
334	**CONSTRUCTION**	**747 days**	**Mon 2/24/2**	**Tue 1/4/28**	
335	**Reach 3 - Ferraro Fields to Brazil St.**	**747 days**	**Mon 2/24/2**	**Tue 1/4/28**	
336	**Mobilization and Preparatory Work**	**40 days**	**Mon 2/24/2**	**Fri 4/18/25**	
337	Mobilization	30 days	Mon 2/24/25	Fri 4/4/25	333FS+30 days
338	Site Access and Staging	10 days	Mon 4/7/25	Fri 4/18/25	337
339	**In-Channel Work Period I**	**137 days**	**Mon 4/21/2**	**Tue 10/28/2**	
340	Temporary Cofferdam Installation	15 days	Mon 4/21/25	Fri 5/9/25	338
341	Erosion Control	7 days	Mon 4/21/25	Tue 4/29/25	338
342	**Measure 3/5 - Create Geomorphology and Plant for Freshwater Marsh**	**105 days**	**Wed 4/30/25**	**Tue 9/23/25**	
343	Riprap Placement	90 days	Wed 4/30/25	Tue 9/2/25	341
344	Compacted Fill	60 days	Wed 7/2/25	Tue 9/23/25	343SS+45 days
345	**Measure 10 - Divert Tributary & River Flow Into Side Channels (E)**	**70 days**	**Wed 7/23/25**	**Tue 10/28/25**	
346	Excavation, Embankment	30 days	Wed 7/23/25	Tue 9/2/25	343FS-30 days
347	Riprap Placement	55 days	Wed 8/13/25	Tue 10/28/2	346SS+15 days
348	**In-Channel Work Period II**	**152 days**	**Wed 4/8/26**	**Thu 11/5/26**	
349	Temporary Cofferdam Installation	15 days	Wed 4/8/26	Tue 4/28/26	347FS+115 da
350	Erosion Control	7 days	Wed 4/29/26	Thu 5/7/26	349
351	**Measure 25 - Tributary Channels - Verdugo Wash**	**98 days**	**Fri 5/8/26**	**Tue 9/22/26**	



Project: LA River_Project Schedule
Date: Thu 3/5/15

Task	Milestone	Project Summary	External Milestone	Inactive Milestone	Duration-only	Manual Summary	Finish-only	Progress					
Split	Summary	External Tasks	Inactive Task	Inactive Summary	Manual Summary Rollup	Start-only	Deadline	Manual Progress					

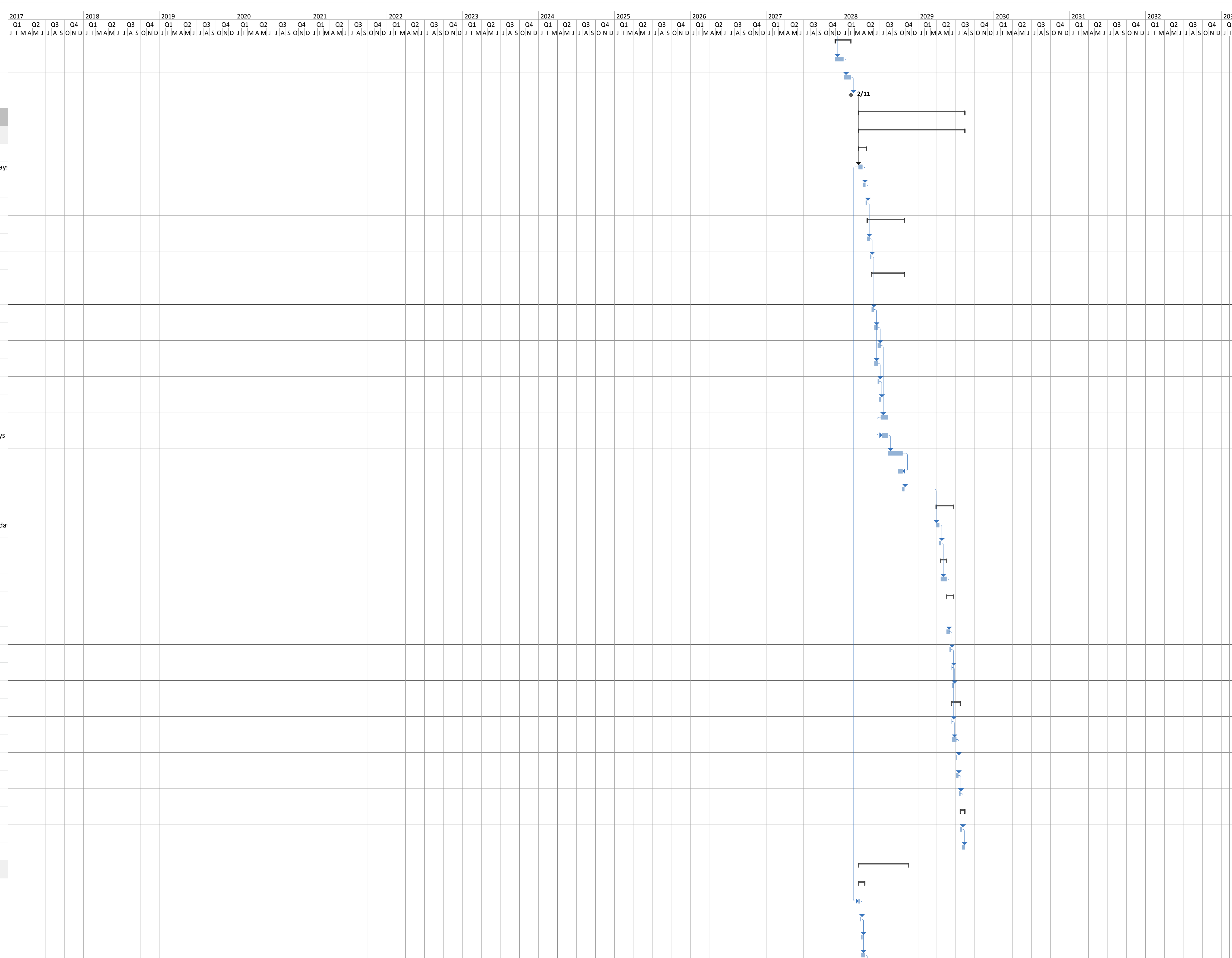
ID	Task Name	Duration	Start	Finish	Predecessors
352	Concrete Demolition	20 days	Fri 5/8/26	Thu 6/4/26	350
353	Excavation, Structural	60 days	Fri 5/15/26	Thu 8/6/26	352SS+5 days
354	Turf Reinforcement Mat	25 days	Fri 7/24/26	Thu 8/27/26	353FS-10 days
355	Chain Link Fence Installation	7 days	Fri 8/7/26	Mon 8/17/26	353
356	Aggregate Base and Asphalt Installation	5 days	Tue 8/18/26	Mon 8/24/26	355
357	Planting, Shrubs	10 days	Tue 8/25/26	Mon 9/7/26	356
358	Planting, Trees	3 days	Tue 9/8/26	Thu 9/10/26	357
359	Fertilize and Seed	4 days	Fri 9/11/26	Wed 9/16/26	358
360	Temporary Irrigation	4 days	Thu 9/17/26	Tue 9/22/26	359
361	**Measure 2 - Expose Storm Drain Outlets**	**130 days**	**Fri 5/8/26**	**Thu 11/5/26**	
362	Clearing and Grubbing	15 days	Fri 5/8/26	Thu 5/28/26	350
363	Excavation, Structural	15 days	Fri 5/22/26	Thu 6/11/26	362SS+10 days
364	Demo Existing Stormdrain	25 days	Fri 6/5/26	Thu 7/9/26	363SS+10 days
365	Install New Storm Drain, Piping, and Splitter Box	40 days	Fri 6/12/26	Thu 8/6/26	364SS+5 days
366	Backfill	15 days	Fri 7/17/26	Thu 8/6/26	365FF
367	Planting, Shrubs	25 days	Fri 8/7/26	Thu 9/10/26	366
368	Planting, Trees	25 days	Fri 9/11/26	Thu 10/15/26	367
369	Fertilize and Seed	10 days	Fri 10/16/26	Thu 10/29/26	368
370	Temporary Irrigation	10 days	Fri 10/23/26	Thu 11/5/26	369SS+5 days
371	**In-Channel Work Period III**	**148 days**	**Fri 4/2/27**	**Tue 10/26/2**	
372	Temporary Cofferdam Installation	15 days	Fri 4/2/27	Thu 4/22/27	370FS+105 da
373	Erosion Control	7 days	Fri 4/23/27	Mon 5/3/27	372
374	**Measure 25 - Tributary Channels - Verdugo Wash**	**98 days**	**Tue 5/4/27**	**Thu 9/16/27**	
375	Concrete Demolition	20 days	Tue 5/4/27	Mon 5/31/27	373
376	Excavation, Structural	60 days	Tue 5/11/27	Mon 8/2/27	375SS+5 days
377	Turf Reinforcement Mat	25 days	Tue 7/20/27	Mon 8/23/27	376FS-10 days
378	Chain Link Fence Installation	7 days	Tue 8/3/27	Wed 8/11/27	376
379	Aggregate Base and Asphalt Installation	5 days	Thu 8/12/27	Wed 8/18/27	378
380	Planting, Shrubs	10 days	Thu 8/19/27	Wed 9/1/27	379
381	Planting, Trees	3 days	Thu 9/2/27	Mon 9/6/27	380
382	Fertilize and Seed	4 days	Tue 9/7/27	Fri 9/10/27	381
383	Temporary Irrigation	4 days	Mon 9/13/27	Thu 9/16/27	382
384	**Measure 17 - Habitat Corridors/Riparain Planting (**	**49 days**	**Thu 8/19/27**	**Tue 10/26/2**	
385	Planting, Shrubs	20 days	Thu 8/19/27	Wed 9/15/27	379
386	Planting, Trees	15 days	Thu 9/16/27	Wed 10/6/27	385
387	Fertilize and Seed	7 days	Thu 10/7/27	Fri 10/15/27	386
388	Temporary Irrigation	7 days	Mon 10/18/2	Tue 10/26/2	387
389	**Recreation**	**35 days**	**Wed 10/27/2**	**Tue 12/14/2**	
390	New Unpaved Trail	7 days	Wed 10/27/2	Thu 11/4/27	388
391	Existing Access Road Converstion to Multi-Use Trail	16 days	Fri 11/5/27	Fri 11/26/27	390
392	Wildlife Viewpoint	12 days	Mon 11/29/2	Tue 12/14/2	391
393	**Demobilization and Restoration**	**15 days**	**Wed 12/15/2**	**Tue 1/4/28**	
394	Site Clean Up and Removals	5 days	Wed 12/15/2	Tue 12/21/2	392
395	Demobilization	10 days	Wed 12/22/2	Tue 1/4/28	394
396	**CONTRACT 6 (REACHES 1 and 2)**	**1747 days**	**Mon 6/1/26**	**Tue 2/8/33**	
397	**PRE-CONSTRUCTION AWARD**	**445 days**	**Mon 6/1/26**	**Fri 2/11/28**	
398	**Plans & Specifications**	**390 days**	**Mon 6/1/26**	**Fri 11/26/27**	
399	30% Design	120 days	Mon 6/1/26	Fri 11/13/26	
400	60% Design	120 days	Mon 11/16/2	Fri 4/30/27	399
401	90% Design	120 days	Mon 5/3/27	Fri 10/15/27	400
402	BCOE	30 days	Mon 10/18/2	Fri 11/26/27	401
403	LERRDs Procurement	390 days	Mon 6/1/26	Fri 11/26/27	399SS



Project: LA River_Project Schedule
Date: Thu 3/5/15

Task	Milestone	Project Summary	External Milestone	Inactive Milestone	Duration-only	Manual Summary	Finish-only	Progress	
Split	Summary	External Tasks	Inactive Task	Inactive Summary	Manual Summary Rollup	Start-only	Deadline	Manual Progress	

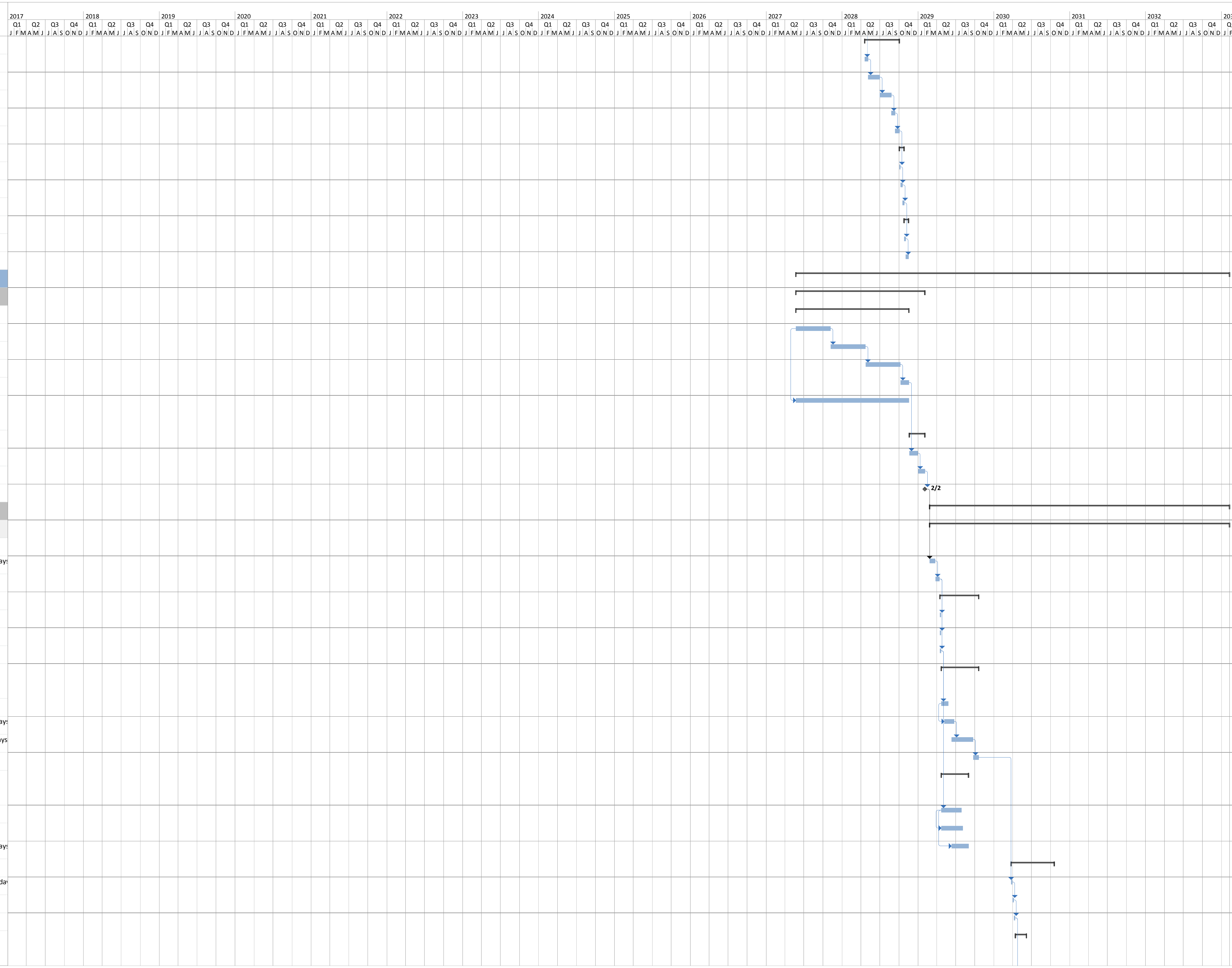
ID	Task Name	Duration	Start	Finish	Predecessors
404	**Procurement & Award**	**55 days**	**Mon 11/29/2**	**Fri 2/11/28**	
405	Advertise	30 days	Mon 11/29/2	Fri 1/7/28	402
406	Award	25 days	Mon 1/10/28	Fri 2/11/28	405
407	NTP	0 days	Fri 2/11/28	Fri 2/11/28	406
408	**CONSTRUCTION**	**366 days**	**Mon 3/20/2**	**Mon 8/13/2**	
409	**Reach 2 - Glendale Freeway to I-5**	**366 days**	**Mon 3/20/2**	**Mon 8/13/2**	
410	**Mobilization and Preparatory Work**	**30 days**	**Mon 3/20/2**	**Fri 4/28/28**	
411	Mobilization	15 days	Mon 3/20/28	Fri 4/7/28	407FS+25 days
412	Site Access and Staging	10 days	Mon 4/10/28	Fri 4/21/28	411
413	Clearing and Grubbing	5 days	Mon 4/24/28	Fri 4/28/28	412
414	**In-Channel Work Period I**	**129 days**	**Mon 5/1/28**	**Thu 10/26/2**	
415	Temporary Cofferdam Installation	10 days	Mon 5/1/28	Fri 5/12/28	413
416	Erosion Control	5 days	Mon 5/15/28	Fri 5/19/28	415
417	**Measure 27 - Modify Trapezoidal Channel to Vertical Sides**	**114 days**	**Mon 5/22/28**	**Thu 10/26/28**	
418	Concrete Demolition	10 days	Mon 5/22/28	Fri 6/2/28	416
419	Grouted Riprap Demolition	12 days	Mon 6/5/28	Tue 6/20/28	418
420	Riprap Demolition	10 days	Wed 6/21/28	Tue 7/4/28	419
421	Sheet Pile Wall Demoition	12 days	Mon 6/5/28	Tue 6/20/28	418
422	Chain Link Fence Installation	5 days	Wed 6/21/28	Tue 6/27/28	421
423	Asphalt Demolition	7 days	Wed 6/28/28	Thu 7/6/28	422
424	Riprap Placement	25 days	Wed 7/5/28	Tue 8/8/28	420
425	Compacted Fill	20 days	Wed 7/12/28	Tue 8/8/28	424SS+5 days
426	Reinforced Concrete Planters	50 days	Wed 8/9/28	Tue 10/17/2	425
427	Chain Link Fence Installation	15 days	Wed 9/27/28	Tue 10/17/2	426FF
428	Aggregate Base and Asphalt Installation	7 days	Wed 10/18/2	Thu 10/26/2	427
429	**In-Channel Work Period II**	**58 days**	**Fri 3/30/29**	**Tue 6/19/29**	
430	Temporary Cofferdam Installation	10 days	Fri 3/30/29	Thu 4/12/29	428FS+110 day
431	Erosion Control	5 days	Fri 4/13/29	Thu 4/19/29	430
432	**Measure 16 - Bioengineer Channel Walls**	**20 days**	**Fri 4/20/29**	**Thu 5/17/29**	
433	Turf Reinforcement Mats	20 days	Fri 4/20/29	Thu 5/17/29	431
434	**Measure 17 - Habitat Corridors/Riparain Planting on Banks**	**23 days**	**Fri 5/18/29**	**Tue 6/19/29**	
435	Planting, Shrubs	10 days	Fri 5/18/29	Thu 5/31/29	433
436	Planting, Trees	6 days	Fri 6/1/29	Fri 6/8/29	435
437	Fertilize and Seed	2 days	Mon 6/11/29	Tue 6/12/29	436
438	Temporary Irrigation	5 days	Wed 6/13/29	Tue 6/19/29	437
439	**Recreation**	**31 days**	**Mon 6/11/2**	**Mon 7/23/2**	
440	Trail Improvements	2 days	Mon 6/11/29	Tue 6/12/29	436
441	New Unpaved Trail	15 days	Wed 6/13/29	Tue 7/3/29	440
442	Trail Access Points	1 day	Wed 7/4/29	Wed 7/4/29	441
443	Restrooms	8 days	Wed 7/4/29	Fri 7/13/29	441
444	Wildlife Viewpoint	6 days	Mon 7/16/29	Mon 7/23/2	443
445	**Demobilization and Restoration**	**15 days**	**Tue 7/24/29**	**Mon 8/13/2**	
446	Site Clean Up and Removals	5 days	Tue 7/24/29	Mon 7/30/2	444
447	Demobilization	10 days	Tue 7/31/29	Mon 8/13/2	446
448	**Reach 1 - Pollywog Park / Headworks to Midpoint of Be**	**173 days**	**Mon 3/20/2**	**Wed 11/15/2**	
449	**Mobilization and Preparatory Work**	**22 days**	**Mon 3/20/2**	**Tue 4/18/28**	
450	Mobilization	5 days	Mon 3/20/28	Fri 3/24/28	411SS
451	Site Access and Staging	5 days	Mon 3/27/28	Fri 3/31/28	450
452	Temporary Cofferdam Installation	5 days	Mon 4/3/28	Fri 4/7/28	451
453	Clearing and Grubbing	12 days	Mon 4/3/28	Tue 4/18/28	451



Project: LA River_Project Schedule
Date: Thu 3/5/15

Task	Milestone	Project Summary	External Milestone	Inactive Milestone	Duration-only	Manual Summary	Finish-only	Progress
Split	Summary	External Tasks	Inactive Task	Inactive Summary	Manual Summary Rollup	Start-only	Deadline	Manual Progress

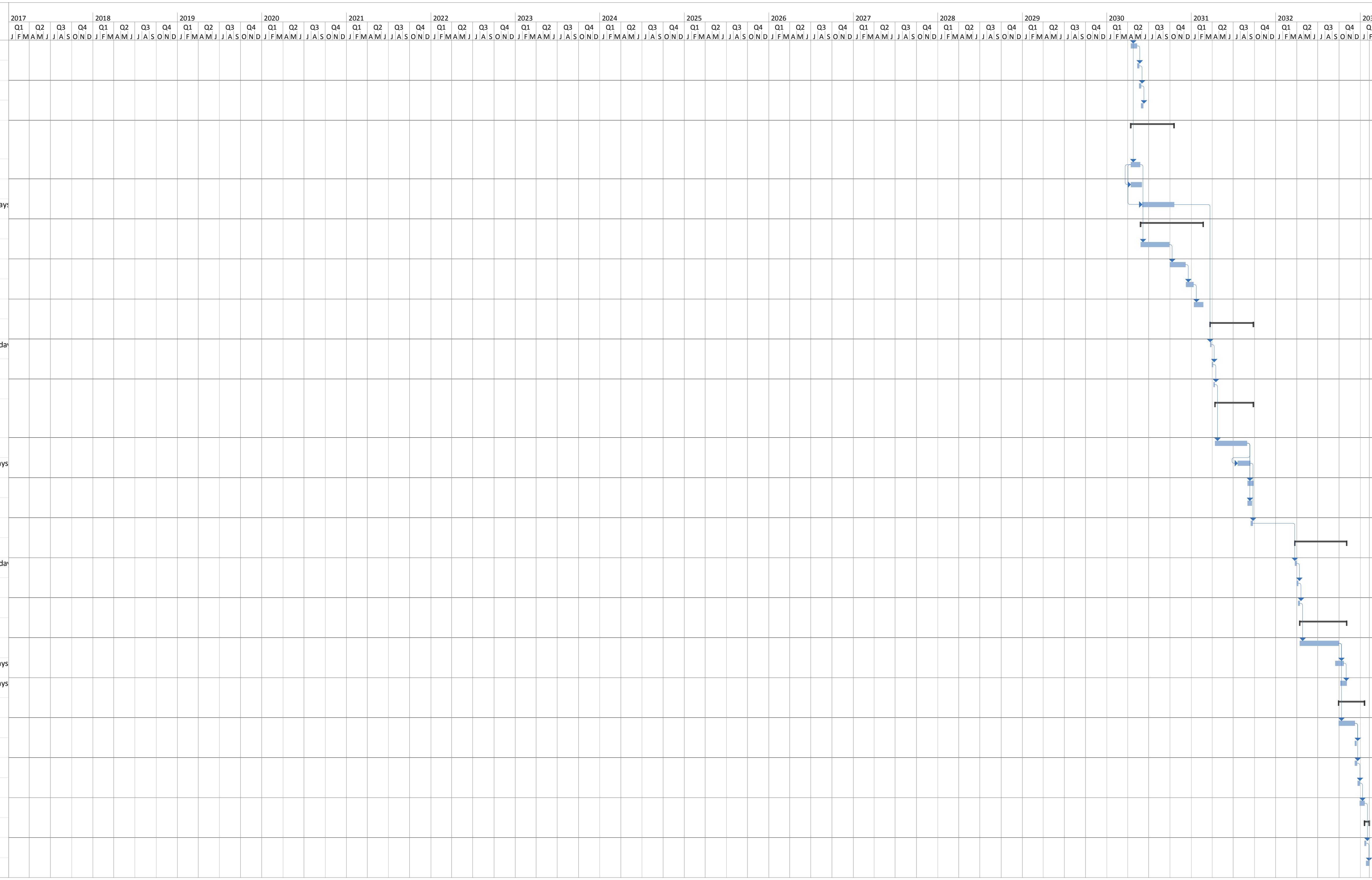
ID	Task Name	Duration	Start	Finish	Predecessors
454	**Measure 17 - Habitat Corridors/Riparain Planting on**	**119 days**	**Wed 4/19/28**	**Mon 10/2/28**	
455	Top Soil Placement	12 days	Wed 4/19/28	Thu 5/4/28	453
456	Planting, Shrubs	40 days	Fri 5/5/28	Thu 6/29/28	455
457	Planting, Trees	40 days	Fri 6/30/28	Thu 8/24/28	456
458	Fertilize and Seed	12 days	Fri 8/25/28	Mon 9/11/28	457
459	Temporary Irrigation	15 days	Tue 9/12/28	Mon 10/2/28	458
460	**Recreation**	**17 days**	**Tue 10/3/28**	**Wed 10/25/2**	
461	Trail Improvements	4 days	Tue 10/3/28	Fri 10/6/28	459
462	New Unpaved Trail	7 days	Mon 10/9/28	Tue 10/17/2	461
463	Trail Access Points	6 days	Wed 10/18/2	Wed 10/25/2	462
464	**Demobilization and Restoration**	**15 days**	**Thu 10/26/2**	**Wed 11/15/2**	
465	Site Clean Up and Removals	5 days	Thu 10/26/2	Wed 11/1/28	463
466	Demobilization	10 days	Thu 11/2/28	Wed 11/15/2	465
467	**CONTRACT 7 (REACH 8) and LATC RELOCATION**	**1492 days**	**Mon 5/24/2**	**Tue 2/8/33**	
468	**PRE-CONSTRUCTION AWARD**	**445 days**	**Mon 5/24/2**	**Fri 2/2/29**	
469	**Plans & Specifications**	**390 days**	**Mon 5/24/2**	**Fri 11/17/28**	
470	30% Design	120 days	Mon 5/24/27	Fri 11/5/27	
471	60% Design	120 days	Mon 11/8/27	Fri 4/21/28	470
472	90% Design	120 days	Mon 4/24/28	Fri 10/6/28	471
473	BCOE	30 days	Mon 10/9/28	Fri 11/17/28	472
474	LERRDs Procurement, LATC Relocation and Utility Tower Relocations	390 days	Mon 5/24/27	Fri 11/17/28	470SS
475	**Procurement & Award**	**55 days**	**Mon 11/20/2**	**Fri 2/2/29**	
476	Advertise	30 days	Mon 11/20/2	Fri 12/29/28	473
477	Award	25 days	Mon 1/1/29	Fri 2/2/29	476
478	NTP	0 days	Fri 2/2/29	Fri 2/2/29	477
479	**CONSTRUCTION**	**1032 days**	**Mon 2/26/2**	**Tue 2/8/33**	
480	**Reach 8 - Main St. to 1st St.**	**1032 days**	**Mon 2/26/2**	**Tue 2/8/33**	
481	**Mobilization and Preparatory Work**	**35 days**	**Mon 2/26/2**	**Fri 4/13/29**	
482	Mobilization	20 days	Mon 2/26/29	Fri 3/23/29	478FS+15 day
483	Site Access and Staging	15 days	Mon 3/26/29	Fri 4/13/29	482
484	**In Channel Work Period 1**	**135 days**	**Mon 4/16/2**	**Fri 10/19/29**	
485	Temporary Cofferdam Installation	5 days	Mon 4/16/29	Fri 4/20/29	483
486	Erosion Control	5 days	Mon 4/16/29	Fri 4/20/29	483
487	Clearing and Grubbing	5 days	Mon 4/16/29	Fri 4/20/29	483
488	**Measure 3 - Create Geomorphology and Plant for Freshwater Marsh**	**130 days**	**Mon 4/23/29**	**Fri 10/19/29**	
489	Excavation, Grade Control	25 days	Mon 4/23/29	Fri 5/25/29	487
490	Grouted Riprap	35 days	Mon 5/7/29	Fri 6/22/29	489SS+10 day
491	Riprap Placement	75 days	Mon 6/11/29	Fri 9/21/29	490FS-10 days
492	Compacted Fill	20 days	Mon 9/24/29	Fri 10/19/29	491
493	**Measure 6 - Rebuild Geomorphology for Historic Wash (Piggyback Yard)**	**95 days**	**Mon 4/23/29**	**Fri 8/31/29**	
494	Excavation, Embankments	70 days	Mon 4/23/29	Fri 7/27/29	487
495	Load and Haul to Disposal	75 days	Mon 4/23/29	Fri 8/3/29	494SS
496	Riprap Placement	60 days	Mon 6/11/29	Fri 8/31/29	494SS+35 day
497	**In Channel Work Period II**	**150 days**	**Mon 3/25/3**	**Fri 10/18/30**	
498	Temporary Cofferdam Installation	5 days	Mon 3/25/30	Fri 3/29/30	492FS+110 da
499	Erosion Control	5 days	Mon 4/1/30	Fri 4/5/30	498
500	Clearing and Grubbing	5 days	Mon 4/8/30	Fri 4/12/30	499
501	**Measure 3 - Create Geomorphology and Plant for Freshwater Marsh**	**39 days**	**Mon 4/15/30**	**Thu 6/6/30**	



Project: LA River_Project Schedule Date: Thu 3/5/15	Task		Milestone		Project Summary		External Milestone		Inactive Milestone		Duration-only	
	Split		Summary		External Tasks		Inactive Task		Inactive Summary		Manual Summary Rollup	

Manual Summary		Finish-only		Progress	
Start-only		Deadline		Manual Progress	

ID	Task Name	Duration	Start	Finish	Predecessors
502	Planting, Shrubs	20 days	Mon 4/15/30	Fri 5/10/30	500
503	Planting, Trees	6 days	Mon 5/13/30	Mon 5/20/30	502
504	Fertilize and Seed	6 days	Tue 5/21/30	Tue 5/28/30	503
505	Temporary Irrigation	7 days	Wed 5/29/30	Thu 6/6/30	504
506	**Measure 10 - Divert Tributary & River Flow into Side Channels (Piggyback Yard)**	**135 days**	**Mon 4/15/30**	**Fri 10/18/30**	
507	Excavation, Embankments	30 days	Mon 4/15/30	Fri 5/24/30	500
508	Load and Haul to Disposal	35 days	Mon 4/15/30	Fri 5/31/30	507SS
509	Riprap Placement	100 days	Mon 6/3/30	Fri 10/18/30	507SS+35 days
510	**Measure 17 - Habitat Corridors/Riparian Planting (**	**195 days**	**Mon 5/27/30**	**Fri 2/21/31**	
511	Planting, Shrubs	90 days	Mon 5/27/30	Fri 9/27/30	507
512	Planting, Trees	50 days	Mon 9/30/30	Fri 12/6/30	511
513	Fertilize and Seed	25 days	Mon 12/9/30	Fri 1/10/31	512
514	Temporary Irrigation	30 days	Mon 1/13/31	Fri 2/21/31	513
515	**In Channel Work Period III**	**135 days**	**Mon 3/24/31**	**Fri 9/26/31**	
516	Temporary Cofferdam Installation	5 days	Mon 3/24/31	Fri 3/28/31	509FS+110 da
517	Erosion Control	5 days	Mon 3/31/31	Fri 4/4/31	516
518	Clearing and Grubbing	5 days	Mon 4/7/31	Fri 4/11/31	517
519	**Measure 21 - Lower Channel Banks and Provide Setback Levees or Berms**	**120 days**	**Mon 4/14/31**	**Fri 9/26/31**	
520	Excavation, Embankments	100 days	Mon 4/14/31	Fri 8/29/31	518
521	Riprap Placement	40 days	Mon 7/21/31	Fri 9/12/31	520FS-30 days
522	Chain Link Fence Installation	20 days	Mon 9/1/31	Fri 9/26/31	520
523	Aggregate Base and Asphalt Installation	15 days	Mon 9/1/31	Fri 9/19/31	520
524	Top Soil Placement	7 days	Mon 9/15/31	Tue 9/23/31	521
525	**In Channel Work Period IV**	**160 days**	**Wed 3/24/32**	**Tue 11/2/32**	
526	Temporary Cofferdam Installation	5 days	Wed 3/24/32	Tue 3/30/32	524FS+130 da
527	Erosion Control	5 days	Wed 3/31/32	Tue 4/6/32	526
528	Clearing and Grubbing	5 days	Wed 4/7/32	Tue 4/13/32	527
529	**Measure 26 - Terrace Banks**	**145 days**	**Wed 4/14/32**	**Tue 11/2/32**	
530	Excavation, Embankments	120 days	Wed 4/14/32	Tue 9/28/32	528
531	Excavation, Embankments	25 days	Wed 9/15/32	Tue 10/19/32	530FS-10 days
532	Riprap Placement	20 days	Wed 10/6/32	Tue 11/2/32	531FS-10 days
533	**Recreation**	**80 days**	**Wed 9/29/32**	**Tue 1/18/33**	
534	New Unpaved Trail	50 days	Wed 9/29/32	Tue 12/7/32	530
535	Trail Access Points	5 days	Wed 12/8/32	Tue 12/14/32	534
536	Restrooms	8 days	Wed 12/8/32	Fri 12/17/32	534
537	Parking Lot	7 days	Mon 12/20/3	Tue 12/28/32	536
538	Pedestrian Bridge	15 days	Wed 12/29/3	Tue 1/18/33	537
539	**Demobilization and Restoration**	**15 days**	**Wed 1/19/33**	**Tue 2/8/33**	
540	Site Clean Up and Removals	5 days	Wed 1/19/33	Tue 1/25/33	538
541	Demobilization	10 days	Wed 1/26/33	Tue 2/8/33	540



Project: LA River_Project Schedule Date: Thu 3/5/15	Task		Milestone		Project Summary		External Milestone		Inactive Milestone		Duration-only
	Split		Summary		External Tasks		Inactive Task		Inactive Summary		Manual Summary Rollup
	Manual Summary		Finish-only		Progress						
	Start-only		Deadline		Manual Progress						

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 10
Labor Rates

April 2015

General Decision Number: CA140033 03/14/2014 CA33

Superseded General Decision Number: CA20130033

State: California

Construction Types: Building, Heavy (Heavy and Dredging) and Highway

County: Los Angeles County in California.

BUILDING CONSTRUCTION PROJECTS; DREDGING PROJECTS (does not include hopper dredge work); HEAVY CONSTRUCTION PROJECTS (does not include water well drilling); HIGHWAY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	01/03/2014
1	01/10/2014
2	01/24/2014
3	01/31/2014
4	02/21/2014
5	03/14/2014

ASBE0005-002 07/01/2013

	Rates	Fringes
Asbestos Workers/Insulator (Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems).....	$ 34.51	18.55
Fire Stop Technician (Application of Firestopping Materials for wall openings and penetrations in walls, floors, ceilings and curtain walls).........................	$ 24.34	16.09

ASBE0005-004 06/24/2013

	Rates	Fringes
Asbestos Removal worker/hazardous material handler (Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing of all insulation materials from mechanical systems, whether they contain asbestos or not)....	$ 16.95	10.23

BOIL0092-003 10/01/2012

	Rates	Fringes

```
BOILERMAKER......................$ 41.17            28.27
----------------------------------------------------------------
* BRCA0004-007 05/01/2013

                                  Rates          Fringes

BRICKLAYER; MARBLE SETTER........$ 37.16            12.85

  *The wage scale for prevailing wage projects performed in
  Blythe, China lake, Death Valley, Fort Irwin, Twenty-Nine
  Palms, Needles and 1-15 corridor (Barstow to the Nevada
  State Line) will be Three Dollars ($3.00) above the
  standard San Bernardino/Riverside County hourly wage rate

----------------------------------------------------------------
 BRCA0018-004 06/01/2012

                                  Rates          Fringes

MARBLE FINISHER..................$ 27.04            10.66
TILE FINISHER....................$ 22.37             9.19
TILE LAYER.......................$ 33.55            13.55
----------------------------------------------------------------
 BRCA0018-010 09/01/2011

                                  Rates          Fringes

TERRAZZO FINISHER................$ 26.59             9.62
TERRAZZO WORKER/SETTER...........$ 33.63            10.46
----------------------------------------------------------------
 CARP0409-001 07/01/2010

                                  Rates          Fringes

CARPENTER
     (1) Carpenter, Cabinet
     Installer, Insulation
     Installer, Hardwood Floor
     Worker and acoustical
     installer...................$ 37.35            11.08
     (2) Millwright..............$ 37.85            11.08
     (3) Piledrivermen/Derrick
     Bargeman, Bridge or Dock
     Carpenter, Heavy Framer,
     Rock Bargeman or Scowman,
     Rockslinger, Shingler
     (Commercial)................$ 37.48            11.08
     (4) Pneumatic Nailer,
     Power Stapler...............$ 37.60            11.08
     (5)  Sawfiler...............$ 37.44            11.08
     (6)  Scaffold Builder.......$ 28.55            11.08
     (7)  Table Power Saw
     Operator....................$ 37.45            11.08

  FOOTNOTE: Work of forming in the construction of open cut
  sewers or storm drains, on operations in which horizontal
  lagging is used in conjunction with steel H-Beams driven or
  placed in pre- drilled holes, for that portion of a lagged
  trench against which concrete is poured, namely, as a
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  substitute for back forms (which work is performed by
  piledrivers): $0.13 per hour additional.

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 CARP0409-002 07/01/2008

                                  Rates          Fringes

Diver
     (1) Wet.....................$ 663.68          9.82
     (2) Standby.................$ 331.84          9.82
     (3) Tender..................$ 323.84          9.82
     (4) Assistant Tender........$ 299.84          9.82

Amounts in "Rates' column are per day
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 CARP0409-005 07/01/2010

                                  Rates          Fringes

Drywall
     DRYWALL INSTALLER/LATHER....$ 37.35          11.08
     STOCKER/SCRAPPER............$ 10.00           6.67
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 CARP0409-008 08/01/2010

                                  Rates          Fringes

Modular Furniture Installer......$ 17.00           7.41
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 ELEC0011-004 01/27/2014

                                  Rates          Fringes

ELECTRICIAN (INSIDE
ELECTRICAL WORK)
     Journeyman Electrician......$ 39.45          24.80
ELECTRICIAN (INTELLIGENT
TRANSPORTATION SYSTEMS Street
Lighting, Traffic Signals,
CCTV,and Underground Systems)
     Journeyman Transportation
     Electrician.................$ 39.20          25.04
     Technician..................$ 29.40          24.75

FOOT NOTE:
  CABLE SPLICER & INSTRUMENT PERSON: Recieve 5% additional per
  hour above Journeyman Electrician basic  hourly rate.
TUNNEL WORK: 10% additional per hour.

SCOPE OF WORK -  TRANSPORTATION SYSTEMS

ELECTRICIAN:
  Installation of street lights and traffic signals,including
  electrical circuitry, programmable controllers,
  pedestal-mounted electrical meter enclosures and laying of
  pre-assembled multi-conductor cable in ducts, layout of
  electrical systems and communication installation,
  including proper position of trench depths and radius at
  duct banks, location for man
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holes, pull boxes, street lights and traffic signals.
Installation of underground ducts for electrical,telephone, cable television and communication systems.
Pulling,termination and
splicing of traffic signal and street lighting conductors and electrical systems including interconnect,detector loop, fiber optic cable and video/cable.

TECHNICIAN:
Distribution of material at job site, manual excavation and backfill, installation of system conduits and raceways for electrical, telephone, cable television and communication systems. Pulling, terminating and splicing of traffic signal and street lighting conductors and electrical systems including interconnect, detector loop, fiber optic cable and video/data.

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* ELEC0011-005 11/25/2013

COMMUNICATIONS & SYSTEMS WORK (excludes any work on Intelligent Transportation Systems or CCTV highway systems)

	Rates	Fringes
Communications System		
Installer...................	$ 27.75	12.36
Technician..................	$ 29.55	12.42

SCOPE OF WORK The work covered shall include the installation, testing, service and maintenance, of the following systems that utilize the transmission and/or transference of voice, sound, vision and digital for commercial, education, security and entertainment purposes for TV monitoring and surveillance, background foreground music, intercom and telephone interconnect, inventory control systems, microwave transmission, multi-media, multiplex, nurse call system, radio page, school intercom and sound, burglar alarms and low voltage master clock systems.

A. Communication systems that transmit or receive information and/or control systems that are intrinsic to the above listed systems SCADA (Supervisory control/data acquisition PCM (Pulse code modulation) Inventory control systems Digital data systems Broadband & baseband and carriers Point of sale systems VSAT data systems Data communication systems RF and remote control systems Fiber optic data systems

B. Sound and Voice Transmission/Transference Systems Background-Foreground Music Intercom and Telephone Interconnect Systems Sound and Musical Entertainment Systems Nurse Call Systems Radio Page Systems School Intercom and Sound Systems Burglar Alarm Systems Low-Voltage Master Clock Systems Multi-Media/Multiplex Systems Telephone Systems RF Systems and Antennas and Wave Guide

C. *Fire Alarm Systems-installation, wire pulling and testing.

D. Television and Video Systems Television Monitoring and Surveillance Systems Video Security Systems Video Entertainment Systems Video Educational Systems CATV and CCTV

E. Security Systems, Perimeter Security Systems, Vibration Sensor Systems
Sonar/Infrared Monitoring Equipment, Access Control Systems, Card Access Systems

*Fire Alarm Systems
1. Fire Alarms-In Raceways: Wire and cable pulling in raceways performed at the current electrician wage rate and fringe benefits.
2. Fire Alarms-Open Wire Systems: installed by the Technician.

ELEC1245-001 06/01/2013

	Rates	Fringes
LINE CONSTRUCTION		
(1) Lineman; Cable splicer..	$ 50.30	15.00
(2) Equipment specialist (operates crawler tractors, commercial motor vehicles, backhoes, trenchers, cranes (50 tons and below), overhead & underground distribution line equipment)...........	$ 40.17	14.56
(3) Groundman...............	$ 30.73	13.48
(4) Powderman...............	$ 44.91	13.48

HOLIDAYS: New Year's Day, M.L. King Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day and day after Thanksgiving, Christmas Day

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ELEV0018-001 01/01/2014

	Rates	Fringes
ELEVATOR MECHANIC................	$ 49.03	26.785

FOOTNOTE:
PAID VACATION: Employer contributes 8% of regular hourly rate as vacation pay credit for employees with more than 5 years of service, and 6% for 6 months to 5 years of service.
PAID HOLIDAYS: New Years Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Friday after Thanksgiving, and Christmas Day.

ENGI0012-003 08/26/2013

	Rates	Fringes

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OPERATOR:  Power Equipment
(All Other Work)
     GROUP  1....................$ 38.20            21.10
     GROUP  2....................$ 38.98            21.10
     GROUP  3....................$ 39.27            21.10
     GROUP  4....................$ 40.76            21.10
     GROUP  5....................$ 41.86            21.10
     GROUP  6....................$ 40.98            21.10
     GROUP  8....................$ 41.09            21.10
     GROUP  9....................$ 42.19            21.10
     GROUP 10....................$ 41.21            21.10
     GROUP 11....................$ 42.31            21.10
     GROUP 12....................$ 41.38            21.10
     GROUP 13....................$ 41.48            21.10
     GROUP 14....................$ 41.51            21.10
     GROUP 15....................$ 41.59            21.10
     GROUP 16....................$ 41.71            21.10
     GROUP 17....................$ 41.88            21.10
     GROUP 18....................$ 41.98            21.10
     GROUP 19....................$ 42.09            21.10
     GROUP 20....................$ 42.21            21.10
     GROUP 21....................$ 42.38            21.10
     GROUP 22....................$ 42.48            21.10
     GROUP 23....................$ 42.59            21.10
     GROUP 24....................$ 42.71            21.10
     GROUP 25....................$ 42.88            21.10
OPERATOR:  Power Equipment
(Cranes, Piledriving &
Hoisting)
     GROUP  1....................$ 39.55            21.10
     GROUP  2....................$ 40.33            21.10
     GROUP  3....................$ 40.62            21.10
     GROUP  4....................$ 40.76            21.10
     GROUP  5....................$ 40.98            21.10
     GROUP  6....................$ 41.09            21.10
     GROUP  7....................$ 41.21            21.10
     GROUP  8....................$ 41.38            21.10
     GROUP  9....................$ 41.55            21.10
     GROUP 10....................$ 42.55            21.10
     GROUP 11....................$ 43.55            21.10
     GROUP 12....................$ 44.55            21.10
     GROUP 13....................$ 45.55            21.10
OPERATOR:  Power Equipment
(Tunnel Work)
     GROUP  1....................$ 40.05            21.10
     GROUP  2....................$ 40.83            21.10
     GROUP  3....................$ 41.12            21.10
     GROUP  4....................$ 41.26            21.10
     GROUP  5....................$ 41.48            21.10
     GROUP  6....................$ 41.59            21.10
     GROUP  7....................$ 41.71            21.10

PREMIUM PAY:
  $3.75 per hour shall be paid on all Power Equipment Operator
  work on the followng Military Bases: China Lake Naval
  Reserve, Vandenberg AFB, Point Arguello, Seely Naval Base,
  Fort Irwin, Nebo Annex Marine Base, Marine Corp Logistics
  Base Yermo, Edwards AFB, 29 Palms Marine Base and Camp
  Pendleton
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Workers required to suit up and work in a hazardous material environment: $2.00 per hour additional. Combination mixer and compressor operator on gunite work shall be classified as a concrete mobile mixer operator.

SEE ZONE DEFINITIONS AFTER CLASSIFICATIONS

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Bargeman; Brakeman; Compressor operator; Ditch Witch, with seat or similar type equipment; Elevator operator-inside; Engineer Oiler; Forklift operator (includes loed, lull or similar types under 5 tons; Generator operator; Generator, pump or compressor plant operator; Pump operator; Signalman; Switchman

GROUP 2: Asphalt-rubber plant operator (nurse tank operator); Concrete mixer operator-skip type; Conveyor operator; Fireman; Forklift operator (includes loed, lull or similar types over 5 tons; Hydrostatic pump operator; oiler crusher (asphalt or concrete plant); Petromat laydown machine; PJU side dum jack; Screening and conveyor machine operator (or similar types); Skiploader (wheel type up to 3/4 yd. without attachment); Tar pot fireman; Temporary heating plant operator; Trenching machine oiler

GROUP 3: Asphalt-rubber blend operator; Bobcat or similar type (Skid steer); Equipment greaser (rack); Ford Ferguson (with dragtype attachments); Helicopter radioman (ground); Stationary pipe wrapping and cleaning machine operator

GROUP 4: Asphalt plant fireman; Backhoe operator (mini-max or similar type); Boring machine operator; Boxman or mixerman (asphalt or concrete); Chip spreading machine operator; Concrete cleaning decontamination machine operator; Concrete Pump Operator (small portable); Drilling machine operator, small auger types (Texoma super economatic or similar types - Hughes 100 or 200 or similar types - drilling depth of 30' maximum); Equipment greaser (grease truck); Guard rail post driver operator; Highline cableway signalman; Hydra-hammer-aero stomper; Micro Tunneling (above ground tunnel); Power concrete curing machine operator; Power concrete saw operator; Power-driven jumbo form setter operator; Power sweeper operator; Rock Wheel Saw/Trencher; Roller operator (compacting); Screed operator (asphalt or concrete); Trenching machine operator (up to 6 ft.); Vacuum or much truck

GROUP 5: Equipment Greaser (Grease Truck/Multi Shift).

GROUP 6: Articulating material hauler; Asphalt plant engineer; Batch plant operator; Bit sharpener; Concrete joint machine operator (canal and similar type); Concrete planer operator; Dandy digger; Deck engine operator; Derrickman (oilfield type); Drilling machine operator, bucket or auger types (Calweld 100 bucket or similar types - Watson 1000 auger or similar types - Texoma 330, 500 or 600 auger or similar types - drilling depth of 45' maximum); Drilling machine operator; Hydrographic seeder machine operator (straw, pulp or seed), Jackson track maintainer, or similar type; Kalamazoo Switch tamper, or similar type; Machine tool operator; Maginnis internal full slab vibrator, Mechanical berm, curb or gutter(concrete or asphalt); Mechanical finisher operator (concrete, Clary-Johnson-Bidwell or similar); Micro tunnel system (below ground); Pavement breaker operator (truck mounted); Road oil mixing machine operator; Roller operator (asphalt or finish), rubber-tired earth moving equipment (single engine, up to and including 25 yds. struck); Self-propelled tar pipelining machine operator; Skiploader operator (crawler and wheel type, over 3/4 yd. and up to and including 1-1/2 yds.); Slip form pump operator (power driven hydraulic lifting device for concrete forms); Tractor operator-bulldozer, tamper-scraper (single engine, up to 100 h.p. flywheel and similar types, up to and including D-5 and similar types); Tugger hoist operator (1 drum); Ultra high pressure waterjet cutting tool system operator; Vacuum blasting machine operator

GROUP 8: Asphalt or concrete spreading operator (tamping or finishing); Asphalt paving machine operator (Barber Greene or similar type); Asphalt-rubber distribution operator; Backhoe operator (up to and including 3/4 yd.), small ford, Case or similar; Cast-in-place pipe laying machine operator; Combination mixer and compressor operator (gunite work); Compactor operator (self-propelled); Concrete mixer operator (paving); Crushing plant operator; Drill Doctor; Drilling machine operator, Bucket or auger types (Calweld 150 bucket or similar types - Watson 1500, 2000 2500 auger or similar types - Texoma 700, 800 auger or similar types - drilling depth of 60' maximum); Elevating grader operator; Grade checker; Gradall operator; Grouting machine operator; Heavy-duty repairman; Heavy equipment robotics operator; Kalamazoo balliste regulator or similar type; Kolman belt loader and similar type; Le Tourneau blob compactor or similar type; Loader operator (Athey, Euclid, Sierra and similar types); Mobark Chipper or similar; Ozzie padder or similar types; P.C. slot saw; Pneumatic concrete placing machine operator (Hackley-Presswell or similar type); Pumpcrete gun operator; Rock Drill or similar types; Rotary drill operator (excluding caisson type); Rubber-tired earth-moving equipment operator (single engine, caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. up to and including 50 cu. yds. struck); Rubber-tired earth-moving equipment operator (multiple engine up to and including 25 yds. struck); Rubber-tired scraper operator (self-loading paddle wheel type-John Deere, 1040 and similar single unit); Self-propelled curb and gutter machine operator; Shuttle buggy; Skiploader operator (crawler and wheel type over 1-1/2 yds. up to and including 6-1/2 yds.); Soil remediation plant operator; Surface heaters and planer operator; Tractor compressor drill combination operator; Tractor operator (any type larger than D-5 - 100 flywheel h.p. and over, or similar-bulldozer, tamper, scraper and push tractor single engine); Tractor operator (boom attachments), Traveling pipe wrapping, cleaning and bendng machine operator; Trenching machine operator (over 6 ft. depth capacity, manufacturer's rating); trenching Machine with Road Miner attachment (over 6 ft depth capacity): Ultra high pressure waterjet cutting tool system mechanic; Water pull (compaction) operator

GROUP 9: Heavy Duty Repairman

GROUP 10: Drilling machine operator, Bucket or auger types (Calweld 200 B bucket or similar types-Watson 3000 or 5000 auger or similar types-Texoma 900 auger or similar types-drilling depth of 105' maximum); Dual drum mixer, dynamic compactor LDC350 (or similar types); Monorail locomotive operator (diesel, gas or electric); Motor patrol-blade operator (single engine); Multiple engine tractor operator (Euclid and similar type-except Quad 9 cat.); Rubber-tired earth-moving equipment operator (single engine, over 50 yds. struck); Pneumatic pipe ramming tool and similar types; Prestressed wrapping machine operator; Rubber-tired earth-moving equipment operator (single engine, over 50 yds. struck); Rubber tired earth moving equipment operator (multiple engine, Euclid, caterpillar and similar over 25 yds. and up to 50 yds. struck), Tower crane repairman; Tractor loader operator (crawler and wheel type over 6-1/2 yds.); Woods mixer operator (and similar Pugmill equipment)

GROUP 11: Heavy Duty Repairman - Welder Combination, Welder - Certified.

GROUP 12: Auto grader operator; Automatic slip form operator; Drilling machine operator, bucket or auger types (Calweld, auger 200 CA or similar types - Watson, auger 6000 or similar types - Hughes Super Duty, auger 200 or similar types - drilling depth of 175' maximum); Hoe ram or similar with compressor; Mass excavator operator less tha 750 cu. yards; Mechanical finishing machine operator; Mobile form traveler operator; Motor patrol operator (multi-engine); Pipe mobile machine operator; Rubber-tired earth- moving equipment operator (multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck); Rubber-tired self- loading scraper operator (paddle-wheel-auger type self-loading - two (2) or more units)

GROUP 13: Rubber-tired earth-moving equipment operator operating equipment with push-pull system (single engine, up to and including 25 yds. struck)

GROUP 14: Canal liner operator; Canal trimmer operator; Remote- control earth-moving equipment operator (operating a second piece of equipment: $1.00 per hour additional); Wheel excavator operator (over 750 cu. yds.)

GROUP 15: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. and up to and including 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine-up to and including 25 yds. struck)

GROUP 16: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 17: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine, Euclid, Caterpillar and similar, over 50 cu. yds. struck); Tandem tractor operator (operating crawler type tractors in tandem - Quad 9 and similar type)

GROUP 18: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, up to and including 25 yds. struck)

GROUP 19: Rotex concrete belt operator (or similar types); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds.and up to and including 50 cu. yds. struck); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - multiple engine, up to and including 25 yds. struck)

GROUP 20: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps, and similar types in any combination, excluding compaction units - multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 21: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck)

GROUP 22: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, up to and including 25 yds. struck)

GROUP 23: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. and up to and including 50 yds. struck); Rubber-tired earth-moving equipment operator, operating with the tandem push-pull system (multiple engine, up to and including 25 yds. struck)

GROUP 24: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)

GROUP 25: Concrete pump operator-truck mounted; Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck)

CRANES, PILEDRIVING AND HOISTING EQUIPMENT CLASSIFICATIONS

GROUP 1: Engineer oiler; Fork lift operator (includes loed, lull or similar types)

GROUP 2: Truck crane oiler

GROUP 3: A-frame or winch truck operator; Ross carrier operator (jobsite)

GROUP 4: Bridge-type unloader and turntable operator; Helicopter hoist operator

GROUP 5: Hydraulic boom truck; Stinger crane (Austin-Western or similar type); Tugger hoist operator (1 drum)

GROUP 6: Bridge crane operator; Cretor crane operator; Hoist operator (Chicago boom and similar type); Lift mobile operator; Lift slab machine operator (Vagtborg and similar types); Material hoist and/or manlift operator; Polar gantry crane operator; Self Climbing scaffold (or similar type); Shovel, backhoe, dragline, clamshell operator (over 3/4 yd. and up to 5 cu. yds. mrc); Tugger hoist operator

GROUP 7: Pedestal crane operator; Shovel, backhoe, dragline, clamshell operator (over 5 cu. yds. mrc); Tower crane repair; Tugger hoist operator (3 drum)

GROUP 8: Crane operator (up to and including 25 ton capacity); Crawler transporter operator; Derrick barge operator (up to and including 25 ton capacity); Hoist operator, stiff legs, Guy derrick or similar type (up to and including 25 ton capacity); Shovel, backhoe, dragline, clamshell operator (over 7 cu. yds., M.R.C.)

GROUP 9: Crane operator (over 25 tons and up to and including 50 tons mrc); Derrick barge operator (over 25 tons up to and including 50 tons mrc); Highline cableway operator; Hoist operator, stiff legs, Guy derrick or similar type (over 25 tons up to and including 50 tons mrc); K-crane operator; Polar crane operator; Self erecting tower crane operator maximum lifting capacity ten tons

GROUP 10: Crane operator (over 50 tons and up to and including 100 tons mrc); Derrick barge operator (over 50 tons up to and including 100 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 50 tons up to and including 100 tons mrc), Mobile tower crane operator (over 50 tons, up to and including 100 tons M.R.C.); Tower crane operator and tower gantry

GROUP 11: Crane operator (over 100 tons and up to and including 200 tons mrc); Derrick barge operator (over 100 tons up to and including 200 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 100 tons up to and including 200 tons mrc); Mobile tower crane operator (over 100 tons up to and including 200 tons mrc)

GROUP 12: Crane operator (over 200 tons up to and including 300 tons mrc); Derrick barge operator (over 200 tons up to and including 300 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 200 tons, up to and including 300 tons mrc); Mobile tower crane operator (over 200 tons, up to and including 300 tons mrc)

GROUP 13: Crane operator (over 300 tons); Derrick barge operator (over 300 tons); Helicopter pilot; Hoist operator, stiff legs, Guy derrick or similar type (over 300 tons); Mobile tower crane operator (over 300 tons)

TUNNEL CLASSIFICATIONS

GROUP 1: Skiploader (wheel type up to 3/4 yd. without attachment)

GROUP 2: Power-driven jumbo form setter operator

GROUP 3: Dinkey locomotive or motorperson (up to and including 10 tons)

GROUP 4: Bit sharpener; Equipment greaser (grease truck); Slip form pump operator (power-driven hydraulic lifting device for concrete forms); Tugger hoist operator (1 drum); Tunnel locomotive operator (over 10 and up to and including 30 tons)

GROUP 5: Backhoe operator (up to and including 3/4 yd.); Small Ford, Case or similar; Drill doctor; Grouting machine operator; Heading shield operator; Heavy-duty repairperson; Loader operator (Athey, Euclid, Sierra and similar types); Mucking machine operator (1/4 yd., rubber-tired, rail or track type); Pneumatic concrete placing machine operator (Hackley-Presswell or similar type); Pneumatic heading shield (tunnel); Pumpcrete gun operator; Tractor compressor drill combination operator; Tugger hoist operator (2 drum); Tunnel locomotive operator (over 30 tons)

GROUP 6: Heavy Duty Repairman

GROUP 7: Tunnel mole boring machine operator

ENGINEERS ZONES

$1.00 additional per hour for all of IMPERIAL County and the portions of KERN, RIVERSIDE & SAN BERNARDINO Counties as defined below:

That area within the following Boundary: Begin in San Bernardino County, approximately 3 miles NE of the intersection of I-15 and the California State line at that point which is the NW corner of Section 1, T17N,m R14E, San Bernardino Meridian. Continue W in a straight line to that point which is the SW corner of the northwest quarter of Section 6, T27S, R42E, Mt. Diablo Meridian. Continue North to the intersection with the Inyo County Boundary at that point which is the NE corner of the western half of the northern quarter of Section 6, T25S, R42E, MDM. Continue W along the Inyo and San Bernardino County boundary until the intersection with Kern County, as that point which is the SE corner of Section 34, T24S, R40E, MDM. Continue W along the Inyo and Kern County boundary until the intersection with Tulare County, at that point which is the SW corner of the SE quarter of Section 32, T24S, R37E, MDM. Continue W along the Kern and Tulare County boundary, until that point which is the NW corner of T25S, R32E, MDM. Continue S following R32E lines to the NW corner of T31S, R32E, MDM. Continue W to the NW corner of T31S, R31E, MDM. Continue S to the SW corner of T32S, R31E, MDM. Continue W to SW corner of SE quarter of Section 34, T32S, R30E, MDM. Continue S to SW corner of T11N, R17W, SBM. Continue E along south boundary of T11N, SBM to SW corner of T11N, R7W, SBM. Continue S to SW corner of T9N, R7W, SBM. Continue E along south boundary of T9N, SBM to SW corner of T9N, R1E, SBM. Continue S along west boundary of R1E, SMB to Riverside County line at the SW corner of T1S, R1E, SBM. Continue E along south boundary of T1s, SBM (Riverside County Line) to SW corner of T1S, R10E, SBM. Continue S along west boundary of R10E, SBM to Imperial County line at the SW corner of T8S, R10E, SBM. Continue W along Imperial and Riverside county line to NW corner of T9S, R9E, SBM. Continue S along the boundary between Imperial and San Diego Counties, along the west edge of R9E, SBM to the south boundary of Imperial County/California state line. Follow the California state line west to Arizona state line, then north to Nevada state line, then continuing NW back to start at the point which is the NW corner of Section 1, T17N, R14E, SBM

$1.00 additional per hour for portions of SAN LUIS OBISPO, KERN, SANTA BARBARA & VENTURA as defined below:

That area within the following Boundary: Begin approximately 5 miles north of the community of Cholame, on the Monterey County and San Luis Obispo County boundary at the NW corner of T25S, R16E, Mt. Diablo Meridian. Continue south along the west side of R16E to the SW corner of T30S, R16E, MDM. Continue E to SW corner of T30S, R17E, MDM. Continue S to SW corner of T31S, R17E, MDM. Continue E to SW corner of T31S, R18E, MDM. Continue S along West side of R18E, MDM as it crosses into San Bernardino Meridian numbering area and becomes R30W. Follow the west side of R30W, SBM to the SW corner of T9N, R30W, SBM. Continue E along the south edge of T9N, SBM to the Santa Barbara County and Ventura County boundary at that point whch is the SW corner of Section 34.T9N, R24W, SBM, continue S along the Ventura County line to that point which is the SW corner of the SE quarter of Section 32, T7N, R24W, SBM. Continue E along the south edge of T7N, SBM to the SE corner to T7N, R21W, SBM. Continue N along East side of R21W, SBM to Ventura County and Kern County boundary at the NE corner of T8N, R21W. Continue W along the Ventura County and Kern County boundary to the SE corner of T9N, R21W. Continue North along the East edge of R21W, SBM to the NE corner of T12N, R21W, SBM. Continue

West along the north edge of T12N, SBM to the SE corner of T32S, R21E, MDM. [T12N SBM is a think strip between T11N SBM and T32S MDM]. Continue North along the East side of R21E, MDM to the Kings County and Kern County border at the NE corner of T25S, R21E, MDM, continue West along the Kings County and Kern County Boundary until the intersection of San Luis Obispo County. Continue west along the Kings County and San Luis Obispo County boundary until the intersection with Monterey County. Continue West along the Monterey County and San Luis Obispo County boundary to the beginning point at the NW corner of T25S, R16E, MDM.

$2.00 additional per hour for INYO and MONO Counties and the Northern portion of SAN BERNARDINO County as defined below:

That area within the following Boundary: Begin at the intersection of the northern boundary of Mono County and the California state line at the point which is the center of Section 17, T10N, R22E, Mt. Diablo Meridian. Continue S then SE along the entire western boundary of Mono County, until it reaches Inyo County at the point which is the NE corner of the Western half of the NW quarter of Section 2, T8S, R29E, MDM. Continue SSE along the entire western boundary of Inyo County, until the intersection with Kern County at the point which is the SW corner of the SE 1/4 of Section 32, T24S, R37E, MDM. Continue E along the Inyo and Kern County boundary until the intersection with San Bernardino County at that point which is the SE corner of section 34, T24S, R40E, MDM. Continue E along the Inyo and San Bernardino County boundary until the point which is the NE corner of the Western half of the NW quarter of Section 6, T25S, R42E, MDM. Continue S to that point which is the SW corner of the NW quarter of Section 6, T27S, R42E, MDM. Continue E in a straight line to the California and Nevada state border at the point which is the NW corner of Section 1, T17N, R14E, San Bernardino Meridian. Then continue NW along the state line to the starting point, which is the center of Section 18, T10N, R22E, MDM.

REMAINING AREA NOT DEFINED ABOVE RECIEVES BASE RATE

ENGI0012-004 08/05/2013

	Rates	Fringes
OPERATOR: Power Equipment (DREDGING)		
(1) Leverman	$ 47.70	21.20
(2) Dredge dozer	$ 41.73	21.20
(3) Deckmate	$ 41.62	21.20
(4) Winch operator (stern winch on dredge)	$ 41.07	21.20
(5) Fireman-Oiler, Deckhand, Bargeman, Leveehand	$ 40.53	21.20
(6) Barge Mate	$ 41.14	21.20

IRON0377-002 07/01/2013

	Rates	Fringes
Ironworkers:		
Fence Erector	$ 26.58	17.74
Ornamental, Reinforcing and Structural	$ 33.00	26.30

PREMIUM PAY:

$6.00 additional per hour at the following locations:

China Lake Naval Test Station, Chocolate Mountains Naval Reserve-Niland,
Edwards AFB, Fort Irwin Military Station, Fort Irwin Training Center-Goldstone, San Clemente Island, San Nicholas Island, Susanville Federal Prison, 29 Palms - Marine Corps, U.S. Marine Base - Barstow, U.S. Naval Air Facility - Sealey, Vandenberg AFB

$4.00 additional per hour at the following locations:

Army Defense Language Institute - Monterey, Fallon Air Base, Naval Post Graduate School - Monterey, Yermo Marine Corps Logistics Center

$2.00 additional per hour at the following locations:

Port Hueneme, Port Mugu, U.S. Coast Guard Station - Two Rock

LABO0300-001 07/01/2013

	Rates	Fringes
Brick Tender	$ 28.37	15.78

LABO0300-003 07/01/2013

	Rates	Fringes
LABORER (TUNNEL)		
GROUP 1	$ 34.84	16.02
GROUP 2	$ 35.16	16.02
GROUP 3	$ 35.62	16.02
GROUP 4	$ 36.31	16.02
LABORER		
GROUP 1	$ 28.99	16.02
GROUP 2	$ 29.54	16.02
GROUP 3	$ 30.09	16.02
GROUP 4	$ 31.64	16.02
GROUP 5	$ 31.99	16.02

LABORER CLASSIFICATIONS

GROUP 1: Cleaning and handling of panel forms; Concrete screeding for rough strike-off; Concrete, water curing; Demolition laborer, the cleaning of brick if performed by a worker performing any other phase of demolition work, and the cleaning of lumber; Fire watcher, limber, brush loader, piler and debris handler; Flag person; Gas, oil and/or water pipeline laborer; Laborer, asphalt-rubber material loader; Laborer, general or construction; Laborer, general clean-up; Laborer, landscaping; Laborer, jetting; Laborer, temporary water and air lines; Material hose operator (walls, slabs, floors and decks); Plugging, filling of shee bolt holes; Dry packing of concrete; Railroad maintenance, repair track person and road beds; Streetcar and railroad construction track laborers; Rigging and signaling; Scaler; Slip form raiser; Tar and mortar; Tool crib or tool house laborer; Traffic control by any method; Window cleaner; Wire mesh pulling - all concrete pouring operations

GROUP 2: Asphalt shoveler; Cement dumper (on 1 yd. or larger mixer and handling bulk cement); Cesspool digger and installer; Chucktender; Chute handler, pouring concrete, the handling of the chute from readymix trucks, such as walls, slabs, decks, floors, foundation, footings, curbs, gutters and sidewalks; Concrete curer, impervious membrane and form oiler; Cutting torch operator (demolition); Fine grader, highways and street paving, airport, runways and similar type heavy construction; Gas, oil and/or water pipeline wrapper - pot tender and form person; Guinea chaser; Headerboard person - asphalt; Laborer, packing rod steel and pans; Membrane vapor barrier installer; Power broom sweeper (small); Riprap stonepaver, placing stone or wet sacked concrete; Roto scraper and tiller; Sandblaster (pot tender); Septic tank digger and installer(lead); Tank scaler and cleaner; Tree climber, faller, chain saw operator, Pittsburgh chipper and similar type brush shredder; Underground laborer, including caisson bellower

GROUP 3: Buggymobile person; Concrete cutting torch; Concrete pile cutter; Driller, jackhammer, 2-1/2 ft. drill steel or longer; Dri-pak-it machine; Gas, oil and/or water pipeline wrapper, 6-in. pipe and over, by any method, inside and out; High scaler (including drilling of same); Hydro seeder and similar type; Impact wrench multi-plate; Kettle person, pot person and workers applying asphalt, lay-kold, creosote, lime caustic and similar type materials ("applying" means applying, dipping, brushing or handling of such materials for pipe wrapping and waterproofing); Operator of pneumatic, gas, electric tools, vibrating machine, pavement breaker, air blasting, come-alongs, and similar mechanical tools not separately classified herein; Pipelayer's backup person, coating, grouting, making of joints, sealing, caulking, diapering and including rubber gasket joints, pointing and any and all other services; Rock slinger; Rotary scarifier or multiple head concrete chipping scarifier; Steel headerboard and guideline setter; Tamper, Barko, Wacker and similar type; Trenching machine, hand-propelled

GROUP 4: Asphalt raker, lute person, ironer, asphalt dump person, and asphalt spreader boxes (all types); Concrete core cutter (walls, floors or ceilings), grinder or sander; Concrete saw person, cutting walls or flat work, scoring old or new concrete; Cribber, shorer, lagging, sheeting and trench bracing, hand-guided lagging hammer; Head rock slinger; Laborer, asphalt- rubber distributor boot person;

Laser beam in connection with laborers' work; Oversize concrete vibrator operator, 70 lbs. and over; Pipelayer performing all services in the laying and installation of pipe from the point of receiving pipe in the ditch until completion of operation, including any and all forms of tubular material, whether pipe, metallic or non-metallic, conduit and any other stationary type of tubular device used for the conveying of any substance or element, whether water, sewage, solid gas, air, or other product whatsoever and without regard to the nature of material from which the tubular material is fabricated; No-joint pipe and stripping of same; Prefabricated manhole installer; Sandblaster (nozzle person), water blasting, Porta Shot-Blast

GROUP 5: Blaster powder, all work of loading holes, placing and blasting of all powder and explosives of whatever type, regardless of method used for such loading and placing; Driller: All power drills, excluding jackhammer, whether core, diamond, wagon, track, multiple unit, and any and all other types of mechanical drills without regard to the form of motive power; Toxic waste removal

TUNNEL LABORER CLASSIFICATIONS

GROUP 1: Batch plant laborer; Bull gang mucker, track person; Changehouse person; Concrete crew, including rodder and spreader; Dump person; Dump person (outside); Swamper (brake person and switch person on tunnel work); Tunnel materials handling person

GROUP 2: Chucktender, cabletender; Loading and unloading agitator cars; Nipper; Pot tender, using mastic or other materials (for example, but not by way of limitation, shotcrete, etc.); Vibrator person, jack hammer, pneumatic tools (except driller)

GROUP 3: Blaster, driller, powder person; Chemical grout jet person; Cherry picker person; Grout gun person; Grout mixer person; Grout pump person; Jackleg miner; Jumbo person; Kemper and other pneumatic concrete placer operator; Miner, tunnel (hand or machine); Nozzle person; Operating of troweling and/or grouting machines; Powder person (primer house); Primer person; Sandblaster; Shotcrete person; Steel form raiser and setter; Timber person, retimber person, wood or steel; Tunnel Concrete finisher

GROUP 4: Diamond driller; Sandblaster; Shaft and raise work

LABO0300-005 01/01/2014

	Rates	Fringes
Asbestos Removal Laborer.........	$ 28.00	15.25

SCOPE OF WORK: Includes site mobilization, initial site cleanup, site preparation, removal of asbestos-containing material and toxic waste, encapsulation, enclosure and disposal of asbestos- containing materials and toxic waste by hand or with equipment or machinery; scaffolding, fabrication of temporary wooden barriers and assembly of decontamination stations.

LABO0345-001 07/01/2013

	Rates	Fringes
LABORER (GUNITE)		
GROUP 1	$ 33.04	17.86
GROUP 2	$ 32.09	17.86
GROUP 3	$ 28.55	17.86

FOOTNOTE: GUNITE PREMIUM PAY: Workers working from a Bosn'n's Chair or suspended from a rope or cable shall receive 40 cents per hour above the foregoing applicable classification rates. Workers doing gunite and/or shotcrete work in a tunnel shall receive 35 cents per hour above the foregoing applicable classification rates, paid on a portal-to-portal basis. Any work performed on, in or above any smoke stack, silo, storage elevator or similar type of structure, when such structure is in excess of 75'-0" above base level and which work must be performed in whole or in part more than 75'-0" above base level, that work performed above the 75'-0" level shall be compensated for at 35 cents per hour above the applicable classification wage rate.

GUNITE LABORER CLASSIFICATIONS

GROUP 1: Rodmen, Nozzlemen

GROUP 2: Gunmen

GROUP 3: Reboundmen

LABO1184-001 07/01/2013

	Rates	Fringes
Laborers: (HORIZONTAL DIRECTIONAL DRILLING)		
(1) Drilling Crew Laborer	$ 30.11	11.83
(2) Vehicle Operator/Hauler	$ 30.28	11.83
(3) Horizontal Directional Drill Operator	$ 32.13	11.83
(4) Electronic Tracking Locator	$ 34.13	11.83
Laborers: (STRIPING/SLURRY SEAL)		
GROUP 1	$ 31.06	14.53
GROUP 2	$ 32.36	14.53
GROUP 3	$ 34.37	14.53
GROUP 4	$ 36.11	14.53

LABORERS - STRIPING CLASSIFICATIONS

GROUP 1: Protective coating, pavement sealing, including repair and filling of cracks by any method on any surface in parking lots, game courts and playgrounds; carstops; operation of all related machinery and equipment; equipment repair technician

GROUP 2: Traffic surface abrasive blaster; pot tender - removal of all traffic lines and markings by any method (sandblasting, waterblasting, grinding, etc.) and preparation of surface for coatings. Traffic control person: controlling and directing traffic through both conventional and moving lane closures; operation of all related machinery and equipment

GROUP 3: Traffic delineating device applicator: Layout and application of pavement markers, delineating signs, rumble and traffic bars, adhesives, guide markers, other traffic delineating devices including traffic control. This category includes all traffic related surface preparation (sandblasting, waterblasting, grinding) as part of the application process. Traffic protective delineating system installer: removes, relocates, installs, permanently affixed roadside and parking delineation barricades, fencing, cable anchor, guard rail, reference signs, monument markers; operation of all related machinery and equipment; power broom sweeper

GROUP 4: Striper: layout and application of traffic stripes and markings; hot thermo plastic; tape traffic stripes and markings, including traffic control; operation of all related machinery and equipment

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LABO1414-001 08/07/2013

	Rates	Fringes
LABORER		
PLASTER CLEAN-UP LABORER....	$ 27.45	16.36
PLASTER TENDER.............	$ 30.00	16.36

Work on a swing stage scaffold: $1.00 per hour additional.

PAIN0036-001 01/01/2014

	Rates	Fringes
Painters: (Including Lead Abatement)		
(1) Repaint (excludes San Diego County)...............	$ 26.49	11.73
(2) All Other Work..........	$ 29.82	11.73

REPAINT of any previously painted structure. Exceptions: work involving the aerospace industry, breweries, commercial recreational facilities, hotels which operate commercial establishments as part of hotel service, and sports facilities.

PAIN0036-006 01/01/2014

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                                  Rates          Fringes

DRYWALL FINISHER/TAPER
     Antelope Valley North of
     the following Boundary:
     Kern County Line to Hwy.
     #5, South of Hwy. #5 to
     Hwy. N2, East on N2 to
     Palmdale Blvd., to Hsy.
     #14, South to Hwy. #18,
     East to Hwy. #395...........$ 29.83            15.41
     Remainder of Los Angeles
     County......................$ 34.03            15.41
----------------------------------------------------------------
 PAIN0036-015 02/01/2014

                                  Rates          Fringes

GLAZIER..........................$ 38.95            22.08

  FOOTNOTE:  Additional $1.25 per hour for work in a condor,
  from the third (3rd) floor and up  Additional $1.25 per
  hour for work on the outside  of the building from a swing
  stage or any suspended contrivance, from the ground up

----------------------------------------------------------------
* PAIN1247-002 01/01/2014

                                  Rates          Fringes

SOFT FLOOR LAYER.................$ 29.85            12.56
----------------------------------------------------------------
 PLAS0200-009 08/07/2013

                                  Rates          Fringes

PLASTERER........................$ 36.11            13.13
----------------------------------------------------------------
 PLAS0500-002 07/01/2013

                                  Rates          Fringes

CEMENT MASON/CONCRETE FINISHER...$ 30.85            21.00
----------------------------------------------------------------
 PLUM0016-001 07/01/2013

                                  Rates          Fringes

PLUMBER/PIPEFITTER
     Plumber and Pipefitter
      All other work except
      work on new additions and
      remodeling of bars,
      restaurant, stores and
      commercial buildings not
      to exceed 5,000 sq. ft.
      of floor space and work
      on strip malls, light
      commercial, tenant
      improvement and remodel
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```
      work......................$ 43.60           20.16
     Work ONLY on new additions
     and remodeling of bars,
     restaurant, stores and
     commercial buildings not
     to exceed 5,000 sq. ft. of
     floor space................$ 42.26           19.18
     Work ONLY on strip malls,
     light commercial, tenant
     improvement and remodel
     work.......................$ 34.11           17.51
----------------------------------------------------------------
 PLUM0345-001 01/01/2014

                                  Rates          Fringes

PLUMBER
     Landscape/Irrigation Fitter.$ 28.56           19.55
     Sewer & Storm Drain Work....$ 32.50           17.23
----------------------------------------------------------------
 ROOF0036-002 08/01/2012

                                  Rates          Fringes

ROOFER...........................$ 34.65           11.38

  FOOTNOTE: Pitch premium: Work on which employees are exposed
  to pitch fumes or required to handle pitch, pitch base or
  pitch impregnated products, or any material containing coal
  tar pitch, the entire roofing crew shall receive $1.75 per
  hour "pitch premium" pay.

----------------------------------------------------------------
 SFCA0669-013 07/01/2013

DOES NOT INCLUDE THE CITY OF POMONA, CATALINA ISLAND, AND THAT
PART OF LOS ANGELES COUNTY WITHIN 25 MILES OF THE CITY LIMITS
OF LOS ANGELES:


                                  Rates          Fringes

SPRINKLER FITTER.................$ 34.19           19.37
----------------------------------------------------------------
 SFCA0709-005 01/01/2014

THE CITY OF POMOMA, CATALINA ISLAND, AND THAT PART OF LOS
ANGELES COUNTY WITHIN 25 MILES OF THE CITY LIMITS OF LOS
ANGELES:


                                  Rates          Fringes

SPRINKLER FITTER (Fire)..........$ 40.61           24.02
----------------------------------------------------------------
 SHEE0105-002 01/01/2014

LOS ANGELES (South of a straight line between gorman and Big
Pines including Catalina Island)
```

	Rates	Fringes
SHEET METAL WORKER		
(1) Light Commercial: Work on general sheet metal and heating and AC up to 4000 sq ft	$ 24.47	8.65
(2) Modernization : Excluding New Construction - Under 5000 sq. ft. Does not include modification, upgrades, energy management, or conservation improvements of central heating and AC equpment	$ 40.79	22.88

SHEE0105-003 01/01/2014

LOS ANGELES (South of a straight line drawn between Gorman and Big Pines)and Catalina Island, INYO, KERN (Northeast part, East of Hwy 395), MONO ORANGE, RIVERSIDE, AND SAN BERNARDINO COUNTIES

	Rates	Fringes
SHEET METAL WORKER		
(1) Commercial - New Construction and Remodel work	$ 40.79	22.88
(2) Industrial work including air pollution control systems, noise abatement, hand rails, guard rails, excluding aritechtural sheet metal work, excluding A-C, heating, ventilating systems for human comfort	$ 40.79	22.88

SHEE0105-004 01/01/2014

KERN (Excluding portion East of Hwy 395) & LOS ANGELES (North of a straight line drawn between Gorman and Big Pines including Cities of Lancaster and Palmdale) COUNTIES

	Rates	Fringes
SHEET METAL WORKER	$ 31.08	22.64

TEAM0011-002 07/01/2013

	Rates	Fringes
TRUCK DRIVER		
GROUP 1	$ 27.59	22.69
GROUP 2	$ 27.74	22.69
GROUP 3	$ 27.87	22.69

GROUP 4	$ 28.06	22.69
GROUP 5	$ 28.09	22.69
GROUP 6	$ 28.12	22.69
GROUP 7	$ 28.37	22.69
GROUP 8	$ 28.62	22.69
GROUP 9	$ 28.82	22.69
GROUP 10	$ 29.12	22.69
GROUP 11	$ 29.62	22.69
GROUP 12	$ 30.05	22.69

WORK ON ALL MILITARY BASES:
PREMIUM PAY: $3.00 per hour additional.
[29 palms Marine Base, Camp Roberts, China Lake, Edwards AFB, El Centro Naval Facility, Fort Irwin, Marine Corps Logistics Base at Nebo & Yermo, Mountain Warfare Training Center, Bridgeport, Point Arguello, Point Conception, Vandenberg AFB]

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1: Truck driver

GROUP 2: Driver of vehicle or combination of vehicles - 2 axles; Traffic control pilot car excluding moving heavy equipment permit load; Truck mounted broom

GROUP 3: Driver of vehicle or combination of vehicles - 3 axles; Boot person; Cement mason distribution truck; Fuel truck driver; Water truck - 2 axle; Dump truck, less than 16 yds. water level; Erosion control driver

GROUP 4: Driver of transit mix truck, under 3 yds.; Dumpcrete truck, less than 6-1/2 yds. water level

GROUP 5: Water truck, 3 or more axles; Truck greaser and tire person ($0.50 additional for tire person); Pipeline and utility working truck driver, including winch truck and plastic fusion, limited to pipeline and utility work; Slurry truck driver

GROUP 6: Transit mix truck, 3 yds. or more; Dumpcrete truck, 6-1/2 yds. water level and over; Vehicle or combination of vehicles - 4 or more axles; Oil spreader truck; Dump truck, 16 yds. to 25 yds. water level

GROUP 7: A Frame, Swedish crane or similar; Forklift driver; Ross carrier driver

GROUP 8: Dump truck, 25 yds. to 49 yds. water level; Truck repair person; Water pull - single engine; Welder

GROUP 9: Truck repair person/welder; Low bed driver, 9 axles or over

GROUP 10: Dump truck - 50 yds. or more water level; Water pull - single engine with attachment

GROUP 11: Water pull - twin engine; Water pull - twin engine with attachments; Winch truck driver - $1.25 additional when operating winch or similar special attachments

GROUP 12: Boom Truck 17K and above

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

==

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is union or non-union.

Union Identifiers

An identifier enclosed in dotted lines beginning with characters other than "SU" denotes that the union classification and rate have found to be prevailing for that classification. Example: PLUM0198-005 07/01/2011. The first four letters , PLUM, indicate the international union and the four-digit number, 0198, that follows indicates the local union number or district council number where applicable , i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2011, following these characters is the effective date of the most current negotiated rate/collective bargaining agreement which would be July 1, 2011 in the above example.

Union prevailing wage rates will be updated to reflect any changes in the collective bargaining agreements governing the rates.

0000/9999: weighted union wage rates will be published annually each January.

Non-Union Identifiers

Classifications listed under an "SU" identifier were derived from survey data by computing average rates and are not union rates; however, the data used in computing these rates may include both union and non-union data. Example: SULA2004-007 5/13/2010. SU indicates the rates are not union majority rates, LA indicates the State of Louisiana; 2004 is the year of the survey; and 007 is an internal number used in producing the wage determination. A 1993 or later date, 5/13/2010, indicates the classifications and rates under that identifier were issued as a General Wage Determination on that date.

Survey wage rates will remain in effect and will not change until a new survey is conducted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 11
Estimated Production Rates

April 2015

TITLE:	Los Angeles River Ecosystem Restoration		
SUBJECT:	Output Rates for Excavation		
MADE BY:	SKV	JOB NO.:	T26313
CHECKED BY:		DATE:	3/24/2014

CSI TASK:

CHANNEL BANK EXCAVATION

CREW: *Excavation Crew [2-cy Hydraul. Exc.]* — 2 crew members

1 Equip. Oper. Heavy
1 Oiler
1 Hydraul. Excavator, 2-cy Bucket

PRODUCTION

2.0	cy bucket
0.85	% fill
55	min/hr
1.00	cycle/min

94 cy/crew hr

EXCAVATION, EMBANKMENTS

CREW: *Excavation Crew [scraper]* — 2 crew members

1 Equip. Oper. Heavy
1 Oiler
1 28-cy Scraper

PRODUCTION

28.0	cy bucket
0.85	% fill
55	min/hr
0.15	cycle/min

196 cy/crew hr

EXCAVATION, SPALLS

CREW: *Excavation Crew [2-cy Hydraul. Exc.]* — 2 crew members

1 Equip. Oper. Heavy
1 Oiler
1 Hydraul. Excavator, 2-cy Bucket

PRODUCTION

2.0	cy bucket
0.85	% fill
55	min/hr
0.90	cycle/min

84 cy/crew hr

TITLE:	Los Angeles River Ecosystem Restoration		
SUBJECT:	Output Rates for Excavation		
MADE BY:	SKV	JOB NO.:	T26313
CHECKED BY:		DATE:	3/24/2014

EXCAVATION, STORM DRAIN

CREW: *Excavation Crew [2-cy Hydraul. Exc.]* — 2 crew members

1 Equip. Oper. Heavy
1 Oiler
1 Hydraul. Excavator, 2-cy Bucket

PRODUCTION

2.0	cy bucket
0.85	% fill
55	min/hr
0.70	cycle/min

65 cy/crew hr

EXCAVATE BASE LAYER
[Staging/Access Areas]

CREW: *Staging/Access Excavation Crew* — 1.5 crew members

1 Equip. Oper. Heavy
0.5 Laborer
1 Hydraul. Excavator, 2-cy Bucket

PRODUCTION

2.0	cy bucket
0.85	% fill
55	min/hr
1.00	cycle/min

94 cy/crew hr

TITLE:	Los Angeles River Ecosystem Restoration		
SUBJECT:	Output Rates for Excavation		
MADE BY:	SKV	JOB NO.:	T26313
CHECKED BY:		DATE:	3/24/2014

CSI TASK:

LOAD AND HAUL TO DISPOSAL
[3-cy Loader, 20-cy Dump Truck, 20 Mile Haul, 35-mph Avg.]

CREW NAME: *Excavate, Load and Haul Crew* — 18 crew members

1	Eq. Oper. Heavy
1	Oilers
16	Truck Driver, Heavy
1	Front End Loader, 3-cy Bucket
16	12-cy Dump Trucks

OVERALL PRODUCTION RATE — **255 cy/crew hr**

LOADING

SUB-CREW: Loading Crew — 2 crew members

1	Equip. Oper. Heavy
1	Oiler
1	Front End Loader, 3-cy Bucket

PRODUCTION

3	cy bucket
0.85	% fill
50	min/hr
2.00	cycle/min

255 cy/crew hr — 255 cy/crew hr

1.00 crews/equipment members to match overall production rate

1.00 total number of crews needed

HAUL TO DISPOSAL SITE

SUB-CREW:		Truck Haul Crew	1 crew members
	1	Truck Driver, Heavy	
	1	20-cy Dump Truck	

PRODUCTION

	20	cy truck
	0.95	% fill
	4.7	min. for loading
	20	mi. to disposal location
	35	mph haul speed
	2.4	min. dump time
	55	min/hr
QUANTITY PER TRUCK	19.0	cy/truck
DURATION OF HAULING	1.38	hr

13.8 cy/hr

16.00 Number of truck crews required to have little or no back up on route

TITLE:	Los Angeles River Ecosystem Restoration		
SUBJECT:	Output Rates for Fill and Compact From Stockpile		
MADE BY:	SKV	JOB NO.:	T26313
CHECKED BY:		DATE:	3/24/2014

CSI TASK:

FILL AND COMPACT FROM STOCKPILE
[300-ft Haul , 3-cy Bucket, Vibro Compacted, with 3,000-gal Water Truck]

CREW NAME: *Fill and Compact from Stockpile Crew* — 5 crew members

3 Eq. Oper. Med.
1 Laborers
1 Truck Driver, Heavy
1 Dozer
1 Front End Loader 3-cy Bucket
1 Vibratory Roller
1 Dozer
1 Water Truck, 3000-gal

OVERALL PRODUCTION RATE — **102 cy/crew hr**

FILL FROM STOCKPILE

SUB-CREW: Fill From Stockpile Crew — 3 crew members

2 Eq. Oper. Med.
0.5 Laborer
1 Dozer
1 Front End Loader, 3-cy Bucket

PRODUCTION

3 cy bucket (avg.)
0.85 % fill
50 min/hr
0.80 cycle/min

102 cy/crew hr

COMPACT FILL

SUB-CREW: Compaction Crew — 1.5 crew members

0.5 laborer
1 Equip. Oper. Medium
1 Vibratory Roller

PRODUCTION 0.24 min/cy — 250 cy/hr

0.41 crews/equipment members to match overall production rate

1.00 total number of crews needed

WATER TRUCK

SUB-CREW:		Water Truck Crew	1 crew members
	1	Truck Driver, Heavy	
	1	Water Truck, 3000-gal	
PRODUCTION	0.48	min/cy	125 cy/hr
	0.82	crews/equipment members to match overall production rate	
	1.00	total number of crews needed	

TITLE:	Los Angeles River Ecosystem Restoration			
SUBJECT:	Output Rates for Topsoil Placement			
MADE BY:	SKV		JOB NO.:	T26313
CHECKED BY:			DATE:	3/24/2014

CSI TASK:

TOP SOIL, PLACEMENT

CREW NAME: *Fill and Compact from Stockpile Crew* — 5 crew members

3 Eq. Oper. Med.
1 Laborers
1 Truck Driver, Heavy
1 Dozer
1 Front End Loader 3-cy Bucket
1 Vibratory Roller
1 Dozer
2 Water Truck, 3000-gal

OVERALL PRODUCTION RATE — **159 cy/crew hr** →

FILL FROM STOCKPILE

SUB-CREW: Fill From Stockpile Crew — 3 crew members

2 Eq. Oper. Med.
0.5 Laborer
1 Dozer
1 Front End Loader, 3-cy Bucket

PRODUCTION

3 cy bucket (avg.)
0.85 % fill
50 min/hr
1.25 cycle/min

159 cy/crew hr →

COMPACT FILL

SUB-CREW: Compaction Crew — 1.5 crew members

0.5 laborer
1 Equip. Oper. Medium
1 Vibratory Roller

PRODUCTION 0.24 min/cy — 250 cy/hr →

0.64 crews/equipment members to match overall production rate

1.00 total number of crews needed

TITLE:	Los Angeles River Ecosystem Restoration		
SUBJECT:	Output Rates for Topsoil Placement		
MADE BY:	SKV	JOB NO.:	T26313
CHECKED BY:		DATE:	3/24/2014

WATER TRUCK

SUB-CREW: Water Truck Crew — 1 crew members
1 Truck Driver, Heavy
1 Water Truck, 3000-gal

PRODUCTION 0.48 min/cy — 125 cy/hr

1.28 crews/equipment members to match overall production rate

2.00 total number of crews needed

TITLE:	Los Angeles River Ecosystem Restoration		
SUBJECT:	Output Rates for Stone Placement		
MADE BY:	SKV	JOB NO.:	T26313
CHECKED BY:		DATE:	3/24/2014

CSI TASK:

AGGREGATE BASE, PLACEMENT

CREW: *Aggregate Base Crew* — 5 crew members

3 Equip. Oper. Medium
1 Labor Foreman
1 Laborer
1 Front End Loader, 3-cy Bucket
1 Vibratory Roller
1 Grader

3	cy bucket
0.90	% fill
55	min/hr
0.75	cycle/min

OVERALL PRODUCTION RATE — **111 cy/hr**

RIPRAP PLACEMENT

CREW: *Rip Rap Placement Crew* — 5 crew members

1 Equip. Oper. Heavy
1 Oiler
1 Labore Foreman
2 Laborers
1 3-cy Hydraul. Excavator

3	cy bucket
0.60	% fill
50	min/hr
0.33	cycle/min

OVERALL PRODUCTION RATE — **30 cy/hr**

TIE-IN STONE, PLACEMENT

CREW: *Tie-In Stone Crew* — 5 crew members

1 Equip. Oper. Heavy
1 Oiler
1 Labore Foreman
2 Laborers
1 1.5-cy Hydraul. Excavator

1.5	cy bucket
0.75	% fill
50	min/hr
0.60	cycle/min

OVERALL PRODUCTION RATE — **34 cy/hr**

TITLE:	Los Angeles River Ecosystem Restoration			
SUBJECT:	Output Rates for Stone Placement			
MADE BY:	SKV		JOB NO.:	T26313
CHECKED BY:			DATE:	3/24/2014

CSI TASK:

DECOMPOSED GRANITE, PLACEMENT

CREW: *Decomposed Granite Crew* — 6 crew members

2 Equip. Oper. Medium
1 Truck Driver, Heavy
1 Labor Foreman
2 Laborers
1 Front End Loader, 3-cy Bucket
1 Drum Roller
1 Water Truck

3	cy bucket
0.75	% fill
50	min/hr
0.28	cycle/min
9.0	in. thick

OVERALL PRODUCTION RATE — **1114 sf/hr**

TITLE:	Los Angeles River Ecosystem Restoration		
SUBJECT:	Output Rates for Demolition Items		
MADE BY:	SKV	JOB NO.:	T26313
CHECKED BY:		DATE:	3/24/2014

CSI TASK:

DEMO CONCRETE, REINFORCED

CREW: *Concrete Demo Crew* — 5 crew members

1 Labor Foreman
2 Laborers
1 Equip. Oper. Light
1 Equip. Oper. Med.
1 2.5-cy Hydraul. Excavator
1 3.5-cy Front End Loader

30.00 min/cy

OVERALL PRODUCTION RATE **2.0 cy/hr**

DEMO ASPHALT, ACCESS ROAD

CREW: *Concrete Demo Crew* — 5 crew members

1 Labor Foreman
2 Laborers
1 Equip. Oper. Light
1 Equip. Oper. Med.
1 2.5-cy Hydraul. Excavator
1 3.5-cy Front End Loader

24.00 min/cy

OVERALL PRODUCTION RATE **2.5 cy/hr**

CHAIN LINK FENCE, DEMOLITION

CREW: *Concrete Demo Crew* — 3 crew members

2 Laborers
1 Equip. Oper. Light
1 Backhoe

1.20 min/lf

OVERALL PRODUCTION RATE **50.0 lf/hr**

TITLE:	Los Angeles River Ecosystem Restoration		
SUBJECT:	Output Rates for Loading and Hauling Concrete		
MADE BY:	SKV	JOB NO.:	T26313
CHECKED BY:		DATE:	3/24/2014

CSI TASK:

CONCRETE LOAD AND HAUL
16-cy Dump Truck, 10-mile Haul, 35-mph Avg.

CREW: *Concrete Load and Haul Crew* — 6 crew members

1	Equip. Oper. Heavy
1	Oiler
4	Truck Driver, Heavy
1	Front End Loader, 3-cy Bucket
4	12-cy Dump Truck

OVERALL PRODUCTION RATE → **75 cy/crew hr**

LOADING

SUB-CREW: Loading Crew — 2 crew members

1	Equip. Oper. Heavy
1	Oiler
1	Front End Loader, 3-cy Bucket

PRODUCTION

3	cy bucket
0.50	% fill
50	min/hr
1.00	cycle/min
75	cy/crew hr

→ 75 cy/crew hr

HAUL TO DISPOSAL SITE

SUB-CREW:		Truck Haul Crew	1 crew members
	1	Truck Driver, Heavy	
	1	16-cy Dump Truck	

PRODUCTION

16	cy truck
0.80	% fill
12.8	min. for loading
10	mi. to disposal location
35	mph haul speed
6.4	min. dump time
55	min/hr

QUANTITY PER TRUCK 12.8 cy/truck

DURATION OF HAULING 0.97 hr

13.2 cy/hr →

4.00 Number of truck crews required to have little or no back up on route

TITLE:	Los Angeles River Ecosystem Restoration		
SUBJECT:	Output Rates for Clearing and Grubbing		
MADE BY:	SKV	JOB NO.:	T26313
CHECKED BY:		DATE:	3/24/2014

Sheet No. 1 of 1

CSI TASK:

CLEARING AND GRUBBING
[Medium Brush Including Trees]

CREW:	*Clear and Grub Crew*	3 crew members
	2 Laborer	
	1 Equip. Oper. Medium	
	1 Dozer with Land Clearing Equip.	
PRODUCTION	480.00 min/acre	
OVERALL PRODUCTION RATE		**0.125 acre/hr**

CLEARING AND GRUBBING
[For Trails]

CREW:	*Clear and Grub Crew*	3 crew members
	2 Laborer	
	1 Equip. Oper. Medium	
	1 Dozer with Land Clearing Equip.	
PRODUCTION	0.25 min/sy	
OVERALL PRODUCTION RATE		**2160 sf/hr**

TITLE:	Los Angeles River Ecosystem Restoration		
SUBJECT:	Output Rates for Fill and Compact From Stockpile		
MADE BY:	SKV	JOB NO.:	T26313
CHECKED BY:		DATE:	3/24/2014

CSI TASK:

TOP SOIL PLACEMENT

CREW NAME: *Fill and Compact from Stockpile Crew* — 5 crew members

2 Eq. Oper. Med.
2 Laborers
1 Truck Driver, Heavy
1 Dozer
1 Front End Loader 6-cy Bucket
1 Dozer
2 Water Truck, 3000-gal

OVERALL PRODUCTION RATE — **159 cy/crew hr**

FILL FROM STOCKPILE

SUB-CREW: Fill From Stockpile Crew — 3 crew members

2 Eq. Oper. Med.
2 Laborer
1 Dozer
1 Front End Loader, 3-cy Bucket

PRODUCTION

3	cy bucket (avg.)
0.85	% fill
50	min/hr
1.25	cycle/min

159 cy/crew hr

WATER TRUCK

SUB-CREW: Water Truck Crew — 1 crew members

1 Truck Driver, Heavy
1 Water Truck, 3000-gal

PRODUCTION 0.48 min/cy — 125 cy/hr

1.28 crews/equipment members to match overall production rate

2.00 total number of crews needed

TITLE:	Los Angeles River Ecosystem Restoration			
SUBJECT:	Output Rates for Vegetation			
MADE BY:	SKV		JOB NO.:	T26313
CHECKED BY:			DATE:	3/24/2014

CSI TASK:

SHRUBS

CREW:	Planting Crew	2 crew members
	2 Laborers	
PRODUCTION	5.00 min/ea per person	
OVERALL PRODUCTION RATE		24 ea/hr

TREES

CREW:	Planting Crew	2 crew members
	2 Laborers	
	1 Pickup Truck	
PRODUCTION	12.00 min/ea	
OVERALL PRODUCTION RATE		5 ea/hr

TITLE:	Los Angeles River Ecosystem Restoration		
SUBJECT:	Output Rates for Utility Tower Work		
MADE BY:	SKV	JOB NO.:	T26313
CHECKED BY:		DATE:	3/24/2014

CSI TASK:

TRANSMISSION TOWER DEMOLITION

CREW:		Steel Lattice Tower Crew	12 crew members
	6	Laborers	
	5	Electricians	
	1	Foreman	
	2	Crane	

PRODUCTION 40.00 hr/ea

OVERALL PRODUCTION RATE **0.025 ea/hr**

US Army Corps of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 12
Cost and Schedule Risk Analysis (CSRA)

April 2015

NATIONAL ECOSYSTEM RESTORATION PLAN – ALTERNATIVE 13v

COST AND SCHEDULE RISK ANALYSIS

US Army Corps
of Engineers®

Los Angeles District

Los Angeles River Ecosystem Restoration

Feasibility Study

DRAFT
Cost and Schedule Risk Analysis Report
National Ecosystem Restoration Plan
Alternative 13v

March 2015

TETRA TECH

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EXECUTIVE SUMMARY

This report presents a recommendation for the total project cost and schedule contingency for the Los Angeles River Ecosystem Restoration Project. A formal risk analysis study was conducted to develop a reliable and defensible contingency factor for the total project cost associated with the MCACES construction cost estimate. The cost and schedule risk analysis involved the development of project contingencies by identifying and evaluating the impacts of project uncertainties on the construction cost and schedule and a subsequent calculation of the estimated total project cost.

The Project Delivery Team (PDT) conducted one brainstorming session on November 5, 2013, to identify the risks associated with the project. Additional coordination of the PDT for review and input occurred thereafter. Key project and risk assumptions reflected in the analysis were identified. The risk analysis was performed using Oracle Crystal Ball software to estimate a contingency with the use of Monte Carlo simulations in correlation with the proposed risks and uncertainties.

The contingency is based on an 80 percent (P80) confidence level, per accepted U.S. Army Corps of Engineers Civil Works guidance. For the Los Angeles river Ecosystem Restoration project, the most likely baseline construction cost is estimated at approximately $129,610,919 (Table ES-1). The risk analysis resulted in a contingency value of $37,970,169 based on the cost risks and a contingency of $5,820,801 based on the schedule risks. This translates to a total project contingency value of $43,790,969 which equates to approximately 33.79 percent of construction costs.

CONTINGENCY SUMMARY

Contingency on Baseline Cost Estimate	80% Confidence Project Cost
Baseline Estimated Cost (Most Likely) ->	**$129,610,919**
Baseline Estimated Cost Contingency Amount ->	$37,970,169
Baseline Estimated Construction Cost (80% Confidence) ->	**$167,581,088**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	**129.0 Months**
Schedule Contingency Duration ->	44.4 Months
Project Schedule Duration (80% Confidence) ->	**173.4 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$5,820,801**

Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$43,790,969**
Project Contingency Percentage (80% Confidence) ->	**33.79%**

Project Cost (80% Confidence) ->	**$173,401,889**

Please note that cost estimates fluctuate over time. During this period of study, minor cost fluctuations can and have occurred. For this reason, costs may vary a slight degree between this document and the primary cost estimating components of the MCACES construction cost estimate and the Total Project Cost Summary (TPCS). Therefore, values in this document may not exactly match those from the TPCS and MCACES, but should be very similar in scale.

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

An analysis of the relative impact of the key cost drivers on the cost and schedule contingency indicates that following risks result in the most impact on the overall project contingency:

- Cost Risks:
    - PR-7: political factors change at local, state or federal level – Due to the projected costs of this project, and the number of different agencies involved, funding difficulties may arise which could impact the costs of construction.
    - TL-1: low design level – This project is currently at a preliminary design level. All quantities and costs are based on typical cross sections, but as the project progresses more design detail will be completed. Thus this risk should be mitigated during future design phases.
    - PR-4: market conditions and bidding competition – This risk falls outside the PDT's sphere of influence. It is difficult to project these conditions several years out, but given that this project is also anticipated to take over 10-years to construct, it is even more difficult to predict adequate conditions that far out. Thus costs for this must be accounted for at this time.
    - TL-2: investigations remain to be completed – As noted in risk item TL-1, this project is still at a low design level. As the project moves forward all outstanding investigations will be completed, and the impact of this risk will be lowered.
- Schedule Risks:
    - PR-6: flooding / earthquake – Los Angeles is renowned for earthquakes and is susceptible to flash floods. These risks are unavoidable, but would pose significant delays to construction if they occur, which is likely due to the proposed construction duration.
    - PR-7: political factors change at local, state or federal level – As noted under the costs risks above, the different entities involved in this project may not always see eye to eye. Construction could be delayed if all agencies are not on board with the selected plan.
    - CA-4: acquisition plan to accommodate funding stream – The current estimate assumes intermittent funding, but the assumption of four contracts may not be sufficient. The funding stream could change the number of contracts, which may push the construction schedule out.

The key recommendations from this study are the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life cycle, potential mitigation throughout the planning, engineering and design phase, and proactive monitoring and control of the internal risks identified in this study.

1. PURPOSE

A cost and schedule risk analysis (CSRA) was conducted to develop a reliable and defensible contingency factor for the construction cost estimate developed for the Los Angeles River Ecosystem Restoration Feasibility Study Cost Appendix with the use of the Micro-Computer Aided Estimating System (MII). The appendix describes the design and cost assumptions that go into developing the MII estimate. The contingency factor was calculated at the 80 percent confidence level as recommended by U.S. Army Corps of Engineers (USACE) guidance (2009). The contingency was calculated in terms of dollars for the cost analysis and in terms of months for the schedule analysis.

The Project Delivery Team (PDT) studied a variety of risks that could affect the construction cost and/or schedule. The events were grouped into the following categories:

- Project and program management
- Contract acquisition
- Technical
- Lands and damages
- Construction
- Estimate and schedule
- Programmatic (external)

All of the risk categories except “programmatic” include risks that could be generated, caused, or controlled by the PDT. Programmatic, or external, risks are those outside the sphere of influence of the PDT.

2. BACKGROUND

The primary purpose of this project is to restore approximately 11 miles of the Los Angeles River. This stretch of channel starts at Griffith Park and extends to the Downtown Los Angeles area. The project is designed to reestablish riparian strands, freshwater marshes and aquatic habitat communities as well as reconnect the river to major tributaries, historic floodplains and regional habitat zones. This project is also designed to provide recreational opportunities that are consistent with the restored ecosystem.

The Los Angeles River has been degraded over time by a cycle of increasing urban development, flooding, and channelization. This cycle led to the Los Angeles County Drainage Area (LACDA) project that was completed in the mid-20th century. The LACDA was a Federal flood control project that straightened the channel and encased much of it with concrete banks and concrete beds. This greatly diminished the plant and wildlife diversity and quality and disconnected the channel from its floodplains and significant ecological zones.

Other sections of the Los Angeles River that are outside of this project’s reach are too urbanized to be considered for potential habitat connectivity and expansion projects. Thus this 11 mile stretch, known as the “Area with Restoration Benefits and Opportunities for Revitalization (ARBOR)” reach, has the most potential for restoration benefits.

This project initially looked at various alternatives that comprised of numerous restoration sub-measures. Initial construction cost estimates were developed and a final array of four alternatives was selected for further analysis. From these four alternatives, the National Ecosystem Restoration (NER) Plan was identified as Alternative 13v. This alternative was estimated using MII software and is the basis for the risk analysis within this report.

The following design documents were available for use in this CSRA:

- Los Angeles River Ecosystem Restoration – Feasibility Study, Draft Integrated Report September 2013
- Los Angeles River Ecosystem Restoration – Feasibility Study, Conceptual Design Drawings, April 2013
- Los Angeles River Ecosystem Restoration – Feasibility Study, Design Appendix, April 2013
- Los Angeles River Ecosystem Restoration – Feasibility Study, Cost Appendix, March 2014

3. REPORT SCOPE

The scope of this CSRA report is the calculation and presentation of cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes mandated by USACE Engineer Regulation (ER) 1110-2-1150, ER 1110-2-1302, and Engineer Technical Letter 1110-2-573 (USACE 1999, 2008a, 2008b). The report presents the contingency results for cost risks for all project features. The study excluded a consideration of operation and maintenance and life cycle costs.

3.1 Project Scope

3.1.1 Mandates and Appropriations

- The study was authorized by Senate Committee on Public Works Resolution, approved June 25, 1969.
- Section 4018 of the Water Resources Development Act of 2007 provided authorization for a "feasibility study for environmental ecosystem restoration, flood risk management, recreation and other aspects of Los Angeles River revitalization that is consistent with the goals of the Los Angeles River Revitalization Master Plan published by the city of Los Angeles…"

3.1.2 Product Development

The project technical scope, estimate, and schedule developed by Tetra Tech, Inc. served as the basis for the risk analysis for the construction cost estimate. The construction cost estimate scope consists of the following:

- Civil Works Work Breakdown Structure feature account: 06, Fish and Wildlife Facilities and 14, Recreation (USACE 2008b)

- Design level: includes conceptual design cross sections for the Los Angeles River Ecosystem Restoration Feasibility Study

3.2 USACE Risk Analysis Process

The risk analysis process used in this study follows the USACE Headquarters requirements as well as guidance from the Cost Engineering Directory of Expertise for Civil Works. It uses probabilistic CSRA methods within the framework of the Oracle Crystal Ball software. The results of a risk analysis are intended to serve several functions, one being the establishment of reasonable contingencies reflective of an 80 percent confidence level to successfully accomplish the project work within that established contingency amount. The scope of the report includes the identification of important steps, rationale, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

The risk analysis results discussed in this report are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, CSRAs should be considered an ongoing process that is conducted concurrently 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 satisfying broadly defined risk analysis standards and recommended practices, this risk analysis was performed in accordance with the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Guidance USACE (2009)
- Memorandum from Major General Don T. Riley, U.S. Army Director of Civil Works (USACE 2007a)
- Engineering and Construction Bulletin 2007-17 (USACE 2007b)
- Engineer Regulation 1110-2-1150 (USACE 1999)
- Engineer Regulation 1110-2-1302 (USACE 2008a)
- Engineer Technical Letter 1110-2-573 (USACE 2008b)

4. METHODOLOGY/PROCESS

The risk analysis team received cost support from the cost engineer as well as coordination support from project management and the assigned PDT. Several other disciplines, such as Construction, were invited, but not all disciplines attended the meeting. The members of the risk analysis team are indicated in Table 1.

Table 1 – PDT Member Positions and Organizations

Position	Name	Organization
Hydrology and Hydraulics	Kerry Casey	USACE, Los Angeles
Geotechnical	Chris Spitzer	USACE, Los Angeles
Plan Formulation Branch Chief	Ed Demesa	USACE, Los Angeles
Project Manager	Tawny Tran	USACE, Los Angeles
Cost Engineer	Arnecia Williams	USACE, Los Angeles
Biologist	Eric Jones	USACE, Los Angeles
Design	Frank Mallette	USACE, Los Angeles
Real Estate	Lisa Sandoval	USACE, Los Angeles
Economics	Mike Hallisy	USACE, Los Angeles
Project Manager	Scott Estergard	Tetra Tech
Cost Estimator	Scott Vose	Tetra Tech
Project Engineer	Ike Pace	Tetra Tech
Senior Water Resource Planner	Ira Artz	Tetra Tech
Local Sponsor Representative	Megan Whalen	City of Los Angeles
Local Sponsor Representative	Rene Curtis	City of Los Angeles
Local Sponsor Representative	Carol Armstrong	City of Los Angeles
Local Sponsor Representative	Michael Affeldt	City of Los Angeles

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 confidence related to project cost.

Contingency is defined as 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 or additional time. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept the 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 Engineering District guidance for CSRA generally focuses on the 80 percent level of confidence (P80) for cost contingency calculation. The use of P80 as a decision criterion is a risk-averse approach (whereas the use of P50 is considered a risk-neutral approach, and the use of levels less than 50 percent is considered a risk-seeking approach). Thus, the use of a P80 confidence level results in a greater contingency relative to that resulting from 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 (Oracle Crystal Ball), which 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.

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

4.1 Identification and Assessment of Risk Factors

Identification of the risk factors by the PDT is considered a qualitative process that results in the establishment of a risk register, which is used to document the results of the quantitative study of risks. Risk factors are events and conditions that may influence or drive uncertainty associated with 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.

Checklists or historical databases of common risk factors are sometimes used to facilitate the identification of risk factors. However, the key risk factors are often unique to a project and cannot be readily derived from historical information. Therefore, input is obtained from the entire PDT be means of creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable.

Formal PDT meetings are held for the purposes of identifying and assessing risk factors. The meetings should include capable and qualified representatives from multiple project team disciplines and functions, for example:

- Project/program managers
- Contracting/acquisitions
- Real estate
- Relocations
- Environmental
- Civil and coastal design
- Cost and schedule engineers
- Construction
- Key sponsors

The initial formal meetings should focus primarily on risk factor identification using brainstorming techniques but also include some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings should focus primarily on risk factor assessment and quantification. Conference calls and informal meetings also occur throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment. The risk register document developed for this project can be seen in Attachment A.

4.2 Quantification of Risk Factor Impacts

The quantitative impacts of risk factors on project plans are analyzed using a combination of professional judgment, empirical data, and analytical techniques. Risk factor impacts are 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 involves multiple project team disciplines and functions. However, the quantification process relies more extensively on collaboration between cost engineering and risk analysis team members with lesser input from the other functions and disciplines. The quantification process uses 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 for both cost and schedule risk concerns. The risk register documents the PDT's risk concerns, discussions related to those concerns, and potential impacts on the current cost and schedule estimates. The concerns and discussions are meant to support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analysis of 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 and the market research. 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 in this study, the contingency was calculated as the difference between the P80 cost forecast and the base cost estimate. Each option-specific contingency was 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 was used as the feature-specific measure of risk for contingency allocation purposes. This approach resulted in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

For the schedule in this study, contingency was calculated as the difference between the duration forecast at various confidence level intervals and the base schedule duration. The duration contingency was then used to estimate hotel costs and calculate the additional time value of money impact due to project delays that are included in the total cost contingency presented in Section 6. The resulting time value of money, or added escalation risk, and hotel costs were added into the cost contingency amount to reflect the USACE standard for presenting the estimated cost for the fully funded project amount.

Schedule contingency was analyzed only on the basis of each option and not allocated to specific tasks. Based on the guidance, only critical path and near critical path tasks are considered uncertain for the purposes of contingency analysis (USACE 2009).

5. KEY ASSUMPTIONS

The CSRA for the Los Angeles River Ecosystem Restoration project was based on the following key assumptions:

- The project is currently in the conceptual design stage. Various alternatives were analyzed previously based on conceptual cross-sections for each reach. These same cross-sections and designs are utilized for development of the MCACES cost estimate.
- Many of the requisite studies (geotechnical, H&H, etc.) have not been completed. The design is subject to change once the information from these reports can be incorporated.
- Project study costs to date are not included in the risk study.
- Neither life cycle nor operation and maintenance costs are included in the risk study. This study is based solely on the initial construction of the project.
- Major features of this project include concrete demolition; excavation and fill; riprap; grouted riprap; turf reinforcement mats; fencing; clearing and grubbing; reinforced cast-in-place concrete;; sub-drainage system; asphalt; multi-use trail; trail access points; pedestrian bridges and other recreation components.
- The feature cost accounts for this project include Lands and Damages; Relocations; Fish and Wildlife Facilities; Recreation; Planning, Engineering, and Design; and Construction Management.
    - Lands and Damages: The costs for this account have been estimated by the USACE. However, these costs have not been included in this CSRA analysis, because due to the overwhelming size of the costs for this account, the risk analysis would be completed swayed towards the risks associated with this account. Also, the real estate report develops their own contingencies to be utilized for this project, which have been deemed sufficient to account for any unforeseen changes that may occur to these costs.
    - Relocations: Costs for this account have been estimated by the USACE. Again, like the lands and damages, these costs have not been included in this analysis. A contingency has been provided for this account, which is utilized in the total project cost summary sheet.
    - Fish and Wildlife Facilities: Costs for this account include the majority of the construction costs for this project.

- Recreation: Costs for this account include the components that are not primarily aimed at ecosystem restoration. These include construction activities such as multi-use trails, trail access points, wildlife viewing areas, pedestrian bridges and other recreation trail components.
- Planning, Engineering, and Design: Costs for this account were estimated at 11 percent of the construction cost. This account covers the preparation of the plans, specifications, and estimate for construction.
- Construction Management: Costs for this account were estimated at 6.5 percent of the construction cost. This account covers construction management during the construction contract.
- Monitoring and Adaptive Management: Costs for this item were added to the costs estimated for construction management. These costs were estimated as 3% of the Fish and Wildlife Facilities costs only.

- The cost estimate is based on local labor, material, and fuel costs. The construction schedule is based on production rates of the construction elements in the cost estimate.
- The recommended contingency is based on an 80 percent confidence level, per accepted USACE Civil Works guidance.
- Only the high and moderate risk levels as determined by the PDT in the risk register are included in the risk analysis. The low risk levels are excluded based on the assumption that they would have a negligible impact in determining the contingency.

6. RISK ANALYSIS RESULTS

The CSRA results are provided in the following subsections. In addition to the contingency calculations, the results of sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The risk register developed for this project is provided in Attachment A; a condensed version of the risk register is provided in Table 2. The complete risk register includes low-level risks, as well as additional information regarding the nature and impacts of each risk.

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 the following:

- 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

Table 2 – Condensed Risk Register

Risk No.	Risk/Opportunity Event	Concerns	Project Cost			Project Schedule		
			Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)							
	PROJECT & PROGRAM MGMT							
PPM-1	Interactions between all agencies involved in project	Many different agencies will be involved in order to complete this project. Managing and assuring that all agencies complete requisite needs may prove difficult.	Very Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE
PPM-2	Dealings with multiple stakeholders	The various stakeholders in the project may cause difficulties in funding, changes to design, etc.	Very Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE
PPM-3	Project competing with other projects, funding and resources	Other projects may threaten funding streams and/or delays receive of funds needed to meet design/construction milestones.	Very Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE
PPM-4	Losing critical staff at crucial points of project	Loss of crucial staff prior to or during critical milestones could delay project.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
PPM-5	Product development by several sources	This project requires members from various entities both governmental and private to complete.	Likely	Negligible	LOW	Likely	Negligible	LOW
PPM-6	Priorities change on existing program	If USACE priorities on ecosystem restoration change, then this project could be impacted.	Unlikely	Negligible	LOW	Likely	Marginal	MODERATE
	CONTRACT ACQUISITION RISKS							
CA-1	Contracting plan has not been developed	Contracting plan has not been fully developed at this stage. Changes to current assumptions could occur.	Likely	Marginal	MODERATE	Likely	Significant	HIGH
CA-2	Possibility for 8(a) or small business contractor(s)	Some portions of the project may be bid to 8(a) contractors, which could increase costs for construction.	Likely	Negligible	LOW	Likely	Negligible	LOW
CA-3	Number of separate contracts and prime contractors	Current estimate assumes 4 separate contracts with each one having a separate prime contractor. Further analysis into contracting plan may change this.	Likely	Negligible	LOW	Likely	Negligible	LOW
CA-4	Acquisition plan to accommodate funding stream	The funding stream will be a major driver of the contracts. If funding stream changes or is inadequate current assumptions will change.	Likely	Marginal	MODERATE	Likely	Significant	HIGH
	TECHNICAL RISKS							

Risk No.	Risk/Opportunity Event	Concerns	Project Cost			Project Schedule		
			Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
TL-1	Low design level	Project is at a low design level. All quantities and assumptions are subject to changes as project progresses.	Very Likely	Critical	HIGH	Very Likely	Marginal	MODERATE
TL-2	Investigations remain to be completed (H&H, Geotech, HTRW, etc.)	Many investigations still remain to be completed. Once finalized, these reports may cause design changes.	Very Likely	Significant	HIGH	Very Likely	Marginal	MODERATE
TL-3	Hazardous waste concerns	Encountering unanticipated HTRWs can cause significant increase in earthwork costs.	Very Likely	Significant	HIGH	Very Likely	Marginal	MODERATE
TL-4	Disposal locations and costs for excavated materials	Preliminary landfills have been assumed to be capable of accepting excavated materials. Further analysis could lead to cost savings (if cheap/no cost site is found) or increased costs based on tipping fees.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
TL-5	All Disciplines	Many investigations remain to be completed, which once finished, could change current design	Very Likely	Significant	HIGH	Likely	Negligible	LOW
TL-6	Locations and costs for borrow materials	Changes in material prices and locations from borrow sites may change.	Unlikely	Significant	MODERATE	Unlikely	Negligible	LOW
	LANDS AND DAMAGES RISKS							
LD-1	Status of real estate / easement acquisition	Real estate and easements need to be purchased in a timely fashion such that the construction phases can begin as scheduled.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
LD-2	Railroad involvement	Project may require railroad involvement for culverts and right-of-way acquisition	Likely	Negligible	LOW	Likely	Marginal	MODERATE
LD-3	Relocations identified	Detailed relocation designs/report has not been fully developed at time of estimate.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
LD-4	Known and unknown utility impacts	Unknown utilities may be found during construction thus causing increased costs and delayed schedules.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
LD-5	Vagrancy, loitering issues	Dealing with vagrant population may cause some minor delays.	Likely	Negligible	LOW	Likely	Negligible	LOW
LD-6	Accuracy of current values of lands and easements	Real estate costs are more than 3 times more costly than the current construction costs. Thus changes in costs to real estate effect total cost significantly.	Very Unlikely	Critical	LOW	Unlikely	Critical	MODERATE
LD-7	Railroad trestle	Railroad involvement, design of trestles, other easement acquisition, temporary operation facilities	Likely	Significant	HIGH	Likely	Significant	HIGH
	REGULATORY AND ENVIRONMENTAL RISKS							

Risk No.	Risk/Opportunity Event	Concerns	Project Cost			Project Schedule		
			Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
RE-1	Status of permits	Many permits will need to be obtained for construction. Prompt receive of permits will be needed to keep construction schedule on track.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
RE-2	Potential for critical regulation changes	Regulation changes within the Corps could impact this project	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
RE-3	Negative community impacts	Construction vehicles, noise, pollution, etc., are all to be encountered during construction.	Likely	Negligible	LOW	Likely	Negligible	LOW
RE-4	Endangered species present	Further research may find endangered species present which could delay project.	Unlikely	Negligible	LOW	Unlikely	Negligible	LOW
RE-5	Preliminary HTRW complete	HTRW report is not finalized currently	Likely	Significant	HIGH	Likely	Negligible	LOW
RE-6	Agency actions/reviews are delayed or take longer than expected	Due to number of agencies involved, keeping all actions and reviews on time will be imperative to meeting the project milestones.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
RE-7	Flood risk policy	Flood risk policies from FEMA, DWR, USACE, may change which would impact design	Likely	Negligible	LOW	Likely	Marginal	MODERATE
	CONSTRUCTION RISKS							
CON-1	Permits, licenses, submittal approvals	Delays in acquiring all permits, licenses, and receiving submittal approvals can delay the start of construction or alter sequencing.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
CON-2	Permit and environmental work windows	Work windows based on environmental issues are accounted for, but could change.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW
CON-3	Site access restrictions	Due to the length of the reaches, site accessibility may be a problem.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
CON-4	Adequate staging areas	No staging areas have been designed, and due to size of project significant staging would be required.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
CON-5	Unknown utilities	Unknown utilities may be found during construction thus causing increased costs and delayed schedules.	Likely	Significant	HIGH	Likely	Negligible	LOW
CON-6	Traffic issues for all haul vehicles	Traffic is going to be an issue for any haul trucks bringing or taking away materials to and from the project site.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
CON-7	Diversion and control of water	Diversion and control of water is going to be significant effort, and is based on general assumptions at this time.	Unlikely	Significant	MODERATE	Likely	Negligible	LOW
CON-8	Change orders and modification growths	There may be modification issues that have not been captured in the estimate or schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE

Risk No.	Risk/Opportunity Event	Concerns	Project Cost			Project Schedule		
			Likelihood*	**Impact***	**Risk Level***	**Likelihood***	**Impact***	**Risk Level***
CON-9	Unidentified hazardous waste	Encountering unanticipated HTRWs during construction can cause significant increase in earthwork costs.	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE
CON-10	Adaptive management	Managing the project through unexpected changes.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
	ESTIMATE AND SCHEDULE RISKS							
EST-1	Estimate confidence in large and critical quantities	Design is at low level, and quantities are based on one typical section for each reach.	Likely	Marginal	MODERATE	Likely	Significant	HIGH
EST-2	Estimate reasonableness of crews and productivities	Production rates used in estimate may differ from those in the field.	Likely	Significant	HIGH	Likely	Significant	HIGH
EST-3	Accuracy of construction schedule durations, sequencing, phasing, etc.	Contractor may have different sequencing to construction activities within the contracts which could decrease or increase duration.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW
Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)								
PR-1	Adequacy of project funding	There is some concern in obtaining funds on a timely basis or in the necessary increments. Receiving less than required or in delayed increments is a concern.	Unlikely	Marginal	LOW	Unlikely	Significant	MODERATE
PR-2	Local communities have objections	Delays may occur due to local communities objecting to the work planning to be constructed.	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE
PR-3	Stakeholders request late changes	Late changes by the various stakeholders can cause redesign, increased costs and delays.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
PR-4	Market conditions and bidding competition	Real estate market could be significant risk with variability in this market.	Likely	Significant	HIGH	Unlikely	Marginal	LOW
PR-5	Unexpected escalation on key materials	There could be increases in the cost materials, primarily including the riprap and borrow materials.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
PR-6	Flooding/Earthquake	Small chance of major floods and earthquakes occurring, but these could delay project and cause major re-work.	Likely	Marginal	MODERATE	Likely	Significant	HIGH
PR-7	Political factors change at local, state or federal level	Concern due to large cost and all government agencies agreeing on design and implementation.	Likely	Significant	HIGH	Likely	Significant	HIGH

6.2 Discussion of Moderate and High Risks

The following sections discuss the risk items that have are the most impactful to the contingency development. All risk items that generate over 10 percent of the contingency, as shown in the sensitivity analysis, for both cost and schedule are here. Further information on all risk items and their corresponding PDT discussions can be found in Attachment A.

The discussion of each item includes general concerns and discussions developed by the PDT as well as a general discussion of the anticipated cost increases or opportunities that the risks could have. The full market research back-up can be found in Attachment B.

6.2.1 Cost Risks

(i) High Risks

- PR-7: political factors change at local, state or federal level – This risk is an external risk that falls outside of the PDT's sphere of influence. There is a concern that due to the large costs and all the government agencies that are involved, that agreement on the design and implementation may be difficult to achieve. There are already discussions surrounding the various alternatives and which should be the selected plan. Also, political opposition may arise to the current plan due to the overall total cost of the project. The CSRA assumes that political opposition could decrease the scope of the project, thus decreasing construction costs by 7.5%. The political pressures could significantly increase costs as well, and it is assumed that a possible 10% increase may occur.
- TL-1: low design level – This risk is one that should decrease as the project progresses. Currently, the design is at a conceptual level with all quantities and costs based on one typical section per reach. Obviously, as the project moves forward the impacts of this risk will be lowered as the design becomes more detailed and the quantities are fine tuned. But at the time being, the low design level could lead to significant changes in quantities. The CSRA assumed that due to the level of design the cost estimate could decrease upwards of 7.5% or increase by 10%.
- PR-4: market conditions and bidding competition – This risk is an external risk that falls outside of the PDT's sphere of influence. At time of bidding, the market conditions are an unknown and could significantly impact the values of the bids received. There could be a saturation of contractors willing to bid, which could lead to lower bids received, or the opposite is possible. The market research assumed a possible 5% decrease in the overall construction costs for the low cost and a 7.5% increase to construction costs for the possibility of higher bids.
- TL-2: investigations remain to be completed (H&H, Geotech, HTRW, etc.) – This project is currently at the conceptual design level and thus many investigations still remain to be completed. Upon completion of all the necessary studies, the PDT agrees that many aspects of the current design may change. These changes, plus the overall scale of the project, could result in significant impacts to the overall cost of the project. The cost impacts could be positive or negative, as further analysis may show that current designs are over designed to meet all engineering standards, or perhaps the project is significantly under-designed thus requiring larger structures.

The CSRA assumes a 5% decrease in total construction costs and a 10 % increase in are possible.

6.2.2 Schedule Risks

(i) High Risks

- PR-6: flooding / earthquake – There is a small chance that a major flood or earthquake could occur at some point during the construction time frame. If either of these occurred, then major delays could be expected and even some re-work may be required if structures are damaged. Therefore the CSRA analysis assumed construction continuing for twelve more months if a major flood or earthquake is experienced.
- PR-7: political factors change at local, state or federal level – This risk is an external risk that falls outside of the PDT's sphere of influence. There is a concern that due to the large costs and all the government agencies that are involved, that agreement on the design and implementation may be difficult to achieve. There are already discussions surrounding the various alternatives and which should be the selected plan. Also, political opposition to the current plan may arise due to the overall total cost of the project. Disagreement between all the governmental entities could delay the project from being completed. For this risk it was assumed that the project would be pushed back twelve months.
- CA-4: acquisition plan to accommodate funding stream – The funding stream is anticipated to be the major driver of the number and size of the contracts issued. If the funding stream is changed or inadequate, then the current assumption of four contracts would require changing. The PDT thinks there is a risk of this occurring and that it would primarily impact the schedule. Therefore the CSRA analysis assumes that the schedule would not decrease, but funding stream delays may increase by up to twelve months.

6.3 Cost Risk Analysis – Cost Contingency Results

The project cost contingencies calculated for each confidence level are provided in Table 3. The estimated project cost contingency for the P80 confidence level was quantified as approximately $38.0 million, which equates to approximately 29.3 percent of the total project cost. This contingency value was calculated solely from the costs of the project and is not for use as the overall project contingency.

Table 3 – Project Cost Contingency Summary

Confidence Level	Baseline Total Project Cost	Contingency	Total Project Cost with Contingency	Contingency
0%	$129,610,919	($2,967,405)	$126,643,515	-2.29%
5%	$129,610,919	$14,746,725	$144,357,645	11.38%
10%	$129,610,919	$17,882,817	$147,493,737	13.80%
15%	$129,610,919	$20,016,062	$149,626,982	15.44%
20%	$129,610,919	$21,804,988	$151,415,908	16.82%
25%	$129,610,919	$23,386,907	$152,997,827	18.04%
30%	$129,610,919	$24,833,895	$154,444,815	19.16%
35%	$129,610,919	$26,155,502	$155,766,422	20.18%
40%	$129,610,919	$27,312,425	$156,923,345	21.07%
45%	$129,610,919	$28,478,878	$158,089,797	21.97%
50%	$129,610,919	$29,690,887	$159,301,807	22.91%
55%	$129,610,919	$30,880,438	$160,491,358	23.83%
60%	$129,610,919	$32,168,393	$161,779,312	24.82%
65%	$129,610,919	$33,515,968	$163,126,887	25.86%
70%	$129,610,919	$34,868,416	$164,479,336	26.90%
75%	$129,610,919	$36,318,659	$165,929,578	28.02%
80%	$129,610,919	$37,970,169	$167,581,088	29.30%
85%	$129,610,919	$39,849,645	$169,460,565	30.75%
90%	$129,610,919	$42,211,239	$171,822,158	32.57%
95%	$129,610,919	$45,849,967	$175,460,887	35.38%
100%	$129,610,919	$66,975,278	$196,586,197	51.67%

A sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. From this analysis, the key cost drivers can be identified and used to support the development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project life cycle.

The cost sensitivity analysis for this project shows the rank of the risks from the highest impact on the cost contingency to the lowest (Figure 1). Approximately 59.5 percent of the resulting cost contingency comes from four of the analyzed risk items: PR-7 (political factors change at local, state or federal level), TL-1 (low design level), TL-2 (investigations remain to be completed) and PR-4 (market conditions and bidding competition).

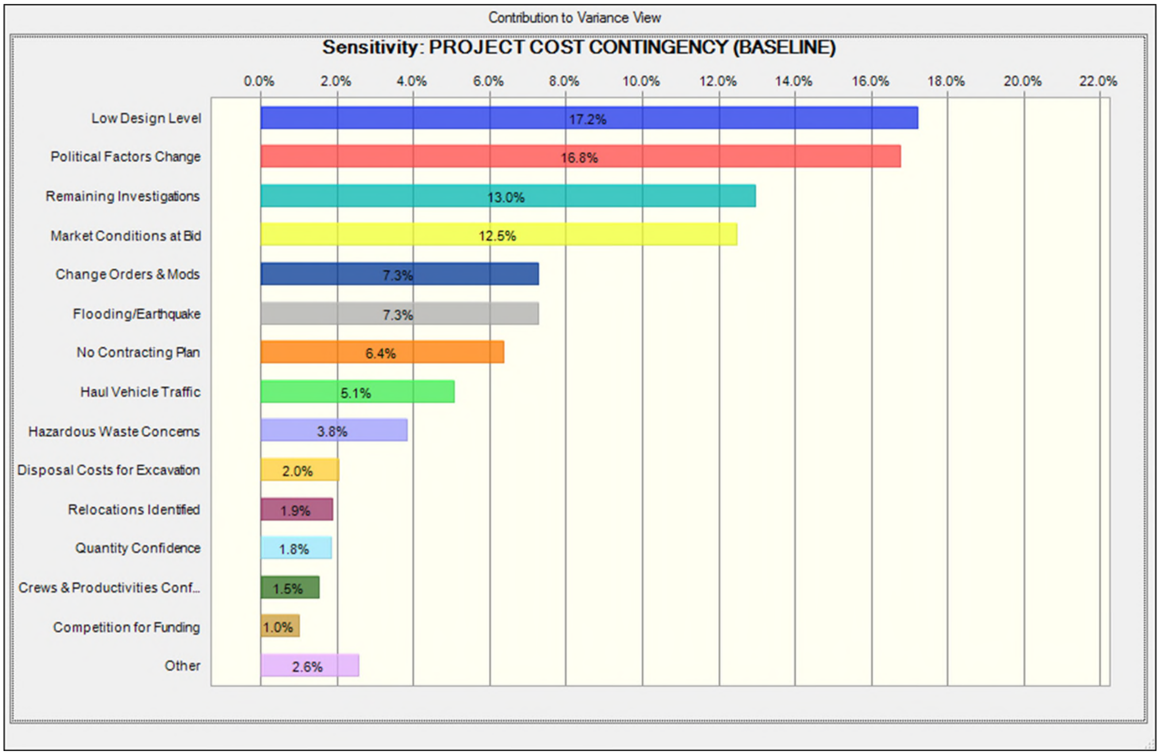

Figure 1 – Sensitivity Analysis (Cost)

6.4 Schedule Duration Risk Analysis – Schedule Contingency Results

The schedule duration contingencies calculated for each confidence level are provided in Table 4. The estimated schedule duration contingency for the P80 confidence level was quantified as approximately 44.4 months, which equates to approximately 34.4 percent of the total project schedule duration. This contingency duration was calculated solely from the schedule of the project and is not for use as the overall project contingency.

Table 4 – Project Schedule Duration Contingency Summary

Confidence Level	Baseline Schedule Duration	Contingency (Duration)	Baseline Schedule Duration with Contingency	Contingency
0%	129.0 Months	16.6 Months	145.6 Months	12.88%
5%	129.0 Months	27.2 Months	156.2 Months	21.12%
10%	129.0 Months	29.6 Months	158.6 Months	22.93%
15%	129.0 Months	31.1 Months	160.1 Months	24.13%
20%	129.0 Months	32.5 Months	161.5 Months	25.16%
25%	129.0 Months	33.6 Months	162.6 Months	26.04%
30%	129.0 Months	34.6 Months	163.6 Months	26.84%
35%	129.0 Months	35.7 Months	164.7 Months	27.66%
40%	129.0 Months	36.6 Months	165.6 Months	28.34%
45%	129.0 Months	37.5 Months	166.5 Months	29.05%
50%	129.0 Months	38.4 Months	167.4 Months	29.77%
55%	129.0 Months	39.3 Months	168.3 Months	30.43%
60%	129.0 Months	40.2 Months	169.2 Months	31.15%
65%	129.0 Months	41.1 Months	170.1 Months	31.90%
70%	129.0 Months	42.2 Months	171.2 Months	32.70%
75%	129.0 Months	43.3 Months	172.3 Months	33.59%
80%	129.0 Months	44.4 Months	173.4 Months	34.43%
85%	129.0 Months	45.8 Months	174.8 Months	35.51%
90%	129.0 Months	47.6 Months	176.6 Months	36.92%
95%	129.0 Months	50.2 Months	179.2 Months	38.88%
100%	129.0 Months	67.2 Months	196.2 Months	52.06%

The schedule duration sensitivity analysis for this project shows the rank of the risks from the highest impact on the schedule duration contingency to the lowest (Figure 2). Approximately 48.2 percent of the resulting schedule duration contingency comes from three of the analyzed risk items: CA-4 (acquisition plan to accommodate funding stream), PR-6 (flooding/earthquake), and PR-7 (political factors change at local, state or federal level).

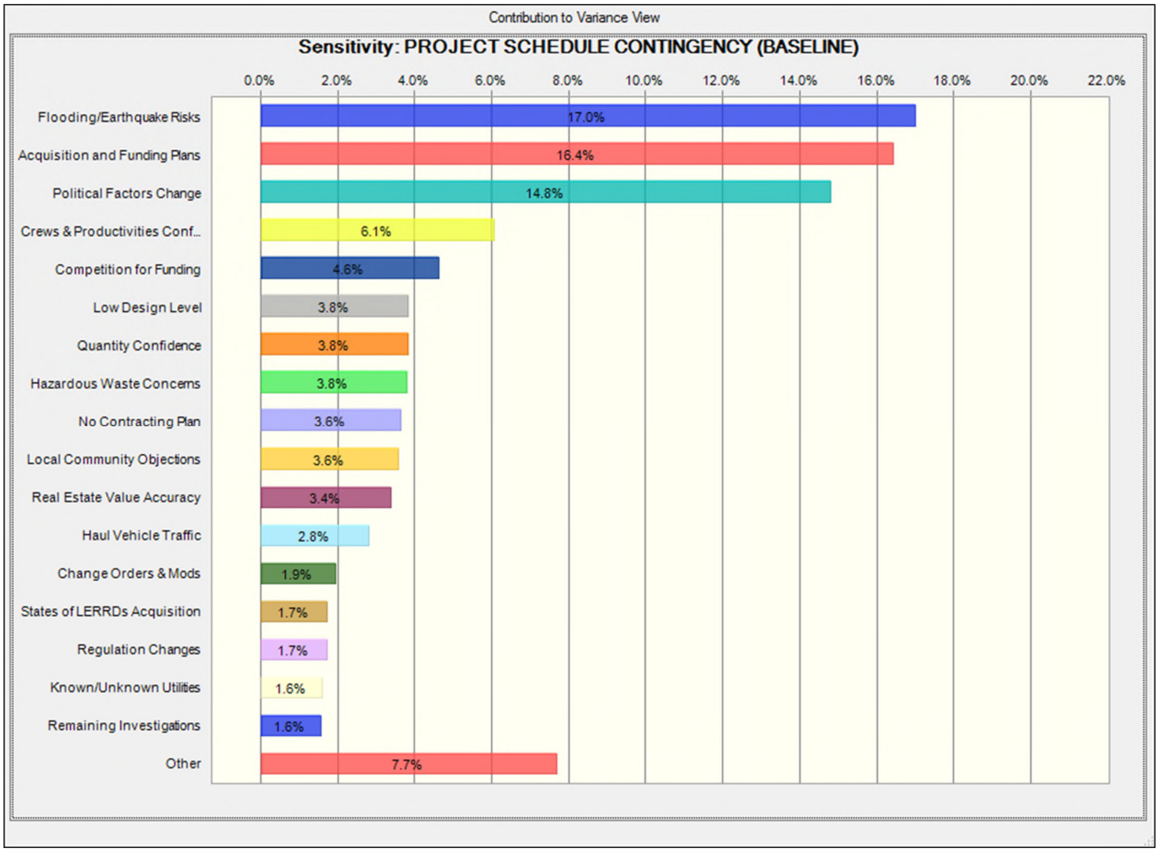

Figure 2 – Sensitivity Analysis (Schedule)

6.5 Schedule Contingency Value Results

The schedule contingency is presented as a monetary value such that it can be combined with the cost contingency to generate the total project contingency (Table 5). The schedule contingency is calculated from the estimated "hotel" costs, which are fixed costs that are inherently incurred as a result of schedule delays. These fixed costs may include rents, project management, supervision and administration, and elements of home office or field office overhead. In practice, sufficiently detailed cost estimates and resource-loaded schedules are often not available to support detailed hotel cost estimates for risk analysis, and only rough order of magnitude estimates can be developed.

For this analysis the combined job office overhead costs from both prime contractors was used to develop an assumed hotel rate of 8.46 percent. This percentage is applied to the overall project cost along with the current escalation rate from the Office of Management and Budget and local project escalation obtained from the USACE escalation factors. These rates generated an approximate schedule contingency of $5.8 million for the P80 confidence level.

Table 5 – Schedule Contingency Value Summary

Confidence Level	Date	Escalation Delta Amount	Hotel Amount	Total Schedule Contingency
0%	12-Mar-28	$1,730,222	$1,399,766	$3,129,988
5%	29-Jan-29	$1,856,548	$2,302,344	$4,158,892
10%	11-Apr-29	$1,884,326	$2,500,814	$4,385,140
15%	28-May-29	$1,902,697	$2,632,072	$4,534,769
20%	7-Jul-29	$1,918,545	$2,745,305	$4,663,850
25%	11-Aug-29	$1,932,035	$2,841,690	$4,773,725
30%	11-Sep-29	$1,944,242	$2,928,909	$4,873,151
35%	13-Oct-29	$1,956,778	$3,018,471	$4,975,248
40%	9-Nov-29	$1,967,232	$3,093,167	$5,060,399
45%	7-Dec-29	$1,978,130	$3,171,030	$5,149,160
50%	4-Jan-30	$1,989,133	$3,249,643	$5,238,775
55%	30-Jan-30	$1,999,282	$3,322,157	$5,321,439
60%	27-Feb-30	$2,010,284	$3,400,764	$5,411,047
65%	28-Mar-30	$2,021,758	$3,482,742	$5,504,500
70%	29-Apr-30	$2,034,106	$3,570,967	$5,605,073
75%	3-Jun-30	$2,047,614	$3,667,485	$5,715,099
80%	6-Jul-30	$2,060,592	$3,760,209	$5,820,801
85%	17-Aug-30	$2,077,130	$3,878,367	$5,955,497
90%	12-Oct-30	$2,098,739	$4,032,763	$6,131,502
95%	28-Dec-30	$2,128,852	$4,247,917	$6,376,769
100%	28-May-32	$2,330,818	$5,690,930	$8,021,748

6.6 Combined Cost and Schedule Contingency Results

The combined cost and schedule contingency results show a 33.79 percent contingency (or $43,790,969) at the P80 confidence level (Table 6). This table combines the cost and schedule contingencies in summation to generate the contingency amount to be used in developing the fully funded project amount.

Table 6 – Combined Cost and Schedule Contingency Values

Confidence Level	Baseline Total Project Cost	Cost Contingency	Schedule Contingency	Total Project Cost with Contingency	Contingency
0%	$129,610,919	($2,967,405)	$3,129,988	$129,773,502	0.13%
5%	$129,610,919	$14,746,725	$4,158,892	$148,516,536	14.59%
10%	$129,610,919	$17,882,817	$4,385,140	$151,878,876	17.18%
15%	$129,610,919	$20,016,062	$4,534,769	$154,161,751	18.94%
20%	$129,610,919	$21,804,988	$4,663,850	$156,079,758	20.42%
25%	$129,610,919	$23,386,907	$4,773,725	$157,771,552	21.73%
30%	$129,610,919	$24,833,895	$4,873,151	$159,317,966	22.92%
35%	$129,610,919	$26,155,502	$4,975,248	$160,741,670	24.02%
40%	$129,610,919	$27,312,425	$5,060,399	$161,983,744	24.98%
45%	$129,610,919	$28,478,878	$5,149,160	$163,238,957	25.95%
50%	$129,610,919	$29,690,887	$5,238,775	$164,540,582	26.95%
55%	$129,610,919	$30,880,438	$5,321,439	$165,812,797	27.93%
60%	$129,610,919	$32,168,393	$5,411,047	$167,190,359	28.99%
65%	$129,610,919	$33,515,968	$5,504,500	$168,631,387	30.11%
70%	$129,610,919	$34,868,416	$5,605,073	$170,084,409	31.23%
75%	$129,610,919	$36,318,659	$5,715,099	$171,644,677	32.43%
80%	$129,610,919	$37,970,169	$5,820,801	$173,401,889	33.79%
85%	$129,610,919	$39,849,645	$5,955,497	$175,416,061	35.34%
90%	$129,610,919	$42,211,239	$6,131,502	$177,953,660	37.30%
95%	$129,610,919	$45,849,967	$6,376,769	$181,837,655	40.30%
100%	$129,610,919	$66,975,278	$8,021,748	$204,607,945	57.86%

The overall cost with contingency for each of the confidence levels along with the overall confidence curve are shown in Figure 3.

Contingency Analysis

Most Likely Cost Estimate	$129,610,919	
Confidence Level	**Value**	**Contingency**
0%	$129,773,502	0.13%
5%	$148,516,536	14.59%
10%	$151,878,876	17.18%
15%	$154,161,751	18.94%
20%	$156,079,758	20.42%
25%	$157,771,552	21.73%
30%	$159,317,966	22.92%
35%	$160,741,670	24.02%
40%	$161,983,744	24.98%
45%	$163,238,957	25.95%
50%	$164,540,582	26.95%
55%	$165,812,797	27.93%
60%	$167,190,359	28.99%
65%	$168,631,387	30.11%
70%	$170,084,409	31.23%
75%	$171,644,677	32.43%
80%	$173,401,889	33.79%
85%	$175,416,061	35.34%
90%	$177,953,660	37.30%
95%	$181,837,655	40.30%
100%	$204,607,945	57.86%

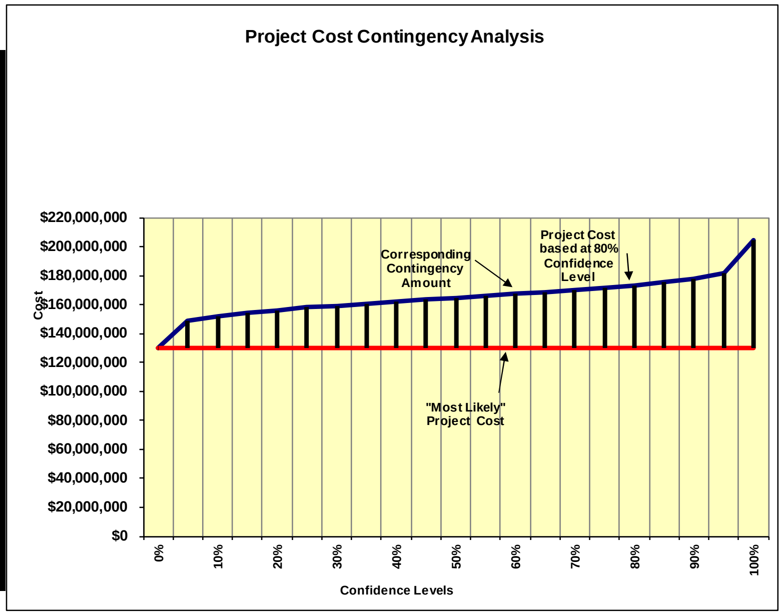

Figure 3 – Combined Cost and Schedule Contingency Value Curve

7. MAJOR FINDINGS/OBSERVATIONS

This section summarizes the significant results of the risk analysis:

1) Based on the results of this analysis a recommended contingency value of $43.8 million dollars or 33.79 percent of the total costs is to be used to generate the fully funded project cost. Of this $43.8 million, approximately $38.0 million (86.8 percent) was derived from the construction cost risks, and $5.8 million (13.2 percent) was derived from the schedule risks.

2) The schedule duration contingency is estimated to be 44.4 months, which equates to an approximate contingency of 34.4 percent of the total project duration.

3) The key cost risk drivers identified through the sensitivity analysis are:

   - PR-7: political factors change at local, state or federal level
   - TL-1: low design level
   - PR-4: market conditions and bidding competition
   - TL-2: investigations remain to be completed

4) The key schedule duration risk drivers identified through the sensitivity analysis are:

   - PR-6: flooding / earthquake
   - PR-7: political factors change at local, state or federal level
   - CA-4: acquisition plan to accommodate funding stream

5) PR-4, PR-6 and PR-7 are external risks, meaning that the PDT has no control over them. If the opinions of the political organizations change or if a major flood or earthquake occurs, then major delays and increased costs are to be incurred.

8. MITIGATION RECOMMENDATIONS

Risk management is an all-encompassing, iterative, life cycle process of project management. According to *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, “project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project” (PMI 2008). Risk identification and risk analysis are processes within the knowledge area of risk management. Their output pertinent to this effort includes the risk register, risk quantification (risk analysis model), the contingency report, and the sensitivity analysis.

The results of the CSRA sensitivity analysis indicate that the following risk factors have the most significant impact on the project contingency and thus mitigation recommendations are discussed for these items:

- TL-1: low design level (cost)
- TL-2: investigations remain to be completed (cost)
- PR-4: market conditions and bidding competition (cost)
- PR-7: political factors change at local, state or federal level (cost and schedule)
- CA-4: contracting plan has not been developed (schedule)
- PR-6: flooding / earthquake (schedule)

8.2 Cost Mitigation Recommendations

One of the significant risks to the cost contingency is that **investigations remain to be completed**. The current cost estimate is based on the information at hand, and thus may be subject to significant changes due to the findings of the various outstanding studies. The impact of this risk may be lowered as the project progresses provided that these investigations are completed in a timely and accurate fashion. Incorporation of the findings into the design and thus into the estimate will ensure that this risk is reduced in future iterations of this document.

Another significant risk to the cost is the risk of **market conditions and bidding competition.** This risk is not something the PDT can help to mitigate significantly over the course of the project. The primary method to limiting this risk is as the project nears construction the estimate must be updated continually to best estimate the current market conditions. The current USACE policies regarding construction cost estimating will help to ensure this, and should help limit the risk. However, given the current estimated timeframe, market conditions are still going to be a significant risk moving forward.

The risk of **political factors changing at local, state or federal level** is significant to both the cost and schedule. This risk is beyond the control of the PDT because various political entities must be involved to complete this project, and all must be onboard with the design and costs of the project. Thus, it would be beneficial of management personnel to try and keep all government agencies involved with the planning of this project, and to monitor any significant changes in preferences that these agencies may have in terms of design and implementation of the project. Again, this risk will be tough to mitigate against as the project progresses, but ensuring any changes are dealt with early on will limit the unanticipated delays and cost increases that would be most detrimental if they arise as the project nears the onset of construction.

8.3 Schedule Mitigation Recommendations

Political factors changing at local, state or federal level also has a significant impact on the schedule contingency. As noted in the cost section, this risk can be mitigated by management personnel consistently monitoring all policy stakeholder opinions and keeping an open dialogue with these agencies in order to try and keep design in line with what is asked for.

The contracting plan has not been developed and thus the current assumptions used to develop the cost estimate and tentative project schedule are subject to change. As the project progresses more analysis should be taken to look into the appropriate contracting plan and this should be incorporated into the estimate and schedule respectively. As the project nears completion this risk should theoretically decrease in impact as the updated contracting plan will have a better guarantee of being correct.

The risk of **flooding, or earthquake** occurring is significant risk to the project. This risk is entirely beyond the control of the PDT because these are naturally occurring events. Due to the overall length of the construction period, encountering one of these events during construction is fairly likely. If a major event of either of these does occur, then significant delays could be incurred due to major repairs and re-construction of failed structures. The avoidance of flooding may be mitigated against by not constructing during flood seasons, but mitigating against a major earthquake is more difficult. Ensuring design of the elements that may be affected by these types of events takes these risks into account may also limit the overall risk to the project.

9. REFERENCES

PMI (Project Management Institute). 2008. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide). 4th edition.*

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USACE. 2007b. *Application of Cost Risk Analysis Methods to Develop Contingencies for Civil Works Total Project Costs*. Engineering and Construction Bulletin 2007-17. September 10.

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ATTACHMENT A

Project Delivery Team Risk Register

Los Angeles River Ecosystem Restoration Project - PDT Risk Register

Risk Level

Likelihood of Occurrence					
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High
	Negligible	Marginal	Significant	Critical	Crisis

Impact or Consequence of Occurrence

Overall Project Scope
The Los Angeles River Ecosystem Restoration Feasibility Study is evaluating ecosystem restoration opportunities along an 11.5-mile long stretch of the Los Angeles River. This project is based on preliminary, planning-level conceptual designs, and common engineering practices. The project is split into eight (8) sub-reaches and the design features for each of these sub-reaches includes: demolition of existing concrete structures; riprap and grouted riprap placement; earthwork; turf reinforcement mats; chain link fences; clearing and grubbing; cast-in-place concrete walls, planters, slabs, and piers; detention basins; sub-drainage systems; and recreation features.

Cost Impacts
For the LA River Project, any cost impact of $1.0 Million or higher should be considered at least "Significant."
Anything over $0.5 Million should be considered at least "Marginal."

Schedule Impacts
For the LA River Project, any schedule impact of 12 months or greater should be considered at least "Significant."
Anything over 6 months should be considered at least "Marginal."

				Project Cost				Project Schedule							
Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)	Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
	PROJECT & PROGRAM MGMT														
PPM-1	Interactions between all agencies involved in project	Many different agencies will be involved in order to complete this project. Managing and assuring that all agencies complete requesite needs may prove difficult.	PDT agrees that this risk is already occuring on the project and that significant cost and schedule impacts could occur in the future	Very Likely	Marginal	MODERATE		Very Likely	Marginal	MODERATE					
PPM-2	Dealings with multiple stakeholders	The various stakeholders in the project may cause difficulties in funding, changes to design, etc.	There are so many stakeholders on the project that this risk is likely to occur; issues are already arising from stakeholders; PDT agrees marginal impact is appropriate	Very Likely	Marginal	MODERATE		Very Likely	Marginal	MODERATE					
PPM-3	Project competing with other projects, funding and resources	Other projects may threaten funding streams and/or delay receival of funds needed to meet design/construction milestones.	This is a typically risk at this stage as other projects may take away funding and resources leading up to the construction; Also construction funds might not be available if other large projects are approved prior to this one. PDT feels this is high risk to project schedule primarily.	Very Likely	Marginal	MODERATE		Very Likely	Marginal	MODERATE					
PPM-4	Losing critical staff at crucial points of project	Loss of crucial staff prior to or during critical milestones could delay project.	Imapct overall life of project would cause marginal impacts; project staff would probably be lost but project would move forward;	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
PPM-5	Product development by several sources	This project requires members from various entities both governemntal and private to complete.	This project does involve many entities, but USACE is used to and able to manage and complete projects with various entities completing work.	Likely	Negligible	LOW		Likely	Negligible	LOW					
PPM-6	Priorities change on existing program	If USACE priorities on ecosystem restoration change, then this project could be impacted.	This project is a major priority to the City and not likely to change; USACE priority on ecosystem restoration may change, but this project is already a priority; Assumes unlikely to impact costs, but schedule could marginally change;	Unlikely	Negligible	LOW		Likely	Marginal	MODERATE					
	CONTRACT ACQUISITION RISKS														
CA-1	Contracting plan has not been developed	Contracting plan has not been fully developed at this stage. Changes to current assumptions could occur.	Current assumption of 4 separate contracts is very likely to change but is a conservative assumption; methods will be looked at to minimize costs of multiple contracts; certain sections (Piggyback Yard/Taylor Yard) may be broken out in separate contracts; PDT agrees for both cost and schedule this would likely occur but impacts would be marginal	Likely	Marginal	MODERATE		Likely	Significant	HIGH					
CA-2	Possibility for 8(a) or small business contractor(s)	Some portions of the project may be bid to 8(a) contractors, which could increase costs for construction.	There may be some small business contractors for some of the smaller portions of the project. But PDT feels low risk that these contractors would impact cost/schedule significantly as work would be low risk.	Likely	Negligible	LOW		Likely	Negligible	LOW					
CA-3	Number of separate contracts and prime contractors	Current estimate assumes 4 separate contracts with each one having a separate prime contractor. Further analysis into contracting plan may change this.	Estimate currently matches current contracting plan. Plan seems more than reasonable and not anticipated to change significantly. PDT thinks this would be low risk for both cost and schedule as an itermittent funding stream is a "less risky" assumption, and is not anticipated to have significant impacts to cost or schedule.	Likely	Negligible	LOW		Likely	Negligible	LOW					
CA-4	Acquisition plan to accommodate funding stream	The funding stream will be a major driver of the contracts. If funding stream changes or is inadequate current assumptions will change.	Project could have agreement in place to have funding available; PDT agrees this would be likely to occur but that the impacts would be marginal to the costs, but significant to the schdedule as project would be delayed;	Likely	Marginal	MODERATE		Likely	Significant	HIGH					

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
	TECHNICAL RISKS														
TL-1	Low design level	Project is at a low design level. All quantities and assumptions are subject to changes as project progresses.	PDT agrees that changes are very likely to occur; There are items missing from the current design and estimate; This item impacts the costs greater than the schedule;	Very Likely	Critical	HIGH		Very Likely	Marginal	MODERATE					
TL-2	Investigations remain to be completed (H&H, Geotech, HTRW, etc.)	Many investigations still remain to be completed. Once finalized, these reports may cause design changes.	These studies need to be completed, and PDT agrees that risk is very likely and significant; Further analysis not currently anticipated may cause significant increases in PED;	Very Likely	Significant	HIGH		Very Likely	Marginal	MODERATE					
TL-3	Hazardous waste concerns	Encountering unanticipated HTRWs can cause significant increase in earthwork costs.	It is known that hazardous wastes are to be encountered, thus it is a very likely risk; HTRWs is not considered a project cost but will need to be accounted for in the schedule; City is to take care of known HTRWs, and unknown HTRWs will need to be removed during construction, but will not be project cost to USACE;	Very Likely	Significant	HIGH		Very Likely	Marginal	MODERATE					
TL-4	Disposal locations and costs for excavated materials	Preliminary landfills have been assumed to be capable of accepting excavated materials. Further analysis could lead to cost savings (if cheap/no cost site is found) or increased costs based on tipping fees.	PDT agrees there is a high chance of a change in disposal costs; Current estimate assumes materials would be hauled off-site and include tipping fees; There are benefits due to HTRW removal will lower earthwork quantities at some sites (need to estimate quantity of HTRW);	Likely	Marginal	MODERATE		Likely	Negligible	LOW					
TL-5	All Disciplines	Many investigations remain to be completed, which once finished, could change current design	Investigations have yet to be completed to verify current design; Once all investigations are completed changes to design are likely to occur; If changes to certain design items occurred impacts to costs would be significant; Schedule is not anticipated to be impacted as plenty of design time is currently in schedule.	Very Likely	Significant	HIGH		Likely	Negligible	LOW					
TL-6	Locations and costs for borrow materials	Changes in material prices and locations from borrow sites may change.	PDT agrees there is a good chance of assumed borrow sites are not going to be same at time of construction; Changes in location or cost of borrow material would be significant to costs.	Unlikely	Significant	MODERATE		Unlikely	Negligible	LOW					
	LANDS AND DAMAGES RISKS														
LD-1	Status of real estate / easement acquisition	Real estate and easements need to be purchased in a timely fashion such that the construction phases can begin as scheduled.	Current plan only requires two areas two be purchased; Schedule is estimated to limit the risk generated from this item; Therefore PDT concludes that this risk is likely to occur but negligible to costs as the cost is being paid regardless; for schedule assumes it is likely to occur and marginal	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
LD-2	Railroad involvement	Project may require railroad involvement for culverts and right-of-way acquisition	Railroad involvement would be required in Piggyback Yard and Taylor Yard; PDT agrees that this is more impactful to schedule than cost; PDT thinks cost risks are low, but for schedule it is likely and significant; any track closures have been estimated to cost $1,000,000/hr	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
LD-3	Relocations identified	Detailed relocation designs/report has not been fully developed at time of estimate.	Current relocation costs are based on building relcoations, and it is assumed to be very likely that these would be encountered; Costs for relocating items would be significant, but would negligable to schedule;	Likely	Marginal	MODERATE		Likely	Negligible	LOW					
LD-4	Known and unknown utility impacts	Unknown utilities may be found during construction thus causing increased costs and delayed schedules.	Utilities have been constructed along the banks and right-of-way of the channel; Therefore these items are very likely to occur, but the quantity is unknown; PDT agrees both for schedule and costs are high risk;	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
LD-5	Vagrancy, loitering issues	Dealing with vagrant population may cause some minor delays.	PDT agrees this is likely to occur but negligible to both costs and schedule;	Likely	Negligible	LOW		Likely	Negligible	LOW					
LD-6	Accuracy of current values of lands and easements	Real estate costs are more than 3 times more costly than the current construction costs. Thus changes in costs to real estate effect total cost significantly.	Detailed appraisals have been completed; PDT agrees costs are anticipated to change, and any increases would be critical; could be significant impact to schedule if land values increase; Changes to the boundaries could add cost and delay construction as well; PDT feels that contingency developed by RE should be more than sufficient, as the current boundaries are very well defined and not likely to change for the current plan.	Very Unlikely	Critical	LOW		Unlikely	Critical	MODERATE					
LD-7	Railroad trestle	Railroad involement, design of trestles, other easement acquisition, temporary operation facilities	If TSP changes to an alternative that requires the railroad trestles, then significant changes to costs and schedule could be incurred. A lot of coordination would be required between agencies and railroads, and additional costs may be needed than currently assumed. PDT thinks this is high risk for both cost and schedule.	Likely	Significant	HIGH		Likely	Significant	HIGH					
	REGULATORY AND ENVIRONMENTAL RISKS														

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost: Likelihood*	Project Cost: Impact*	Project Cost: Risk Level*	Project Cost: Rough Order Impact ($)	Project Schedule: Likelihood*	Project Schedule: Impact*	Project Schedule: Risk Level*	Project Schedule: Rough Order Impact (mo)	Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
RE-1	Status of permits	Many permits will need to be obtained for construction. Prompt receival of permits will be needed to keep construction schedule on track.	Not anticipated to be a risk to costs, but is assumed to be a schedule risk; It is assumed to be likely to occur, but would be marginal impact to schedule;	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
RE-2	Potential for critical regulation changes	Regulation changes within the Corps could impact this project	Regulations are anticipated to change; PDT agrees that the impact would be marginal;	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
RE-3	Negative community impacts	Construction vehichles, noise, pollution, etc, are all to be encountered during construction.	These negative impacts are all likely to occur, but would be negligible to cost; There may be some specific BMP that was not assumed; Howerver, very low risks to the both cost and schedule;	Likely	Negligible	LOW		Likely	Negligible	LOW					
RE-4	Endangered species present	Further research may find endangered species present which could delay project.	This is unlikely to occur throughout this reach; It is not anticipated to impact cost significantly, and project is generally designed to be constructed around at risk species;	Unlikely	Negligible	LOW		Unlikely	Negligible	LOW					
RE-5	Preliminary HTRW complete	HTRW report is not finalized currently	Correlated to TL-2	Likely	Significant	HIGH		Likely	Negligible	LOW					
RE-6	Agency actions/reviews are delayed or take longer than expected	Due to number of agencies involved, keeping all actions and reviews on time will be imperative to meeting the project milestones.	This is similar to RE-1; It is likely to occur but only marginal impact to schedule and negligible to costs.	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
RE-7	Flood risk policy	Flood risk policies from FEMA, DWR, USACE, may change which would impact design	Flood risk policy is likely to change, and this could put some delays in this project. However, PDT does not think this would impact costs much as design is currently capable of handling some policy changes without need for too much new items.	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
	CONSTRUCTION RISKS														
CON-1	Permits, licenses, submittal approvals	Delays in acquiring all permits, licenses, and receiving submittal approvals can delay the start of construction or alter sequencing.	There are many permits and licenses that contractors will have to obtain; This will probably be negligible to costs, and marginal to the schedule;	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
CON-2	Permit and environmental work windows	Work windows based on environmental issues are accounted for, but could change.	PDT agrees that this is unlikely to occur for both costs and schedule; The schedule includes windows for working around nesting season and flood season; Assumes impacts would be marginal to both cost and schedule	Unlikely	Marginal	LOW		Unlikely	Marginal	LOW					
CON-3	Site access restrictions	Due to the length of the reaches, site accessibility may be a problem.	This is likley to occur as there are railroads, and bridges; Contractor should be able to work around these issues and plan accordingly; Some reaches may have more restrictions, and secondary access may be required; PDT agrees the costs impacts would be likely and marginal, and likely and negligible for the schedule	Likely	Marginal	MODERATE		Likely	Negligible	LOW					
CON-4	Adequate staging areas	No staging areas have been designed, and due to size of project significant staging would be required.	Staging areas would be designed as the project progresses. Current costs for staging may not be adequate once more detailed analysis is completed. PDT thinks this is likely to occur but only be marginal impact to costs and negligible to schedule.	Likely	Marginal	MODERATE		Likely	Negligible	LOW					
CON-5	Unknown utilities	Unknown utilities may be found during construction thus causing increased costs and delayed schedules.	Similar to LD-4 this would be a high risk to cost but a low risk to schedule.	Likely	Significant	HIGH		Likely	Negligible	LOW					
CON-6	Traffic issues for all haul vehicles	Traffic is going to be an issue for any haul trucks bringing or taking away materials to and from the project site.	There is no traffic control plan at this point; Construction is in an urbanized location, and traffic is likely to occur; If roads need to be repaired then there would be significant cost increases;	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
CON-7	Diversion and control of water	Diversion and control of water is going to be significant effort, and is based on general assumptions at this time.	70% of the flow is from Tillman, and if flows are incresed for any reason, then assumptions for water control would change; PDT assumes that this would be likely and significant impact to costs;	Unlikely	Significant	MODERATE		Likely	Negligible	LOW					
CON-8	Change orders and modification growths	There may be modifcation issues that have not been captured in the estimate or schedule.	Redesign to sponsor changes, discovering unidentified utilities, etc.; A project of this scale is likely to incur some changes during construction; These changes are assumed to be significantly impacted to both cost and schedule;	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
CON-9	Unidentified hazardous waste	Encountering unanticipated HTRWs during construction can cause significant increase in earthwork costs.	After the investigations are complete, construction activities still may encounter hazardous materials; PDT agrees that impact for both cost and schedule would be unlikely and significant;	Unlikely	Significant	MODERATE		Unlikely	Significant	MODERATE					

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
CON-10	Adaptive management	Managing the project through unexpected changes.	Not anticipated to be a significant risk to either cost or schedule, but is likely to have some issues brought up.	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
	ESTIMATE AND SCHEDULE RISKS														
EST-1	Estimate confidence in large and critical quantities	Design is at low level, and quantities are based on one typical section for each reach.	As progress progresses it is very likely that quantities will change since design is currently at a very low level. This would impact both cost and construction schedule. This could also be a benefit to the project if quantities are currently over estimated compared to future designs.	Likely	Marginal	MODERATE		Likely	Significant	HIGH					
EST-2	Estimate reasonableness of crews and productivities	Production rates used in estimate may differ from those in the field.	Production rates for primary construction items have been estimated based on various sources as well as estimator experience and expected site conditions. However, actual rates may still vary based on contractors capabilities. The are likely to be different but would only marginally affect costs and construction schedule. Could be a benefit too.	Likely	Significant	HIGH		Likely	Significant	HIGH					
EST-3	Accuracy of construction schedule durations, sequencing, phasing, etc.	Contractor may have different sequencing to construction activities within the contracts which could decrease or increase duration.	Construction schedule may be different than currently assumed. The current assumptions are based on proposed contracting plan, which has been considered a low risk to change. Therfore this item is unlikely to be a high risk either.	Unlikely	Marginal	LOW		Unlikely	Marginal	LOW					
Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)															
PR-1	Adequacy of project funding	There is some concern in obtaining funds on a timely basis or in the necessary increments. Receiving less than required or in delayed increments is a concern.	This would be a significant risk to the schedule as the project would be delayed if funding is not available.	Unlikely	Marginal	LOW		Unlikely	Significant	MODERATE					
PR-2	Local communities have objections	Delays may occur due to local communities objecting to the work planning to be constructed.	There are already objections to the current plan; Most of these objecting views are asking for alternatives that are greater in scope than the proposed one. Therfore costs and schedules could be impacted significantly if this changes.	Unlikely	Significant	MODERATE		Unlikely	Significant	MODERATE					
PR-3	Stakeholders request late changes	Late changes by the various stakeholders can cause redesign, increased costs and delays.	Similar to PR-2, in that requests for changes to the plan are already being made, and more changes are expected to be requested in the future. These changes would most likely only raise costs, but not anticipated to impact schedule as stakeholders want this work done sooner as opposed to later.	Likely	Marginal	MODERATE		Likely	Negligible	LOW					
PR-4	Market conditions and bidding competition	Real estate market could be significant risk with variability in this market.	This could be an opportunity or negative risk based on the bidding climate; With real estate property and construction this could be a significant impact to costs; There may be others bidding on real estate; Not anticipated to impact the schedule significantly	Likely	Significant	HIGH		Unlikely	Marginal	LOW					
PR-5	Unexpected escalation on key materials	There could be increases in the cost materials, primarily including the riprap and borrow materials.	Costs for materials could increase or decrease based on market conditions; It is anticipated that materials would more likely increase than decrease; Some materials may become more scarce; These are likely to impact both cost and schedule significantly	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
PR-6	Flooding/Earthquake	Small chance of major floods and earthquakes occuring, but these could delay project and cause major re-work.	PDT believes likelihood of having a major flood or earthquake during construction is high due to the overall length of construction. If one of these events occurred there would probably be significant delays and large cost impacts due to repairs and re-construction due to failed structures.	Likely	Marginal	MODERATE		Likely	Significant	HIGH					
PR-7	Political factors change at local, state or federal level	Concern due to large cost and all government agencies agreeing on design and implementation.	There is already some discussions between various agencies over the selected plan. Also due the projected costs to the project many political issues could arise that deter funding; Due to number of agencies involved this risk is believed to be likely to occur and could significanlty affect both the cost and schedule.	Likely	Significant	HIGH		Likely	Significant	HIGH					

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

ATTACHMENT B

Market Research

(Available Upon Request)

US Army Corps
of Engineers®

Los Angeles District

Los Angeles River Ecosystem Restoration

Feasibility Study

DRAFT
Cost and Schedule Risk Analysis Report
Locally Preferred Plan
Alternative 20

March 2015

TETRA TECH

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EXECUTIVE SUMMARY

This report presents a recommendation for the total project cost and schedule contingency for the Los Angeles River Ecosystem Restoration Project's Locally Preferred Plan. A formal risk analysis study was conducted to develop a reliable and defensible contingency factor for the total project cost associated with the MCACES construction cost estimate. The cost and schedule risk analysis involved the development of project contingencies by identifying and evaluating the impacts of project uncertainties on the construction cost and schedule and a subsequent calculation of the estimated total project cost.

The Project Delivery Team (PDT) conducted one brainstorming session on November 5, 2013, to identify the risks associated with the project. Additional coordination of the PDT for review and input occurred thereafter. Key project and risk assumptions reflected in the analysis were identified. The risk analysis was performed using Oracle Crystal Ball software to estimate a contingency with the use of Monte Carlo simulations in correlation with the proposed risks and uncertainties.

The contingency is based on an 80 percent (P80) confidence level, per accepted U.S. Army Corps of Engineers Civil Works guidance. For the Los Angeles river Ecosystem Restoration project, the most likely baseline construction cost is estimated at approximately $464,924,107 (Table ES-1). The risk analysis resulted in a contingency value of $152,771,267 based on the cost risks and a contingency of $18,342,738 based on the schedule risks. This translates to a total project contingency value of $171,114,005 which equates to approximately 36.80 percent of construction costs.

CONTINGENCY SUMMARY

Contingency on Baseline Cost Estimate	80% Confidence Project Cost
Baseline Estimated Cost (Most Likely) ->	**$464,924,107**
Baseline Estimated Cost Contingency Amount ->	$152,771,267
Baseline Estimated Construction Cost (80% Confidence) ->	**$617,695,374**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	**192.0 Months**
Schedule Contingency Duration ->	**53.9 Months**
Project Schedule Duration (80% Confidence) ->	**245.9 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$18,342,738**

Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$171,114,005**
Project Contingency Percentage (80% Confidence) ->	**36.80%**

Project Cost (80% Confidence) ->	**$636,038,112**

Please note that cost estimates fluctuate over time. During this period of study, minor cost fluctuations can and have occurred. For this reason, costs may vary a slight degree between this document and the primary cost estimating components of the MCACES construction cost estimate and the Total Project Cost Summary (TPCS). Therefore, values in this document may not exactly match those from the TPCS and MCACES, but should be very similar in scale.

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

An analysis of the relative impact of the key cost drivers on the cost and schedule contingency indicates that following risks result in the most impact on the overall project contingency:

- Cost Risks:
    - PR-7: political factors change at local, state or federal level – Due to the projected costs of this project, and the number of different agencies involved, funding difficulties may arise which could impact the costs of construction.
    - TL-1: low design level – This project is currently at a preliminary design level. All quantities and costs are based on typical cross sections, but as the project progresses more design detail will be completed. Thus this risk should be mitigated during future design phases.
    - PR-4: market conditions and bidding competition – This risk falls outside the PDT's sphere of influence. It is difficult to project these conditions several years out, but given that this project is also anticipated to take over 10-years to construct, it is even more difficult to predict adequate conditions that far out. Thus costs for this must be accounted for at this time.
    - TL-2: investigations remain to be completed – As noted in risk item TL-1, this project is still at a low design level. As the project moves forward all outstanding investigations will be completed, and the impact of this risk will be lowered.
- Schedule Risks:
    - PR-6: flooding / earthquake – Los Angeles is renowned for earthquakes and is susceptible to flash floods. These risks are unavoidable, but would pose significant delays to construction if they occur, which is likely due to the proposed construction duration.
    - PR-7: political factors change at local, state or federal level – As noted under the costs risks above, the different entities involved in this project may not always see eye to eye. Construction could be delayed if all agencies are not on board with the selected plan.
    - CA-4: acquisition plan to accommodate funding stream – The current estimate assumes intermittent funding, but the assumption of four contracts may not be sufficient. The funding stream could change the number of contracts, which may push the construction schedule out.

The key recommendations from this study are the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life cycle, potential mitigation throughout the planning, engineering and design phase, and proactive monitoring and control of the internal risks identified in this study.

1. PURPOSE

A cost and schedule risk analysis (CSRA) was conducted to develop a reliable and defensible contingency factor for the construction cost estimate developed for the Los Angeles River Ecosystem Restoration Feasibility Study Cost Appendix with the use of the Micro-Computer Aided Estimating System (MII). The appendix describes the design and cost assumptions that go into developing the MII estimate. The contingency factor was calculated at the 80 percent confidence level as recommended by U.S. Army Corps of Engineers (USACE) guidance (2009). The contingency was calculated in terms of dollars for the cost analysis and in terms of months for the schedule analysis.

The Project Delivery Team (PDT) studied a variety of risks that could affect the construction cost and/or schedule. The events were grouped into the following categories:

- Project and program management
- Contract acquisition
- Technical
- Lands and damages
- Construction
- Estimate and schedule
- Programmatic (external)

All of the risk categories except “programmatic” include risks that could be generated, caused, or controlled by the PDT. Programmatic, or external, risks are those outside the sphere of influence of the PDT.

2. BACKGROUND

The primary purpose of this project is to restore approximately 11 miles of the Los Angeles River. This stretch of channel starts at Griffith Park and extends to the Downtown Los Angeles area. The project is designed to reestablish riparian strands, freshwater marshes and aquatic habitat communities as well as reconnect the river to major tributaries, historic floodplains and regional habitat zones. This project is also designed to provide recreational opportunities that are consistent with the restored ecosystem.

The Los Angeles River has been degraded over time by a cycle of increasing urban development, flooding, and channelization. This cycle led to the Los Angeles County Drainage Area (LACDA) project that was completed in the mid-20th century. The LACDA was a Federal flood control project that straightened the channel and encased much of it with concrete banks and concrete beds. This greatly diminished the plant and wildlife diversity and quality and disconnected the channel from its floodplains and significant ecological zones.

Other sections of the Los Angeles River that are outside of this project’s reach are more urbanized and were not considered for potential habitat connectivity and expansion projects. Thus this 11 mile stretch, known as the “Area with Restoration Benefits and Opportunities for Revitalization (ARBOR)” reach, has the most potential for restoration benefits.

This project initially looked at various alternatives that comprised numerous restoration sub-measures. Initial construction cost estimates were developed and a final array of four alternatives was selected for further analysis. From these four alternatives, the locally preferred plan (LPP) was chosen. The LPP turned out to be Alternative 20, entitled ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER). This alternative was estimated using MII software and is the basis for the risk analysis within this report.

The following design documents were available for use in this CSRA:

- Los Angeles River Ecosystem Restoration – Feasibility Study, Draft Integrated Report September 2013
- Los Angeles River Ecosystem Restoration – Feasibility Study, Conceptual Design Drawings, April 2013
- Los Angeles River Ecosystem Restoration – Feasibility Study, Design Appendix, August 2014
- Los Angeles River Ecosystem Restoration – Feasibility Study, Cost Appendix, August 2014

3. REPORT SCOPE

The scope of this CSRA report is the calculation and presentation of cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes mandated by USACE Engineer Regulation (ER) 1110-2-1150, ER 1110-2-1302, and Engineer Technical Letter 1110-2-573 (USACE 1999, 2008a, 2008b). The report presents the contingency results for cost risks for all project features. The study excluded a consideration of operation and maintenance and life cycle costs.

3.1 Project Scope

3.1.1 Mandates and Appropriations

- The study was authorized by Senate Committee on Public Works Resolution, approved June 25, 1969.
- Section 4018 of the Water Resources Development Act of 2007 provided authorization for a "feasibility study for environmental ecosystem restoration, flood risk management, recreation and other aspects of Los Angeles River revitalization that is consistent with the goals of the Los Angeles River Revitalization Master Plan published by the city of Los Angeles…"

3.1.2 Product Development

The project technical scope, estimate, and schedule developed by Tetra Tech, Inc. served as the basis for the risk analysis for the construction cost estimate. The construction cost estimate scope consists of the following:

- Civil Works Work Breakdown Structure feature account: 02, Relocations, 06, Fish and Wildlife Facilities and 14, Recreation (USACE 2008b)

- Design level: includes conceptual design cross sections for the Los Angeles River Ecosystem Restoration Feasibility Study

3.2 USACE Risk Analysis Process

The risk analysis process used in this study follows the USACE Headquarters requirements as well as guidance from the Cost Engineering Directory of Expertise for Civil Works. It uses probabilistic CSRA methods within the framework of the Oracle Crystal Ball software. The results of a risk analysis are intended to serve several functions, one being the establishment of reasonable contingencies reflective of an 80 percent confidence level to successfully accomplish the project work within that established contingency amount. The scope of the report includes the identification of important steps, rationale, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

The risk analysis results discussed in this report are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, a CSRA should be considered an ongoing process that is conducted concurrently 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 satisfying broadly defined risk analysis standards and recommended practices, this risk analysis was performed in accordance with the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Guidance USACE (2009)
- Memorandum from Major General Don T. Riley, U.S. Army Director of Civil Works (USACE 2007a)
- Engineering and Construction Bulletin 2007-17 (USACE 2007b)
- Engineer Regulation 1110-2-1150 (USACE 1999)
- Engineer Regulation 1110-2-1302 (USACE 2008a)
- Engineer Technical Letter 1110-2-573 (USACE 2008b)

4. METHODOLOGY/PROCESS

The risk analysis team received cost support from the cost engineer as well as coordination support from project management and the assigned PDT. Several other disciplines, such as Construction, were invited, but not all disciplines attended the meeting. The members of the risk analysis team are indicated in Table 1.

Table 1 – PDT Member Positions and Organizations

Position	Name	Organization
Hydrology and Hydraulics	Kerry Casey	USACE, Los Angeles
Geotechnical	Chris Spitzer	USACE, Los Angeles
Plan Formulation Branch Chief	Ed Demesa	USACE, Los Angeles
Project Manager	Tawny Tran	USACE, Los Angeles
Cost Engineer	Arnecia Williams	USACE, Los Angeles
Biologist	Eric Jones	USACE, Los Angeles
Design	Frank Mallette	USACE, Los Angeles
Real Estate	Lisa Sandoval	USACE, Los Angeles
Economics	Mike Hallisy	USACE, Los Angeles
Project Manager	Scott Estergard	Tetra Tech
Cost Estimator	Scott Vose	Tetra Tech
Project Engineer	Ike Pace	Tetra Tech
Senior Water Resource Planner	Ira Artz	Tetra Tech
Local Sponsor Representative	Megan Whalen	City of Los Angeles
Local Sponsor Representative	Rene Curtis	City of Los Angeles
Local Sponsor Representative	Carol Armstrong	City of Los Angeles
Local Sponsor Representative	Michael Affeldt	City of Los Angeles

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 confidence related to project cost.

Contingency is defined as 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 or additional time. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept the 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 Engineering District guidance for CSRA generally focuses on the 80 percent level of confidence (P80) for cost contingency calculation. The use of P80 as a decision criterion is a risk-averse approach (whereas the use of P50 is considered a risk-neutral approach, and the use of levels less than 50 percent is considered a risk-seeking approach). Thus, the use of a P80 confidence level results in a greater contingency relative to that resulting from 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 (Oracle Crystal Ball), which 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.

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

4.1 Identification and Assessment of Risk Factors

Identification of the risk factors by the PDT is considered a qualitative process that results in the establishment of a risk register, which is used to document the results of the quantitative study of risks. Risk factors are events and conditions that may influence or drive uncertainty associated with 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.

Checklists or historical databases of common risk factors are sometimes used to facilitate the identification of risk factors. However, the key risk factors are often unique to a project and cannot be readily derived from historical information. Therefore, input is obtained from the entire PDT be means of creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable.

Formal PDT meetings are held for the purposes of identifying and assessing risk factors. The meetings should include capable and qualified representatives from multiple project team disciplines and functions, for example:

- Project/program managers
- Contracting/acquisitions
- Real estate
- Relocations
- Environmental
- Civil and coastal design
- Cost and schedule engineers
- Construction
- Key sponsors

The initial formal meetings should focus primarily on risk factor identification using brainstorming techniques but also include some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings should focus primarily on risk factor assessment and quantification. Conference calls and informal meetings also occur throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment. The risk register document developed for this project can be seen in Attachment A.

4.2 Quantification of Risk Factor Impacts

The quantitative impacts of risk factors on project plans are analyzed using a combination of professional judgment, empirical data, and analytical techniques. Risk factor impacts are 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 involves multiple project team disciplines and functions. However, the quantification process relies more extensively on collaboration between cost engineering and risk analysis team members with lesser input from the other functions and disciplines. The quantification process uses 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 for both cost and schedule risk concerns. The risk register documents the PDT's risk concerns, discussions related to those concerns, and potential impacts on the current cost and schedule estimates. The concerns and discussions are meant to support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analysis of 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 and the market research. 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 in this study, the contingency was calculated as the difference between the P80 cost forecast and the base cost estimate. Each option-specific contingency was 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 was used as the feature-specific measure of risk for contingency allocation purposes. This approach resulted in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

For the schedule in this study, contingency was calculated as the difference between the duration forecast at various confidence level intervals and the base schedule duration. The duration contingency was then used to estimate hotel costs and calculate the additional time value of money impact due to project delays that are included in the total cost contingency presented in Section 6. The resulting time value of money, or added escalation risk, and hotel costs were added into the cost contingency amount to reflect the USACE standard for presenting the estimated cost for the fully funded project amount.

Schedule contingency was analyzed only on the basis of each option and not allocated to specific tasks. Based on the guidance, only critical path and near critical path tasks are considered uncertain for the purposes of contingency analysis (USACE 2009).

5. KEY ASSUMPTIONS

The CSRA for the Los Angeles River Ecosystem Restoration project was based on the following key assumptions:

- The project is currently in the conceptual design stage. Various alternatives were analyzed previously based on conceptual cross-sections for each reach. These same cross-sections and designs are utilized for development of the MCACES cost estimate.
- Many of the requisite studies (geotechnical, H&H, etc.) have not been completed. The design is subject to change once the information from these reports can be incorporated.
- Project study costs to date are not included in the risk study.
- Neither life cycle nor operation and maintenance costs are included in the risk study. This study is based solely on the initial construction of the project.
- Major features of this project include concrete demolition; excavation and fill; riprap; grouted riprap; turf reinforcement mats; fencing; clearing and grubbing; reinforced cast-in-place concrete; sub-drainage system; asphalt; multi-use trail; trail access points; pedestrian bridges and other recreation components.
- The feature cost accounts for this project include Lands and Damages; Relocations; Fish and Wildlife Facilities; Recreation; Planning, Engineering, and Design; and Construction Management.
    - Lands and Damages: The costs for this account have been estimated by the USACE. However, these costs have not been included in this CSRA analysis, because due to the overwhelming size of the costs for this account, the risk analysis would be completed swayed towards the risks associated with this account. Also, the real estate report develops their own contingencies to be utilized for this project, which have been deemed sufficient to account for any unforeseen changes that may occur to these costs.
    - Relocations: Costs for this account include utility relocations, estimated in MII, and business relocation costs that have been provided by the USACE. The utility relocations include electrical tower relocations and several pipe relocations. The utility relocations are included in this risk analysis.
    - Fish and Wildlife Facilities: Costs for this account include the majority of the construction costs for this project.

- Recreation: Costs for this account include the components that are not primarily aimed at ecosystem restoration. These include construction activities such as multi-use trails, trail access points, wildlife viewing areas, pedestrian bridges and other recreation trail components.
- Planning, Engineering, and Design: Costs for this account were estimated at 14 percent of the construction cost. This account covers the preparation of the plans, specifications, and estimate for construction, as well as adaptive management and monitoring post construction.
- Construction Management: Costs for this account were estimated at 6.5 percent of the construction cost. This account covers construction management during the construction contract.
- Monitoring and Adaptive Management: Costs for this item were added to the costs estimated for construction management. These costs were estimated as 3% of the Fish and Wildlife Facilities costs only.

- The cost estimate is based on local labor, material, and fuel costs. The construction schedule is based on production rates of the construction elements in the cost estimate.
- The recommended contingency is based on an 80 percent confidence level, per accepted USACE Civil Works guidance.
- Only the high and moderate risk levels as determined by the PDT in the risk register are included in the risk analysis. The low risk levels are excluded based on the assumption that they would have a negligible impact in determining the contingency.

6. RISK ANALYSIS RESULTS

The CSRA results are provided in the following subsections. In addition to the contingency calculations, the results of sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The risk register developed for this project is provided in Attachment A; a condensed version of the risk register is provided in Table 2. The complete risk register includes low-level risks, as well as additional information regarding the nature and impacts of each risk.

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 the following:

- 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

Table 2 – Condensed Risk Register

Risk No.	Risk/Opportunity Event	Concerns	Project Cost			Project Schedule		
			Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)							
	PROJECT & PROGRAM MGMT							
PPM-1	Interactions between all agencies involved in project	Many different agencies will be involved in order to complete this project. Managing and assuring that all agencies complete requisite needs may prove difficult.	Very Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE
PPM-2	Dealings with multiple stakeholders	The various stakeholders in the project may cause difficulties in funding, changes to design, etc.	Very Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE
PPM-3	Project competing with other projects, funding and resources	Other projects may threaten funding streams and/or delays receive of funds needed to meet design/construction milestones.	Very Likely	Marginal	MODERATE	Very Likely	Marginal	MODERATE
PPM-4	Losing critical staff at crucial points of project	Loss of crucial staff prior to or during critical milestones could delay project.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
PPM-5	Product development by several sources	This project requires members from various entities both governmental and private to complete.	Likely	Negligible	LOW	Likely	Negligible	LOW
PPM-6	Priorities change on existing program	If USACE priorities on ecosystem restoration change, then this project could be impacted.	Unlikely	Negligible	LOW	Likely	Marginal	MODERATE
	CONTRACT ACQUISITION RISKS							
CA-1	Contracting plan has not been developed	Contracting plan has not been fully developed at this stage. Changes to current assumptions could occur.	Likely	Marginal	MODERATE	Likely	Significant	HIGH
CA-2	Possibility for 8(a) or small business contractor(s)	Some portions of the project may be bid to 8(a) contractors, which could increase costs for construction.	Likely	Negligible	LOW	Likely	Negligible	LOW
CA-3	Number of separate contracts and prime contractors	Current estimate assumes 4 separate contracts with each one having a separate prime contractor. Further analysis into contracting plan may change this.	Likely	Negligible	LOW	Likely	Negligible	LOW
CA-4	Acquisition plan to accommodate funding stream	The funding stream will be a major driver of the contracts. If funding stream changes or is inadequate current assumptions will change.	Likely	Marginal	MODERATE	Likely	Significant	HIGH
	TECHNICAL RISKS							

Risk No.	Risk/Opportunity Event	Concerns	Project Cost			Project Schedule		
			Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
TL-1	Low design level	Project is at a low design level. All quantities and assumptions are subject to changes as project progresses.	Very Likely	Critical	HIGH	Very Likely	Marginal	MODERATE
TL-2	Investigations remain to be completed (H&H, Geotech, HTRW, etc.)	Many investigations still remain to be completed. Once finalized, these reports may cause design changes.	Very Likely	Significant	HIGH	Very Likely	Marginal	MODERATE
TL-3	Hazardous waste concerns	Encountering unanticipated HTRWs can cause significant increase in earthwork costs.	Very Likely	Significant	HIGH	Very Likely	Marginal	MODERATE
TL-4	Disposal locations and costs for excavated materials	Preliminary landfills have been assumed to be capable of accepting excavated materials. Further analysis could lead to cost savings (if cheap/no cost site is found) or increased costs based on tipping fees.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
TL-5	All Disciplines	Many investigations remain to be completed, which once finished, could change current design	Very Likely	Significant	HIGH	Likely	Negligible	LOW
TL-6	Locations and costs for borrow materials	Changes in material prices and locations from borrow sites may change.	Unlikely	Significant	MODERATE	Unlikely	Negligible	LOW
	LANDS AND DAMAGES RISKS							
LD-1	Status of real estate / easement acquisition	Real estate and easements need to be purchased in a timely fashion such that the construction phases can begin as scheduled.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
LD-2	Railroad involvement	Project may require railroad involvement for culverts and right-of-way acquisition	Likely	Negligible	LOW	Likely	Marginal	MODERATE
LD-3	Relocations identified	Detailed relocation designs/report has not been fully developed at time of estimate.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
LD-4	Known and unknown utility impacts	Unknown utilities may be found during construction thus causing increased costs and delayed schedules.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
LD-5	Vagrancy, loitering issues	Dealing with vagrant population may cause some minor delays.	Likely	Negligible	LOW	Likely	Negligible	LOW
LD-6	Accuracy of current values of lands and easements	Real estate costs are more than 3 times more costly than the current construction costs. Thus changes in costs to real estate effect total cost significantly.	Very Unlikely	Critical	LOW	Unlikely	Critical	MODERATE
LD-7	Railroad trestle	Railroad involvement, design of trestles, other easement acquisition, temporary operation facilities	Likely	Significant	HIGH	Likely	Significant	HIGH
	REGULATORY AND ENVIRONMENTAL RISKS							

Risk No.	Risk/Opportunity Event	Concerns	Project Cost			Project Schedule		
			Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
RE-1	Status of permits	Many permits will need to be obtained for construction. Prompt receive of permits will be needed to keep construction schedule on track.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
RE-2	Potential for critical regulation changes	Regulation changes within the Corps could impact this project	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
RE-3	Negative community impacts	Construction vehicles, noise, pollution, etc., are all to be encountered during construction.	Likely	Negligible	LOW	Likely	Negligible	LOW
RE-4	Endangered species present	Further research may find endangered species present which could delay project.	Unlikely	Negligible	LOW	Unlikely	Negligible	LOW
RE-5	Preliminary HTRW complete	HTRW report is not finalized currently	Likely	Significant	HIGH	Likely	Negligible	LOW
RE-6	Agency actions/reviews are delayed or take longer than expected	Due to number of agencies involved, keeping all actions and reviews on time will be imperative to meeting the project milestones.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
RE-7	Flood risk policy	Flood risk policies from FEMA, DWR, USACE, may change which would impact design	Likely	Negligible	LOW	Likely	Marginal	MODERATE
	CONSTRUCTION RISKS							
CON-1	Permits, licenses, submittal approvals	Delays in acquiring all permits, licenses, and receiving submittal approvals can delay the start of construction or alter sequencing.	Likely	Negligible	LOW	Likely	Marginal	MODERATE
CON-2	Permit and environmental work windows	Work windows based on environmental issues are accounted for, but could change.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW
CON-3	Site access restrictions	Due to the length of the reaches, site accessibility may be a problem.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
CON-4	Adequate staging areas	No staging areas have been designed, and due to size of project significant staging would be required.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
CON-5	Unknown utilities	Unknown utilities may be found during construction thus causing increased costs and delayed schedules.	Likely	Significant	HIGH	Likely	Negligible	LOW
CON-6	Traffic issues for all haul vehicles	Traffic is going to be an issue for any haul trucks bringing or taking away materials to and from the project site.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
CON-7	Diversion and control of water	Diversion and control of water is going to be significant effort, and is based on general assumptions at this time.	Unlikely	Significant	MODERATE	Likely	Negligible	LOW
CON-8	Change orders and modification growths	There may be modification issues that have not been captured in the estimate or schedule.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE

Risk No.	Risk/Opportunity Event	Concerns	Project Cost			Project Schedule		
			Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*
CON-9	Unidentified hazardous waste	Encountering unanticipated HTRWs during construction can cause significant increase in earthwork costs.	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE
CON-10	Adaptive management	Managing the project through unexpected changes.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
	ESTIMATE AND SCHEDULE RISKS							
EST-1	Estimate confidence in large and critical quantities	Design is at low level, and quantities are based on one typical section for each reach.	Likely	Marginal	MODERATE	Likely	Significant	HIGH
EST-2	Estimate reasonableness of crews and productivities	Production rates used in estimate may differ from those in the field.	Likely	Significant	HIGH	Likely	Significant	HIGH
EST-3	Accuracy of construction schedule durations, sequencing, phasing, etc.	Contractor may have different sequencing to construction activities within the contracts which could decrease or increase duration.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW
	Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)							
PR-1	Adequacy of project funding	There is some concern in obtaining funds on a timely basis or in the necessary increments. Receiving less than required or in delayed increments is a concern.	Unlikely	Marginal	LOW	Unlikely	Significant	MODERATE
PR-2	Local communities have objections	Delays may occur due to local communities objecting to the work planning to be constructed.	Unlikely	Significant	MODERATE	Unlikely	Significant	MODERATE
PR-3	Stakeholders request late changes	Late changes by the various stakeholders can cause redesign, increased costs and delays.	Likely	Marginal	MODERATE	Likely	Negligible	LOW
PR-4	Market conditions and bidding competition	Real estate market could be significant risk with variability in this market.	Likely	Significant	HIGH	Unlikely	Marginal	LOW
PR-5	Unexpected escalation on key materials	There could be increases in the cost materials, primarily including the riprap and borrow materials.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE
PR-6	Flooding/Earthquake	Small chance of major floods and earthquakes occurring, but these could delay project and cause major re-work.	Likely	Marginal	MODERATE	Likely	Significant	HIGH
PR-7	Political factors change at local, state or federal level	Concern due to large cost and all government agencies agreeing on design and implementation.	Likely	Significant	HIGH	Likely	Significant	HIGH

6.2 Discussion of Moderate and High Risks

The following sections discuss the risk items that have are the most impactful to the contingency development. All risk items that generate over 7 percent of the contingency, as shown in the sensitivity analysis, for both cost and schedule are here. Further information on all risk items and their corresponding PDT discussions can be found in Attachment A.

The discussion of each item includes general concerns and discussions developed by the PDT as well as a general discussion of the anticipated cost increases or opportunities that the risks could have. The full market research back-up can be found in Attachment B.

6.2.1 Cost Risks

(i) High Risks

- PR-4: market conditions and bidding competition – This risk is an external risk that falls outside of the PDT's sphere of influence. At time of bidding, the market conditions are an unknown and could significantly impact the values of the bids received. There could be a saturation of contractors willing to bid, which could lead to lower bids received, or the opposite is possible. The market research assumed a possible 5% decrease in the overall construction costs for the low cost and a 15% increase to construction costs for the possibility of higher bids.
- PR-7: political factors change at local, state or federal level – This risk is an external risk that falls outside of the PDT's sphere of influence. There is a concern that due to the large costs and all the government agencies that are involved, that agreement on the design and implementation may be difficult to achieve. There are already discussions surrounding the various alternatives and which should be the selected plan. Also, political opposition may arise to the current plan due to the overall total cost of the project. The CSRA assumes that political opposition could decrease the scope of the project, thus decreasing construction costs by 7.5%. The political pressures could significantly increase costs as well, and it is assumed that a possible 10% increase may occur.
- TL-1: low design level – This risk is one that should decrease as the project progresses. Currently, the design is at a conceptual level with all quantities and costs based on one typical section per reach. Obviously, as the project moves forward the impacts of this risk will be lowered as the design becomes more detailed and the quantities are fine tuned. But at the time being, the low design level could lead to significant changes in quantities. The CSRA assumed that due to the level of design the cost estimate could decrease upwards of 7.5% or increase by 10%.
- TL-2: investigations remain to be completed (H&H, Geotech, HTRW, etc.) – This project is currently at the conceptual design level and thus many investigations still remain to be completed. Upon completion of all the necessary studies, the PDT agrees that many aspects of the current design may change. These changes, plus the overall scale of the project, could result in significant impacts to the overall cost of the project. The cost impacts could be positive or negative, as further analysis may show that current designs are over designed to meet all engineering standards, or perhaps the project is significantly under-designed thus requiring larger structures.

The CSRA assumes a 5% decrease in total construction costs and a 10% increase in are possible.

6.2.2 Schedule Risks

(i) High Risks

- CA-4: acquisition plan to accommodate funding stream – The funding stream is anticipated to be the major driver of the number and size of the contracts issued. If the funding stream is changed or inadequate, then the current assumption of seven contracts would require changing. The PDT thinks there is a risk of this occurring and that it would primarily impact the schedule. Therefore the CSRA analysis assumes that the schedule may decrease by six months if funding stream requires, or may increase by up to twelve months.
- PR-6: flooding / earthquake – There is a small chance that a major flood or earthquake could occur at some point during the construction time frame. If either of these occurred, then major delays could be expected and even some re-work may be required if structures are damaged. Therefore the CSRA analysis assumed construction continuing for twelve more months if a major flood or earthquake is experienced.
- PR-7: political factors change at local, state or federal level – This risk is an external risk that falls outside of the PDT's sphere of influence. There is a concern that due to the large costs and all the government agencies that are involved, that agreement on the design and implementation may be difficult to achieve. There are already discussions surrounding the various alternatives and which should be the selected plan. Also, political opposition to the current plan may arise due to the overall total cost of the project. Disagreement between all the governmental entities could delay the project from being completed. For this risk it was assumed that the project would be pushed back twelve months.

6.3 Cost Risk Analysis – Cost Contingency Results

The project cost contingencies calculated for each confidence level are provided in Table 3. The estimated project cost contingency for the P80 confidence level was quantified as approximately $152.8 million, which equates to approximately 32.9 percent of the total project cost. This contingency value was calculated solely from the costs of the project and is not for use as the overall project contingency.

Table 3 – Project Cost Contingency Summary

Confidence Level	Baseline Total Project Cost	Contingency	Total Project Cost with Contingency	Contingency
0%	$464,924,107	$2,563,494	$467,487,601	0.55%
5%	$464,924,107	$63,597,773	$528,521,880	13.68%
10%	$464,924,107	$75,586,811	$540,510,918	16.26%
15%	$464,924,107	$83,720,942	$548,645,049	18.01%
20%	$464,924,107	$90,830,029	$555,754,136	19.54%
25%	$464,924,107	$96,959,129	$561,883,236	20.85%
30%	$464,924,107	$102,561,180	$567,485,287	22.06%
35%	$464,924,107	$107,552,486	$572,476,593	23.13%
40%	$464,924,107	$112,355,379	$577,279,486	24.17%
45%	$464,924,107	$117,150,356	$582,074,463	25.20%
50%	$464,924,107	$121,519,808	$586,443,915	26.14%
55%	$464,924,107	$126,307,043	$591,231,150	27.17%
60%	$464,924,107	$130,843,157	$595,767,264	28.14%
65%	$464,924,107	$135,603,537	$600,527,644	29.17%
70%	$464,924,107	$140,942,464	$605,866,571	30.32%
75%	$464,924,107	$146,551,074	$611,475,181	31.52%
80%	$464,924,107	$152,771,267	$617,695,374	32.86%
85%	$464,924,107	$160,352,838	$625,276,945	34.49%
90%	$464,924,107	$169,184,041	$634,108,148	36.39%
95%	$464,924,107	$183,870,021	$648,794,129	39.55%
100%	$464,924,107	$261,655,158	$726,579,265	56.28%

A sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. From this analysis, the key cost drivers can be identified and used to support the development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project life cycle.

The cost sensitivity analysis for this project shows the rank of the risks from the highest impact on the cost contingency to the lowest (Figure 1). Approximately 60.4 percent of the resulting cost contingency comes from four of the analyzed risk items: PR-7 (political factors change at local, state or federal level), TL-1 (low design level), TL-2 (investigations remain to be completed) and PR-4 (market conditions and bidding competition).

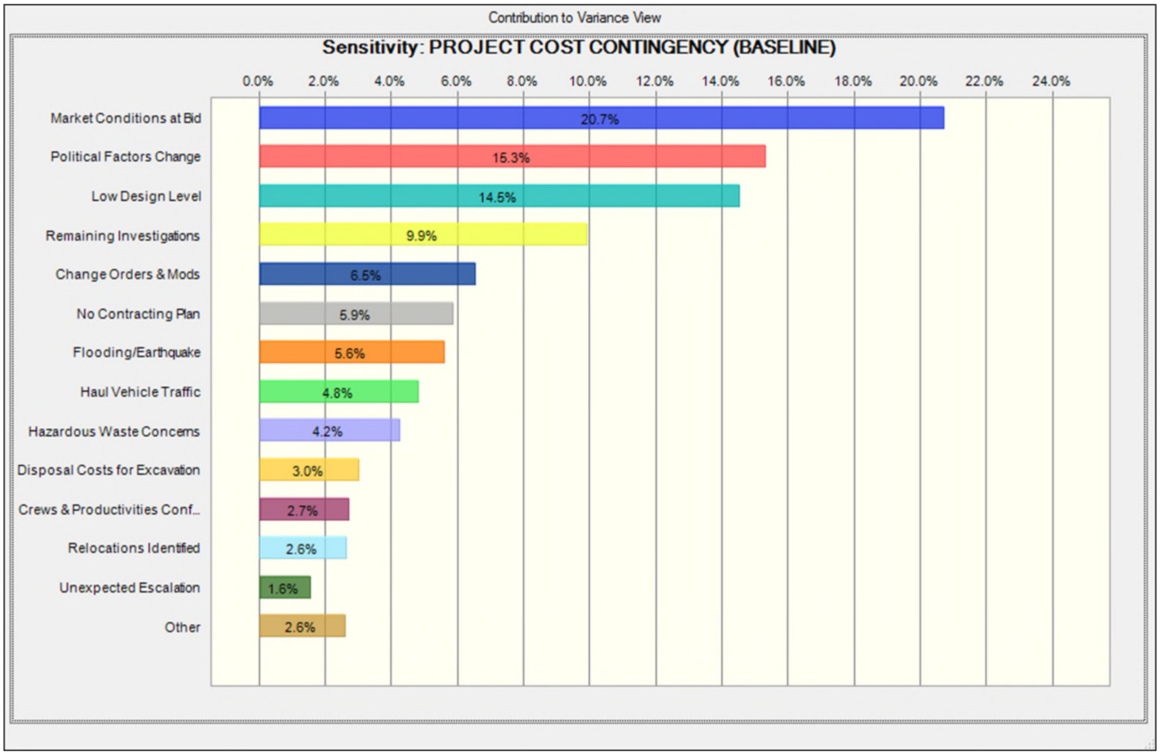

Figure 1 – Sensitivity Analysis (Cost)

6.4 Schedule Duration Risk Analysis – Schedule Contingency Results

The schedule duration contingencies calculated for each confidence level are provided in Table 4. The estimated schedule duration contingency for the P80 confidence level was quantified as approximately 53.9 months, which equates to approximately 28.1 percent of the total project schedule duration. This contingency duration was calculated solely from the schedule of the project and is not for use as the overall project contingency.

Table 4 – Project Schedule Duration Contingency Summary

Confidence Level	Baseline Schedule Duration	Contingency (Duration)	Baseline Schedule Duration with Contingency	Contingency
0%	192.0 Months	19.1 Months	211.1 Months	9.92%
5%	192.0 Months	34.5 Months	226.5 Months	17.98%
10%	192.0 Months	37.0 Months	229.0 Months	19.27%
15%	192.0 Months	38.8 Months	230.8 Months	20.21%
20%	192.0 Months	40.3 Months	232.3 Months	20.99%
25%	192.0 Months	41.6 Months	233.6 Months	21.66%
30%	192.0 Months	42.8 Months	234.8 Months	22.28%
35%	192.0 Months	43.9 Months	235.9 Months	22.87%
40%	192.0 Months	45.0 Months	237.0 Months	23.46%
45%	192.0 Months	46.0 Months	238.0 Months	23.96%
50%	192.0 Months	47.1 Months	239.1 Months	24.53%
55%	192.0 Months	48.1 Months	240.1 Months	25.07%
60%	192.0 Months	49.2 Months	241.2 Months	25.60%
65%	192.0 Months	50.2 Months	242.2 Months	26.13%
70%	192.0 Months	51.3 Months	243.3 Months	26.74%
75%	192.0 Months	52.6 Months	244.6 Months	27.38%
80%	192.0 Months	53.9 Months	245.9 Months	28.09%
85%	192.0 Months	55.6 Months	247.6 Months	28.95%
90%	192.0 Months	57.7 Months	249.7 Months	30.03%
95%	192.0 Months	60.6 Months	252.6 Months	31.57%
100%	192.0 Months	79.2 Months	271.2 Months	41.24%

The schedule duration sensitivity analysis for this project shows the rank of the risks from the highest impact on the schedule duration contingency to the lowest (Figure 2). Approximately 37.8 percent of the resulting schedule duration contingency comes from three of the analyzed risk items: CA-4 (acquisition plan to accommodate funding stream), PR-6 (flooding/earthquake), and PR-7 (political factors change at local, state or federal level).

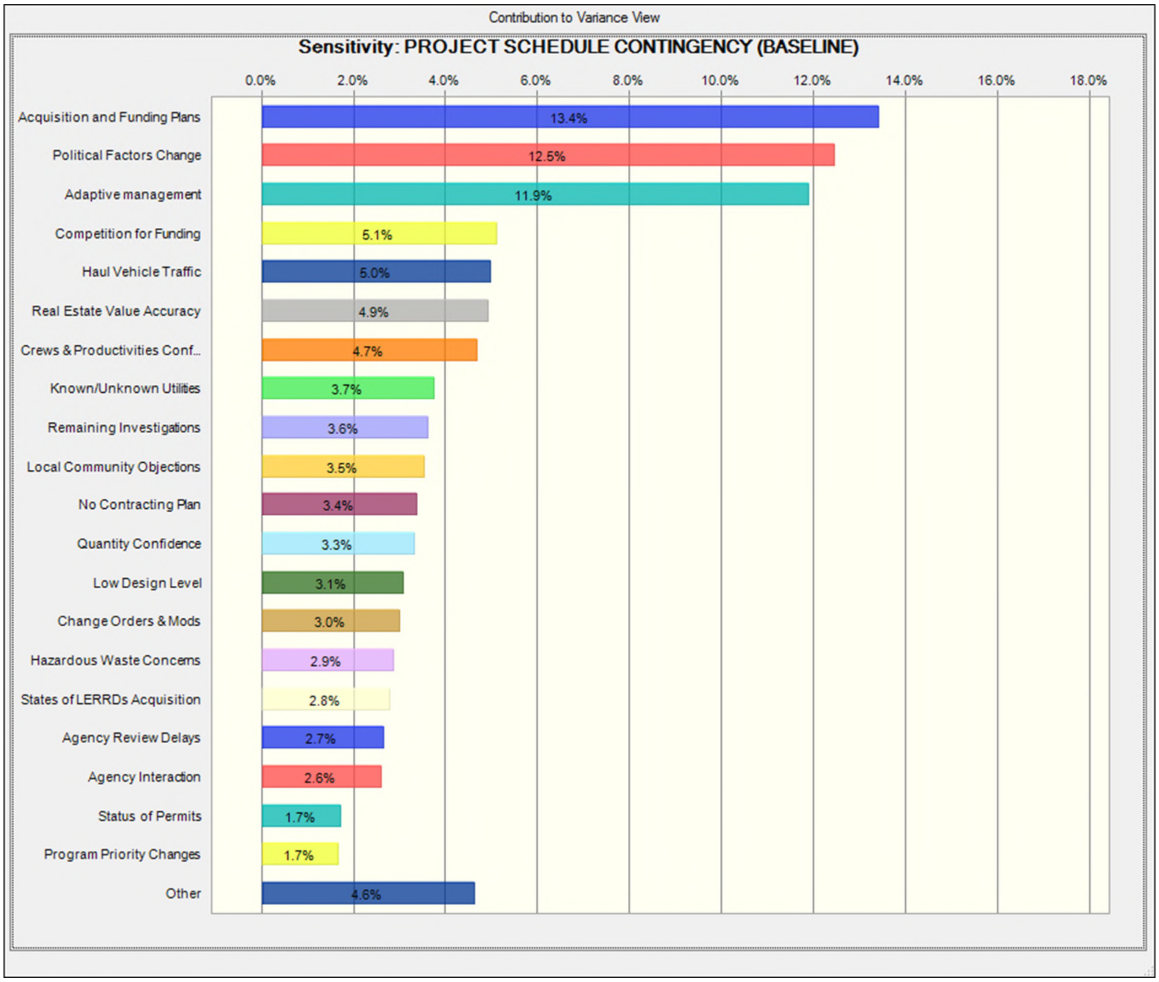

Figure 2 – Sensitivity Analysis (Schedule)

6.5 Schedule Contingency Value Results

The schedule contingency is presented as a monetary value such that it can be combined with the cost contingency to generate the total project contingency (Table 5). The schedule contingency is calculated from the estimated "hotel" costs, which are fixed costs that are inherently incurred as a result of schedule delays. These fixed costs may include rents, project management, supervision and administration, and elements of home office or field office overhead. In practice, sufficiently detailed cost estimates and resource-loaded schedules are often not available to support detailed hotel cost estimates for risk analysis, and only rough order of magnitude estimates can be developed.

For this analysis the combined job office overhead costs from the prime contractors was used to develop an assumed hotel rate of 6.04 percent. This percentage is applied to the overall project cost along with the current escalation rate from the Office of Management and Budget and local project escalation obtained from the USACE escalation factors. These rates generated an approximate schedule contingency of $18.3 million for the P80 confidence level.

Table 5 – Schedule Contingency Value Summary

Confidence Level	Date	Escalation Delta Amount	Hotel Amount	Total Schedule Contingency
0%	5-Sep-34	$8,995,594	$2,759,431	$11,755,025
5%	19-Dec-35	$9,654,885	$5,020,729	$14,675,615
10%	4-Mar-36	$9,760,593	$5,383,294	$15,143,887
15%	27-Apr-36	$9,837,108	$5,645,735	$15,482,844
20%	12-Jun-36	$9,901,474	$5,866,501	$15,767,975
25%	21-Jul-36	$9,956,074	$6,053,773	$16,009,847
30%	26-Aug-36	$10,006,496	$6,226,716	$16,233,211
35%	30-Sep-36	$10,054,877	$6,392,659	$16,447,536
40%	3-Nov-36	$10,103,291	$6,558,714	$16,662,005
45%	3-Dec-36	$10,144,439	$6,699,848	$16,844,287
50%	5-Jan-37	$10,190,766	$6,858,745	$17,049,512
55%	5-Feb-37	$10,234,914	$7,010,167	$17,245,081
60%	8-Mar-37	$10,278,691	$7,160,317	$17,439,007
65%	8-Apr-37	$10,321,956	$7,308,712	$17,630,668
70%	14-May-37	$10,371,834	$7,479,787	$17,851,620
75%	21-Jun-37	$10,424,498	$7,660,420	$18,084,918
80%	1-Aug-37	$10,482,698	$7,860,040	$18,342,738
85%	20-Sep-37	$10,552,561	$8,099,662	$18,652,223
90%	22-Nov-37	$10,641,119	$8,403,409	$19,044,528
95%	20-Feb-38	$10,767,031	$8,835,274	$19,602,305
100%	8-Sep-39	$11,558,314	$11,549,289	$23,107,602

6.6 Combined Cost and Schedule Contingency Results

The combined cost and schedule contingency results show a 36.80 percent contingency (or $171,114,005) at the P80 confidence level (Table 6). This table combines the cost and schedule contingencies in summation to generate the contingency amount to be used in developing the fully funded project amount.

Table 6 – Combined Cost and Schedule Contingency Values

Confidence Level	Baseline Total Project Cost	Cost Contingency	Schedule Contingency	Total Project Cost with Contingency	Contingency
0%	$464,924,107	$2,563,494	$11,755,025	$479,242,626	3.08%
5%	$464,924,107	$63,597,773	$14,675,615	$543,197,495	16.84%
10%	$464,924,107	$75,586,811	$15,143,887	$555,654,805	19.52%
15%	$464,924,107	$83,720,942	$15,482,844	$564,127,893	21.34%
20%	$464,924,107	$90,830,029	$15,767,975	$571,522,111	22.93%
25%	$464,924,107	$96,959,129	$16,009,847	$577,893,083	24.30%
30%	$464,924,107	$102,561,180	$16,233,211	$583,718,498	25.55%
35%	$464,924,107	$107,552,486	$16,447,536	$588,924,129	26.67%
40%	$464,924,107	$112,355,379	$16,662,005	$593,941,491	27.75%
45%	$464,924,107	$117,150,356	$16,844,287	$598,918,749	28.82%
50%	$464,924,107	$121,519,808	$17,049,512	$603,493,427	29.80%
55%	$464,924,107	$126,307,043	$17,245,081	$608,476,231	30.88%
60%	$464,924,107	$130,843,157	$17,439,007	$613,206,271	31.89%
65%	$464,924,107	$135,603,537	$17,630,668	$618,158,312	32.96%
70%	$464,924,107	$140,942,464	$17,851,620	$623,718,192	34.15%
75%	$464,924,107	$146,551,074	$18,084,918	$629,560,099	35.41%
80%	$464,924,107	$152,771,267	$18,342,738	$636,038,112	36.80%
85%	$464,924,107	$160,352,838	$18,652,223	$643,929,168	38.50%
90%	$464,924,107	$169,184,041	$19,044,528	$653,152,676	40.49%
95%	$464,924,107	$183,870,021	$19,602,305	$668,396,434	43.76%
100%	$464,924,107	$261,655,158	$23,107,602	$749,686,867	61.25%

The overall cost with contingency for each of the confidence levels along with the overall confidence curve are shown in Figure 3.

Contingency Analysis

Most Likely Cost Estimate	$464,924,107	
Confidence Level	**Value**	**Contingency**
0%	$479,242,626	3.08%
5%	$543,197,495	16.84%
10%	$555,654,805	19.52%
15%	$564,127,893	21.34%
20%	$571,522,111	22.93%
25%	$577,893,083	24.30%
30%	$583,718,498	25.55%
35%	$588,924,129	26.67%
40%	$593,941,491	27.75%
45%	$598,918,749	28.82%
50%	$603,493,427	29.80%
55%	$608,476,231	30.88%
60%	$613,206,271	31.89%
65%	$618,158,312	32.96%
70%	$623,718,192	34.15%
75%	$629,560,099	35.41%
80%	$636,038,112	36.80%
85%	$643,929,168	38.50%
90%	$653,152,676	40.49%
95%	$668,396,434	43.76%
100%	$749,686,867	61.25%

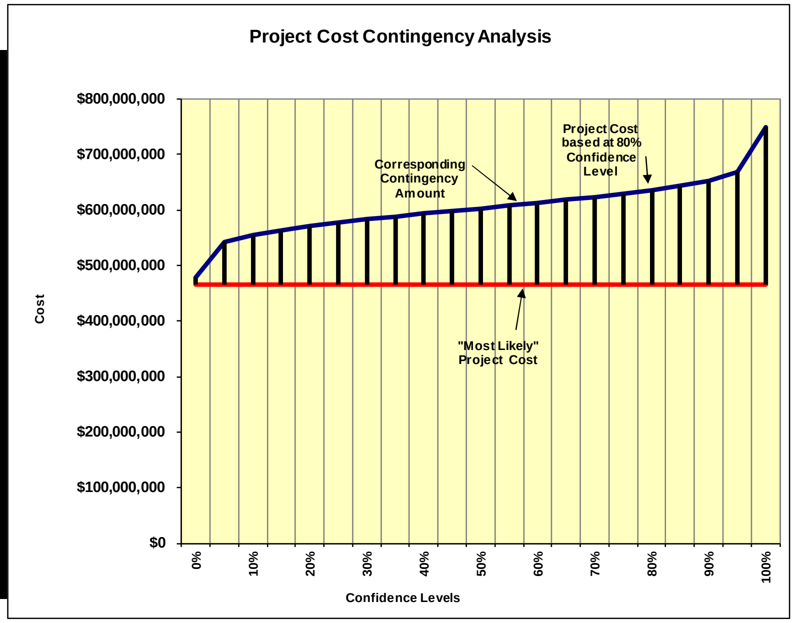

Figure 3 – Combined Cost and Schedule Contingency Value Curve

7. MAJOR FINDINGS/OBSERVATIONS

This section summarizes the significant results of the risk analysis:

1) Based on the results of this analysis a recommended contingency value of $171.1 million dollars or 36.80 percent of the total costs is to be used to generate the fully funded project cost. Of this $171.1 million, approximately $152.8 million (89.3 percent) was derived from the construction cost risks, and $18.3 million (10.7 percent) was derived from the schedule risks.

2) The schedule duration contingency is estimated to be 53.9 months, which equates to an approximate contingency of 28.1 percent of the total project duration.

3) The key cost risk drivers identified through the sensitivity analysis are:

   - PR-7: political factors change at local, state or federal level
   - TL-1: low design level
   - PR-4: market conditions and bidding competition
   - TL-2: investigations remain to be completed

4) The key schedule duration risk drivers identified through the sensitivity analysis are:

   - PR-6: flooding / earthquake
   - PR-7: political factors change at local, state or federal level
   - CA-4: acquisition plan to accommodate funding stream

5) PR-4, PR-6 and PR-7 are external risks, meaning that the PDT has no control over them. If the opinions of the political organizations change or if a major flood or earthquake occurs, then major delays and increased costs would be incurred.

8. MITIGATION RECOMMENDATIONS

Risk management is an all-encompassing, iterative, life cycle process of project management. According to *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project" (PMI 2008). Risk identification and risk analysis are processes within the knowledge area of risk management. Their output pertinent to this effort includes the risk register, risk quantification (risk analysis model), the contingency report, and the sensitivity analysis.

The results of the CSRA sensitivity analysis indicate that the following risk factors have the most significant impact on the project contingency and thus mitigation recommendations are discussed for these items:

- TL-1: low design level (cost)
- TL-2: investigations remain to be completed (cost)
- PR-4: market conditions and bidding competition (cost)
- PR-7: political factors change at local, state or federal level (cost and schedule)
- CA-4: contracting plan has not been developed (schedule)
- PR-6: flooding / earthquake (schedule)

8.2 Cost Mitigation Recommendations

One of the significant risks to the cost contingency is that **investigations remain to be completed**. The current cost estimate is based on the information at hand, and thus may be subject to significant changes due to the findings of the various outstanding studies. The impact of this risk may be lowered as the project progresses provided that these investigations are completed in a timely and accurate fashion. Incorporation of the findings into the design and thus into the estimate will ensure that this risk is reduced in future iterations of this document.

Another significant risk to the cost is the risk of **market conditions and bidding competition.** This risk is not something the PDT can help to mitigate significantly over the course of the project. The primary method to limiting this risk is as the project nears construction the estimate must be updated continually to best estimate the current market conditions. The current USACE policies regarding construction cost estimating will help to ensure this, and should help limit the risk. However, given the current estimated timeframe, market conditions are still going to be a significant risk moving forward.

The risk of **political factors changing at local, state or federal level** is significant to both the cost and schedule. This risk is beyond the control of the PDT because various political entities must be involved to complete this project, and all must be onboard with the design and costs of the project. Thus, it would be beneficial of management personnel to try and keep all government agencies involved with the planning of this project, and to monitor any significant changes in preferences that these agencies may have in terms of design and implementation of the project. Again, this risk will be tough to mitigate against as the project progresses, but ensuring any changes are dealt with early on will limit the unanticipated delays and cost increases that would be most detrimental if they arise as the project nears the onset of construction.

8.3 Schedule Mitigation Recommendations

Political factors changing at local, state or federal level also has a significant impact on the schedule contingency. As noted in the cost section, this risk can be mitigated by management personnel consistently monitoring all policy stakeholder opinions and keeping an open dialogue with these agencies in order to try and keep design in line with what is asked for.

The contracting plan has not been developed and thus the current assumptions used to develop the cost estimate and tentative project schedule are subject to change. As the project progresses more analysis should be taken to look into the appropriate contracting plan and this should be incorporated into the estimate and schedule respectively. As the project nears completion this risk should theoretically decrease in impact as the updated contracting plan will be more certain.

The risk of **flooding, or earthquake** occurring is a significant risk to the project. This risk is entirely beyond the control of the PDT because these are naturally occurring events. Due to the overall length of the construction period, encountering one of these events during construction is fairly likely. If a major event of either of these does occur, then significant delays could be incurred due to major repairs and re-construction of failed structures. The avoidance of flooding may be mitigated against by not constructing during flood seasons, but mitigating against a major earthquake is more difficult. Ensuring design of the elements that may be affected by these types of events takes these risks into account may also limit the overall risk to the project.

9. REFERENCES

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ATTACHMENT A

Project Delivery Team Risk Register

Los Angeles River Ecosystem Restoration Project - PDT Risk Register

Risk Level

Likelihood of Occurrence					
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High
	Negligible	Marginal	Significant	Critical	Crisis

Impact or Consequence of Occurrence

Overall Project Scope
The Los Angeles River Ecosystem Restoration Feasibility Study is evaluating ecosystem restoration opportunities along an 11.5-mile long stretch of the Los Angeles River. This project is based on preliminary, planning-level conceptual designs, and common engineering practices. The project is split into eight (8) sub-reaches and the design features for each of these sub-reaches includes: demolition of existing concrete structures; riprap and grouted riprap placement; earthwork; turf reinforcement mats; chain link fences; clearing and grubbing; cast-in-place concrete walls, planters, slabs, and piers; detention basins; sub-drainage systems; and recreation features.

Cost Impacts
For the LA River Project, any cost impact of $1.0 Million or higher should be considered at least "Significant."
Anything over $0.5 Million should be considered at least "Marginal."

Schedule Impacts
For the LA River Project, any schedule impact of 12 months or greater should be considered at least "Significant."
Anything over 6 months should be considered at least "Marginal."

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
	PROJECT & PROGRAM MGMT														
PPM-1	Interactions between all agencies involved in project	Many different agencies will be involved in order to complete this project. Managing and assuring that all agencies complete requesite needs may prove difficult.	PDT agrees that this risk is already occuring on the project and that significant cost and schedule impacts could occur in the future	Very Likely	Marginal	MODERATE		Very Likely	Marginal	MODERATE					
PPM-2	Dealings with multiple stakeholders	The various stakeholders in the project may cause difficulties in funding, changes to design, etc.	There are so many stakeholders on the project that this risk is likely to occur; issues are already arising from stakeholders; PDT agrees marginal impact is appropriate	Very Likely	Marginal	MODERATE		Very Likely	Marginal	MODERATE					
PPM-3	Project competing with other projects, funding and resources	Other projects may threaten funding streams and/or delay receival of funds needed to meet design/construction milestones.	This is a typically risk at this stage as other projects may take away funding and resources leading up to the construction; Also construction funds might not be available if other large projects are approved prior to this one. PDT feels this is high risk to project schedule primarily.	Very Likely	Marginal	MODERATE		Very Likely	Marginal	MODERATE					
PPM-4	Losing critical staff at crucial points of project	Loss of crucial staff prior to or during critical milestones could delay project.	Imapct overall life of project would cause marginal impacts; project staff would probably be lost but project would move forward;	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
PPM-5	Product development by several sources	This project requires members from various entities both governemntal and private to complete.	This project does involve many entities, but USACE is used to and able to manage and complete projects with various entities completing work.	Likely	Negligible	LOW		Likely	Negligible	LOW					
PPM-6	Priorities change on existing program	If USACE priorities on ecosystem restoration change, then this project could be impacted.	This project is a major priority to the City and not likely to change; USACE priority on ecosystem restoration may change, but this project is already a priority; Assumes unlikely to impact costs, but schedule could marginally change;	Unlikely	Negligible	LOW		Likely	Marginal	MODERATE					
	CONTRACT ACQUISITION RISKS														
CA-1	Contracting plan has not been developed	Contracting plan has not been fully developed at this stage. Changes to current assumptions could occur.	Current assumption of 4 separate contracts is very likely to change but is a conservative assumption; methods will be looked at to minimize costs of multiple contracts; certain sections (Piggyback Yard/Taylor Yard) may be broken out in separate contracts; PDT agrees for both cost and schedule this would likely occur but impacts would be marginal	Likely	Marginal	MODERATE		Likely	Significant	HIGH					
CA-2	Possibility for 8(a) or small business contractor(s)	Some portions of the project may be bid to 8(a) contractors, which could increase costs for construction.	There may be some small business contractors for some of the smaller portions of the project. But PDT feels low risk that these contractors would impact cost/schedule significantly as work would be low risk.	Likely	Negligible	LOW		Likely	Negligible	LOW					
CA-3	Number of separate contracts and prime contractors	Current estimate assumes 4 separate contracts with each one having a separate prime contractor. Further analysis into contracting plan may change this.	Estimate currently matches current contracting plan. Plan seems more than reasonable and not anticipated to change significantly. PDT thinks this would be low risk for both cost and schedule as an itermittent funding stream is a "less risky" assumption, and is not anticipated to have significant impacts to cost or schedule.	Likely	Negligible	LOW		Likely	Negligible	LOW					
CA-4	Acquisition plan to accommodate funding stream	The funding stream will be a major driver of the contracts. If funding stream changes or is inadequate current assumptions will change.	Project could have agreement in place to have funding available; PDT agrees this would be likely to occur but that the impacts would be marginal to the costs, but significant to the schdedule as project would be delayed;	Likely	Marginal	MODERATE		Likely	Significant	HIGH					

				Project Cost				Project Schedule							
Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)	Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
	TECHNICAL RISKS														
TL-1	Low design level	Project is at a low design level. All quantities and assumptions are subject to changes as project progresses.	PDT agrees that changes are very likely to occur; There are items missing from the current design and estimate; This item impacts the costs greater than the schedule;	Very Likely	Critical	HIGH		Very Likely	Marginal	MODERATE					
TL-2	Investigations remain to be completed (H&H, Geotech, HTRW, etc.)	Many investigations still remain to be completed. Once finalized, these reports may cause design changes.	These studies need to be completed, and PDT agrees that risk is very likely and significant; Further analysis not currently anticipated may cause significant increases in PED;	Very Likely	Significant	HIGH		Very Likely	Marginal	MODERATE					
TL-3	Hazardous waste concerns	Encountering unanticipated HTRWs can cause significant increase in earthwork costs.	It is known that hazardous wastes are to be encountered, thus it is a very likely risk; HTRWs is not considered a project cost but will need to be accounted for in the schedule; City is to take care of known HTRWs, and unknown HTRWs will need to be removed during construction, but will not be project cost to USACE;	Very Likely	Significant	HIGH		Very Likely	Marginal	MODERATE					
TL-4	Disposal locations and costs for excavated materials	Preliminary landfills have been assumed to be capable of accepting excavated materials. Further analysis could lead to cost savings (if cheap/no cost site is found) or increased costs based on tipping fees.	PDT agrees there is a high chance of a change in disposal costs; Current estimate assumes materials would be hauled off-site and include tipping fees; There are benefits due to HTRW removal will lower earthwork quantities at some sites (need to estimate quantity of HTRW);	Likely	Marginal	MODERATE		Likely	Negligible	LOW					
TL-5	All Disciplines	Many investigations remain to be completed, which once finished, could change current design	Investigations have yet to be completed to verify current design; Once all investigations are completed changes to design are likely to occur; If changes to certain design items occurred impacts to costs would be significant; Schedule is not anticipated to be impacted as plenty of design time is currently in schedule.	Very Likely	Significant	HIGH		Likely	Negligible	LOW					
TL-6	Locations and costs for borrow materials	Changes in material prices and locations from borrow sites may change.	PDT agrees there is a good chance of assumed borrow sites are not going to be same at time of construction; Changes in location or cost of borrow material would be significant to costs.	Unlikely	Significant	MODERATE		Unlikely	Negligible	LOW					
	LANDS AND DAMAGES RISKS														
LD-1	Status of real estate / easement acquisition	Real estate and easements need to be purchased in a timely fashion such that the construction phases can begin as scheduled.	Current plan only requires two areas two be purchased; Schedule is estimated to limit the risk generated from this item; Therefore PDT concludes that this risk is likely to occur but negligible to costs as the cost is being paid regardless; for schedule assumes it is likely to occur and marginal	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
LD-2	Railroad involvement	Project may require railroad involvement for culverts and right-of-way acquisition	Railroad involvement would be required in Piggyback Yard and Taylor Yard; PDT agrees that this is more impactful to schedule than cost; PDT thinks cost risks are low, but for schedule it is likely and significant; any track closures have been estimated to cost $1,000,000/hr	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
LD-3	Relocations identified	Detailed relocation designs/report has not been fully developed at time of estimate.	Current relocation costs are based on building relcoations, and it is assumed to be very likely that these would be encountered; Costs for relocating items would be significant, but would negligable to schedule;	Likely	Marginal	MODERATE		Likely	Negligible	LOW					
LD-4	Known and unknown utility impacts	Unknown utilities may be found during construction thus causing increased costs and delayed schedules.	Utilities have been constructed along the banks and right-of-way of the channel; Therefore these items are very likely to occur, but the quantity is unknown; PDT agrees both for schedule and costs are high risk;	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
LD-5	Vagrancy, loitering issues	Dealing with vagrant population may cause some minor delays.	PDT agrees this is likely to occur but negligible to both costs and schedule;	Likely	Negligible	LOW		Likely	Negligible	LOW					
LD-6	Accuracy of current values of lands and easements	Real estate costs are more than 3 times more costly than the current construction costs. Thus changes in costs to real estate effect total cost significantly.	Detailed appraisals have been completed; PDT agrees costs are anticipated to change, and any increases would be critical; could be significant impact to schedule if land values increase; Changes to the boundaries could add cost and delay construction as well; PDT feels that contingency developed by RE should be more than sufficient, as the current boundaries are very well defined and not likely to change for the current plan.	Very Unlikely	Critical	LOW		Unlikely	Critical	MODERATE					
LD-7	Railroad trestle	Railroad involement, design of trestles, other easement acquisition, temporary operation facilities	If TSP changes to an alternative that requires the railroad trestles, then significant changes to costs and schedule could be incurred. A lot of coordination would be required between agencies and railroads, and additional costs may be needed than currently assumed. PDT thinks this is high risk for both cost and schedule.	Likely	Significant	HIGH		Likely	Significant	HIGH					
	REGULATORY AND ENVIRONMENTAL RISKS														

				Project Cost				Project Schedule							
Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)	Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
RE-1	Status of permits	Many permits will need to be obtained for construction. Prompt receival of permits will be needed to keep construction schedule on track.	Not anticipated to be a risk to costs, but is assumed to be a schedule risk; It is assumed to be likely to occur, but would be marginal impact to schedule;	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
RE-2	Potential for critical regulation changes	Regulation changes within the Corps could impact this project	Regulations are anticipated to change; PDT agrees that the impact would be marginal;	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
RE-3	Negative community impacts	Construction vehichles, noise, pollution, etc, are all to be encountered during construction.	These negative impacts are all likely to occur, but would be negligible to cost; There may be some specific BMP that was not assumed; Howerver, very low risks to the both cost and schedule;	Likely	Negligible	LOW		Likely	Negligible	LOW					
RE-4	Endangered species present	Further research may find endangered species present which could delay project.	This is unlikely to occur throughout this reach; It is not anticipated to impact cost significantly, and project is generally designed to be constructed around at risk species;	Unlikely	Negligible	LOW		Unlikely	Negligible	LOW					
RE-5	Preliminary HTRW complete	HTRW report is not finalized currently	Correlated to TL-2	Likely	Significant	HIGH		Likely	Negligible	LOW					
RE-6	Agency actions/reviews are delayed or take longer than expected	Due to number of agencies involved, keeping all actions and reviews on time will be imperative to meeting the project milestones.	This is similar to RE-1; It is likely to occur but only marginal impact to schedule and negligible to costs.	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
RE-7	Flood risk policy	Flood risk policies from FEMA, DWR, USACE, may change which would impact design	Flood risk policy is likely to change, and this could put some delays in this project. However, PDT does not think this would impact costs much as design is currently capable of handling some policy changes without need for too much new items.	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
	CONSTRUCTION RISKS														
CON-1	Permits, licenses, submittal approvals	Delays in acquiring all permits, licenses, and receiving submittal approvals can delay the start of construction or alter sequencing.	There are many permits and licenses that contractors will have to obtain; This will probably be negligible to costs, and marginal to the schedule;	Likely	Negligible	LOW		Likely	Marginal	MODERATE					
CON-2	Permit and environmental work windows	Work windows based on environmental issues are accounted for, but could change.	PDT agrees that this is unlikely to occur for both costs and schedule; The schedule includes windows for working around nesting season and flood season; Assumes impacts would be marginal to both cost and schedule	Unlikely	Marginal	LOW		Unlikely	Marginal	LOW					
CON-3	Site access restrictions	Due to the length of the reaches, site accessibility may be a problem.	This is likley to occur as there are railroads, and bridges; Contractor should be able to work around these issues and plan accordingly; Some reaches may have more restrictions, and secondary access may be required; PDT agrees the costs impacts would be likely and marginal, and likely and negligible for the schedule	Likely	Marginal	MODERATE		Likely	Negligible	LOW					
CON-4	Adequate staging areas	No staging areas have been designed, and due to size of project significant staging would be required.	Staging areas would be designed as the project progresses. Current costs for staging may not be adequate once more detailed analysis is completed. PDT thinks this is likely to occur but only be marginal impact to costs and negligible to schedule.	Likely	Marginal	MODERATE		Likely	Negligible	LOW					
CON-5	Unknown utilities	Unknown utilities may be found during construction thus causing increased costs and delayed schedules.	Similar to LD-4 this would be a high risk to cost but a low risk to schedule.	Likely	Significant	HIGH		Likely	Negligible	LOW					
CON-6	Traffic issues for all haul vehicles	Traffic is going to be an issue for any haul trucks bringing or taking away materials to and from the project site.	There is no traffic control plan at this point; Construction is in an urbanized location, and traffic is likely to occur; If roads need to be repaired then there would be significant cost increases;	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
CON-7	Diversion and control of water	Diversion and control of water is going to be significant effort, and is based on general assumptions at this time.	70% of the flow is from Tillman, and if flows are incresed for any reason, then assumptions for water control would change; PDT assumes that this would be likely and significant impact to costs;	Unlikely	Significant	MODERATE		Likely	Negligible	LOW					
CON-8	Change orders and modification growths	There may be modifcation issues that have not been captured in the estimate or schedule.	Redesign to sponsor changes, discovering unidentified utilities, etc.; A project of this scale is likely to incur some changes during construction; These changes are assumed to be significantly impacted to both cost and schedule;	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
CON-9	Unidentified hazardous waste	Encountering unanticipated HTRWs during construction can cause significant increase in earthwork costs.	After the investigations are complete, construction activities still may encounter hazardous materials; PDT agrees that impact for both cost and schedule would be unlikely and significant;	Unlikely	Significant	MODERATE		Unlikely	Significant	MODERATE					

				Project Cost				Project Schedule							
Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)	Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
CON-10	Adaptive management	Managing the project through unexpected changes.	Not anticipated to be a significant risk to either cost or schedule, but is likely to have some issues brought up.	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
	ESTIMATE AND SCHEDULE RISKS														
EST-1	Estimate confidence in large and critical quantities	Design is at low level, and quantities are based on one typical section for each reach.	As progress progresses it is very likely that quantities will change since design is currently at a very low level. This would impact both cost and construction schedule. This could also be a benefit to the project if quantities are currently over estimated compared to future designs.	Likely	Marginal	MODERATE		Likely	Significant	HIGH					
EST-2	Estimate reasonableness of crews and productivities	Production rates used in estimate may differ from those in the field.	Production rates for primary construction items have been estimated based on various sources as well as estimator experience and expected site conditions. However, actual rates may still vary based on contractors capabilities. The are likely to be different but would only marginally affect costs and construction schedule. Could be a benefit too.	Likely	Significant	HIGH		Likely	Significant	HIGH					
EST-3	Accuracy of construction schedule durations, sequencing, phasing, etc.	Contractor may have different sequencing to construction activities within the contracts which could decrease or increase duration.	Construction schedule may be different than currently assumed. The current assumptions are based on proposed contracting plan, which has been considered a low risk to change. Therfore this item is unlikely to be a high risk either.	Unlikely	Marginal	LOW		Unlikely	Marginal	LOW					
Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)															
PR-1	Adequacy of project funding	There is some concern in obtaining funds on a timely basis or in the necessary increments. Receiving less than required or in delayed increments is a concern.	This would be a significant risk to the schedule as the project would be delayed if funding is not available.	Unlikely	Marginal	LOW		Unlikely	Significant	MODERATE					
PR-2	Local communities have objections	Delays may occur due to local communities objecting to the work planning to be constructed.	There are already objections to the current plan; Most of these objecting views are asking for alternatives that are greater in scope than the proposed one. Therfore costs and schedules could be impacted significantly if this changes.	Unlikely	Significant	MODERATE		Unlikely	Significant	MODERATE					
PR-3	Stakeholders request late changes	Late changes by the various stakeholders can cause redesign, increased costs and delays.	Similar to PR-2, in that requests for changes to the plan are already being made, and more changes are expected to be requested in the future. These changes would most likely only raise costs, but not anticipated to impact schedule as stakeholders want this work done sooner as opposed to later.	Likely	Marginal	MODERATE		Likely	Negligible	LOW					
PR-4	Market conditions and bidding competition	Real estate market could be significant risk with variability in this market.	This could be an opportunity or negative risk based on the bidding climate; With real estate property and construction this could be a significant impact to costs; There may be others bidding on real estate; Not anticipated to impact the schedule significantly	Likely	Significant	HIGH		Unlikely	Marginal	LOW					
PR-5	Unexpected escalation on key materials	There could be increases in the cost materials, primarily including the riprap and borrow materials.	Costs for materials could increase or decrease based on market conditions; It is anticipated that materials would more likely increase than decrease; Some materials may become more scarce; These are likely to impact both cost and schedule significantly	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE					
PR-6	Flooding/Earthquake	Small chance of major floods and earthquakes occuring, but these could delay project and cause major re-work.	PDT believes likelihood of having a major flood or earthquake during construction is high due to the overall length of construction. If one of these events occurred there would probably be significant delays and large cost impacts due to repairs and re-construction due to failed structures.	Likely	Marginal	MODERATE		Likely	Significant	HIGH					
PR-7	Political factors change at local, state or federal level	Concern due to large cost and all government agencies agreeing on design and implementation.	There is already some discussions between various agencies over the selected plan. Also due the projected costs to the project many political issues could arise that deter funding; Due to number of agencies involved this risk is believed to be likely to occur and could significanlty affect both the cost and schedule.	Likely	Significant	HIGH		Likely	Significant	HIGH					

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

ATTACHMENT B

Market Research

(Available Upon Request)

US Army Corps of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 13
MCACES Construction Cost Estimate Summary

April 2015

NATIONAL ECOSYSTEM RESTORATION PLAN – ALTERNATIVE 13v

MCACES COST ESTIMATE SUMMARY

The Los Angeles River Ecosystem Restoration Feasibility Study is evaluating ecosystem restoration opportunities on an 11.5-mile long reach of the Los Angeles River (River) located in southern California. This reach, named the Los Angeles River ARBOR (Area with Restoration Benefits and Opportunities for Revitalization) extends from the Headworks area downstream to First Street in downtown Los Angeles. The ARBOR reach includes the Glendale Narrows—one of the few sections of the study area that does not have a hardened river bed—and contains several distinctive sites and connections including the Headworks, Pollywog Park, Bette Davis Park, the Burbank-Western Channel and Glendale River Walk, Griffith Park, Ferraro Fields, Verdugo Wash, Atwater Village, Taylor Yard and the Rio de Los Angeles State Park, the “Cornfields” (Los Angeles State Historic Park), Arroyo Seco, Elysian Park, “Piggyback Yard” (also known as the “Los Angeles Transportation Center” as well as “Mission Yard”), and downtown Los Angeles.

The National Ecosystem Restoration (NER) Plan is Alternative 13SPL. This alternative incorporates various construction items from each of the eight sub-reaches of the project. The design features for the sub-reaches are designed at a conceptual level. Features for the NER Plan include concrete demolition; excavation and fill; riprap; grouted riprap; turf reinforcement mats; fencing; clearing and grubbing; reinforced cast-in-place concrete;; sub-drainage system; asphalt; multi-use trail; trail access points; pedestrian bridges and other recreation components.

The current designs are based on preliminary, planning-level conceptual designs, and common engineering practices. The design level used to complete the MCACES construction cost estimate has not progressed beyond the level used at the alternatives analysis stage. More detailed assumptions have been developed for key construction items that were not included in the alternatives analysis, which primarily includes diversion and control of water elements.

Estimated by	Tetra Tech, Inc.
Designed by	Tetra Tech, Inc.
Prepared by	Tetra Tech, Inc
Preparation Date	3/5/2015
Effective Date of Pricing	3/5/2015
Estimated Construction Time	2,807 Days

Description	Quantity	UOM	ContractCost	ProjectCost	C/O
Project Cost Summary Report			**229,932,569**	**229,932,569**	
Los Angeles River - ARBOR Corridor Extension (ACE)	**1.00**	**LS**	**229,932,569**	**229,932,569**	
Contract 1 [Reach 6]	**1.00**	**LS**	**33,454,901**	**33,454,901**	
R6 Reach 6 - Glendale Freeway to I-5	**1.00**	**LS**	**30,951,845**	**30,951,845**	
R6 02 Relocations	**1.00**	**LS**	**2,330,372**	**2,330,372**	
R6 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**27,630,226**	**27,630,226**	
R6 14 14 - Recreation	**1.00**	**LS**	**991,247**	**991,247**	
MAM Monitoring and Adaptive Management - Contract 1	**1.00**	**LS**	**2,503,056**	**2,503,056**	
MAM 01 Monitoring and Adaptive Management - Contract 1	**1.00**	**LS**	**2,503,056**	**2,503,056**	
Contract 2 [Reach 3, 4 & 5]	**1.00**	**LS**	**35,787,032**	**35,787,032**	
R5 Reach 5 - Los Feliz Blvd to Glendale Freeway	**1.00**	**LS**	**1,709,583**	**1,709,583**	
R5 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**263,583**	**263,583**	
R5 14 14 - Recreation	**1.00**	**LS**	**1,446,000**	**1,446,000**	
R4 Reach 4 - Brazil St. to Los Feliz Blvd	**1.00**	**LS**	**17,560,643**	**17,560,643**	
R4 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**16,640,334**	**16,640,334**	
R4 14 14 - Recreation	**1.00**	**LS**	**920,309**	**920,309**	
R3 Reach 3 - Ferraro Fields to Brazil St.	**1.00**	**LS**	**13,821,591**	**13,821,591**	
R3 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**12,847,469**	**12,847,469**	
R3 14 14 - Recreation	**1.00**	**LS**	**974,122**	**974,122**	
MAM Monitoring and Adaptive Management - Contract 2	**1.00**	**LS**	**2,695,215**	**2,695,215**	
MAM 01 Monitoring and Adaptive Management - Contract 2	**1.00**	**LS**	**2,695,215**	**2,695,215**	
Contract 3 [Reach 1 & 2]	**1.00**	**LS**	**2,800,650**	**2,800,650**	
R2 Reach 2 - Midpoint of Betty Davis Park to Upstream End of Ferraro Fields	**1.00**	**LS**	**341,679**	**341,679**	
R2 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**157,481**	**157,481**	
R2 14 14 - Recreation	**1.00**	**LS**	**184,198**	**184,198**	
R1 Reach 1 - Pollywog Park / Headworks to Midpoint of Betty Davis Park	**1.00**	**LS**	**2,266,243**	**2,266,243**	
R1 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**1,969,960**	**1,969,960**	
R1 14 14 - Recreation	**1.00**	**LS**	**296,283**	**296,283**	
MAM Monitoring and Adaptive Management - Contract 3	**1.00**	**LS**	**192,728**	**192,728**	
MAM 01 Monitoring and Adaptive Management - Contract 3	**1.00**	**LS**	**192,728**	**192,728**	
Contract 4 [Reach 7 & 8]	**1.00**	**LS**	**35,518,336**	**35,518,336**	
R8 Reach 8 - Main St. to 1st St.	**1.00**	**LS**	**15,095,175**	**15,095,175**	

Currency in US dollars

Description	Quantity	UOM	ContractCost	ProjectCost	C/O
R8 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**13,776,400**	**13,776,400**	
R8 14 14 - Recreation	**1.00**	**LS**	**1,318,775**	**1,318,775**	
R7 Reach 7 - I-5 to Main St.	**1.00**	**LS**	**18,194,310**	**18,194,310**	
R7 02 02 - Relocations	**1.00**	**LS**	**7,219,964**	**7,219,964**	
R7 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**10,826,987**	**10,826,987**	
R7 14 14 - Recreation	**1.00**	**LS**	**147,359**	**147,359**	
MAM Monitoring and Adaptive Management - Contract 4	**1.00**	**LS**	**2,228,851**	**2,228,851**	
MAM 01 Monitoring and Adaptive Management - Contract 4	**1.00**	**LS**	**2,228,851**	**2,228,851**	
Contract 5 [LATC]	**1.00**	**LS**	**122,371,650**	**122,371,650**	
LATC LATC Intermodal Facility Relocation	**1.00**	**LS**	**122,371,650**	**122,371,650**	
LATC 02 02 - Relocations	**1.00**	**LS**	**122,371,650**	**122,371,650**	

Currency in US dollars

LOCALLY PREFERRED PLAN – ALTERNATIVE 20

MCACES COST ESTIMATE SUMMARY

The Los Angeles River Ecosystem Restoration Feasibility Study is evaluating ecosystem restoration opportunities on an 11.5-mile long reach of the Los Angeles River (River) located in southern California. This reach, named the Los Angeles River ARBOR (Area with Restoration Benefits and Opportunities for Revitalization) extends from the Headworks area downstream to First Street in downtown Los Angeles. The ARBOR reach includes the Glendale Narrows—one of the few sections of the study area that does not have a hardened river bed—and contains several distinctive sites and connections including the Headworks, Pollywog Park, Bette Davis Park, the Burbank-Western Channel and Glendale River Walk, Griffith Park, Ferraro Fields, Verdugo Wash, Atwater Village, Taylor Yard and the Rio de Los Angeles State Park, the "Cornfields" (Los Angeles State Historic Park), Arroyo Seco, Elysian Park, "Piggyback Yard" (also known as the "Los Angeles Transportation Center" as well as "Mission Yard"), and downtown Los Angeles.

The LPP is Alternative 20, ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER). This alternative incorporates various construction items from each of the eight sub-reaches of the project. The design features for the sub-reaches are designed at a conceptual level. Features for the LPP include concrete demolition; excavation and fill; riprap; grouted riprap; turf reinforcement mats; fencing; clearing and grubbing; reinforced cast-in-place concrete; sub-drainage system; asphalt; multi-use trail; trail access points; railroad trestles; pedestrian bridges and other recreation components.

The current designs are based on preliminary, planning-level conceptual designs, and common engineering practices. The design level used to complete the MCACES construction cost estimate has not progressed beyond the level used at the alternatives analysis stage. More detailed assumptions have been developed for key construction items that were not included in the alternatives analysis, which primarily includes diversion and control of water elements.

Estimated by	Tetra Tech, Inc.
Designed by	Tetra Tech, Inc.
Prepared by	Tetra Tech, Inc
Preparation Date	3/5/2015
Effective Date of Pricing	3/5/2015
Estimated Construction Time	4,177 Days

Description	Quantity	UOM	ContractCost	ProjectCost	C/O
Project Cost Summary Report			**508,200,756**	**508,200,756**	
Los Angeles River - ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER)	**1.00**	**LS**	**508,200,756**	**508,200,756**	
			32,822,960.56	*32,822,960.56*	
Contract 1 [Reach 6]	**1.00**	**EA**	**32,822,961**	**32,822,961**	
R6 Reach 6 - Glendale Freeway to I-5	**1.00**	**LS**	**32,045,089**	**32,045,089**	
R6 02 Relocations	**1.00**	**LS**	**2,430,078**	**2,430,078**	
R6 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**28,589,134**	**28,589,134**	
R6 14 14 - Recreation	**1.00**	**LS**	**1,025,877**	**1,025,877**	
MAM Monitoring and Adaptive Management - Contract 1	**1.00**	**LS**	**777,872**	**777,872**	
MAM 01 Monitoring and Adaptive Management - Contract 1	**1.00**	**LS**	**777,872**	**777,872**	
Contract 2 [Reach 5]	**1.00**	**LS**	**93,930,602**	**93,930,602**	
R5 Reach 5 - Los Feliz Blvd to Glendale Freeway	**1.00**	**LS**	**91,480,824**	**91,480,824**	
R5 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**90,036,767**	**90,036,767**	
R5 14 14 - Recreation	**1.00**	**LS**	**1,444,057**	**1,444,057**	
MAM Monitoring and Adaptive Management - Contract 2	**1.00**	**LS**	**2,449,778**	**2,449,778**	
MAM 01 Monitoring and Adaptive Management - Contract 2	**1.00**	**LS**	**2,449,778**	**2,449,778**	
Contract 3 [Reach 4]	**1.00**	**LS**	**18,263,614**	**18,263,614**	
R4 Reach 4 - Brazil St. to Los Feliz Blvd	**1.00**	**LS**	**17,804,241**	**17,804,241**	
R4 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**16,883,366**	**16,883,366**	
R4 14 14 - Recreation	**1.00**	**LS**	**920,874**	**920,874**	
MAM Monitoring and Adaptive Management - Contract 3	**1.00**	**LS**	**459,373**	**459,373**	
MAM 01 Monitoring and Adaptive Management - Contract 3	**1.00**	**LS**	**459,373**	**459,373**	
Contract 4 [Reach 7]	**1.00**	**LS**	**19,879,663**	**19,879,663**	
R7 Reach 7 - I-5 to Main St.	**1.00**	**LS**	**19,590,936**	**19,590,936**	
R7 02 02 - Relocations	**1.00**	**LS**	**7,122,644**	**7,122,644**	
R7 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**10,611,601**	**10,611,601**	
R7 14 14 - Recreation	**1.00**	**LS**	**1,856,691**	**1,856,691**	
MAM Monitoring and Adaptive Management - Contract 4	**1.00**	**LS**	**288,727**	**288,727**	
MAM 01 Monitoring and Adaptive Management - Contract 4	**1.00**	**LS**	**288,727**	**288,727**	
Contract 5 [Reach 3]	**1.00**	**LS**	**64,125,133**	**64,125,133**	
R3 Reach 3 - Ferraro Fields to Brazil St.	**1.00**	**LS**	**62,454,445**	**62,454,445**	
R3 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**61,402,853**	**61,402,853**	

Currency in US dollars

Description	Quantity	UOM	ContractCost	ProjectCost	C/O
R3 14 14 - Recreation	**1.00**	**LS**	**1,051,593**	**1,051,593**	
MAM Monitoring and Adaptive Management - Contract 5	**1.00**	**LS**	**1,670,688**	**1,670,688**	
MAM 01 Monitoring and Adaptive Management - Contract 5	**1.00**	**LS**	**1,670,688**	**1,670,688**	
Contract 6 [Reach 1 & 2]	**1.00**	**LS**	**20,967,329**	**20,967,329**	
R2 Reach 2 - Midpoint of Betty Davis Park to Upstream End of Ferraro Fields	**1.00**	**LS**	**18,298,564**	**18,298,564**	
R2 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**18,104,648**	**18,104,648**	
R2 14 14 - Recreation	**1.00**	**LS**	**193,915**	**193,915**	
R1 Reach 1 - Pollywog Park / Headworks to Midpoint of Betty Davis Park	**1.00**	**LS**	**2,125,950**	**2,125,950**	
R1 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**1,845,443**	**1,845,443**	
R1 14 14 - Recreation	**1.00**	**LS**	**280,507**	**280,507**	
MAM Monitoring and Adaptive Management - Contract 6	**1.00**	**LS**	**542,815**	**542,815**	
MAM 01 Monitoring and Adaptive Management - Contract 6	**1.00**	**LS**	**542,815**	**542,815**	
Contract 7 [Reach 8]	**1.00**	**LS**	**135,839,804**	**135,839,804**	
R8 Reach 8 - Main St. to 1st St.	**1.00**	**LS**	**133,238,538**	**133,238,538**	
R8 02 02 - Relocations	**1.00**	**LS**	**33,699,479**	**33,699,479**	
R8 06 06 - Fish and Wildlife Facilities	**1.00**	**LS**	**95,604,405**	**95,604,405**	
R8 14 14 - Recreation	**1.00**	**LS**	**3,934,655**	**3,934,655**	
MAM Monitoring and Adaptive Management - Contract 7	**1.00**	**LS**	**2,601,266**	**2,601,266**	
MAM 01 Monitoring and Adaptive Management - Contract 7	**1.00**	**LS**	**2,601,266**	**2,601,266**	
Contract 8 [LATC]	**1.00**	**LS**	**122,371,650**	**122,371,650**	
LATC LATC Intermodal Facility Relocation	**1.00**	**LS**	**122,371,650**	**122,371,650**	
LATC 02 02 - Relocations	**1.00**	**LS**	**122,371,650**	**122,371,650**	

Currency in US dollars

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Cost Appendix

Attachment 14
Total Project Cost Summary (TPCS)

April 2015

NATIONAL ECOSYSTEM RESTORATION PLAN – ALTERNATIVE 13v

TPCS SPREADSHEET

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

PROJECT: Los Angeles River Feasibility Project, NER Plan
PROJECT No: 104791
LOCATION: Los Angeles, CA

DISTRICT: Los Angeles District PREPARED: February 27, 2015
POC: Mike Newnam, Chief, Cost Engineering

This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
						Program Year (Budget EC): 2016 Effective Price Level Date: 1 Oct 2015				Spent Thru: 1 Oct 2015	Obligations up to: 1 Oct 2015			
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	($K)	($K)	COST ($K)	CNTG ($K)	FULL ($K)
02	RELOCATIONS	131,922	46,057	34.9%	177,979	1.9%	134,387	46,918	181,305			158,239	55,245	213,484
06	FISH & WILDLIFE FACILITIES	84,112	28,421	33.8%	112,533	1.9%	85,685	28,952	114,637			97,870	33,069	130,939
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	7,620	2,575	33.8%	10,195	1.9%	7,763	2,623	10,386			9,171	3,098	12,269
14	RECREATION FACILITIES	6,278	2,121	33.8%	8,399	1.9%	6,396	2,160	8,556			7,341	2,479	9,820
	CONSTRUCTION ESTIMATE TOTALS:	229,933	79,174		309,107		234,231	80,653	314,884			272,621	93,891	366,512
01	LANDS AND DAMAGES	296,303	44,445	15.0%	340,748	2.3%	303,144	45,471	348,615			341,842	51,275	393,117
30	PLANNING, ENGINEERING & DESIGN	19,882	6,764	34.0%	26,646	3.4%	20,564	6,992	27,556			25,258	8,596	33,854
31	CONSTRUCTION MANAGEMENT	9,668	3,299	34.1%	12,967	3.4%	10,000	3,412	13,412			13,375	4,564	17,939
	PROJECT COST TOTALS:	555,785	133,682	24.1%	689,468		567,939	136,528	**704,467**			653,096	158,326	**811,422**

CHIEF, COST ENGINEERING AND SPECIFICATIONS, Michael D. Newnam, P.E.

PROJECT MANAGEMENT, Tawny Tran

CHIEF, REAL ESTATE, Theresa Kaplan

CHIEF, ENGINEERING, Richard J. Leifield, P.E.

ESTIMATED FEDERAL COST:	24.5%	**198,880**
ESTIMATED NON-FEDERAL COST:	75.5%	**612,542**
ESTIMATED TOTAL PROJECT COST:		**811,422**
PREVIOUS TPCS:		
Dated:		
THIS TPCS REFLECTS A PROJECT COST INCREASE OF:		**811,422**
THE 902 COST LIMIT IS:		
Dated:		
O&M OUTSIDE OF TOTAL PROJECT COST:		**N/A**

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

CONTRACT 1 - REACH 6

**** CONTRACT COST SUMMARY ****

PROJECT: Los Angeles River Feasibility Project, NER Plan
LOCATION: Los Angeles, CA
This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

DISTRICT: Los Angeles District PREPARED: February 27, 2015
POC: Mike Newnam, Chief, Cost Engineering

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared: 2014(Oct - Dec)				Program Year (Budget EC): 2016 Effective Price Level Date: 1 Oct 2015								
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 1 - REACH 6													
02	RELOCATIONS	2,330	787	33.8%	3,117	1.9%	2,374	802	3,176	2020Q2	8.7%	2,582	872	3,454
06	FISH & WILDLIFE FACILITIES	27,630	9,336	33.8%	36,966	1.9%	28,147	9,511	37,658	2020Q2	8.7%	30,609	10,343	40,952
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	2,503	846	33.8%	3,349	1.9%	2,550	862	3,412	2022Q4	14.3%	2,914	985	3,899
14	RECREATION FACILITIES	991	335	33.8%	1,326	1.9%	1,010	341	1,351	2020Q2	8.7%	1,098	371	1,469
	CONSTRUCTION ESTIMATE TOTALS:	33,455	11,304	33.8%	44,759		34,081	11,516	45,597			37,203	12,571	49,774
01	LANDS AND DAMAGES	$63,227	9,484	15.0%	72,711	2.3%	64,687	9,703	74,390	2017Q1	2.3%	66,147	9,922	76,069
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	335	113	33.8%	448	3.4%	347	117	464	2017Q1	3.9%	360	122	482
1.0%	Planning & Environmental Compliance	335	113	33.8%	448	3.4%	347	117	464	2017Q1	3.9%	360	122	482
10.0%	Engineering & Design	3,345	1,130	33.8%	4,475	3.4%	3,460	1,169	4,629	2017Q1	3.9%	3,594	1,214	4,808
1.0%	Reviews, ATRs, IEPRs, VE	335	113	33.8%	448	3.4%	347	117	464	2017Q1	3.9%	360	122	482
0.5%	Life Cycle Updates (cost, schedule, risks)	167	56	33.8%	223	3.4%	173	58	231	2017Q1	3.9%	180	60	240
0.5%	Contracting & ReprographicsContracting	167	56	33.8%	223	3.4%	173	58	231	2017Q1	3.9%	180	60	240
0.5%	Engineering During Construction	167	56	33.8%	223	3.4%	173	58	231	2020Q2	17.7%	204	68	272
	Planning During Construction			33.8%										
	Project Operation			33.8%										
				PED Subtotal:	6,488			PED Subtotal:	6,714				PED Subtotal:	7,006
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	2,175	735	33.8%	2,910	3.4%	2,250	760	3,010	2020Q2	17.7%	2,649	895	3,544
	Project Operation:			33.8%										
	Project Management			33.8%										
	CONTRACT COST TOTALS:	103,708	23,160		126,868		106,038	23,673	129,711			111,237	25,156	**136,393**

COST SPLIT

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

CONTRACT 2 - REACHES 3, 4 & 5

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

PROJECT: Los Angeles River Feasibility Project, NER Plan
LOCATION: Los Angeles, CA
This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

DISTRICT: Los Angeles District
POC: Mike Newnam, Chief, Cost Engineering
PREPARED: February 27, 2015

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		2014(Oct - Dec)		Program Year (Budget EC): 2016 Effective Price Level Date: 1 Oct 2015								
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 2 - REACHES 3, 4 & 5													
02	RELOCATIONS			33.8%										
06	FISH & WILDLIFE FACILITIES	29,751	10,053	33.8%	39,804	1.9%	30,308	10,241	40,549	2022Q2	13.1%	34,291	11,587	45,878
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	2,695	911	33.8%	3,606	1.9%	2,746	928	3,674	2024Q4	18.9%	3,265	1,103	4,368
14	RECREATION FACILITIES	3,340	1,129	33.8%	4,469	1.9%	3,403	1,150	4,553	2022Q2	13.1%	3,850	1,301	5,151
	CONSTRUCTION ESTIMATE TOTALS:	35,787	12,093	33.8%	47,880		36,457	12,319	48,776			41,406	13,991	55,397
01	LANDS AND DAMAGES	$10,258	1,539	15.0%	11,797	2.3%	10,495	1,574	12,069	2019Q2	6.8%	11,206	1,681	12,887
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	358	121	33.8%	479	3.4%	370	125	495	2019Q2	13.3%	419	142	561
1.0%	Planning & Environmental Compliance	358	121	33.8%	479	3.4%	370	125	495	2019Q2	13.3%	419	142	561
10.0%	Engineering & Design	3,579	1,209	33.8%	4,788	3.4%	3,702	1,251	4,953	2019Q2	13.3%	4,193	1,417	5,610
1.0%	Reviews, ATRs, IEPRs, VE	358	121	33.8%	479	3.4%	370	125	495	2019Q2	13.3%	419	142	561
0.5%	Life Cycle Updates (cost, schedule, risks)	179	60	33.8%	239	3.4%	185	62	247	2019Q2	13.3%	210	70	280
0.5%	Contracting & ReprographicsContracting	179	60	33.8%	239	3.4%	185	62	247	2019Q2	13.3%	210	70	280
0.5%	Engineering During Construction	179	60	33.8%	239	3.4%	185	62	247	2022Q2	27.3%	236	79	315
	Planning During Construction			33.8%										
	Project Operation			33.8%										
				PED Subtotal:	6,942			PED Subtotal:	7,179				PED Subtotal:	8,168
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	2,326	786	33.8%	3,112	3.4%	2,406	813	3,219	2022Q2	27.3%	3,064	1,035	4,099
	Project Operation:			33.8%										
	Project Management			33.8%										
	CONTRACT COST TOTALS:	53,562	16,170		69,731		54,725	16,518	71,243			61,782	18,769	**80,551**

COST SPLIT

Filename: LA River Restoration_TPCS_ALT 13_20150305 JGN
TPCS

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

CONTRACT 3 - REACHES 1 & 2

**** CONTRACT COST SUMMARY ****

PROJECT: Los Angeles River Feasibility Project, NER Plan
LOCATION: Los Angeles, CA
This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

DISTRICT: Los Angeles District
POC: Mike Newnam, Chief, Cost Engineering
PREPARED: February 27, 2015

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		2014(Oct - Dec)		Program Year (Budget EC): 2016 Effective Price Level Date: 1 Oct 2015								
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 3 - REACHES 1 & 2													
02	RELOCATIONS			33.8%										
06	FISH & WILDLIFE FACILITIES	2,127	719	33.8%	2,846	1.9%	2,167	732	2,899	2024Q4	18.9%	2,576	870	3,446
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	193	65	33.8%	258	1.9%	196	66	262	2027Q2	21.3%	238	80	318
14	RECREATION FACILITIES	480	162	33.8%	642	1.9%	489	165	654	2024Q4	18.9%	581	196	777
	CONSTRUCTION ESTIMATE TOTALS:	2,801	946	33.8%	3,747		2,852	963	3,815			3,395	1,146	4,541
01	LANDS AND DAMAGES	$9,841	1,476	15.0%	11,317	2.3%	10,068	1,510	11,578	2022Q2	13.5%	11,431	1,714	13,145
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	28	9	33.8%	37	3.4%	29	9	38	2022Q2	27.3%	37	11	48
1.0%	Planning & Environmental Compliance	28	9	33.8%	37	3.4%	29	9	38	2022Q2	27.3%	37	11	48
10.0%	Engineering & Design	280	95	33.8%	375	3.4%	290	98	388	2022Q2	27.3%	369	125	494
1.0%	Reviews, ATRs, IEPRs, VE	28	9	33.8%	37	3.4%	29	9	38	2022Q2	27.3%	37	11	48
0.5%	Life Cycle Updates (cost, schedule, risks)	14	5	33.8%	19	3.4%	14	5	19	2022Q2	27.3%	18	6	24
0.5%	Contracting & ReprographicsContracting	14	5	33.8%	19	3.4%	14	5	19	2022Q2	27.3%	18	6	24
0.5%	Engineering During Construction	14	5	33.8%	19	3.4%	14	5	19	2024Q4	40.8%	20	7	27
	Planning During Construction			33.8%										
	Project Operation			33.8%										
				PED Subtotal:	543			PED Subtotal:	559				PED Subtotal:	713
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	182	61	33.8%	243	3.4%	188	63	251	2024Q4	40.8%	265	89	354
	Project Operation:			33.8%										
	Project Management			33.8%										
	CONTRACT COST TOTALS:	13,229	2,620		15,849		13,527	2,676	16,203			15,627	3,126	**18,753**

COST SPLIT

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

CONTRACT 4 - REACHES 8 & 7

**** CONTRACT COST SUMMARY ****

PROJECT: Los Angeles River Feasibility Project, NER Plan
LOCATION: Los Angeles, CA
This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

DISTRICT: Los Angeles District PREPARED: February 27, 2015
POC: Mike Newnam, Chief, Cost Engineering

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		2014(Oct - Dec)		Program Year (Budget EC): 2016 Effective Price Level Date: 1 Oct 2015								
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 4 - REACHES 8 & 7													
02	RELOCATIONS	7,220	2,440	33.8%	9,660	1.9%	7,355	2,486	9,841	2026Q2	21.3%	8,919	3,015	11,934
06	FISH & WILDLIFE FACILITIES	24,603	8,313	33.8%	32,916	1.9%	25,063	8,468	33,531	2026Q2	21.3%	30,394	10,269	40,663
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	2,229	753	33.8%	2,982	1.9%	2,271	767	3,038	2028Q4	21.3%	2,754	930	3,684
14	RECREATION FACILITIES	1,466	495	33.8%	1,961	1.9%	1,494	504	1,998	2026Q2	21.3%	1,812	611	2,423
	CONSTRUCTION ESTIMATE TOTALS:	35,518	12,001	33.8%	47,519		36,183	12,225	48,408			43,879	14,825	58,704
01	LANDS AND DAMAGES	$32,141	4,821	15.0%	36,962	2.3%	32,883	4,932	37,815	2024Q2	18.1%	38,820	5,822	44,642
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	355	120	33.8%	475	3.4%	367	124	491	2024Q2	37.9%	506	171	677
1.0%	Planning & Environmental Compliance	355	120	33.8%	475	3.4%	367	124	491	2024Q2	37.9%	506	171	677
10.0%	Engineering & Design	3,552	1,200	33.8%	4,752	3.4%	3,674	1,241	4,915	2024Q2	37.9%	5,067	1,712	6,779
1.0%	Reviews, ATRs, IEPRs, VE	355	120	33.8%	475	3.4%	367	124	491	2024Q2	37.9%	506	171	677
0.5%	Life Cycle Updates (cost, schedule, risks)	178	60	33.8%	238	3.4%	184	62	246	2024Q2	37.9%	254	86	340
0.5%	Contracting & ReprographicsContracting	178	60	33.8%	238	3.4%	184	62	246	2024Q2	37.9%	254	86	340
0.5%	Engineering During Construction	178	60	33.8%	238	3.4%	184	62	246	2026Q2	49.9%	276	93	369
	Planning During Construction			33.8%										
	Project Operation			33.8%										
				PED Subtotal:	6,891			PED Subtotal:	7,126				PED Subtotal:	9,859
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	2,309	780	33.8%	3,089	3.4%	2,388	807	3,195	2026Q2	49.9%	3,579	1,209	4,788
	Project Operation:			33.8%										
	Project Management			33.8%										
	CONTRACT COST TOTALS:	75,119	19,342		94,461		76,781	19,763	96,544			93,647	24,346	**117,993**

COST SPLIT

Filename: LA River Restoration_TPCS_ALT 13_20150305 JGN
TPCS

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

CONTRACT 5 - LATC RELOCATION

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

PROJECT: Los Angeles River Feasibility Project, NER Plan
LOCATION: Los Angeles, CA
This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

DISTRICT: Los Angeles District
POC: Mike Newnam, Chief, Cost Engineering
PREPARED: February 27, 2015

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		2014(Oct - Dec)		Program Year (Budget EC): 2016 Effective Price Level Date: 1 Oct 2015								
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 5 - LATC RELOCATION													
02	RELOCATIONS	122,372	42,830	35.0%	165,202	1.9%	124,658	43,630	168,288	2024Q2	17.7%	146,738	51,358	198,096
06	FISH & WILDLIFE FACILITIES													
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)													
14	RECREATION FACILITIES													
	CONSTRUCTION ESTIMATE TOTALS:	122,372	42,830	35.0%	165,202		124,658	43,630	168,288			146,738	51,358	198,096
01	LANDS AND DAMAGES	$180,836	27,125	15.0%	207,961	2.3%	185,011	27,752	212,763	2023Q4	15.8%	214,238	32,136	246,374
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	612	214	35.0%	826	3.4%	633	221	854	2023Q4	35.2%	856	299	1,155
0.5%	Planning & Environmental Compliance	612	214	35.0%	826	3.4%	633	221	854	2023Q4	35.2%	856	299	1,155
0.5%	Engineering & Design	612	214	35.0%	826	3.4%	633	221	854	2023Q4	35.2%	856	299	1,155
0.5%	Reviews, ATRs, IEPRs, VE	612	214	35.0%	826	3.4%	633	221	854	2023Q4	35.2%	856	299	1,155
0.5%	Life Cycle Updates (cost, schedule, risks)	612	214	35.0%	826	3.4%	633	221	854	2023Q4	35.2%	856	299	1,155
0.5%	Contracting & ReprographicsContracting	612	214	35.0%	826	3.4%	633	221	854	2023Q4	35.2%	856	299	1,155
0.5%	Engineering During Construction	612	214	35.0%	826	3.4%	633	221	854	2024Q2	37.9%	873	305	1,178
	Planning During Construction			35.0%										
	Project Operation			35.0%										
				PED Subtotal:	5,782			PED Subtotal:	5,978				PED Subtotal:	8,108
31	CONSTRUCTION MANAGEMENT													
2.2%	Construction Management	2,676	937	35.0%	3,613	3.4%	2,768	969	3,737	2024Q2	37.9%	3,818	1,336	5,154
	Project Operation:			35.0%										
	Project Management			35.0%										
	CONTRACT COST TOTALS:	310,168	72,390.39		382,558		316,868	73,898	390,766			370,803	86,929	**457,732**

COST SPLIT

LOCALLY PREFERRED PLAN – ALTERNATIVE 20

TPCS SPREADSHEET

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

PROJECT: Los Angeles River Feasibility Project, LPP Plan
PROJECT No: 104791
LOCATION: Los Angeles, CA

DISTRICT: Los Angeles District
POC: Mike Newnam, Chief, Cost Engineering
PREPARED: February 27, 2015

This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
						Program Year (Budget EC): 2016								
						Effective Price Level Date: 1 Oct 2015								
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 2014 ($K)	Obligations up to: 1 Oct 2015 ($K)	COST ($K)	CNTG ($K)	FULL ($K)
02	RELOCATIONS	165,624	58,746	35.5%	224,370	1.9%	168,718	59,844	228,562			203,859	72,298	276,157
06	FISH & WILDLIFE FACILITIES	323,078	118,893	36.8%	441,971	1.9%	329,118	121,115	450,233			389,515	143,342	532,857
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	8,791	3,235	36.8%	12,026	1.9%	8,955	3,295	12,250			10,810	3,976	14,786
14	RECREATION FACILITIES	10,708	3,941	36.8%	14,649	1.9%	10,907	4,014	14,921			12,923	4,756	17,679
	CONSTRUCTION ESTIMATE TOTALS:	508,201	184,815		693,016		517,698	188,268	705,966			617,107	224,372	841,479
01	LANDS AND DAMAGES	446,789	67,620	15.1%	514,409	2.3%	457,104	69,181	526,285			536,142	81,137	617,279
30	PLANNING, ENGINEERING & DESIGN	60,228	22,085	36.7%	82,313	3.4%	62,294	22,841	85,135			88,662	32,487	121,149
31	CONSTRUCTION MANAGEMENT	27,754	10,166	36.6%	37,920	3.4%	28,707	10,515	39,222			45,819	16,770	62,589
	PROJECT COST TOTALS:	1,042,971	284,686	27.3%	1,327,657		1,065,803	290,805	**1,356,608**			1,287,730	354,766	**1,642,496**

CHIEF, COST ENGINEERING AND SPECIFICATIONS, Michael D. Newnam, P.E.

PROJECT MANAGEMENT, Tawny Tran

CHIEF, REAL ESTATE, Theresa Kaplan

CHIEF, ENGINEERING, Richard J. Leifield, P.E.

ESTIMATED TOTAL PROJECT COST: **1,642,496**

OPTION 1

ESTIMATED FEDERAL COST:	11.6%	**191,121**
ESTIMATED NON-FEDERAL COST:	88.4%	**1,451,375**

OPTION 2

ESTIMATED FEDERAL COST:	30.0%	**492,034**
ESTIMATED NON-FEDERAL COST:	70.0%	**1,150,462**

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

CONTRACT 1 - REACH 6

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

PROJECT: Los Angeles River Feasibility Project, LPP Plan
LOCATION: Los Angeles, CA
This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

DISTRICT: Los Angeles District
POC: Mike Newnam, Chief, Cost Engineering
PREPARED: February 27, 2015

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		2014(Oct - Dec)		Program Year (Budget EC): 2016 Effective Price Level Date: 1 Oct 2015								
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 1 - REACH 6													
02	RELOCATIONS	2,430	894	36.8%	3,324	1.9%	2,475	911	3,386	2019Q2	6.6%	2,639	971	3,610
06	FISH & WILDLIFE FACILITIES	28,589	10,521	36.8%	39,110	1.9%	29,124	10,718	39,842	2020Q3	9.3%	31,830	11,714	43,544
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	778	286	36.8%	1,064	1.9%	792	291	1,083	2023Q1	14.8%	909	334	1,243
14	RECREATION FACILITIES	1,026	378	36.8%	1,404	1.9%	1,045	385	1,430	2020Q3	9.3%	1,142	421	1,563
	CONSTRUCTION ESTIMATE TOTALS:	32,823	12,079	36.8%	44,902		33,436	12,305	45,741			36,520	13,440	49,960
01	LANDS AND DAMAGES	$63,227	9,484	15.0%	72,711	2.3%	64,687	9,703	74,390	2017Q4	2.3%	66,147	9,922	76,069
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	328	121	36.8%	449	3.4%	339	125	464	2017Q4	6.9%	362	134	496
1.0%	Planning & Environmental Compliance	328	121	36.8%	449	3.4%	339	125	464	2017Q4	6.9%	362	134	496
10.0%	Engineering & Design	3,282	1,208	36.8%	4,490	3.4%	3,395	1,249	4,644	2017Q4	6.9%	3,630	1,335	4,965
1.0%	Reviews, ATRs, IEPRs, VE	328	121	36.8%	449	3.4%	339	125	464	2017Q4	6.9%	362	134	496
0.5%	Life Cycle Updates (cost, schedule, risks)	164	60	36.8%	224	3.4%	170	62	232	2017Q4	6.9%	182	66	248
0.5%	Contracting & ReprographicsContracting	164	60	36.8%	224	3.4%	170	62	232	2017Q4	6.9%	182	66	248
0.5%	Engineering During Construction	164	60	36.8%	224	3.4%	170	62	232	2020Q3	18.9%	202	74	276
	Planning During Construction			36.8%										
	Project Operation			36.8%										
			PED Subtotal:		6,509		PED Subtotal:		6,732			PED Subtotal:		7,225
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	2,133	785	36.8%	2,918	3.4%	2,206	812	3,018	2020Q3	18.9%	2,623	966	3,589
	Project Operation:			36.8%										
	Project Management			36.8%										
	CONTRACT COST TOTALS:	102,941	24,099		127,040		105,251	24,630	129,881			110,572	26,271	**136,843**

COST SPLIT

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

CONTRACT 2 - REACH 5

**** CONTRACT COST SUMMARY ****

PROJECT: Los Angeles River Feasibility Project, LPP Plan
LOCATION: Los Angeles, CA
This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

DISTRICT: Los Angeles District
POC: Mike Newnam, Chief, Cost Engineering
PREPARED: February 27, 2015

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		2014(Oct - Dec)		Program Year (Budget EC):			2016					
						Effective Price Level Date:			1 Oct 2015					
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 2 - REACH 5													
02	RELOCATIONS			36.8%										
06	FISH & WILDLIFE FACILITIES	90,037	33,134	36.8%	123,171	1.9%	91,720	33,753	125,473	2023Q3	16.0%	106,379	39,147	145,526
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	2,450	902	36.8%	3,352	1.9%	2,496	919	3,415	2026Q1	21.3%	3,027	1,114	4,141
14	RECREATION FACILITIES	1,444	531	36.8%	1,975	1.9%	1,471	541	2,012	2023Q3	16.0%	1,706	627	2,333
	CONSTRUCTION ESTIMATE TOTALS:	93,931	34,567	36.8%	128,498		95,687	35,213	130,900			111,112	40,888	152,000
01	LANDS AND DAMAGES	$449	78	17.3%	526	2.31%	459	79	538	2020Q2	9.0%	500	86	586
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	939	346	36.8%	1,285	3.4%	971	358	1,329	2020Q2	17.7%	1,143	422	1,565
1.0%	Planning & Environmental Compliance	939	346	36.8%	1,285	3.4%	971	358	1,329	2020Q2	17.7%	1,143	422	1,565
10.0%	Engineering & Design	9,393	3,457	36.8%	12,850	3.4%	9,716	3,576	13,292	2020Q2	17.7%	11,440	4,210	15,650
1.0%	Reviews, ATRs, IEPRs, VE	939	346	36.8%	1,285	3.4%	971	358	1,329	2020Q2	17.7%	1,143	422	1,565
0.5%	Life Cycle Updates (cost, schedule, risks)	470	173	36.8%	643	3.4%	486	179	665	2020Q2	17.7%	572	211	783
0.5%	Contracting & ReprographicsContracting	470	173	36.8%	643	3.4%	486	179	665	2020Q2	17.7%	572	211	783
0.5%	Engineering During Construction	470	173	36.8%	643	3.4%	486	179	665	2023Q3	33.8%	650	240	890
	Planning During Construction			36.8%										
	Project Operation			36.8%										
			PED Subtotal:		18,634		PED Subtotal:		19,274			PED Subtotal:		22,801
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	6,105	2,247	36.8%	8,352	3.4%	6,315	2,324	8,639	2023Q3	33.8%	8,452	3,111	11,563
	Project Operation:			36.8%										
	Project Management			36.8%										
	CONTRACT COST TOTALS:	114,104	41,906		156,010		116,548	42,803	159,351			136,727	50,223	**186,950**

COST SPLIT

CONTRACT 3 - REACH 4

**** CONTRACT COST SUMMARY ****

PROJECT: Los Angeles River Feasibility Project, LPP Plan
LOCATION: Los Angeles, CA
This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

DISTRICT: Los Angeles District
POC: Mike Newnam, Chief, Cost Engineering
PREPARED: February 27, 2015

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared: 2014(Oct - Dec)				Program Year (Budget EC): 2016; Effective Price Level Date: 1 Oct 2015								
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 3 - REACH 4													
02	RELOCATIONS			36.8%										
06	FISH & WILDLIFE FACILITIES	16,883	6,213	36.8%	23,096	1.9%	17,199	6,329	23,528	2023Q2	15.4%	19,848	7,304	27,152
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	459	169	36.8%	628	1.9%	468	172	640	2025Q4	21.3%	568	209	777
14	RECREATION FACILITIES	921	339	36.8%	1,260	1.9%	938	345	1,283	2023Q2	15.4%	1,082	398	1,480
	CONSTRUCTION ESTIMATE TOTALS:	18,264	6,721	36.8%	24,985		18,605	6,846	25,451			21,498	7,911	29,409
01	LANDS AND DAMAGES	$5,314	956	18.0%	6,269	2.3%	5,436	978	6,414	2021Q2	11.3%	6,049	1,088	7,137
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	183	67	36.8%	250	3.4%	189	69	258	2021Q2	22.4%	231	84	315
1.0%	Planning & Environmental Compliance	183	67	36.8%	250	3.4%	189	69	258	2021Q2	22.4%	231	84	315
10.0%	Engineering & Design	1,826	672	36.8%	2,498	3.4%	1,889	695	2,584	2021Q2	22.4%	2,313	851	3,164
1.0%	Reviews, ATRs, IEPRs, VE	183	67	36.8%	250	3.4%	189	69	258	2021Q2	22.4%	231	84	315
0.5%	Life Cycle Updates (cost, schedule, risks)	91	33	36.8%	124	3.4%	94	34	128	2021Q2	22.4%	115	42	157
0.5%	Contracting & ReprographicsContracting	91	33	36.8%	124	3.4%	94	34	128	2021Q2	22.4%	115	42	157
0.5%	Engineering During Construction	91	33	36.8%	124	3.4%	94	34	128	2023Q2	32.5%	125	45	170
	Planning During Construction			36.8%										
	Project Operation			36.8%										
				PED Subtotal:	3,620			PED Subtotal:	3,742				PED Subtotal:	4,593
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	1,187	437	36.8%	1,624	3.4%	1,228	452	1,680	2023Q2	32.5%	1,627	599	2,226
	Project Operation:			36.8%										
	Project Management			36.8%										
	CONTRACT COST TOTALS:	27,412	9,086		36,498		28,007	9,280	37,287			32,535	10,830	**43,365**

COST SPLIT

CONTRACT 4 - REACH 7

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

PROJECT: Los Angeles River Feasibility Project, LPP Plan
LOCATION: Los Angeles, CA
This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

DISTRICT: Los Angeles District
POC: Mike Newnam, Chief, Cost Engineering
PREPARED: February 27, 2015

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		2014(Oct - Dec)		Program Year (Budget EC): 2016 Effective Price Level Date: 1 Oct 2015								
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 4 - REACH 7													
02	RELOCATIONS	7,123	2,621	36.8%	9,744	1.9%	7,256	2,670	9,926	2023Q3	16.0%	8,416	3,097	11,513
06	FISH & WILDLIFE FACILITIES	10,612	3,905	36.8%	14,517	1.9%	10,810	3,978	14,788	2024Q4	18.9%	12,852	4,730	17,582
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	289	106	36.8%	395	1.9%	294	108	402	2027Q2	21.3%	357	131	488
14	RECREATION FACILITIES	1,857	683	36.8%	2,540	1.9%	1,891	696	2,587	2024Q4	18.9%	2,248	827	3,075
	CONSTRUCTION ESTIMATE TOTALS:	19,880	7,315	36.8%	27,195		20,251	7,452	27,703			23,873	8,785	32,658
01	LANDS AND DAMAGES	$24,896	3,834	15.4%	28,730	2.3%	25,470	3,922	29,392	2023Q3	15.8%	29,494	4,542	34,036
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	199	73	36.8%	272	3.4%	206	76	282	2023Q3	33.8%	276	102	378
1.0%	Planning & Environmental Compliance	199	73	36.8%	272	3.4%	206	76	282	2023Q3	33.8%	276	102	378
10.0%	Engineering & Design	1,988	732	36.8%	2,720	3.4%	2,056	757	2,813	2023Q3	33.8%	2,752	1,013	3,765
1.0%	Reviews, ATRs, IEPRs, VE	199	73	36.8%	272	3.4%	206	76	282	2023Q3	33.8%	276	102	378
0.5%	Life Cycle Updates (cost, schedule, risks)	99	36	36.8%	135	3.4%	102	37	139	2023Q3	33.8%	137	50	187
0.5%	Contracting & ReprographicsContracting	99	36	36.8%	135	3.4%	102	37	139	2023Q3	33.8%	137	50	187
0.5%	Engineering During Construction	99	36	36.8%	135	3.4%	102	37	139	2024Q4	40.8%	144	52	196
	Planning During Construction			36.8%										
	Project Operation			36.8%										
				PED Subtotal:	3,941			PED Subtotal:	4,076				PED Subtotal:	5,469
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	1,292	475	36.8%	1,767	3.4%	1,336	491	1,827	2024Q4	40.8%	1,881	691	2,572
	Project Operation:			36.8%										
	Project Management			36.8%										
	CONTRACT COST TOTALS:	48,949	12,683		61,632		50,037	12,961	62,998			59,246	15,489	**74,735**

COST SPLIT

CONTRACT 5 - REACH 3

**** CONTRACT COST SUMMARY ****

PROJECT: Los Angeles River Feasibility Project, LPP Plan
LOCATION: Los Angeles, CA
This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

DISTRICT: Los Angeles District
POC: Mike Newnam, Chief, Cost Engineering
PREPARED: February 27, 2015

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		2014(Oct - Dec)		Program Year (Budget EC): 2016								
						Effective Price Level Date: 1 Oct 2015								
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 5 - REACH 3													
02	RELOCATIONS			36.8%										
06	FISH & WILDLIFE FACILITIES	61,403	22,596	36.8%	83,999	1.9%	62,551	23,018	85,569	2026Q4	21.3%	75,855	27,914	103,769
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	1,671	615	36.8%	2,286	1.9%	1,702	626	2,328	2029Q2	21.3%	2,064	759	2,823
14	RECREATION FACILITIES	1,052	387	36.8%	1,439	1.9%	1,071	394	1,465	2026Q4	21.3%	1,299	478	1,777
	CONSTRUCTION ESTIMATE TOTALS:	64,125	23,598	36.8%	87,723		65,324	24,038	89,362			79,218	29,151	108,369
01	LANDS AND DAMAGES	$131,279	19,996	15.2%	151,275	2.3%	134,310	20,458	154,768	2024Q2	18.1%	158,559	24,152	182,711
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	641	236	36.8%	877	3.4%	663	244	907	2024Q2	37.9%	914	337	1,251
1.0%	Planning & Environmental Compliance	641	236	36.8%	877	3.4%	663	244	907	2024Q2	37.9%	914	337	1,251
10.0%	Engineering & Design	6,413	2,360	36.8%	8,773	3.4%	6,633	2,441	9,074	2024Q2	37.9%	9,148	3,367	12,515
1.0%	Reviews, ATRs, IEPRs, VE	641	236	36.8%	877	3.4%	663	244	907	2024Q2	37.9%	914	337	1,251
0.5%	Life Cycle Updates (cost, schedule, risks)	321	118	36.8%	439	3.4%	332	122	454	2024Q2	37.9%	458	168	626
0.5%	Contracting & ReprographicsContracting	321	118	36.8%	439	3.4%	332	122	454	2024Q2	37.9%	458	168	626
0.5%	Engineering During Construction	321	118	36.8%	439	3.4%	332	122	454	2026Q4	53.1%	508	187	695
	Planning During Construction			36.8%										
	Project Operation			36.8%										
			PED Subtotal:		12,721		PED Subtotal:		13,157			PED Subtotal:		18,215
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	4,168	1,534	36.8%	5,702	3.4%	4,311	1,587	5,898	2026Q4	53.1%	6,602	2,430	9,032
	Project Operation:			36.8%										
	Project Management			36.8%										
	CONTRACT COST TOTALS:	208,871	48,550		257,421		213,563	49,622	263,185			257,693	60,634	**318,327**

COST SPLIT

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

CONTRACT 6 - REACHES 1 & 2

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

PROJECT: Los Angeles River Feasibility Project, LPP Plan
LOCATION: Los Angeles, CA
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DISTRICT: Los Angeles District
POC: Mike Newnam, Chief, Cost Engineering
PREPARED: February 27, 2015

WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared: 2014(Oct - Dec)				Program Year (Budget EC): 2016; Effective Price Level Date: 1 Oct 2015								
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 6 - REACHES 1 & 2													
02	RELOCATIONS			36.8%										
06	FISH & WILDLIFE FACILITIES	19,950	7,342	36.8%	27,292	1.9%	20,323	7,479	27,802	2029Q1	21.3%	24,646	9,070	33,716
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	543	200	36.8%	743	1.9%	553	204	757	2031Q3	21.3%	671	247	918
14	RECREATION FACILITIES	474	175	36.8%	649	1.9%	483	178	661	2029Q1	21.3%	586	216	802
	CONSTRUCTION ESTIMATE TOTALS:	20,967	7,717	36.8%	28,684		21,359	7,861	29,220			25,903	9,533	35,436
01	LANDS AND DAMAGES	$9,913	1,494	15.1%	11,407	2.3%	10,142	1,529	11,671	2027Q2	24.8%	12,660	1,909	14,569
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	210	77	36.8%	287	3.4%	217	80	297	2027Q2	56.4%	339	125	464
1.0%	Planning & Environmental Compliance	210	77	36.8%	287	3.4%	217	80	297	2027Q2	56.4%	339	125	464
10.0%	Engineering & Design	2,097	772	36.8%	2,869	3.4%	2,169	799	2,968	2027Q2	56.4%	3,393	1,250	4,643
1.0%	Reviews, ATRs, IEPRs, VE	210	77	36.8%	287	3.4%	217	80	297	2027Q2	56.4%	339	125	464
0.5%	Life Cycle Updates (cost, schedule, risks)	105	39	36.8%	144	3.4%	109	40	149	2027Q2	56.4%	170	63	233
0.5%	Contracting & ReprographicsContracting	105	39	36.8%	144	3.4%	109	40	149	2027Q2	56.4%	170	63	233
0.5%	Engineering During Construction	105	39	36.8%	144	3.4%	109	40	149	2029Q1	68.9%	184	68	252
	Planning During Construction			36.8%										
	Project Operation			36.8%										
				PED Subtotal:	4,162			PED Subtotal:	4,306				PED Subtotal:	6,753
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	1,363	502	36.8%	1,865	3.4%	1,410	519	1,929	2029Q1	68.9%	2,381	876	3,257
	Project Operation:			36.8%										
	Project Management			36.8%										
	CONTRACT COST TOTALS:	35,285	10,833		46,118		36,058	11,068	47,126			45,878	14,137	**60,015**

COST SPLIT

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

CONTRACT 7 - REACH 8

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

PROJECT: Los Angeles River Feasibility Project, LPP Plan
LOCATION: Los Angeles, CA
This Estimate reflects the scope and schedule in feasibility report; Los Angeles River Ecosystem Restoration Feasibility Report

DISTRICT: Los Angeles District
POC: Mike Newnam, Chief, Cost Engineering
PREPARED: February 27, 2015

WBS STRUCTURE		**ESTIMATED COST**				**PROJECT FIRST COST (Constant Dollar Basis)**				**TOTAL PROJECT COST (FULLY FUNDED)**				
		Mii Estimate Prepared:		2014(Oct - Dec)		Program Year (Budget EC):			2016					
						Effective Price Level Date:			1 Oct 2015					
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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	CONTRACT 7 - REACH 8													
02	RELOCATIONS	33,699	12,401	36.8%	46,100	1.9%	34,329	12,633	46,962	2028Q2	21.3%	41,631	15,320	56,951
06	FISH & WILDLIFE FACILITIES	95,604	35,182	36.8%	130,786	1.9%	97,391	35,840	133,231	2031Q2	21.3%	118,105	43,463	161,568
06	FISH & WILDLIFE FACILITIES (Monitoring & Adaptive Management)	2,601	957	36.8%	3,558	1.9%	2,650	975	3,625	2033Q4	21.3%	3,214	1,182	4,396
14	RECREATION FACILITIES	3,935	1,448	36.8%	5,383	1.9%	4,008	1,475	5,483	2031Q2	21.3%	4,860	1,789	6,649
	CONSTRUCTION ESTIMATE TOTALS:	135,840	49,988	36.8%	185,828		138,378	50,923	189,301			167,810	61,754	229,564
01	LANDS AND DAMAGES	$30,876	4,653	15.1%	35,529	2.3%	31,589	4,760	36,349	2028Q2	27.1%	40,144	6,049	46,193
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	1,358	500	36.8%	1,858	3.4%	1,405	517	1,922	2028Q2	63.3%	2,295	844	3,139
1.0%	Planning & Environmental Compliance	1,358	500	36.8%	1,858	3.4%	1,405	517	1,922	2028Q2	63.3%	2,295	844	3,139
10.0%	Engineering & Design	13,584	4,999	36.8%	18,583	3.4%	14,050	5,171	19,221	2028Q2	63.3%	22,948	8,446	31,394
1.0%	Reviews, ATRs, IEPRs, VE	1,358	500	36.8%	1,858	3.4%	1,405	517	1,922	2028Q2	63.3%	2,295	844	3,139
0.5%	Life Cycle Updates (cost, schedule, risks)	679	250	36.8%	929	3.4%	702	259	961	2028Q2	63.3%	1,147	423	1,570
0.5%	Contracting & ReprographicsContracting	679	250	36.8%	929	3.4%	702	259	961	2028Q2	63.3%	1,147	423	1,570
0.5%	Engineering During Construction	679	250	36.8%	929	3.4%	702	259	961	2031Q2	87.0%	1,313	484	1,797
	Planning During Construction			36.8%										
	Project Operation			36.8%										
				PED Subtotal:	26,944			PED Subtotal:	27,870				PED Subtotal:	45,748
31	CONSTRUCTION MANAGEMENT													
6.5%	Construction Management	8,830	3,249	36.8%	12,079	3.4%	9,133	3,361	12,494	2031Q2	87.0%	17,077	6,285	23,362
	Project Operation:			36.8%										
	Project Management			36.8%										
	CONTRACT COST TOTALS:	195,241	65,139		260,380		199,471	66,543	266,014			258,471	86,396	**344,867**

COST SPLIT

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

LATC RELOCATION - CONSTRUCTION CONTRACT

**** CONTRACT COST SUMMARY ****

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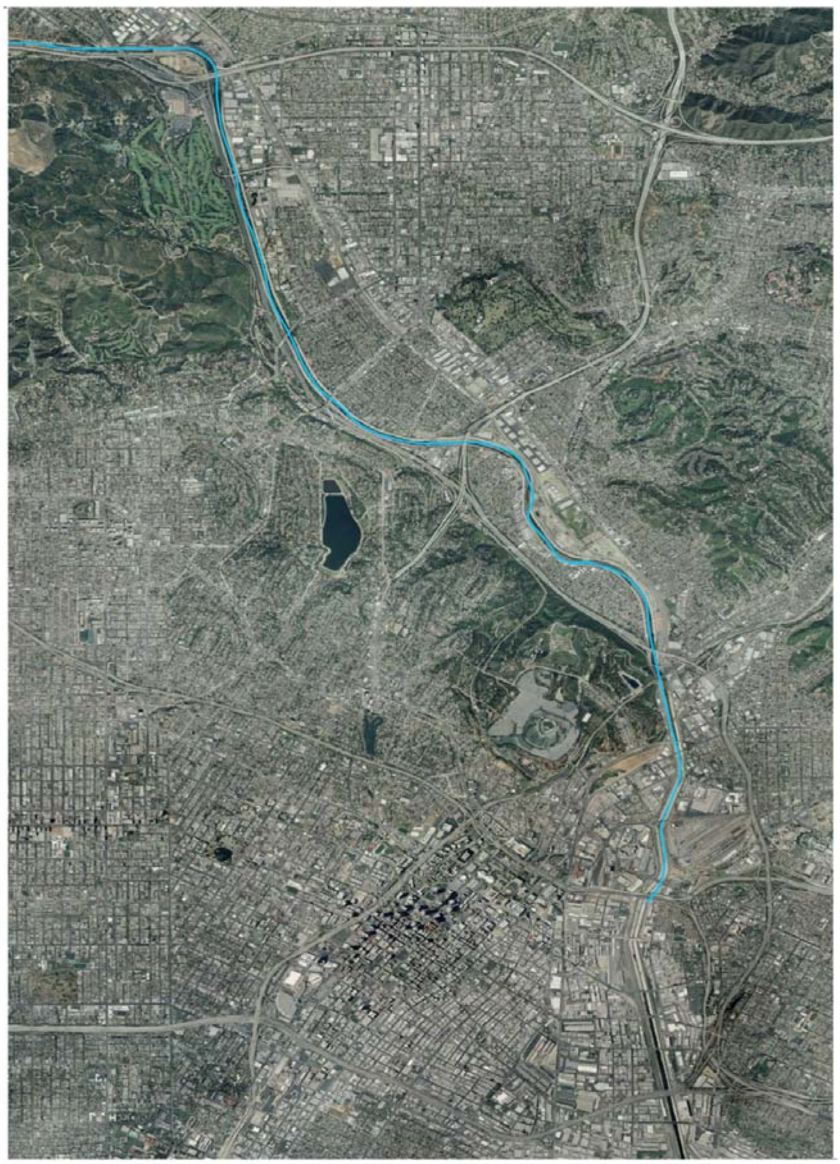
WBS STRUCTURE		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Mii Estimate Prepared:		2014(Oct - Dec)		Program Year (Budget EC): 2016 Effective Price Level Date: 1 Oct 2015								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	LATC RELOCATION - CONSTRUCTION CONTRACT													
02	RELOCATIONS	122,372	42,830	35.0%	165,202	1.9%	124,658	43,630	168,288	2029Q2	21.3%	151,173	52,910	204,083
06	FISH & WILDLIFE FACILITIES													
14	RECREATION FACILITIES													
	CONSTRUCTION ESTIMATE TOTALS:	122,372	42,830	35.0%	165,202		124,658	43,630	168,288			151,173	52,910	204,083
01	LANDS AND DAMAGES	$180,836	27,125	15.0%	207,961	2.3%	185,011	27,752	212,763	2025Q3	20.3%	222,589	33,389	255,978
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	612	214	35.0%	826	3.4%	633	221	854	2029Q2	70.7%	1,081	377	1,458
0.5%	Planning & Environmental Compliance	612	214	35.0%	826	3.4%	633	221	854	2029Q2	70.7%	1,081	377	1,458
0.5%	Engineering & Design	612	214	35.0%	826	3.4%	633	221	854	2029Q2	70.7%	1,081	377	1,458
0.5%	Reviews, ATRs, IEPRs, VE	612	214	35.0%	826	3.4%	633	221	854	2029Q2	70.7%	1,081	377	1,458
0.5%	Life Cycle Updates (cost, schedule, risks)	612	214	35.0%	826	3.4%	633	221	854	2029Q2	70.7%	1,081	377	1,458
0.5%	Contracting & ReprographicsContracting	612	214	35.0%	826	3.4%	633	221	854	2029Q2	70.7%	1,081	377	1,458
0.5%	Engineering During Construction	612	214	35.0%	826	3.4%	633	221	854	2031Q2	87.0%	1,184	413	1,597
	Planning During Construction			35.0%										
	Project Operation			35.0%										
				PED Subtotal:	5,782			PED Subtotal:	5,978				PED Subtotal:	10,345
31	CONSTRUCTION MANAGEMENT													
2.2%	Construction Management	2,676	937	35.0%	3,613	3.4%	2,768	969	3,737	2031Q2	87.0%	5,176	1,812	6,988
	Project Operation:			35.0%										
	Project Management			35.0%										
	CONTRACT COST TOTALS:	310,168	72,390		382,558		316,868	73,898	390,766			386,608	90,786	**477,394**

COST SPLIT

US Army Corps
of Engineers®
Los Angeles District
Geotechnical Branch

Geotechnical Feasibility Report
Los Angeles River Ecosystem Restoration Study Project Area, Los Angeles County, CA



2015

Geotechnical Feasibility Report
Los Angeles River Ecosystem Restoration Study Project Area

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1.0 INTRODUCTION

1.1 Context

This Geotechnical Feasibility Report has been prepared in support of the Los Angeles River Ecosystem Restoration Study (referred hereafter as the Study) and provides conditions and considerations from a geologic, geotechnical and environmental engineering perspective to aid in decision-making and alternative selection processes for the Ecosystem Restoration. The Geotechnical Feasibility Report is designed to address geologic, geotechnical and environmental conditions and constraints that are associated with the LA River Ecosystem Restoration Study (the Study) and should not be utilized for other purposes. Some sections and content within this report may also be repeated in other sections or appendices of the Study report.

1.2 Los Angeles River Description and General History

A brief description of the Los Angeles River (LA River), as it pertains to the Study, is presented in this section as background for the geologic, geotechnical and environmental concepts as presented in the report. A more detailed depiction of the LA River as a whole is presented in the Study report and associated appendices.

The LA River begins at the confluence of the Arroyo Calabasas and Bell Creek, flows through the San Fernando Valley, passes through the Glendale Narrows, onto the coastal plain, and eventually drains into the Pacific Ocean. From the confluence of Arroyo Calabasas and Bell Creek, the LA River flows through the western San Fernando Valley and through Sepulveda Reservoir where the flow is joined from the north by the Tujunga Wash. Tujunga Wash includes flow from both Hansen Dam and Pacoima Wash. Downstream of the Sepulveda Reservoir, the Burbank-Western channel, and smaller tributary drainages that emanate from the western San Gabriel Mountains join the River as it flows easterly through the San Fernando Valley. As the river approaches the Study area, it bends around the Hollywood Hills and is joined from the east by the Verdugo Wash, and then flows south through the Glendale Narrows and onto the broad coastal plain. The LA River is joined within the coastal plain by a number of tributaries including the Arroyo Seco and the Rio Hondo Diversion Channel from the Rio Hondo Diversion Channel confluence. The LA River then continues south for 12 miles and finally discharges into the Pacific Ocean at the San Pedro/Long Beach Harbor. Figure 1 presents a graphical depiction of the LA River and the Study area.

The LA River is an ephemeral stream that naturally meanders and periodically floods during the rainy winter season. Development in the LA River’s natural floodplain has occurred and continues into the present. As such, the seasonal flows that would have been dispersed over the floodplain have been directed into the main channel. As the population has increased and development has expanded within the LA River's natural floodplain, flood threats from the storm season flows have also increased. In the late 19th and early 20th centuries, massive storm flows in the LA River caused flooding that resulted in the loss of lives and significant property damage. As a result of these storm events, City of Los Angeles (City) and County of Los Angeles (County) leaders decided to have the LA River channelized. The U.S. Army Corps of Engineers (USACE) completed the task by channelizing the river with concrete bottoms, concrete side slopes, grouted stone slopes, stabilized soft bottoms, channel walls, floodwalls, and levees. The levees within the ARBOR reach total approximately 11.3 miles in length (located along both banks of the 11 mile ARBOR reach), vary in height from several to approximately 30 feet, are typically 2:1 (H:V) or shallower side slopes, and are constructed of material that was borrowed from the channel or the adjacent river banks. Further discussion on the historical impact of the LA River and the construction of the LA River channel can be found in the additional appendices which accompany the main Integrated Feasibility Report (IFR).

1.3 Scope of Work

The geotechnical support for the feasibility study included review and reference of existing geotechnical information, identification of project constraints, preliminary and ongoing evaluation of project alternatives, and preparation of this report. The scope of work included the following:

a. Review of published and unpublished data pertaining to the geotechnical conditions in the general vicinity of the project study;

b. Attendance of project meetings and review sessions;

c. Evaluation of geotechnical, geologic, and groundwater data collected during the review process;

d. Evaluation of the potential impact and the anticipated geologic conditions on proposed alternatives and measures;

e. Development of a list of constraints and considerations potentially impacting the proposed alternatives and measures for ecosystem restoration;

f. Preparation of comments and recommendations for geotechnical considerations on other documents for the study; and

g. Preparation of this report documenting the work performed, information gathered during the review of available data, and geotechnical considerations and constraints.

2.0 STUDY AREA

The Study area is known as the “ARBOR” Reach (Area with Restoration Benefits and Opportunities for Revitalization), an eleven mile portion of the LA River, which extends from the Headworks site downstream to First Street. The ARBOR Reach was chosen for study partly because of the soft-bottom within the “Glendale Narrows." The Study area also contains numerous restoration opportunity locations where restoration may be achieved as the locations are local Sponsor property or property that may be acquired by the local Sponsor. These areas include the following: Headworks, Pollywog Park, Bette Davis Park, Griffith Park, Ferraro Fields, the Burbank Western Channel and Glendale River Walk, Verdugo Wash, the Bowtie and Taylor Yard, Cornfields (LA State Historic Park), Arroyo Seco, Elysian Park, Atwater Park, Los Angeles Trailer and Container Intermodal Facility (LATC) (also known as Piggyback Yard or Mission Yard), and Downtown Los Angeles. Please refer to the main IFR for detailed descriptions and locations of these areas and the importance of these locations to the Study.

The ARBOR Reach has been subdivided into eight sub-reaches (Sub-Reach 1 through Sub-Reach 8). These sub-reaches are defined based on physical characteristics that define channel functions, existing habitat, and surrounding land uses. The selected criteria include: (1) channel bed type (e.g., soft-bottom with groundwater-surface water exchange or concrete); (2) side slope condition (e.g., vertical or trapezoidal); and (3) adjacent land uses (e.g. development or open space). The general extent of these sub-reaches are presented in Figure 1. A summary of the current conditions is presented in the attached Table 1 and a further detailed description of these sub-reaches is provided in the main IFR.

2.1 Proposed Improvements and Alternatives

Extensive plan formulation and community involvement was undertaken to develop the goals, objectives, and alternatives for this Study. Details are presented in the main report and other appendices. Due to the dynamic conditions of the planning processes and study timeframes, a detailed and complete description of plans, alternatives, measures and sub-measures, are not included in this portion of the Study. However, a summary of potential sub-measures and the sub-reaches where those sub-measures may be applied as well as the associated plan are included in the attached Table 2. The four plans considered in of the Draft IFR for the Study are plan numbers 10, 13, 16, and 20. Additional detailed cost analysis identified a variation on plan 13 that is identical to 13 except that it includes the Reach 7 plan from Alternative 20. This variation is called 13v for “variation” and is within the spectrum of plans considered in the Draft IFR. This numbering is discussed in the main IFR.

2.2 Considered Improvements

A comprehensive list of considered improvements can be found in the main IFR. The considered improvements included tunnels, underground basins, underground channels, ponds and pump stations, and other options. Many of the improvements were not carried forward due to exorbitant cost or hydraulic infeasibility. Details regarding these improvements can be found in other appendices and in the main IFR.

2.3 Locally Preferred Plan

The locally preferred plan (LPP) is currently Alternative 20. For consistency, the potential constraints and options associated with the other alternatives are included in this report.

3.0 SITE CONDITIONS

3.1 General Overview and Topography

The Los Angeles River Ecosystem Restoration Study area is located in Los Angeles County within portions of both the Los Angeles and the San Fernando topographic basins of southern California. These basins are connected by the LA River through a narrow gap between the Santa Monica Mountains and the Elysian Hills, to the west, and the Repetto Hills and the Verdugo Mountains, to the east, which is locally known as the Glendale Narrows. The LA River captures all of the drainage area of the San Fernando topographic basin and flows out onto the upper portion of the Los Angeles topographic basin. These basins and the Study portion of the LA River are depicted on Figure 2. Upstream of the Glendale Narrows, the LA River drains a watershed that is greater than 800 square miles.

Elevations in the Los Angeles River Watershed range from approximately 10,000 feet in the San Gabriel Mountains to sea level at the mouth of the Los Angeles River. Elevations of the river within the Study area itself range from approximately 490 feet at the upstream end of the Study area to approximately 240 feet at the downstream end. The average slope of the LA River is approximately 4 to 14 feet per mile.

The project area includes adjacent neighborhoods in the Cities of Glendale and Burbank in addition to those in the City of Los Angeles. Property uses include private residential, industrial and commercial properties as well as parks, public service yards, utilities, and other community service facilities. Transportation and infrastructure crossing the river includes local streets, an adjacent interstate highway, several state highways, rail yards, and two rail lines. Over 1,000,000 people live within a short distance of this reach.

3.2 Geology

3.2.1 Regional Geology

The Study area is located within a geologically complex region of southern California near the intersection of the Peninsular Ranges Geomorphic Province and the Transverse Ranges Geomorphic province. The roughly east-west trending Santa Monica-Raymond Hill Fault marks the boundary between the Transverse Ranges and the Peninsular Ranges geomorphic provinces.

The Transverse Ranges are characterized by east-west trending folds and faults (Wright, 1991). Regional geologic structure in the Transverse Ranges is characterized by right-lateral high angle to vertical strike-slip faults, folds and associated thrust or reverse faults. The Santa Monica Mountains, along with the offshore Channel Islands to the west and the San Bernardino Mountains to the east, are situated within the Transverse Ranges Geomorphic Province. The east-west structure of the Transverse Ranges is oblique to the normal northwest structural trend of the Coast Ranges to the north and the Peninsular Ranges to the south.

The Peninsular Ranges province is characterized by a series of northwest to southeast-oriented valleys, hills and mountains separated by faults associated with, and sub-parallel to, the San Andreas Fault system. The Peninsular Ranges Geomorphic Province extends southward to the tip of Baja California and is for the most part underlain by older metamorphic rocks that have been intruded by granitic rock. Along the coast, the granitic and metamorphic basement rocks are covered by a wedge of marine and non-marine sediments that thicken seaward.

3.2.2 Local Geology

The Study area lies between the eastern end of the Santa Monica Mountains and the Verdugo Mountains with the San Gabriel Mountains further to the east. The valley or gap between the Santa Monica Mountains and the Verdugo Mountains is also locally known as the Glendale Narrows. Within the Glendale Narrows, bedrock is relatively shallow and is covered with relatively thin deposits of alluvium, which increase in thickness to the north and south into the San Fernando and Los Angeles basins, respectively. As a corollary, groundwater is relatively shallow through the Glendale Narrows as well. This condition can be visualized as a small sediment filled bowl (i.e. the San Fernando Basin) with a spout (i.e. the Glendale Narrows) pouring water into a larger sediment filled bowl (i.e. the Los Angeles Basin). This interface between the bedrock, soils and groundwater define the surficial expression and subsurface conditions of the LA River in the Study area. Details of the bedrock, soils, and groundwater are presented in this section.

The local subsurface geology of the project Study area is shown in the LA River Geologic Profile Map, Figure 36. This profile runs approximately southwest to northeast across the project site and is projected in a northwest direction. It averages approximately 6,000 to 7,000 feet thick and expresses the general structure and character of the bedrock and alluvium sediment. The structure of the geology is a series of thick folded sediments (formations of soft and hard bedrock) overlain by very thin (approximately 50 to 300 feet) layers of alluvium (unconsolidated sediment). The LA River and the approximate project Study area are marked on the profile in red lettering. The Study area is dominated by the Elysian Park Anticline structure and a thin layer of Recent and Older alluvium. The alluvium makes up the LA River floodplain and edges of the surrounding San Fernando basin. The local geology is depicted on Figures 28 through 35.

3.2.2.1 Bedrock

There are very few if any exposures of bedrock within the immediate vicinity of the LA River Study area, except for the eastern foothill section of the Santa Monica Mountains. The foothills are composed of Tertiary age sedimentary rocks. These rocks are located on the west side of the river between sub-reaches 1 and 6 (see Figure 1 for sub-reach locations), and are typically less than 1/2 mile from the LA River.

Exposures of shallow bedrock were uncovered in the 1930s and 1940s during original construction of the USACE built channel-levee, along southern portions of Sub-Reaches 7 to 8. This exposure is shown on the Top of Bedrock Contour Maps Figures 3 through 5. The bedrock here has been mapped and described as soft, sedimentary rock related to the Puente Formation. There is sparse evidence of additional exposures of bedrock within the immediate vicinity of the LA River. This is based on the general local geology as mapped by the California Department of Mines and Geology (CDMG), United States Geologic Survey (USGS), and as indicated on USACE as built records/drawings of the LA River channel-levee system. Additional shallow bedrock has not been described or encountered during subsurface samples taken amongst previous investigations; however, more recent geotechnical related soil-alluvium investigations have been done by others such as: the USACE, City, and various HTRW Potential Responsible Parties (PRPs).

Existing bedrock is buried beneath the LA River floodplain and is well below (potentially greater than 50 feet) the channel bottom in all sub-reaches, except at Sub-Reaches 7 to 8. Within these sub-reaches it is shallow and was encountered above the channel bottom and along the banks of the LA River. It is highly probable that bedrock will not be encountered in most of the excavations required for the structures (i.e. removal and redesign of existing Corps LA River channel, construction of bridges, stairways, trails, bathrooms, buildings, etc.) needed in support of the project. It is also not expected to be encountered in soils removed to support the general planting-cultivation requirements for the habitat plans. The exception will be areas alongside Sub-Reaches 7 to 8 and the LATC property. Bedrock is anticipated to be encountered in the near surface in these areas sporadically. If encountered, the bedrock will likely be composed of soft sedimentary bedrock, which can be excavated with moderate to easy difficulty by using conventional heavy construction equipment, such as backhoes, excavators, etc. There are specialized attachments to this equipment such as rock saws and hoe rams, which can penetrate harder sedimentary rock, if encountered. These attachments can slice or break up the rock to where it can be removed easily.

3.3 Alluvium and Soils

In general, deposits of sediment along the LA River and on the alluvial fans and floodplains in the watershed drainages are among the youngest surface soils in the Study area. Deposits of soil within the Study area are generally considered alluvium. Alluvium is defined as soils that have been deposited and transported in their current position as a result of moving water by streams, rivers, sheet wash, etc. Recent alluvial deposits are those stream and river derived deposits that are less than 10,000 years old (Holocene age). The San Fernando Valley and Los Angeles basin alluvium can be generally characterized as recent alluvium and is comprised of moderately dense combinations of silt, sand, and gravel, with lesser amounts of clay.

3.3.1 Historical Soil Uses and Fill

The natural surface soils of the Study area have been highly modified as a result of farming, construction grading, and cut and fill practices during the past century. Artificial fill was generally imported and deposited along the major streams and river channels to fill in low lying areas and to channelize the LA River. Fill was also used in both private and public property in the Study area to raise the grade for the construction of roads, bridges, and railroads. In general, fill soils are brownish and consist of silty sands with gravel. However, fill material in the area ranges from clayey silt and silty clay, to angular gravel with sand (City of Los Angeles 2005).

Fill has also been known to contain a mixture of fill soil with solid waste. The solid waste portion of this mixture is known to commonly contain a combination of household trash, vegetation and construction debris. Fill of this character was commonly added to various properties within the Study area and property abutting the banks of the Los Angeles River during the mid 20th century (1920’s to 1950’s). In some cases the solid waste portion was burned to reduce its density before being mixed in with soil and buried as fill. This practice has been described as “landfilling”, which is inappropriate terminology for use in today’s solid waste environmental compliance regulatory arena. This is because legal disposal of solid waste and soil fill mixtures on both private and public property currently requires a solid waste permit. Using the loose terminology of “landfilling” assumes a specific set of rules, practices and procedures that must be followed, which are closely regulated according to Federal and California solid waste environmental regulations. There were no landfill permits in effect during the time that this type of fill was used. The more appropriate and general description for this practice is “buried fill containing solid waste and soil”. This terminology will be used throughout this report from herein in order to avoid the current regulatory complications inherently related to solid waste environmental regulations in use and enforced.

Buried fill containing solid waste and soil placed in the historical past has been found contaminated with various man made pollutants of metals, petroleum hydrocarbons, etc. The result is that there are various known properties within the Study area and along the upper banks of the LA River that contain this type of contaminated fill. There are also potential unknown amounts of this fill that may still exist in the Study area and particularly along the banks of the LA River because of the past practice of buried fill containing solid waste and soil. Any known contaminated buried solid waste and fill is currently being addressed and regulated by either the California Department of Toxic Substance and Control (DTSC) or the Los Angeles Regional Water Quality Control Board (LARWQCB). This type of fill is regulated not as a landfilled solid waste or landfill derived waste but as a hazardous substance per both the Federal laws of the Comprehensive Environmental Recovery Compensation Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). Further details regarding disposition and use of such fill are described in the Hazardous Toxic and/or Radioactive Waste, HTRW Survey Report appendix.

The banks of many river courses that extended through communities developed during the early part of the last century were used as disposal sites for common trash. Residential and commercial trash was dumped on stream banks and sometimes burned. The resulting debris was typically carried away by intermittent high stream flow conditions and the dumping process was repeated. Because of the localized nature of this debris, typical geotechnical investigation methods are not always successful in identifying and characterizing these conditions. As a result, construction excavations that encounter this type of debris will need to be evaluated during grading.

3.3.2 Engineering Description of Soils (USCS)

The engineering classification (Unified Soil Classification System, USCS) for the surface and deeper soils (a.ka. alluvium) for the project Study area ranges from poorly graded sand (SP) to silty sand (SM) to well graded gravel (GW), with some minor amounts of clay. Samples of the soils were collected in the past by both the City of Los Angeles and the Los Angeles District, USACE. The samples were collected using typical geotechnical trenching and borehole methods. The sampling depths ranged from ground surface to approximately 100 feet below ground surface. The locations of the samples are shown on the Borehole Sample Locations Maps, Figures 21 through 27. The locations shown are approximately within 500 feet of the LA River. Additional samples were collected outside those shown and are not depicted on the Maps. The actual sample descriptions and/or logs of the soils are not provided within this appendix, but are available in the Geotechnical Branch archive working files. To access the files, a Freedom of Information Act request must be generated; the phone number is provided on the inside cover of this report.

3.3.3 Anticipated Soil Usage and Disposal

The project will disturb the existing soils within the project area. Disturbance will involve excavation/removal and replacement of soils during the construction of the project habitat. The existing soils will be recycled/re-used as much as possible during construction. Reused soils will be needed for both engineering and landscaping applications. Uses for such soil will likely consist of engineered fill, filter and backfill and plant bedding/amendment mixtures and plant drainage materials.

Some amounts of soil will not have a use and may have to be hauled away from the project for re-use or disposal. Non-useable soils may consist of soils not meeting requirements for engineering or landscaping applications and HTRW contaminated soils. HTRW contaminated soils may be encountered at unknown locations within the project Study area. These soils may be encountered at or near the HTRW contaminated properties within the project footprint as described in the HTRW Survey Report. These soils are highly likely to be encountered at the Taylor Yard property, since it still contains known amounts of HTRW contaminated soil that have not yet been removed or remediated. According to the USACE Regulation ER 1165-2-132, HTRW Guidance for Civil Works Projects, HTRW contaminated soils must be remediated by the project Sponsor in accordance with Federal CERCLA and/or California State or local HTRW environmental laws prior to providing lands for construction. This means that all known HTRW contaminated soils at Taylor Yard will have to be remediated to meet both the human and ecological health risk standards specific to its land use for the study project. For this project, Taylor Yard's intended land use is for habitat restoration and recreation. As discussed below, HTRW contamination is suspected, although not confirmed, at the LATC site in Reach 8. This site would be subject to further investigation by the Sponsor with all necessary remediation of soils to be completed prior to the Sponsor providing the site to the Project for construction. Further details regarding disposition of HTRW contaminated soil are discussed within the separate HTRW Survey Report and the HTRW Section (6.0) within this report.

4.0 GEOTECHNICAL HAZARDS

Numerous geotechnical hazards exist within the Study area and will impact or could impact the Study area and the project. These hazards include faulting, seismicity and ground shaking, liquefaction and lateral spreading, and landslides.

4.1 Faulting

The intersection of the northwest trending San Andreas Fault System and east-west trending Transverse Ranges Fault system dominates the seismicity of southern California. The project Study area has the potential to experience strong ground shaking from local and regional faults. Three active faults near the Study area include the Verdugo Fault, the San Andreas Fault, and Northridge Blind Thrust Fault. These three faults and several other faults can be the cause of future seismic induced damage to the Study area. Such damages are impossible to predict, but the impacts would be wide reaching and variable depending on the distance and size of the fault that would cause the seismic disturbance of an earthquake. Such damages could affect not only the Study area, but also adjacent property, city wide damage, regional damage, and the loss of human life.

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures with human occupancy (California Geologic Survey 2006). The Act prohibits the siting or zoning for most types of structures built post-1972 across the traces of active faults that may pose a potential hazard to occupants and structures (California Department of Conservation 2012). The California Alquist-Priolo Earthquake Fault Zoning Act defines an active fault as one that has ruptured in the last 11,000 years.

The State of California Building Standards Commission provides a minimum standard for building design through the Building Standards Code. The Building Standards Code is used by the Cities of Los Angeles (LADBS 2012), Glendale (2012), and Burbank (2012) as minimum design criteria for construction of buildings and structures to protect against anticipated seismic events.

4.1.1 San Andreas Fault

The San Andreas Fault, located 30 miles to the northwest of the Study area, forms the boundary between the North America and Pacific Tectonic Plates, and is the most significant fault in the area. The fault extends for about 800 miles from the northern tip of the Gulf of California to the Mendocino triple junction west of San Francisco (Harden 1998). The fault runs along the base of the San Bernardino and San Gabriel Mountains.

In addition to the San Andreas Fault, the Study area lies near numerous other active faults. The Elysian Park Fault in Study Sub-Reaches 4-6 is a blind reverse fault that extends approximately 12 miles through the Elysian Park-Repetto Hills from Silverlake on the west to the Whittier Narrows on the east. Blind reverse faults are those that do not and never have extended upward to the surface of the earth. The Elysian Park anticline forms a segment of the southern boundary of the Transverse Ranges and has an estimated time-average rate of slip of 0.8 to 2.2 millimeters per year (mm/year) (Oskin et al. 2000). The Elysian park anticline is formed by the Elysian Park blind reverse fault.

4.1.2 Verdugo Fault

The Verdugo Fault is located less than 2 miles to the northwest from the Study area Sub-Reach 3, and runs 14 miles from the San Fernando Valley in the northwest to the Los Angeles Basin in the southeast, from the City of Pacoima to the City of Glendale. The Verdugo Fault is an active north-dipping reverse fault, with a minimum uplift rate of 1.1 mm/yr, starting 2.3 million years ago (Arkle and Armstrong 2009).

4.1.3 Raymond Fault

The Raymond Fault is about 16 miles long, with a slip rate of between 0.10 and 0.22 mm/yr. Nearby communities include San Marino, Arcadia, and South Pasadena (Southern California Earthquake Data Center 2006). The Raymond Fault forms the eastern portion of the Santa Monica Mountains Frontal Fault System and extends from western Hollywood east to Pasadena. The fault runs east-west through the Study area in Sub-Reaches 4-6 upstream of Glendale Blvd, across the Los Angeles Narrows (City of Los Angeles 2005).

4.1.4 Hollywood Fault

The Hollywood Fault is about 9.3 miles long and has a slip rate of between 0.33 mm/yr and 0.75 mm/yr. Nearby communities include Hollywood, Beverly Hills, and Glendale. The eastern part of the Hollywood Fault zone extends along the base of the Santa Monica Mountains, near Los Feliz Blvd. From there, the fault trends eastward across the alluvial deposits of the Los Angeles River in the Atwater area. It can be considered a westward extension of the Raymond Fault and runs through the Sub-Reaches 4-6, parallel to the Santa Monica Fault (Southern California Earthquake Data Center 2006).

4.1.5 San Fernando Fault

The San Fernando Fault is about 10.5 miles long and runs from the area of Big Tujunga Canyon north to the San Fernando Valley. The slip rate is not well known, but is believed to be about 5 mm/yr. The last major rupture was February 9, 1971, and is known as the Sylmar or San Fernando Earthquake, which had a magnitude of 6.6. The rupture was roughly 12 miles long, with a maximum slip of six feet (Southern California Earthquake Data Center 2006).

4.1.6 Northridge Blind Thrust Fault

The Northridge Blind Thrust Fault (NBTF) (a.k.a. Pico Thrust Fault) is a south dipping blind thrust fault. It is part of the Oak Ridge Fault (ORF), an extensive fault system, which is approximately 55 miles long and dips to the south at less than a 45 degree angle. It is proposed that the ORF curves from an east to west strike to an east to southeast strike that mimics changes in strike along the pre-Saugus Frew and Torrey Faults. The long term slip rate on the ORF is about 3.5 to 6 mm per year (Southern California Earthquake Data Center 2006). The NBTF is interpreted as the eastern blind continuation of the ORF, and the south slip movement along this portion was responsible for damage caused by the Moment Magnitude 6.7 Northridge Earthquake of 1994. This earthquake measured 6.7 on the moment magnitude scale and was one of the most destructive earthquakes in U.S. history.

4.2 Seismicity and Ground Shaking

The Study area is located within the seismically active area of southern California. Approximately 30 earthquakes happen each day, most of which register a Richter magnitude below 2.0. The last appreciable earthquake in the Los Angeles area was in January 1994 when the Northridge Earthquake hit the San Fernando Valley with a Richter magnitude of 6.7 (USGS 2012). The attached Table 3 is a summary of significant historical or larger magnitude earthquakes in the vicinity of the ARBOR Reach.

Ground shaking is the primary cause of earthquake damage in southern California. Structures on poorly consolidated and thick soils typically incur more damage than buildings on consolidated soils and bedrock. As discussed above, the majority of the Study area is on such soils. Damages to the surrounding areas as well as to the structures and features built as part of the project are to be expected following a major earthquake.

The intensity of the ground shaking is related to the magnitude of the earthquake, type of fault, depth of the earthquake, and distance of the site from the epicenter. Areas near major active faults generally experience stronger seismic shaking more frequently. The Study area can be assumed to experience strong seismic shaking, since it is in an area of high seismic activity and near several active faults. The Los Angeles District has utilized the USGS models to estimate the intensity of the ground motions that should be expected to be imparted on the ARBOR Reach and its foundation. These models are found online and available to the public. The USGS 2008 National Seismic Hazards Mapping Program (NSHMP) Probabilistic Seismic Hazard Assessment (PSHA) Interactive De-aggregations web site is located at https://geohazards.usgs.gov/deaggint/2008/. The following summary of site peak ground accelerations (PGAs) can be expected at the upstream end, the downstream end, and the approximate midpoint of the ARBOR Reach:

Estimated Ground Motions along the ARBOR Reach				
Return Period	Probability of Exceedance (PE)	Estimated PGA[1] (g)		
		Upstream	Downstream	Approximate

(years)		End (34.153°N, 118.326°W)	End (34.048°N, 118.230°W)	Midpoint (34.111°N, 118.262°W)
144	50% in 100 years (OBE)	0.28	0.25	0.29
475	10% in 50 years (MDE)	0.52	0.47	0.59
950	10% in 100 years	0.69	0.64	0.81
2475	2% in 50 years (MCE)	0.97	0.92	1.14

[1] Utilizes 0.0 seconds spectral acceleration, at the recommendation of the model developers, so as to most closely equate the results to PGA. Assumed Vs30=760 m/s

4.3 Liquefaction and Lateral Spreading

The greatest seismic induced damage risk (as opposed to the direct damage caused by ground shaking) to the Study area and the project is due to earthquake induced liquefaction of soils. Liquefaction is caused when the ground shakes wet granular soil and changes it to an unstable liquid state. Areas with high groundwater, saturated loose sands, and silty sands within 50 feet of the ground surface, and are in close proximity to active faulting are most susceptible to liquefaction. Lateral spreading is similar to liquefaction in that it is the deformation of shallow sloping ground towards an open face during a seismic event.

Regions in the Study area with high liquefaction and lateral spread potential include the majority of lowland areas along the LA River and tributaries. In addition, there is high liquefaction potential along the foothills of the Santa Monica Mountains in Sub-Reaches 1-3, along the base of the Elysian and Repetto Hills in Sub-Reaches 4-6, and along the base of the Elysian Hills in Sub-Reaches 7 and 8. These high liquefaction potential areas are all shown on the Liquefaction Potential Maps, Figures 12 through 20 and have been published by the California Department of Conservation Mines and Geology (CDCMG). Impacts of liquefaction and lateral spread will need to be addressed for all potential modifications.

4.4 Landslides

Landslides are a natural hazard throughout southern California, especially within steep terrain underlain by relatively weak soil materials. Factors that affect slope failure are angle, substrate, climate (e.g. precipitation), and seismic shaking. Hillside areas of Los Angeles have geologic and topographic conditions that are conducive to the development of landslides. Landslides can also be triggered by seismic events, causing the soils to lose their stability and possibly to liquefy. Debris flows due to prolonged and heavy precipitation are more localized in small gullies (large ditches or small valleys caused by an advanced stage of channel erosion). These are typically shallow landslides, where the surface material becomes saturated and begins to flow downhill, taking vegetation and buildings with it. Debris flows are known to start on slopes as low as 15 degrees, but are more likely to develop on steeper slopes.

Within the Study area, landslide potential occurs along the eastern Santa Monica Mountains (Sub-Reaches 1-6), Elysian Hills (Sub-Reaches 4-8), and Repetto Hills (Sub-Reaches 4-6). It is anticipated that the alternatives will not affect or disturb any known or potential landslide hazard areas. However, considerations will need to be made for evaluation of landslides during design.

5.0 GROUNDWATER

The groundwater in the Study area is encountered in the shallow subsurface at depths from 15 to 30 feet along the upper banks of the LA River and at depths of river bottom (ground surface within the channel). The direction of the groundwater flow is from northwest to southeast in the general downstream direction of the LA River. The groundwater occurs within a shallow unconfined aquifer that is regionally extensive and is found throughout San Fernando and the Los Angeles Basins. This aquifer is fed from the surrounding runoff of both Basins, as well as man-made recharge areas in the San Fernando Basin. The water table surface of this shallow aquifer is shown as contours on the Water Table Contour Maps, Figures 6 through 11. This surface was estimated based on water level data accumulated from shallow piezometers and observation wells installed in support of geotechnical investigations by the USACE, City of LA and HTRW PRPs during the last 60 years.

5.1 Dewatering

The groundwater in the Study area will be affected more so during construction of the actual project than the time after it is built. This will occur in the case in which any groundwater is encountered and it interferes with future habitat construction activities of excavation, planting, etc. During the most likely case of excavation, this will require that groundwater be removed (dewatered) from the excavation(s) by bailing or by pumping out via temporary, dewatering wells. Because dewatering is temporary, it should not affect the long-term character nor deplete the quantity of the shallow groundwater. Therefore dewatering activities for the project should not impact or interrupt its overall use as a shallow water supply aquifer.

The dewatering activity will more likely affect the temporary movement of groundwater during its removal. This is usually not a cause for concern for construction projects in which the shallow aquifer is known to be uncontaminated with HTRW pollutants. However, there are approximately 22 known HTRW sites and one suspected HTRW site that are in or adjacent to the project Study area with potential to have introduced HTRW contaminants into the groundwater that could be encountered during dewatering. Of these properties, the San

Fernando Valley Superfund (SFVSS) site/property has the greatest impact to project dewatering activities because it is has already caused a regionally extensive amount of HTRW contamination to the shallow aquifer.

As previously mentioned, impacts to construction from routine dewatering of non-HTRW contaminated groundwater is straightforward and mainly involves removal and movement of dewatered groundwater back into (recharge) the surrounding aquifer or placement back into the nearest surface waters (LA River). This usually requires application only for a simple dewatering permit with California State and local regulatory agencies. The simple permit outlines basic coordination planning and monitoring for such non-HTRW dewatering activities. For the aforementioned reasons, existing HTRW contaminated groundwater is more likely to be encountered during future construction activities for this project. As such, the impacts are more complicated and will likely require a complex dewatering permit that requires more extensive monitoring than the simple permit. In addition, it may also require close coordination/consultation and approval from the Los Angeles Regional Water Quality Control Board (LARWQCB) and may also require a waste discharge permit (WDR) tailored specifically to the planned discharge of the project dewatered groundwater.

The additional permitting requirements may require instead that any dewatered groundwater be stored and treated prior to final discharge back into the surrounding shallow groundwater aquifer or LA River. According to USACE Regulation, ER 1165-2-132, "Hazardous, Toxic and Radioactive Waste (HTRW) Guidance for Civil Works Projects", these activities are considered as HTRW response activities. The non-Federal sponsor is responsible at 100 percent non-project cost for addressing any contaminated groundwater encountered during construction dewatering activities, including its treatment and disposal.

5.2 Pumps and Wells

Pump and treat well technology is the current response method being employed to remediate the HTRW contaminants from the shallow aquifer. Numerous wells are deployed across the SFVSS and the nearest pump and treatment facility to the project is the Pollock Well Field. This facility is a series of wells located about less than 1 mile northwest from the Taylor Yard property, near the center of the project. This well field has been in operation for about 10 years and recovers a large portion of the HTRW contamination from SFVSS and is operated by the City of Los Angeles Public Works. The Los Angeles Department of Water and Power (with oversight from the U.S. Environmental Protection Agency (U.S. EPA)), is managing and operations of SFVSS and the Pollock Well Field facility as well as other fields to ensure that they continue to properly remediate the HTRW contamination within the shallow aquifer. The migration pattern of HTRW contamination within the existing shallow groundwater aquifer caused by the SFVSS and the recovery of such contamination by the Pollock well field may also be impacted by the project after it is built. Several of the more likely impacts are as described in the following sections.

5.2.1 **Application of Irrigation Water for Establishment of Restoration Features and During Operation and Maintenance**

Future irrigation water plans and budget for the habitat project may need to consider means for preventing potential interference with the ongoing pump and treat response for the SFVSS contaminated shallow aquifer. This is more likely to occur for any residual HTRW soil contamination left at the Taylor Yard property, because the vertical distance from this contamination to the shallow water aquifer is small. If irrigation water is allowed to infiltrate freely through the soil at this property, it is has the potential to leach out residual HTRW soil contaminants and directly transport them into the surrounding aquifer. However, the likelihood of this occurring will be low because of the following:

a. Residual soil contamination will be removed from this property by the Sponsor, to regulator-required levels as part of the Sponsor's required response activities to facilitate this project;

b. Environmental engineering technologies (e.g., impermeable barriers/covers, soil vapor extraction, localized pump and treat) have been used to remediate similar projects in the past. These technologies may be deployed as part of the overall response but is at the direction and discretion of the Sponsor and per approval of regulatory authorities and must be consistent with needs for the restoration project; and

c. The shallow aquifer beneath Taylor Yard is already contaminated by HTRW and some of this has been attributed to leaching of residual HTRW contaminants from its soil. Much of this attributed contamination is co-mingled with contamination emanating from SFVSS and is currently successfully being remediated by the U.S. EPA pump and treat well system at the nearby Pollock well field.

Nevertheless, as part of operation and maintenance requirements, irrigation water should be applied such that it does not infiltrate in amounts that will affect or alter the current mechanical transport (migration) of the SFVSS contaminated groundwater into the pump wells. The plans and budget also need to include prevention of the introduction or addition of any HTRW soil type contaminants into this aquifer. All of these plans would be reviewed by primary regulatory agencies such as the LARWQCB.

5.2.2 **Unique Habitat Project Designed Features Such as Wetlands**

The construction of unique project features such as wetlands may need to incorporate or consider additional means to avoid interference with ongoing groundwater remediation efforts. This will occur for Taylor Yard, since it directly overlies SFVSS and does include a unique wetland footprint plan for the alternatives selected as part of this project. The likelihood of altering and interfering with the SFVSS plume is low because of the following:

a. As mentioned earlier, much of the SFVSS contaminated groundwater plume is currently successfully being remediated by the LADPW pump and treat well system at the nearby Pollock Well Field. It is unlikely that built features such as wetlands will interfere with the success of this pump and treat system for Taylor Yard since this property is very close to the recovery forces (well radius of influence) of the Pollock Well Field. This will likely continue as long as the wells remain operating. According to EPA, the pump and treat response for Pollock and SFVSS will continue for approximately 10 to 20 years into the future, which will be ongoing beyond the date of final construction of the LA River project. Also, much of the higher concentrations of HTRW within the SFVSS plume are already successfully being captured directly near the Pollock and other pump and treatment well locations. As indicated on the 2010 SFVSS HTRW groundwater plume map (shown in the HTRW Survey Report, part of the HTRW Appendix), there are still portions of this plume that extend beyond the higher concentration areas of capture. These outlier areas contain lower HTRW concentrations from this plume. Because of this, it is likely that any migration of this plume through or around the project that is associated with unique features will be of lower concentrations; and

b. The construction of unique habitat features for this project should not interfere with or alter the existing pathways of migration of contaminated groundwater at SFVSS. This is because there are open bottom areas, plus an extensive system of weep holes/drains that already exist and that have been built into the LA River channel and levee. These devices were built around the 1940s for the purpose of relieving and draining the structure of any surrounding groundwater. They have continued to operate in this manner to this day. The presence of yet to be constructed unique habitat features such as wetlands should not interfere or alter the exiting migration of the SFVSS contaminated plume. This is because portions of the SFVSS HTRW contaminant plume have most likely already migrated through and beneath the LA River channel/levee, since this structure effectively already allows for groundwater seepage into the river.

The shallow groundwater and aquifer will remain unaffected without construction of the project. The SFVSS and HTRW contaminated portions of the shallow aquifer will remain unaffected with construction of the project and with construction of unique features of the project such as wetlands.

6.0 HTRW

There are known HTRW impacts to various properties within the Study area. Taylor Yard G1, Taylor Yard G2 and SFVSS are the three known properties that have the highest HTRW impacts. This is because contamination in soil (at Taylor Yard) and groundwater (SFVSS) is widespread at these properties and most or all of the various habitat feature footprints selected from the final array of project alternatives directly overlie these particular properties.

Nineteen (19) known properties have low potential HTRW impacts to the project. This is because contamination in soil and groundwater is not heavy, is fairly well contained and not widespread at these properties, and all of the habitat footprints are adjacent to but do not directly overlie these properties. However, groundwater adjacent to these sites may impact the project during construction.

One additional property also has an unknown HTRW impact on the project. This property, the LATC, is planned to be a major feature of the project. LATC has potentially high levels of contamination based on its historical uses, although there are no public records available for that site, and as such, the impact to the project is unknown at the time of the study.

According to USACE regulation ER 1165-2-132, remediation of HTRW sites/properties should occur before project implementation or actual construction. This remediation is the responsibility of the project Sponsor and is not paid for by the project, i.e. it is at 100% of non-project cost, and in-kind project credit by the USACE <u>cannot</u> be given to the Sponsor. The ER definition for required remediation includes CERCLA HTRW, i.e. any CERCLA hazardous substance. Hazardous substances include all RCRA type hazardous waste; Clean Air Act hazardous substances and hazardous air pollutants; Clean Water Act toxic pollutants; and Toxic Substance Control Act hazardous chemical substances or mixtures. On the whole, it includes Federal EPA and California State HTRW of all types that have been released into the soil, surface water, groundwater or air at the project site and that are currently regulated under environmental law. The exceptions are petroleum and natural gas products released into the environment at the project site, as these products are not CERCLA hazardous substances. These non-CERCLA hazardous substances may be removed/remediated and paid for by the project, as long as they are required to be removed/remediated according to any validly promulgated Federal, California State, or local regulation.

A large known amount of HTRW contaminated soil exists at the two Taylor Yard properties of G1 and G2. A large amount of known HTRW contaminated groundwater also resides beneath most of the Study project area and is part of the San Fernando Valley Superfund site/property. These are 3 of the 23 known and suspected HTRW contaminated properties described from the HTRW Survey Report in the study area and the 3 that lie within the project footprint. An unknown amount of residual soil and groundwater contamination may also exist at the LATC property and at or near the remaining 19 known properties that are near but outside the project footprint. It is possible, but less likely that unknown amount of soil and groundwater contamination will be encountered during construction of the project near the 19 properties. This is because most of the known HTRW contamination has already been actively removed/remediated from these sites, and any residual contamination is being monitored, and land use controls are in place, or it is being passively remediated, i.e. left to naturally attenuate. It is possible and more likely that unknown amounts of soil and groundwater contamination will be encountered at the habitat footprint at LATC, because much of this property was once used as a railroad maintenance yard. LATC is likely to contain HTRW contamination based on its historical similarity to Taylor Yard, which is heavily contaminated with HTRW and is also a high HTRW impact property to the project. However, there is no material evidence at this time to substantiate this. The sponsor will conduct all necessary investigations and remediate relevant soil contamination prior to project construction at that site.

Regardless of its state, any residual CERCLA derived HTRW contamination encountered before or during construction must be must be removed/remediated by the Sponsor at 100% their cost. The primary regulatory agencies for the approval of the remediation of HTRW will be the California Department of Toxic Substance and Control (DTSC) or the Los Angeles Regional Water Quality Control Board (LARWQCB). Please see the HTRW Survey Report and HTRW Issue Paper, for more information on the HTRW issues.

There will also be construction activities that involve routine transport, use, and disposal of common hazardous materials, such as fuels (gasoline and diesel), oils and lubricants, and cleaners (e.g., solvents, corrosives, soaps, detergents). Accidental spills of such materials can occur around such activities; however, minor spills are not likely to have significant effects. Best Management Practices (BMPs) would be implemented to minimize potential for the public to come into contact with or be exposed to hazardous materials during the routine transport, use, or disposal of hazardous materials or as a result of an accidental release. Prior to the start of construction, the USACE will develop engineering specifications and plans, which will include a written Environmental Protection Plan (EPP). The EPP will also include a written Pollution Prevention Plan that outlines the actions needed to respond and remediate any unknown/ unexpected HTRW contamination or potential release of construction derived hazardous materials.

Existing known and unknown amounts of HTRW will remain throughout the Study area without the project. On-going and progressive remediation, monitoring and regulation of the 23 known HTRW properties by the current PRPs will continue to occur.

7.0 POTENTIAL PLAN ALTERNATIVES AND DESIGN CONSTRAINTS

Existing conditions have been discussed above and are presented in Table 1. Modifications to the existing conditions will consist of specific sub-measures that will alter the existing condition to meet project objectives. The sub-measures proposed at this time are listed in Table 2. Various sub-measures are combined within sub-reaches to comprise various alternative plans. Five plans have been carried forward and are described in detail in other appendices. These five plans are presented in Table 2. A summary of the constraints discussed in sections below are summarized in table form in Table 4. Regardless of which sub-reach is being modified, the following geotechnical constraints and design considerations will need to be addressed:

a. Site-specific exploration and testing of the materials on site will need to be performed. The exploration and testing will be conducted to develop design parameters, which will be used in structural design of the elements required by the selected sub-measures. The parameters developed will be used in the analysis and considerations for hydrostatic pressures, potential seepage gradients, internal erosion potential, slope stability, settlement, and other geotechnical design considerations outlined in the current design standards;

b. Utilities, transportation corridors, infrastructure facilities, residential and commercial structures and other features are in close proximity of the LA River channel. A detailed delineation and inventory of these features will need to be conducted. Potential impacts of channel modifications on these features will need to be evaluated during design;

c. Levees are present throughout the ARBOR Reach. Modifications to existing levees will need to maintain existing flood protection, be designed and constructed according to current standards, and follow current vegetation guidance under ETL 1110-2-583. As part of this study, a memorandum for record has been prepared with "Levee Condition Inspection and Issue Discussion" as the subject. This memorandum is included as Attachment 1;

d. Grading plans will need to be developed and reviewed during design stages in accordance with codes, standards, and practices;

e. Seismic design parameters will need to be developed during design stages for structural design;

f. Scour estimates have not been made at this time, but would have a significant impact on the design and construction. Scour could potentially put the foundation of structures at risk from undermining or direct flow impacts that have not been considered as part of this Study. Scour estimates, when determined, will need to be incorporated into the development of the design parameters mentioned above. Deepened foundations to accommodate a deep scour condition will result in a more robust structural design to accommodate increased lateral loading. The resulting increases in project cost could be significant and are not presently accounted for in the costs. Currently, it is the assumption that scour issues would be able to be adequately addressed during design phases; and

g. The potential for unknown HTRW materials exist within the ARBOR Reach and may be encountered during design exploration as well as during construction.

7.1 Sub-Reach 1

Planned restoration actions and modifications within this sub-reach include habitat corridor construction and riparian planting on the right and left overbanks of the river as well as along the overbank of the Burbank Western Channel and at the Pollywog Park area of Griffith Park. No channel modifications are currently being considered at this time.

Other than those general issues mentioned above, the following constraints and design considerations impact this specific sub-reach:

a. Habitat Corridors will need to take into account potential impacts to the California State 134 Freeway (CA-134) from an easement and structural suitability standpoint;

b. Levees exist within this reach on both the right and left banks. It is currently the assumption that the levees will not be modified and that the planting will be done following policy guidance under ETL 1110-2-583 within this sub-reach; and

c. Soil impacted by known HTRW is not anticipated for this sub- reach. However, groundwater within the project area in this reach may be impacted by HTRW. These impacts may include existing Volatile Organic Compound (VOC/s) contamination associated with the Forest Lawn Cemetery. As the cemetery site is not within the project footprint, impacts from soil contamination are not anticipated. However, potential groundwater contamination may impact the project site as it is generally down gradient from contaminated areas and dewatering is likely during grading operations. This impact will need to be evaluated and if necessary addressed during design phases. As noted above, this remediation is the responsibility of the project Sponsor and is not paid for by the project, i.e. it is at 100% of non-project cost, and in-kind project credit by the USACE cannot be given to the Sponsor.

7.2 Sub-Reach 2

Planned restoration actions within this sub-reach include habitat corridor construction and riparian planting on the overbanks of both sides of the river (all alternatives), a vertical wall from River Station (RS) RS-542+40 to 509+00 on the left bank (only in Alternative 20), planting of vines (only Alternative 20), and construction of a soft bottom (only Alternative 20).

Other than those general issues mentioned above, the following constraints and design considerations impact this specific sub-reach:

a. Habitat Corridors will need to take into account potential impacts to the CA-134 and Interstate 5 Freeway (I-5) from an easement and structural suitability standpoint. Currently, it is the assumption that these impacts will be evaluated during design phases;

b. Impacts to the bridge crossings of I-5 as a result of re-configuration of the channel associated with the vertical wall and scour will need to be considered. Currently, it is the assumption that the bridge impacts and scour will be evaluated during design phases;

c. The walls currently under consideration likely require counterfort or tieback designs. These designs will require extensive right of way, either temporary or permanent, and will need to be considered during design;

d. Levees exist within this reach on both the right and left banks. Modifications to existing levees will need to maintain existing flood protection, be designed and constructed according to current standards, and follow current vegetation guidance under ETL 1110-2-583; and

e. Soil impacted by known HTRW is not anticipated for this sub-reach. However, groundwater within the project area in this reach may be impacted by HTRW. These impacts may include existing VOC contamination associated with the Forest Lawn Cemetery. As the cemetery site is not within the project footprint, soil impacts from the contamination are not anticipated for the project. However, potential groundwater contamination may impact the project site as it is generally down gradient from the cemetery and dewatering operations are likely during site development. This impact will need to be evaluated and if necessary addressed during design phases. As noted above, this remediation is the responsibility of the project Sponsor and is not paid for by the project, i.e. it is at 100% of non-project cost, and in-kind project credit by the USACE cannot be given to the Sponsor.

7.3 Sub-Reach 3

Planned restoration actions within this sub-reach include daylighting of two storm drains on the left bank (Alternatives 10, 13, 13v, and 16) and one on the right bank (all alternatives), expansion of the Verdugo Wash confluence (only in Alternative 20), planting of riparian habitat corridor along Verdugo Wash (Alternative 20 only) and the right bank of the LA River (all alternatives) and diversion of flows into a side channel at Ferraro Fields (all alternatives excluding 10). Daylighting of the storm drain connections would allow for habitat development at storm drain entrance to the river and eliminating closed pipes. The planned changes to Verdugo Wash include removal of the existing paved bottom and widening of the confluence with the LA River to create a soft bottom environment with vegetation.

Other than those general issues mentioned above, the following constraints and design considerations impact this specific sub-reach:

- **a.** Modifications will need to take into account potential impacts to the CA-134 and I-5 interchange, as well as surface streets and railroad crossings from an easement and structural suitability standpoint. Currently, it is the assumption that these impacts will be evaluated during design phases and will be minimized;
- **b.** Impacts to the bride crossings of CA-134 as a result of re-configuration of the channel and scour will need to be considered. Currently, it is the assumption that these impacts and scour will be evaluated during design phases and will be minimized;
- **c.** The walls currently under consideration, in Alternative 20 for the Verdugo Wash confluence, will likely require counterfort or tieback designs. These designs will require extensive right of way, either temporary or permanent, and these issues will need to be evaluated during design;
- **d.** Levees exist within this reach on both the right and left banks. Modifications to existing levees will need to maintain existing flood protection, be designed and constructed according to current standards for seepage, settlement and stability according to EM 1110-2-1913, and follow current vegetation guidance under ETL 1110-2-583; and
- **e.** Soil impacted by known HTRW is not anticipated for this sub- reach. However, groundwater within the project may be impacted by HTRW. These impacts may include existing zinc and chromium contamination associated with the Former Hawkes Finishing site. As the finishing site is not within the footprint of the project site, impacts from soil

contamination are not anticipated for the project. However, groundwater that is contaminated by these conditions may impact the project site. Dewatering and grading operations could aggravate these conditions. This impact will need to be evaluated and if necessary addressed during design phases. As noted above, this remediation is the responsibility of the project Sponsor and is not paid for by the project, i.e. it is at 100% of non-project cost, and in-kind project credit by the USACE cannot be given to the Sponsor.

7.4 Sub-Reach 4

Planned restoration actions within this sub-reach include daylighting of storm drains (all alternatives on left bank), riparian planting (all alternatives on left bank), and diversion of flows into a side channel (all alternatives on right bank) and a lowered area to allow seasonal flooding (all alternatives, left bank). Daylighting of the storm drain connections would allow for habitat development at storm drain entrance to the river and eliminating closed pipes.

Other than those general issues mentioned above, the following constraints and design considerations impact this specific sub-reach:

a. Modifications will need to take into account potential impacts to the I-5, as well as surface street crossings from an easement and structural suitability standpoint. Currently, it is the assumption that these impacts will be evaluated during design phases;

b. Impacts to the bride crossings of the Colorado Street Freeway Extension and Los Feliz Boulevard as a result of re-configuration of the channel and scour will need to be considered. Currently, it is the assumption that these impacts and scour will be evaluated during design phases;

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c. Levees exist within this reach on both the right and left banks. Modifications to existing levees will need to maintain existing flood protection, be designed and constructed according to current standards, and follow current vegetation guidance under ETL 1110-2-583; and

d. No direct HTRW issues are within this sub-reach, but the sub-reach may be impacted by upstream or downstream sites if dewatering operations change the local groundwater gradient. Similarly, impact to the sub-reach may occur if grading changes surficial drainage or exposes soils. As noted above, this remediation is the responsibility of the project Sponsor and is not paid for by the project, i.e. it is at 100% of non-project cost, and in-kind project credit by the USACE cannot be given to the Sponsor.

7.5 Sub-Reach 5

Planned restoration actions within this sub-reach include a riparian corridor on the left bank, daylighting of one storm drain (left bank in all alternatives) and changes to the right and left banks in Alternatives 16 and 20. The right bank of the channel would change from trapezoidal to vertical configuration for the entire sub-reach in Alternatives 16 and 20. The left bank of the channel would change from trapezoidal to vegetated terraces from RS 356+22 to RS 286+05 in Alternatives 16 and 20 with widening at the downstream end on the left bank. The proposed terraces would be 12-feet wide by 4-feet deep and tie into the existing ground elevation at a 3:1 slope. The left bank would then transition from terraces to a vertical configuration from RS 286+05 to RS 271+89, and then transition back into the original design channel configuration starting at RS 274+78.29, before the channel passes under the Glendale Freeway in Alternatives 16 and 20. Daylighting of the storm drain connection would allow for habitat development at the storm drain entrance to the river and elimination of closed pipes.

Other than those general issues mentioned above, the following constraints and design considerations impact this specific sub-reach:

a. Channel modifications will need to take into account potential impacts to the I-5, as well as surface street crossings from an easement and structural suitability standpoint. This impact will not be a factor in Alternatives 10, 13, and 13v. Currently, it is the assumption that these impacts will be evaluated during design phases;

b. The walls currently under consideration in Alternatives 16 and 20 likely require counterfort or tieback designs, These designs will require extensive right of way, either temporary or permanent, and will need to be considered during design;

c. Proposed planting or daylighting of stormdrain structures may require deep foundations depending upon information derived from scour and other hydraulic analyses. Currently, it is the assumption that these requirements will be evaluated during design phases;

d. Impacts to the bride crossings of Hyperion Avenue, Fletcher Drive, and the Glendale Freeway in Alternatives 16 and 20 as a result of re-configuration of the channel and scour will need to be considered. Currently, it is the assumption that these impacts and scour will be evaluated and minimized during design phases;

e. Levees exist within this reach on both the right and left banks. Modifications to existing levees will need to maintain existing flood protection, be designed and constructed according to current standards, and follow current vegetation guidance under ETL 1110-2-583; and

f. Sites within this sub-reach that have known HTRW issues include the following:

- fuel contamination associated with the Former Triangle Gas Station
- fuel and solvent contamination of groundwater associated with the Chevron Gas Station.
- fuel-solvent & metals contamination directly downstream at the Taylor Yard G1 site

As the Taylor Yard G1 site is directly within the project habitat footprint, potential impacts from both soils and groundwater contamination, remediation of soil contamination will need to be addressed as part of the project. Although response at the Taylor Yard sites is currently being addressed, the Sponsor would be 100% responsible for any additional remediation to reach land use levels necessary for the project prior to construction at the site. As the other gas station sites are not within the project footprint, a direct impact from soil contamination is not anticipated. However, groundwater that may migrate from these sites could impact the project site and dewatering, if necessary, would need to account for this condition. These impacts will need to be addressed during design phases. As noted above, this remediation is the responsibility of the project Sponsor and is not paid for by the project, i.e. it is at 100% of non-project cost, and in-kind project credit by the USACE cannot be given to the Sponsor.

7.6 Sub-Reach 6

Planned restoration actions within this sub-reach include the following (note: items a and b are each representative of a different alternative):

a. A small terraced area is planned along the left bank with vegetation at the upstream end of the Bowtie parcel in Alternative 10 from RS 261+80 to RS 256+00; the channel is re-configured to take advantage of the lower Bowtie parcel at RS 243+17, where the channel invert starts to widen into the left bank to add width of more than 80 feet to the existing channel within Taylor Yard before it contracts back to the original channel size at RS 201+76 and the eastern edge of the widened invert is sloped back up at a 4:1 slope to the original ground elevation;

b. A backwater wetland at riverbed level is planned at the upstream end of the Bowtie parcel on the left bank with from RS 261+80 to RS 256+00; the channel is re-configured to take advantage of the lower Bowtie parcel at RS 243+17, where the channel invert starts to widen into the left bank to a width of more than 620 feet (300 feet of new channel width) within Taylor Yard before it contracts back to the original channel size at RS 201+76 and the eastern edge of the widened invert is sloped back at a 3:1 slope to the original ground elevation approximately 15 feet from the railroad tracks; and

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c. Alternatives 13, 13v, 16 and 20 have implanted vegetation on the right bank through the entire reach.

Other than those general issues mentioned above, the following constraints and design considerations impact this specific sub-reach:

a. Modifications will need to take into account potential impacts to the I-5 crossing at the downstream end of the sub-reach, as well as surface streets and railroads adjacent to the channel from an easement and structural suitability standpoint. Currently, it is the assumption that these impacts will be evaluated during design phases;

b. Impacts to the bride crossings of I-5 as a result of re-configuration of the channel and scour will need to be considered. Currently, it is the assumption that these impacts and scour will be evaluated during design phases;

c. Proposed planting structures may require deep foundations depending upon information derived from scour and other hydraulic analyses. Currently, it is the assumption that impacts will be minimized and these requirements will be evaluated during design phases; and

d. Sites within this sub-reach that have known HTRW issues include the following:

- existing fuel-solvent & metals contamination of soils and groundwater associated with the Taylor Yard G1 and G2 parcels,
- fuel contamination of groundwater associated with the Shell Gas Station
- fuel contamination directly downstream, the San Fernando Consolidated Facility site

As the Taylor Yard G1 and G2 sites are directly within the project footprint, potential impacts of this contamination to dewatering and grading operations will need to be addressed and these properties will have to be remediated prior to construction by the Sponsor. Although these sites are currently being addressed by responsible parties, the Sponsor would be responsible for any additional remediation to reach land use levels necessary for the project. The Shell Gas Station site and the San Fernando Consolidated Facility site are not within the project footprint, soil impacts from the contamination are not anticipated for the project. However, these sites are generally up gradient from the project and groundwater flow from them could impact the project as shallow groundwater drains from construction excavations. These conditions would need to be accounted for and addressed during design phases. As noted above, this remediation is the responsibility of the project Sponsor and is not paid for by the project, i.e. it is at 100% of non-project cost, and in-kind project credit by the USACE cannot be given to the Sponsor.

7.7 Sub-Reach 7

Planned restoration actions within this sub-reach include reconfiguration of Arroyo Seco (in four alternative plans, 13, 13v, 16, and 20) and terracing along the banks (of Arroyo Seco in Alternatives 13, 13v, 16, and 20 and of the LA River along the Cornfields site (in Alternatives 13v and 20) by construction of several modifications. Concrete bottom and side slopes would be removed from the Arroyo Seco Channel and riparian corridor vegetation would be planted on its banks for ½ mile upstream of the confluence with the LA River mainstem. Four 4-foot deep terraces on the right bank from RS 102+15 to 97+99 would be added adjacent to the Cornfields site (in Alternatives 13v and 20) and implanted with riparian corridor vegetation. At Cornfields, the western edge of the terrace would be sloped back up to the original ground elevation where the approximately 10 acres of freshwater marsh is restored. The elevation of the railroad would be maintained on trestles from RS 102+15 to 98+98. Modifications to the channel would also include daylighted storm drain connections in Alternatives 10, 13v, and 20 (two on the right bank and one on the left bank). Daylighting of the storm drain connections would allow for habitat development at storm drain entrances to the river and eliminate closed pipes.

Other than those general issues mentioned above, the following constraints and design considerations impact this specific sub-reach:

a. Modifications will need to take into account potential impacts to properties adjacent to the channel as well as surface street crossings from an easement and structural suitability standpoint. Currently, it is the assumption that these impacts will be evaluated during design phases;

b. Impacts to the bride crossings of North Figueroa Street, CA-110 Freeway, North Broadway Street, Spring Street, and North Main Street, and two rail lines as a result of re-configuration of the channel and scour will need to be considered. Currently, it is the assumption that these impacts and scour will be evaluated during design phases;

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c. Under Alternatives 13v and 20 for this reach, existing railroad alignments would be kept at grade but placed onto a trestle in sub-reach 7 on the right bank adjacent to the Cornfields site, with excavation below the existing grade. This trestle will provide access to connect the Cornfields freshwater marsh with the mainstem of the LA River. Uninterrupted service to rail traffic is a primary design criterion and temporary shoofly trestles or bypass lines are not currently anticipated to be needed to allow for uninterrupted service. However, the existing track alignments, construction of new trestle alignments, the configuration of the proposed ecosystem restoration features and existing and anticipated train traffic will be further evaluated during the design phase to verify that temporary shoofly trestles or bypass lines are not needed. If during the design phase, such temporary measures are identified as needed, supplemental analysis would be performed at that time;

d. Proposed planting structures may require deep foundations depending upon information derived from scour and other hydraulic analyses. Currently, it is the assumption that these requirements will be evaluated during design phases;

e. Levees exist within this reach on both the right and left banks. Modifications to existing levees will need to maintain existing flood protection, be designed and constructed according to current standards, and follow current vegetation guidance under ETL 1110-2-583; and

f. Sites within this sub-reach that have known HTRW issues include:

- fuel contamination associated with the San Fernando Consolidated facility,
- solvent and VOC contamination associated with the former Bortz Oil Company site (area a.k.a. Cornfields),
- fuel contamination associated with the former Albion Dairy.
- directly downstream, the former Manufacture Gas Plant site has PAH, metals, VOCs, and fuels contamination
- solvent contamination of the Valspar Corporation site.

As these sites are not within the project footprint, soil impacts from the contamination are not anticipated. However, if groundwater flow from the contaminated sites is toward the project some impact from these contamination sources should be anticipated. These conditions would need to be accounted for and addressed during design phases. As noted above, this remediation is the responsibility of the project Sponsor and is not paid for by the project, i.e. it is at 100% of non-project cost, and in-kind project credit by the USACE cannot be given to the Sponsor.

7.8 Sub-Reach 8

Planned restoration actions in this sub-reach include 3-foot-deep terraces along the right bank along the extent of the LADWP parking lot which would tie into the existing overbank ground elevation with a 3:1 slope (in Alternatives 16 and 20). The terraced area would begin with one 3-foot deep terrace at RS 83+61 and end with seven 3-foot deep terraces at RS 68+38. The Los Angeles River channel would be re-configured in Alternatives 16 and 20 to take advantage of the LATC parcel. At RS 69+93, the channel invert would start to widen into the left bank. The invert width would increase to more than 500 feet before it contracting back to the original channel size at RS 38+47. Within the LATC extent, a bench up to 1000-feet wide would extend from RS 64+92 to RS 50+15. The bench would be established at approximately the 2-year water surface elevation and include marsh vegetation. The eastern edge of the bench would be sloped back up to the original ground elevation to a point about 1800 feet from the channel. The railroad would be trestled over the widened channel from RS 68+38 to RS 40+13. In Alternatives 10, 13, and 13v, the LATC parcel would also be used with restoration of the historic wash and development of a riparian area within its boundaries.

Other than those general issues mentioned above, the following constraints and design considerations impact this specific sub-reach:

a. Modifications will need to take into account potential impacts to properties adjacent to the channel as well as surface street crossings from an easement and structural suitability standpoint. Currently, it is the assumption that these impacts will be evaluated during design phases;

b. Impacts to the bridge crossings of two rail lines, East Cesar Chavez Avenue, US Highway 101, and First Street as a result of re-configuration of the channel and scour will need to be considered. Under the current alternatives for this reach, existing railroad alignments would be kept at grade but placed onto trestles in sub-reach 8 on the left bank south of Main Street to Cesar Chavez Avenue through LATC in Alternatives 16 and 20, with excavation below the existing grade. These trestles will provide access for additional channel capacity and space to implement other restoration measures. Uninterrupted service to rail traffic is a primary design criterion and temporary shoofly trestles or bypass lines are not currently anticipated to be needed to allow for uninterrupted service. However, the existing track alignments, construction of new trestle alignments, the configuration of the proposed ecosystem restoration features and existing and anticipated train traffic will be further evaluated during the design phase to verify that temporary shoofly trestles or bypass lines are not needed. If during the design phase, such temporary measures are identified as needed, supplemental analysis would be performed at that time;

c. Levees exist within this reach on both the right and left banks. Modifications to existing levees in two alternative plans will need to maintain existing flood protection, be designed and constructed according to current standards, and follow current vegetation guidance under ETL 1110-2-583; and

d. Sites within this sub-reach that have known HTRW issues include:
- fuel contamination associated with the former Albion Dairy,
- PAH, metals, VOCs, and fuels contamination of groundwater and soils associated the former Manufacture Gas Plant site,

- VOCs and metals contamination of soils and groundwater associated with the BNSF Tower Site,
- solvent contamination of groundwater associated with the Morton Intl Whittaker Corp. site,
- fuel contamination to soils and groundwater associated with the MTA site,
- fuel contamination of groundwater associated with the Chevron Gas Station site,
- fuel contamination of groundwater associated with the Gannett Outdoor Systems Inc. site,
- solvent contamination of soils and groundwater associated with the Infinity Outdoor Co. site,
- metals contamination to groundwater and soils associated with the Chromal Plating & Grinding Co. site,
- solvent contamination of groundwater associated with the Valspar Corporation site.

As these sites are not within the project footprint, soil impacts from the contamination are not anticipated. However, if groundwater flow from the contaminated sites is toward the project some impact from these contamination sources should be anticipated. These conditions would need to be accounted for and addressed during design phases. As noted above, this remediation is the responsibility of the project Sponsor and is not paid for by the project, i.e. it is at 100% of non-project cost, and in-kind project credit by the USACE cannot be given to the Sponsor.

8.0 LIMITATIONS AND ASSUMPTIONS

The alternatives and restoration actions discussed within this appendix were under development at the time of the compilation of this Geotechnical Study and may not be representative of the final selected alternative.

As is common with feasibility studies, certain engineering investigations and preliminary design aspects are routinely assigned to future stages of study. As a result, some risk is associated with this approach and has been documented in the risk analysis. These aspects include anticipated scour, construction easements and right-of-way considerations, and potential HTRW impacts. The impacts of assigning these Study items to future stages of Study include the unanticipated need for new mitigation measures, re-evaluation of alternatives, and could have impact on final construction costs. For example, scour could potentially put the foundation of structures at risk from undermining or direct flow impacts that have not been considered as part of this Study. Scour estimates will need to be incorporated into the development of the design parameters mentioned above. Deepened foundations to accommodate a deep scour condition will result in a more robust structural design to accommodate increased lateral loading. The resulting increases in project cost could be significant and are not currently accounted for in the costs. It is the current assumption that these aspects will be addressed in design phases.

All information contained within this Appendix is based on the information available to the project team; this information does not constitute all publically available data, and is presumed to be current to the date of the initial release of Geotechnical Study only.

As within any urbanized setting, the potential for undocumented fill, unknown utilities, and changing surface conditions exists. Future activities and studies will need to account for these conditions. Detailed studies could reveal subsurface conditions and issues not yet identified as part of this Study.

9.0 RECOMMENDATIONS FOR FUTURE STUDY AND PATH FORWARD

A thorough subsurface investigation will be required for any engineering design and should be in conformance with current investigation, analysis, and design standards. Efforts conducted during these studies may include subsurface exploration, well testing, data gathering, laboratory testing, and field mapping.

Significant coordination with multiple organizations and agencies as well as land and utility owners will be required for investigation and construction. A detailed breakdown of the selected alternative and the impacted properties should be made to focus investigation efforts. It should be noted that the investigations will likely require multiple phases and coordination efforts with the agencies and owners will need to be ongoing throughout the investigation and design phases.

10.0 REFERENCES

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Table 1
Sub-Reach Descriptions

Sub-Reach	Upstream End	Downstream End	Approximate Length (miles)	Existing Channel Configuration	Areas of Opportunity
Reach 1	Pollywog Park/Headworks	Midpoint of Bette Davis Park	1.5	Rectangular (vertical concrete wall) channel with concrete bottom	Headworks, Pollywog Park, Bette Davis Park
Reach 2	Midpoint of Bette Davis Park	Upstream end of Ferraro Fields	0.73	Trapezoidal channel with grouted stone or concrete side slopes with soft bottom	Bette Davis Park
Reach 3	Upstream end of Ferraro Fields	Brazil Street	1	Trapezoidal channel with concrete side slopes transition into rectangular channel transition into rectangular channel all with concrete bottom	Ferraro Fields, the Burbank Western Channel, Glendale River Walk, Verdugo Wash, Griffith Park,
Reach 4	Brazil Street	Los Feliz Boulevard	1.78	Trapezoidal channel with grouted stone side slopes and soft bottom	Griffith Park, Atwater Park
Reach 5	Los Feliz Boulevard	Glendale Freeway (CA 2)	1.68	Trapezoidal channel with grouted stone and concrete side slopes and soft bottom	Atwater Park, the Bowtie and Taylor Yard,
Reach 6	Glendale Freeway (CA 2)	Interstate 5 (I-5)	2.4	Trapezoidal channel with grouted stone and concrete side slopes and soft bottom	Elysian Park,
Reach 7	Interstate 5 (I-5)	Main Street	1.1	Rectangular and trapezoidal channel with concrete side slopes and concrete bottom	Cornfields (LA State Historic Park), Elysian Park, Arroyo Seco, Downtown Los Angeles
Reach 8	Main Street	First Street	1.44	Trapezoidal channel with concrete side slopes and concrete bottom	Piggyback Yard (also known as Mission Yard), Downtown Los Angeles

Table 2
Los Angeles River Ecosystem Restoration
Sub-Measure Application in Alternative Plans 10, 13, 13v, 16, 20

Sub-measure	Reach 1		Reach 2		Reach 3		Reach 4		Reach 5		Reach 6		Reach 7		Reach 8	
	Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank	Left Bank	Right Bank
Riparian planting of habitat corridors	All	All	All	All	20	All	All		All		All	All	13, 13v, 16, 20	13v , 20		
Expose/daylight stormdrain outlets					10, 13, 13v, 16	All	All		All				10, 13v, 20	10, 13v, 20		
Channel widening			20		20				16, 20	16,20	All	All		13v, 20	16, 20	
Create/rebuild channel geomorphology*															16, 20	16, 20
Divert flows into side channels					13, 13v, 16, 20		All	All							16, 20	
Planting built into walls											13, 13v, 16, 20	13, 13v, 16, 20				
Channel Bed Deepening															16, 20	16, 20
Terrace banks			20						16, 20		13, 13v, 16, 20	13, 13v, 16, 20	13v, 20	13v, 20	All	All
Bioengineer Channel Walls (vines)			20							16, 20			13, 16	13, 16		
Trapezoidal to vertical walls				20						16, 20						
Widen Tributaries					20								13, 13v, 16, 20			
Elevate Railroad														13v, 20	16. 20	

* Within this appendix, references to restoration, creation, or improvement of "hydrology" and "geomorphology" are intended to refer to restoration, creation, or improvement of a more natural hydrologic regime and a more natural geomorphic character.

Table 3
Selected Historic Earthquakes of Southern California

Year	Date	Location	Time	Richter Magnitude	Mercalli Intensity	Casualties/Property Damage
1769	28-Jul	LA Area	--	6	VIII	No information.
1812	8-Dec	Los Angeles Area	3:00 PM	7	VII	40 deaths, Mission San Juan Capistrano severely to moderately damaged. Mission San Gabriel moderately damaged.
1827	24-Sep	Los Angeles Area	4:00 AM	5.5	--	No information.
1855	11-Jul	Los Angeles Area	4:15 AM	6	VIII	Bells of Mission San Gabriel were detached. 6 buildings damaged in LA.
1857	9-Jan	Fort Tejon	4:24 PM	7.9	IX	2 deaths; heavy property damage/loss.
1916	23-Oct	Tejon Pass Region	2:44 PM	5.3	--	No information.
1933	10-Mar	Long Beach	5:54 PM	6.4	IX	120 deaths; $50 million.
1941	21-Oct	Torrance-Gardena	10:57 PM	4.8	VII	No deaths; $100,000.
1941	14-Nov	Torrance-Gardena	12:42 AM	4.8	VIII	No deaths; $1 million.
1951	25-Dec	San Clemente Island	4:46 PM	5.9	--	No deaths; no appreciable damage.
1971	9-Feb	San Fernando	6:01 AM	6.6	--	65 deaths; $505 million.
1979	1-Jan	Malibu	3:15 PM	5.2	--	No deaths; minor damage.
1987	1-Oct	Whittier-Narrows	7:42 AM	5.9	--	8 deaths; $358 million.
1988	3-Dec	Pasadena	11:38 PM	5	--	No deaths; no appreciable damage.
1989	19-Jan	Malibu	10:38 PM	5	--	No deaths; slight damage.
1989	12-Jun	Montebello	9:57 AM	4.6	--	No deaths; no appreciable damage.
1991	28-Jun	Sierra Madre	7:44 AM	5.8	--	2 deaths; $40 million.
1994	17-Jan	Northridge	4:31 AM	6.7	--	61 deaths; est. $20 billion.
2001	9-Sep	SE of West Hollywood	4:59 PM	4.2	--	No deaths; moderate damage.
2005	16-Jun	Los Angeles Area	1:53 PM	4.4	--	No deaths; no appreciable damage
2007	9-Aug	Los Angeles Area	12:58 AM	4.4	--	No deaths; no appreciable damage
2008	29-Jul	Los Angeles Area	5:42 AM	5.5	--	No deaths; no appreciable damage
2009	9-Jan	Los Angeles Area	7:49 PM	4.5	--	No deaths; no appreciable damage
2009	18-May	Los Angeles Area	8:39 PM	4.7	--	No deaths; no appreciable damage

Source: USGS 2012

Table 4
Geotechnical Constaints and Considerations for Design

Sub-Reach	Geotechnical Discipline	Constraints and Considerations for Design
Sub-Reach1	Soils	For off bank grading, testing for soil compatibility, and grading operations will need to be conducted.
		Grading plans will need to be developed and reviewed. Habitat Corridors will need to take into account potential impacts to 134 Freeway.
		Habitat Corridors will need to take into account potential impacts to 134 Freeway.
	Levee Safety	Modifications to levees will need to maintain existing protection.
		Modifications are to be performed and designed according to current standards for levees, floodwalls, and channels.
		Vegetation must follow current vegetation guidance under ETL 1110-2-571.
	HTRW	Forest Lawn Cemetery (Open File CWQCB with VOC impact to groundwater) site may impact dewatering and grading operations and will need to be addressed.
Sub-Reach 2	Soils	Without scour estimate impact to design of wall can not be determined.
		Parameters for structural design will need to be determined.
		These walls will probably require counterfort or tieback designs which will require extensive right of way, either temporary or permanent, and will impact real-estate (estimate 45 feet permanent required behind the wall for anchors, probably less counterforts. An unknown amount for construction).
		Seismic design considerations will also need to be made during design as seismic deformation may require significant costs following an event for reconstruction.
		The I-5 crossing in this reach also has potential cost related issues. Scour could potentially put the bridge foundations at risk from undermining or direct flow impact that has not been considered.
		Foundation depths for both the walls and the potential underpinning of the I-5 Bridge could result in significant costs.
		For off bank grading, testing for soil compatibility, and grading operations will need to be conducted.
		Grading plans will need to be developed and reviewed.
		Habitat Corridors will need to take into account potential impacts to CA-134 and I-5 Freeways.
	Levee Safety	Modifications to levees will need to maintain existing protection.
		Modifications are to be performed and designed according to current standards for levees, floodwalls, and channels.
		Vegetation must follow current vegetation guidance under ETL 1110-2-571.
	HTRW	Forest Lawn Cemetery (Open File CWQCB with VOC impact to groundwater) site may impact dewatering and grading operations and will need to be addressed.
Sub-Reach 3	Soils	Without scour estimate impact to design of features can not be determined. In order to prevent potential undercutting, foundations for simple structures may be a required to be at significant depth and may be exorbitant cost for the proposed features.
		Parameters for structural design will need to be determined.
		Some of these features may require extensive right of way, either temporary or permanent, and will impact real-estate.
		Seismic design considerations will also need to be made during design as seismic deformation may require significant costs following an event for reconstruction.
		The CA-134 crossing in this reach also has potential cost related issues. Scour could potentially put the bridge foundations at risk from undermining or direct flow impact that has not been considered.
		Foundation depths for both features and the walls and the potential underpinning of the CA-134 Bridge could result in significant costs.
		Potential utility impacts (shoring, replacement, re-routing etc.) need to be evaluated and may pose significant cost.
	Levee Safety	Modifications to levees will need to maintain existing protection.
		Modifications are to be performed and designed according to current standards for levees, floodwalls, and channels.
		Vegetation must follow current vegetation guidance under ETL 1110-2-571.
	HTRW	Former Hawkes Finishing site (Open File CWQCB with Cr & Zn impact to soil) may impact dewatering and grading operations and will need to be addressed.

Table 4
Geotechnical Constaints and Considerations for Design

Sub-Reach	Geotechnical Discipline	Constraints and Considerations for Design
Sub-Reach 4	Soils	Without scour estimate impact to design of features can not be determined. In order to prevent potential undercutting, foundations for simple structures may be a required to be at significant depth and may be exorbitant cost for the proposed features.
		Parameters for structural design will need to be determined.
		Some of these features may require extensive right of way, either temporary or permanent, and will impact real-estate.
		Seismic design considerations will also need to be made during design as seismic deformation may require significant costs following an event for reconstruction.
	Levee Safety	Modifications to levees will need to maintain existing protection.
		Modifications are to be performed and designed according to current standards for levees, floodwalls, and channels.
		Vegetation must follow current vegetation guidance under ETL 1110-2-571.
	HTRW	None within reach but may be impacted by upstream or downstream sites if dewatering operations change the local groundwater gradient or grading changes surficial drainage or exposes soils.
Sub-Reach 5	Soils	Without scour estimate impact to design of wall can not be determined.
		These walls, directly adjacent to I-5 will probably require counterfort or tieback designs. That will require extensive right of way, either temporary or permanent, and will impact real-estate (estimate 45 feet permanent required behind the wall for anchors, probably less counterforts. An unknown amount for construction).
		Parameters for structural design will need to be determined.
		Seismic design considerations will also need to be made during design as seismic deformation may require significant costs following an event for reconstruction.
		The Glendale Freeway, Hyperion Avenue, and Los Feliz Blvd. crossings in this reach also have potential cost related issues. Scour could potentially put the bridge foundations at risk from undermining or direct flow impact that has not been considered.
		Foundation depths for both the walls and the potential underpinning of the bridges could result in significant costs.
	Levee Safety	Modifications to levees will need to maintain existing protection.
		Modifications are to be performed and designed according to current standards for levees, floodwalls, and channels.
		Vegetation must follow current vegetation guidance under ETL 1110-2-571.
	HTRW	Former Triangle Gas Station (Open File CWQCB with fuel impact to soil), Chevron Gas Station (Open File CWQCB with fuel-solvent impact to groundwater), and Taylor Yd G1 (Open case with DTSC with fuel-solvent & metals impact to soils and groundwater) directly downstream may impact dewatering and grading operations and will need to be addressed.
Sub-Reach 6	Soils	Without scour estimate impact to design of features can not be determined.
		In order to prevent potential undercutting, foundations for simple structures may be a required to be at significant depth and may be exorbitant cost for the proposed features.
		Parameters for structural design will need to be determined. Some of these features may require extensive right of way, either temporary or permanent, and will impact real-estate.
		Seismic design considerations will also need to be made during design as seismic deformation may require significant costs following an event for reconstruction.
		Potential slope stability issues will need to be evaluated on a case by case basis.
		Impacts to railroad tracks will need evaluation.
	Levee Safety	Modifications to levees will need to maintain existing protection.
		Modifications are to be performed and designed according to current standards for levees, floodwalls, and channels.
		Vegetation must follow current vegetation guidance under ETL 1110-2-571.
	HTRW	Taylor Yd G1 (Open case file with DTSC with fuel-solvent & metals impact to soils and groundwater), Taylor Yd G2 (Open case file with DTSC with fuel-solvent & metals impact to soils groundwater), Shell Gas Station (Open file with CWQCB with fuel impact to groundwater), Chevron Gas Station (Open file with CWQCB with fuel impact to groundwater), and San Fernando Consolidated Facility (Open file with CWQCB with fuel impact to groundwater downstream) may impact dewatering and grading operations and will need to be addressed.

Table 4
Geotechnical Constaints and Considerations for Design

Sub-Reach	Geotechnical Discipline	Constraints and Considerations for Design
Sub-Reach 7	Soils	Without scour estimate impact to design of features can not be determined. In order to prevent potential undercutting, foundations for simple structures may be a required to be at significant depth and may be exorbitant cost for the proposed features.
		Parameters for structural design will need to be determined.
		Some of these features may require extensive right of way, either temporary or permanent, and will impact real-estate.
		Seismic design considerations will also need to be made during design as seismic deformation may require significant costs following an event for reconstruction.
		Potential slope stability issues will need to be evaluated on a case by case basis.
		Impacts to railroad tracks will need evaluation.
	Levee Safety	Modifications to levees will need to maintain existing protection.
		Modifications are to be performed and designed according to current standards for levees, floodwalls, and channels.
		Vegetation must follow current vegetation guidance under ETL 1110-2-571.
	HTRW	San Fernando Consolidated facility (Open file with CWQCB with fuel impact to groundwater), former Bortz Oil Company ((area a.k.a. Cornfields)Open case file with DTSC and CWQCB with solvent-VOC impact to groundwater & soils), former Albion Dairy (Open file with CWQCB with fuel impact to groundwater), former Manufacture Gas Plant (Open case file with DTSC with PAH, metals, VOCs, fuels impact to groundwater and soils is downstream), and Valspar Corporation (Open file with CWQCB with solvent impact to groundwater downstream) may impact dewatering and grading operations and will need to be addressed.
Sub-Reach 8	Soils	Without scour estimate impact to design of features can not be determined. In order to prevent potential undercutting, foundations for simple structures may be a required to be at significant depth and may be exorbitant cost for the proposed features.
		Parameters for structural design will need to be determined.
		Some of these features may require extensive right of way, either temporary or permanent, and will impact real-estate
		Seismic design considerations will also need to be made during design as seismic deformation may require significant costs following an event for reconstruction.
		Potential slope stability issues will need to be evaluated on a case by case basis.
		Impacts to railroad tracks will need evaluation.
	Levee Safety	Modifications to levees will need to maintain existing protection.
		Modifications are to be performed and designed according to current standards for levees, floodwalls, and channels.
		Vegetation must follow current vegetation guidance under ETL 1110-2-571.
	HTRW	Former Albion Dairy (Open file with CWQCB with fuel impact to groundwater), former Manufacture Gas Plant (Open file with DTSC with PAH, metals, VOCs, fuels impact to groundwater and soils), BNSF Tower (Open file with CWQCB with VOCs, metals impact to soils and groundwater), former Manufacture Gas Plant (Open Case file with DTSC with solvent, VOCs, metals impact to groundwater and soils), Morton Intl Whittaker Corp Open file with CWQCB with solvent impact to groundwater), MTA Open file with CWQCB with fuel impact to groundwater and soils), Chevron Gas Station (Open file with CWQCB with fuel impact to groundwater), Gannett Outdoor Systems Inc (Open file with CWQCB with fuel impact to groundwater), Infinity Outdoor Co (Open file with CWQCB with solvent impact to groundwater and soils), . Chromal Plating & Grinding Co (Open file with CWQCB with metals impact to groundwater and soils), and Valspar Corp (Open file with CWQCB with solvent impact to groundwater) may impact dewatering and grading operations and will need to be addressed.

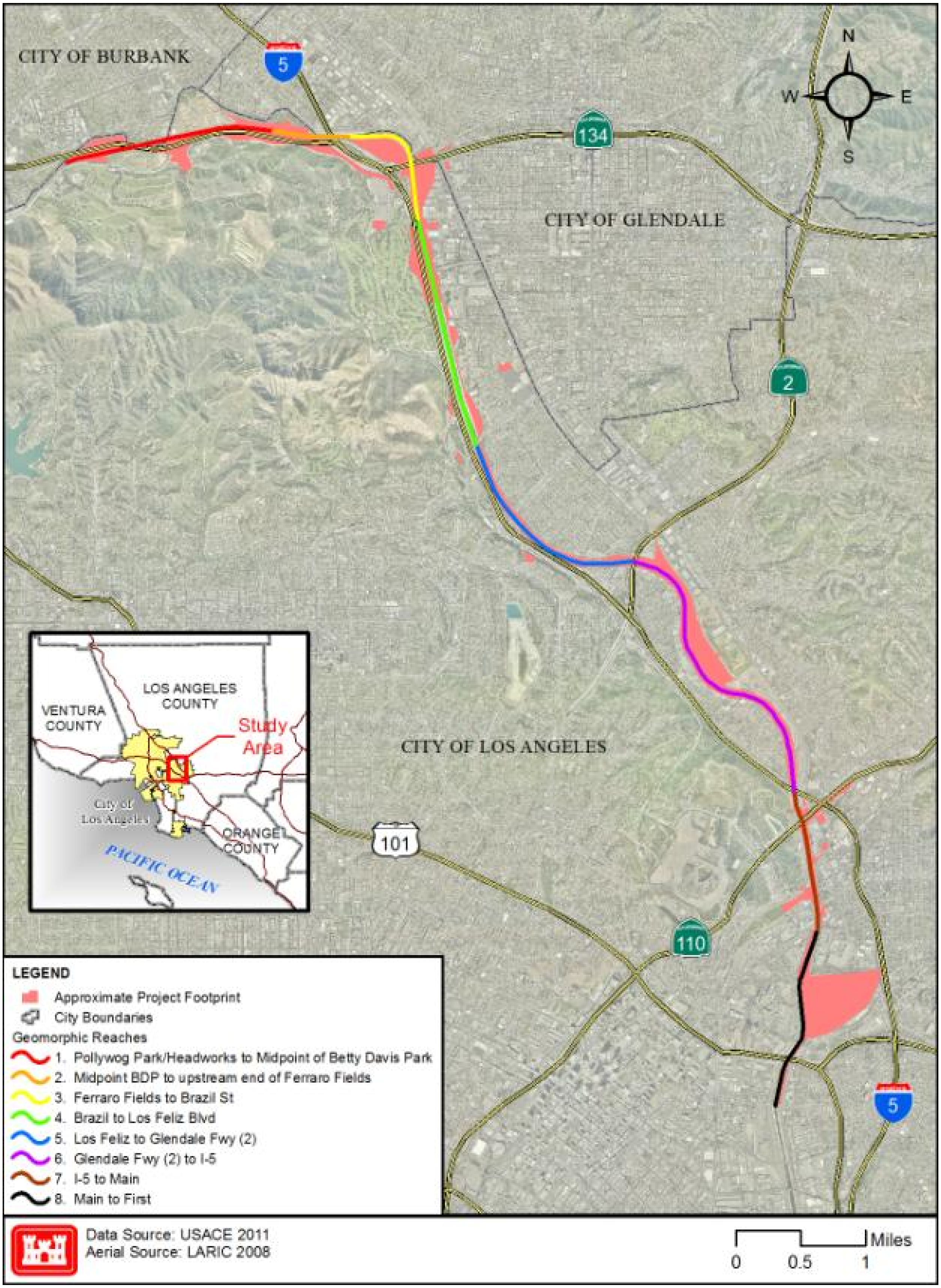


Figure 1
ARBOR Reach and Sub-reaches

Figure 2
General Overview and Topography

Contours shown are the approximate elevation of top of bedrock.

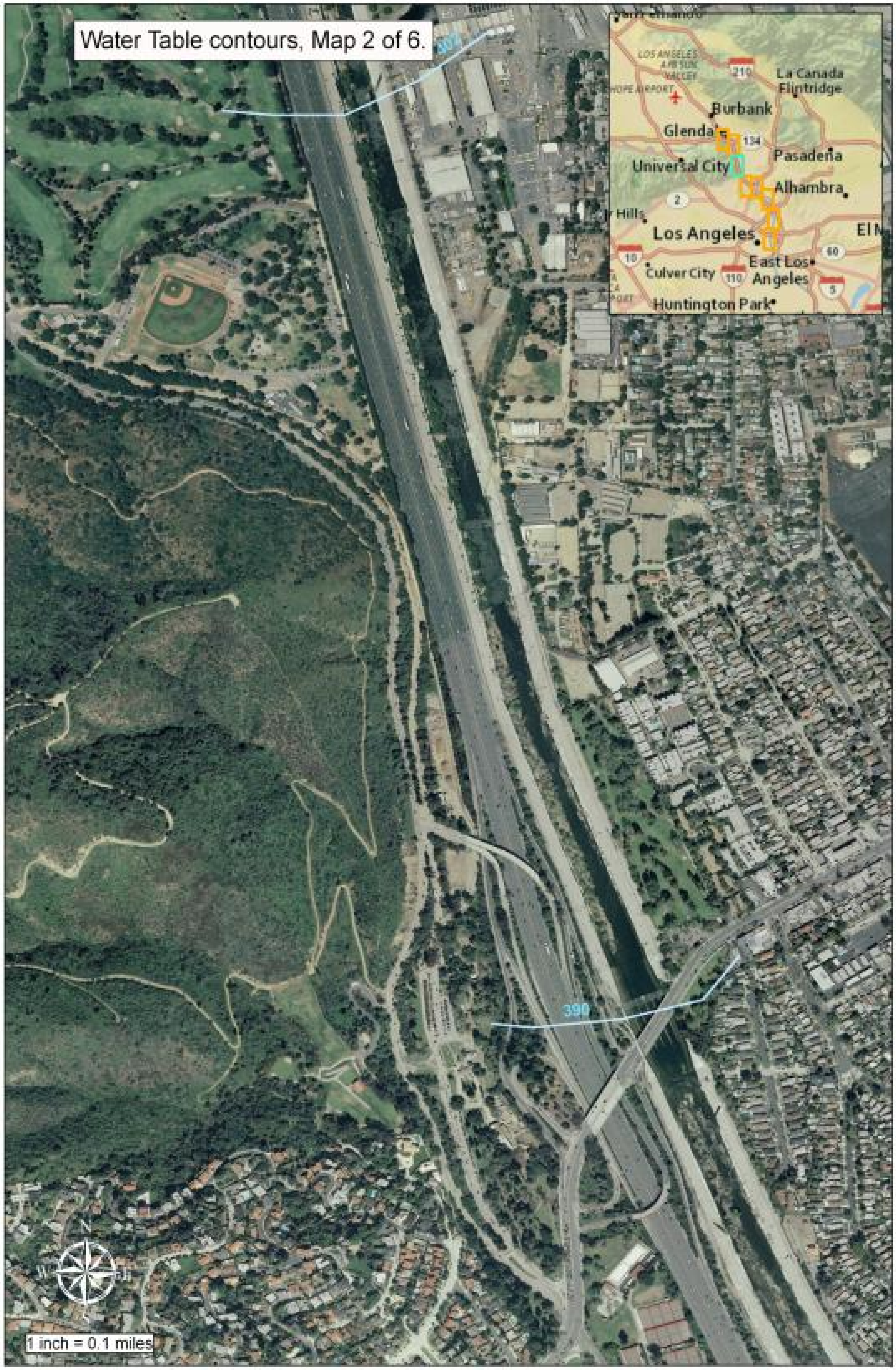
Contours shown are the approximate elevation of top of bedrock.

Figure 4
Top of Bedrock Contour Map

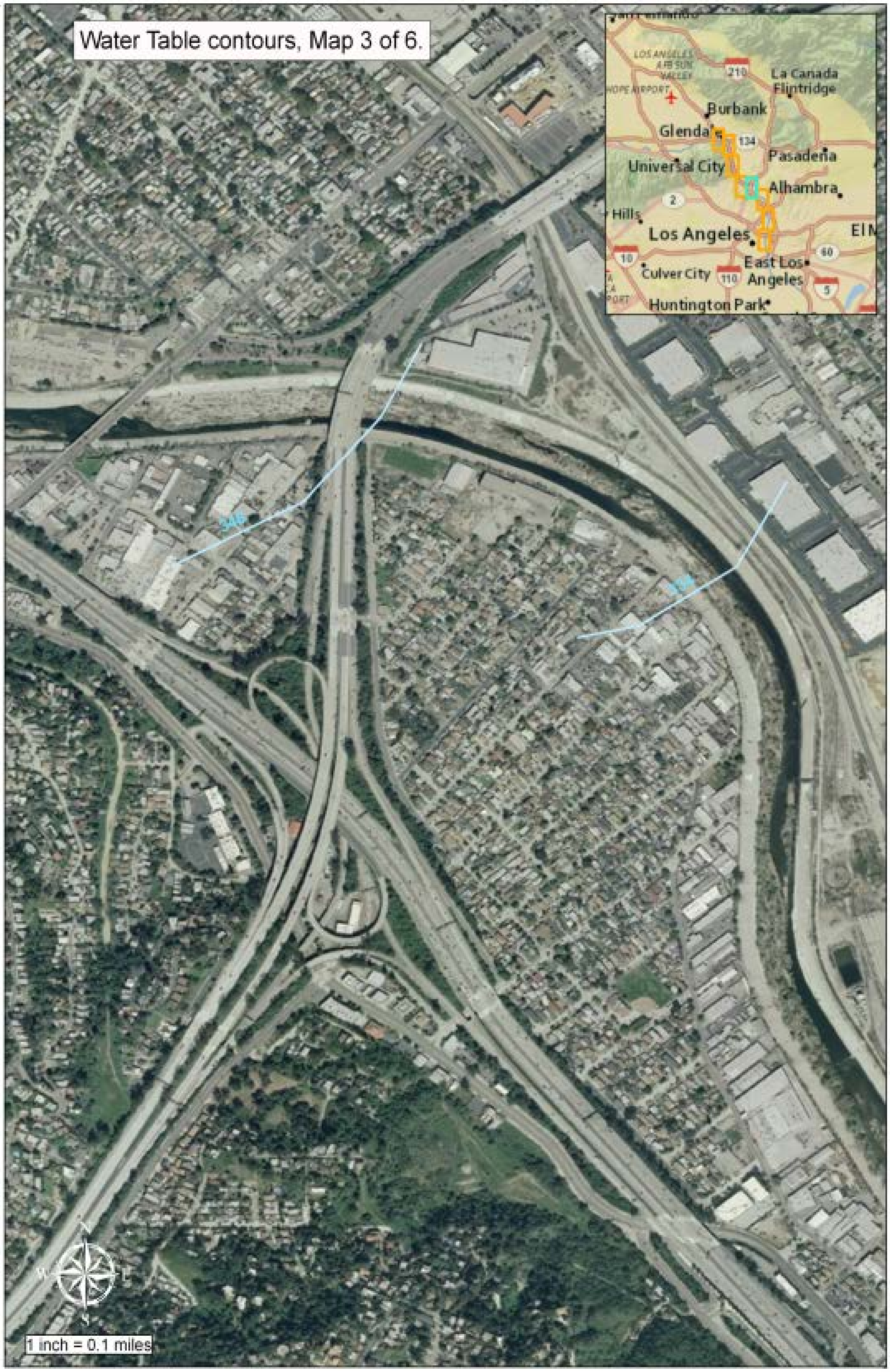
Contours shown are the approximate elevation of top of bedrock.

Figure 5
Top of Bedrock Contour Map

Contours shown are the approximate elevation of groundwater encountered.



Contours shown are the approximate elevation of groundwater encountered.
The elevations presented hereon are based on the State of California Databases.
The data within those databases were provided by third parties.
As such, the data cannot be verified and the elevations are considered to be approximate.

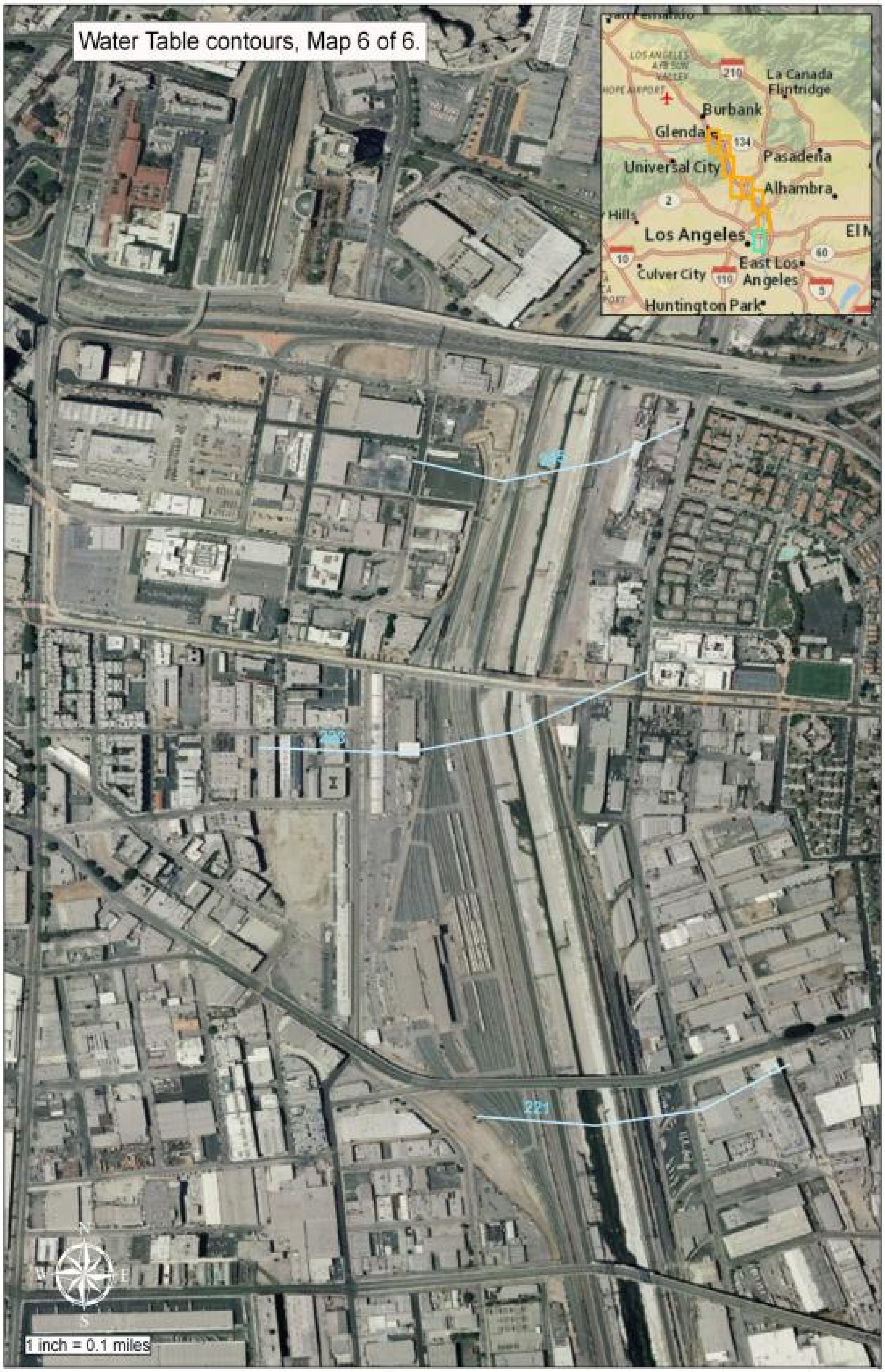


Contours shown are the approximate elevation of groundwater encountered.
The elevations presented hereon are based on the State of California Databases.
The data within those databases were provided by third parties.
As such, the data cannot be verified and the elevations are considered to be approximate.

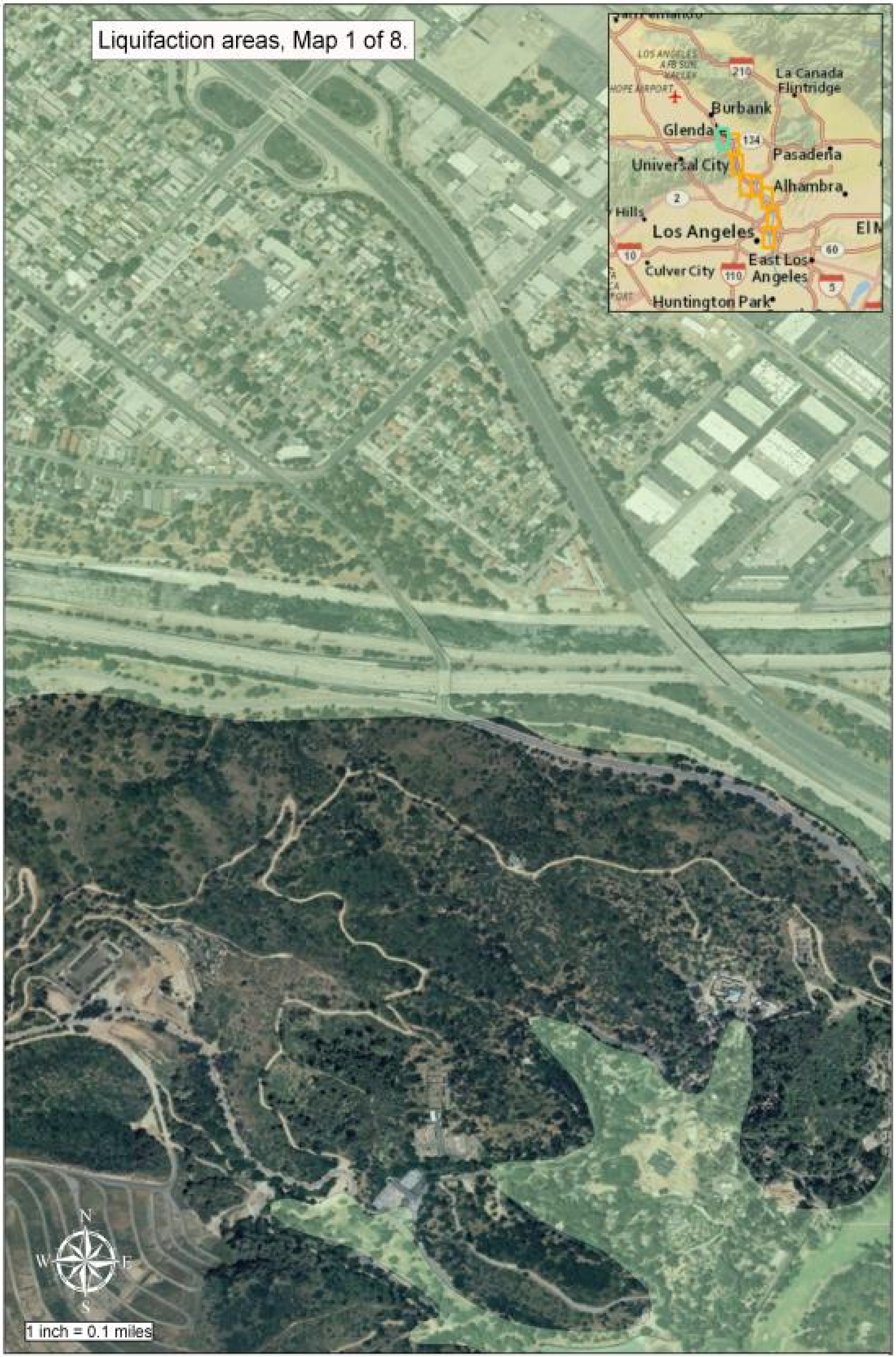
Contours shown are the approximate elevation of groundwater encountered.
The elevations presented hereon are based on the State of California Databases.
The data within those databases were provided by third parties.
As such, the data cannot be verified and the elevations are considered to be approximate.

Figure 9
Water Table Contour Map

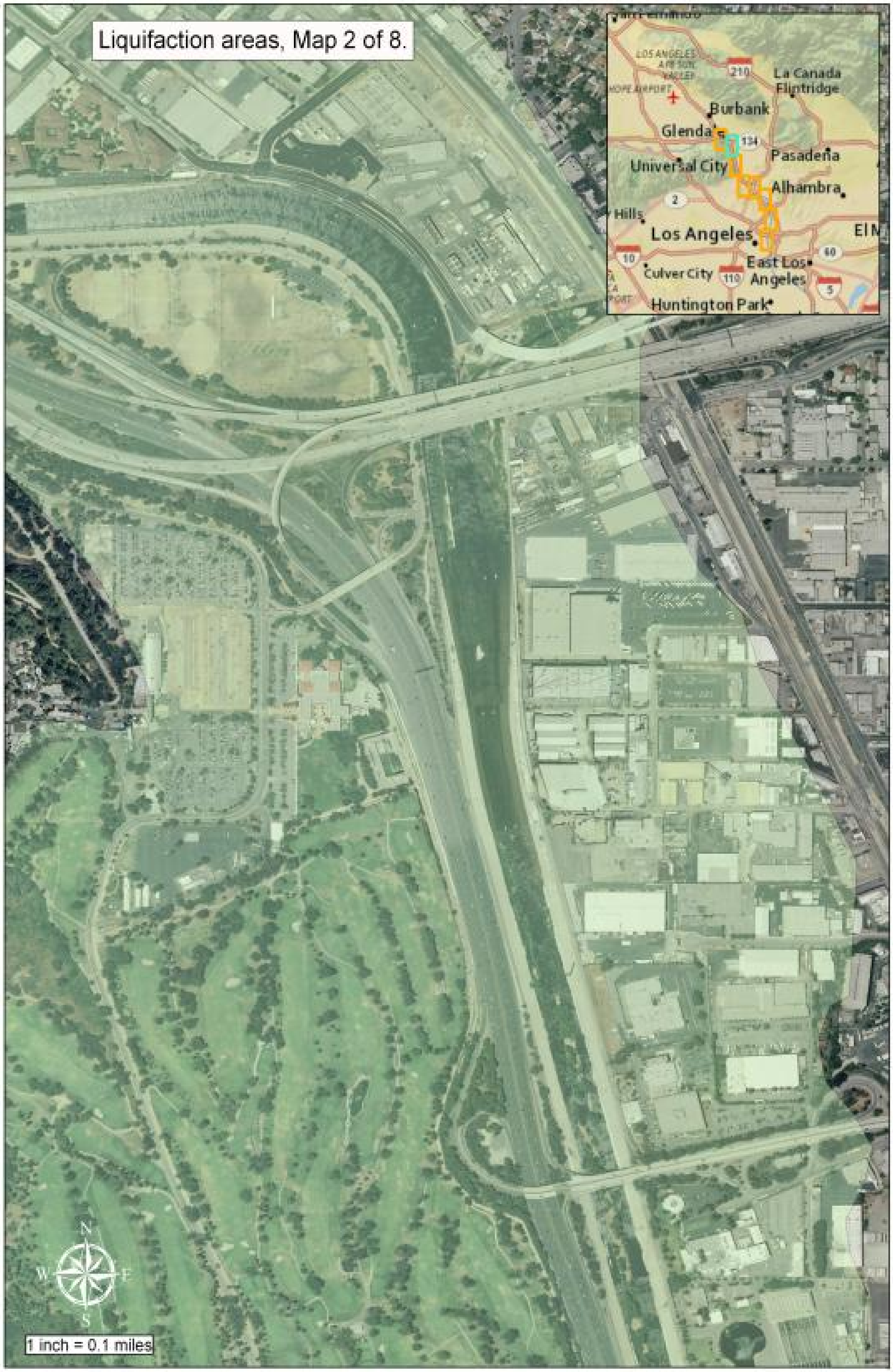
Contours shown are the approximate elevation of groundwater encountered.
The elevations presented hereon are based on the State of California Databases.
The data within those databases were provided by third parties.
As such, the data cannot be verified and the elevations are considered to be approximate.



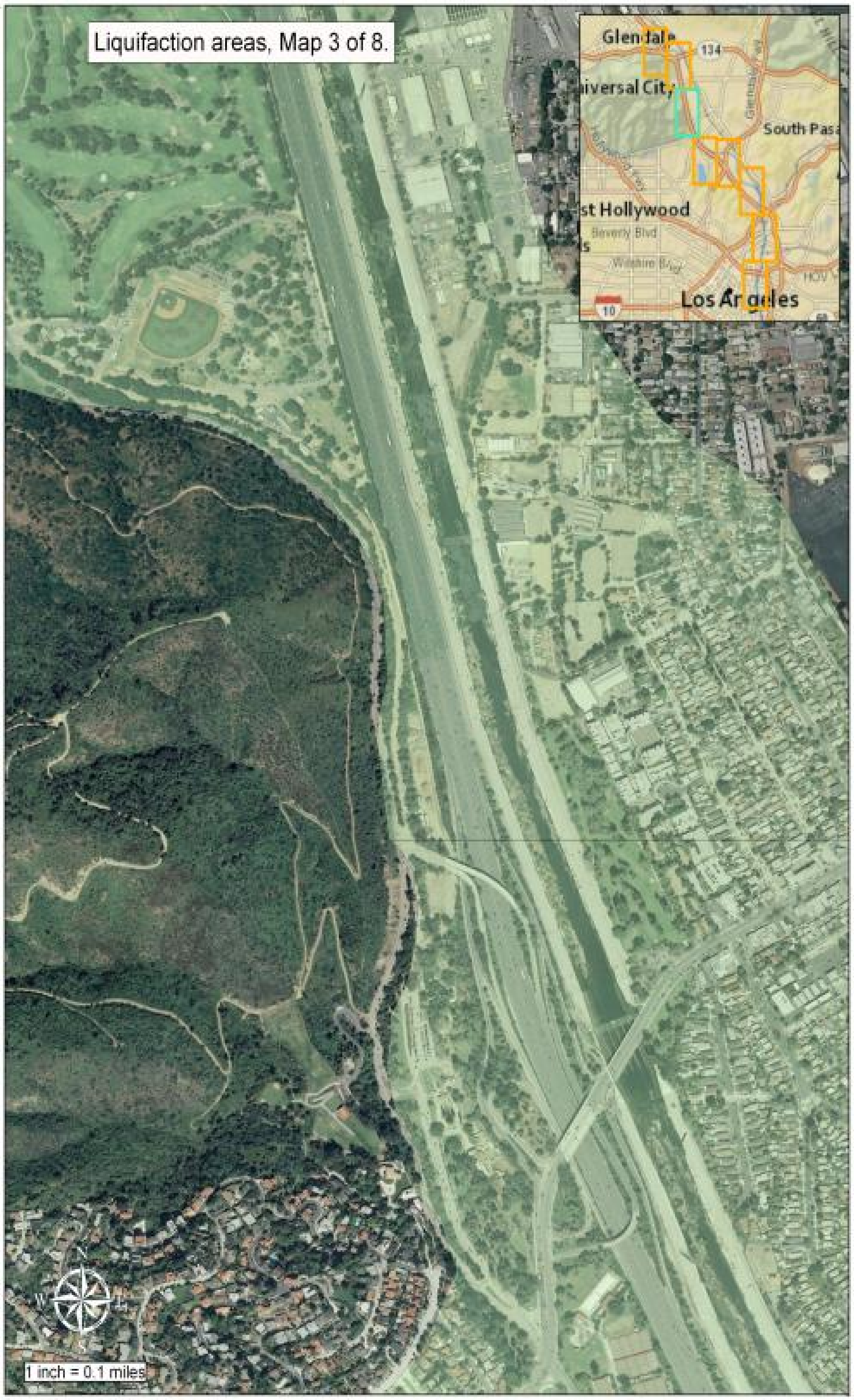
Contours shown are the approximate elevation of groundwater encountered.
The elevations presented hereon are based on the State of California Databases.
The data within those databases were provided by third parties.
As such, the data cannot be verified and the elevations are considered to be approximate.



Green tinted area indicates potential liquefaction prone areas.



Green tinted area indicates potential liquefaction prone areas.



Green tinted area indicates potential liquefaction prone areas.

Green tinted area indicates potential liquefaction prone areas.

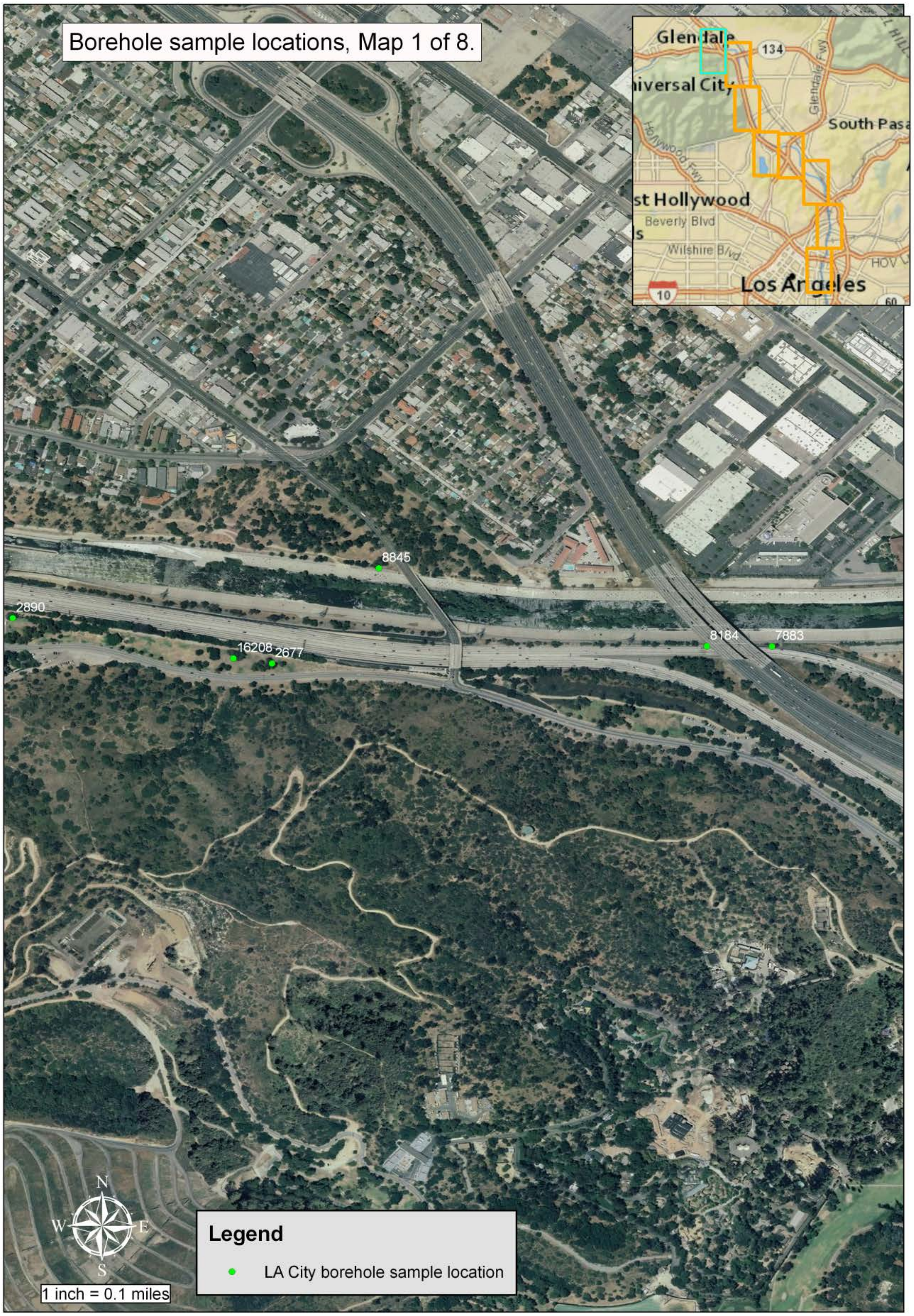
Green tinted area indicates potential liquefaction prone areas.

Green tinted area indicates potential liquefaction prone areas.

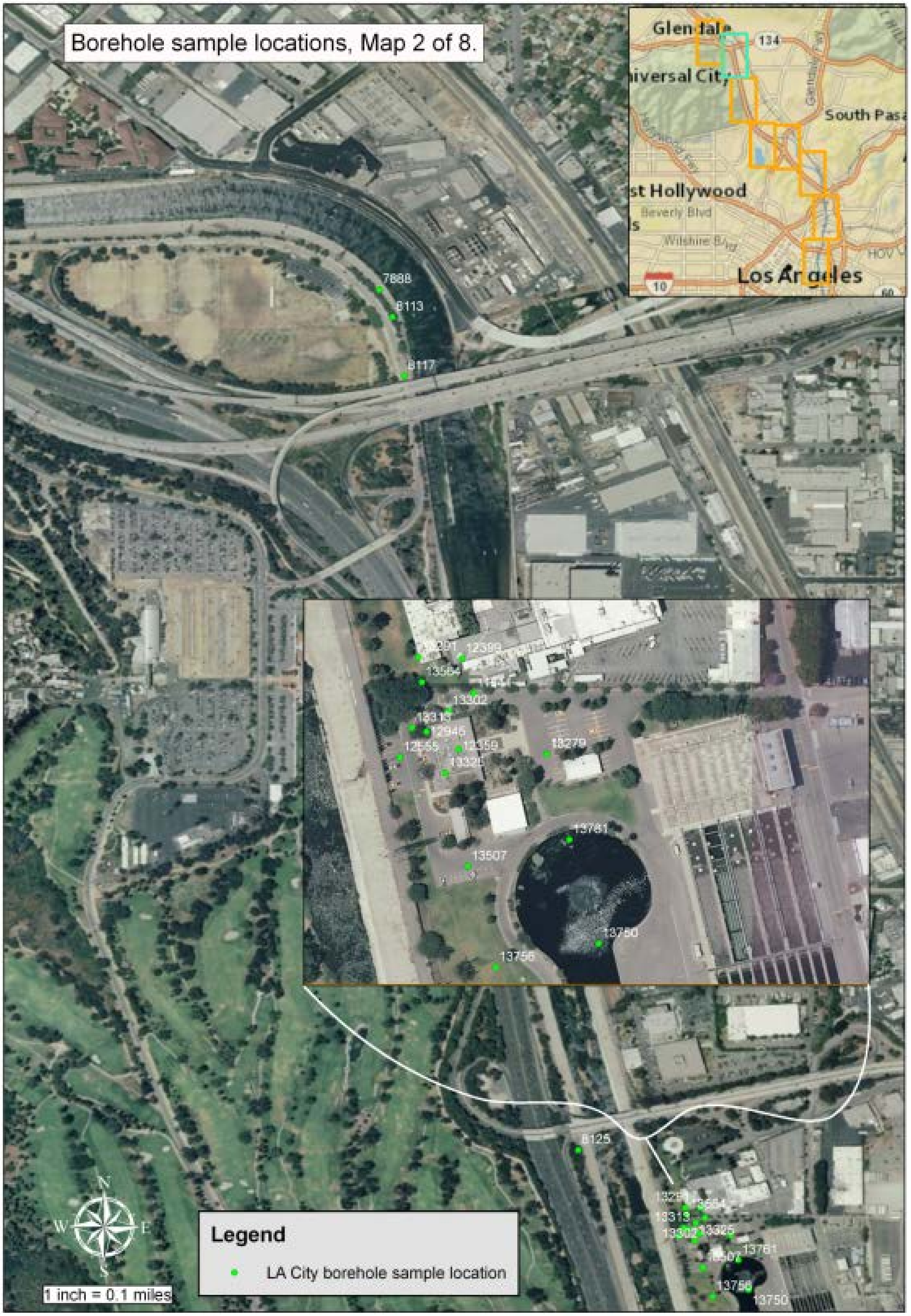
Figure 17
Liquefaction Potential Map

Green tinted area indicates potential liquefaction prone areas.

Green tinted area indicates potential liquefaction prone areas.



Borehole sample locations, Map 1 of 8.
Glendale
134
niversal City
South Pasa
st Hollywood
Beverly Blvd
Wilshire Blvd
Los Angeles
10
8845
2890
16208
2677
8184
7883
N
W
E
S
1 inch = 0.1 miles
Legend
LA City borehole sample location


Borehole sample locations, Map 2 of 8.
Glendale
Universal City
South Pasadena
West Hollywood
Beverly Blvd
Wilshire Blvd
Los Angeles
7888
8113
8117
12391
12399
13564
13302
13313
12946
12555
12359
13325
13279
13781
13507
13750
13756
8125
Legend
LA City borehole sample location
1 inch = 0.1 miles
N
E
S
W

Borehole sample locations, Map 3 of 8.
Legend
LA City borehole sample location
1 inch = 0.1 miles
Burbank
Glendale
Universal City
South Pasadena
Alhambra
West Hollywood
Los Angeles

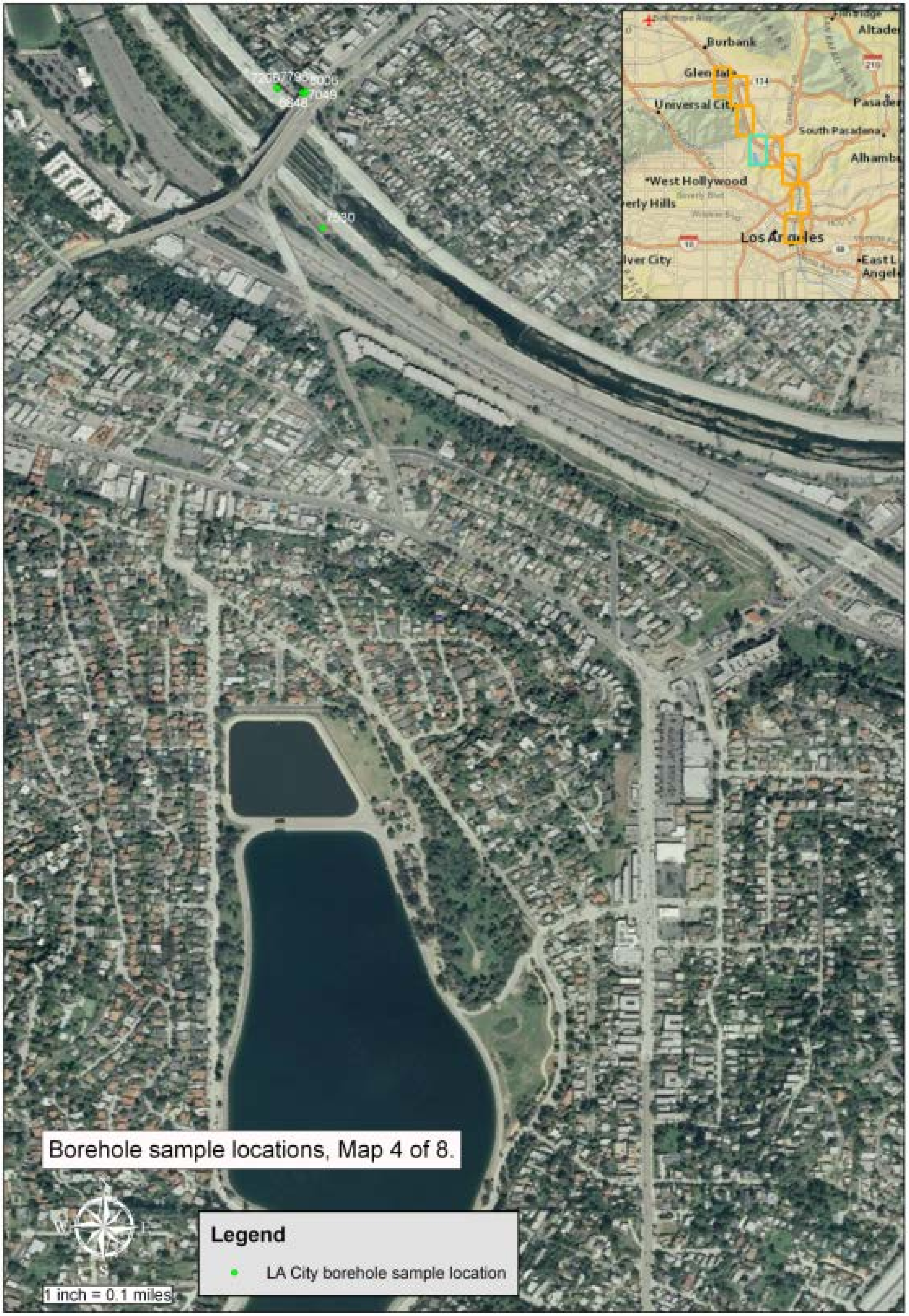


Figure 23
Borehole Location Map


Burbank
Universal City
South Pasadena
West Hollywood
8284
Borehole sample locations, Map 5 of 8.
Legend
LA City borehole sample location
1 inch = 0.1 miles

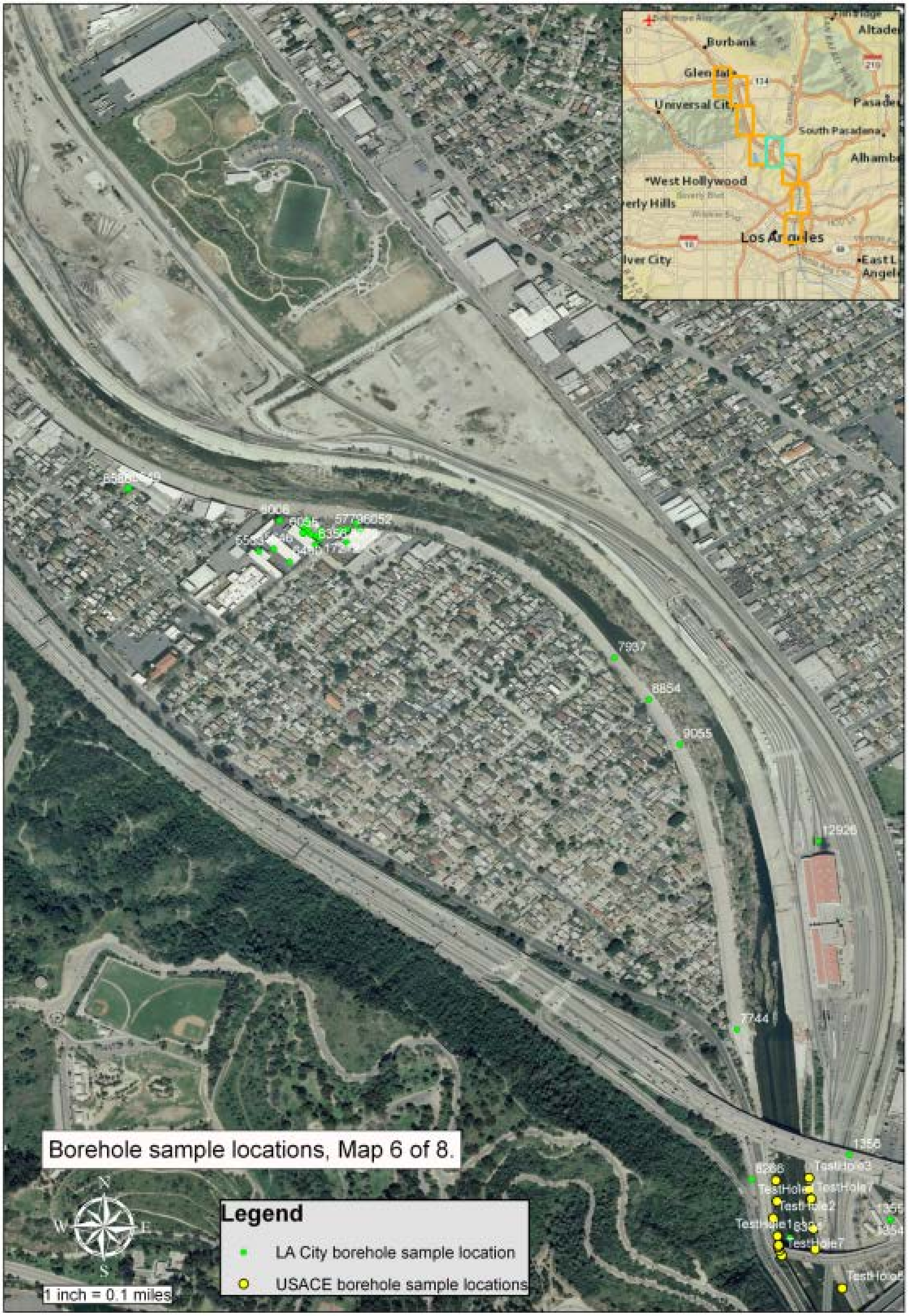

Borehole sample locations, Map 6 of 8.
Legend
LA City borehole sample location
USACE borehole sample locations
1 inch = 0.1 miles
N
S
E
W
Burbank
Universal City
West Hollywood
South Pasadena
7937
8854
9055
12928
7744
1356
8266
TestHole3
TestHole2
TestHole7

Figure 26
Borehole Location Map

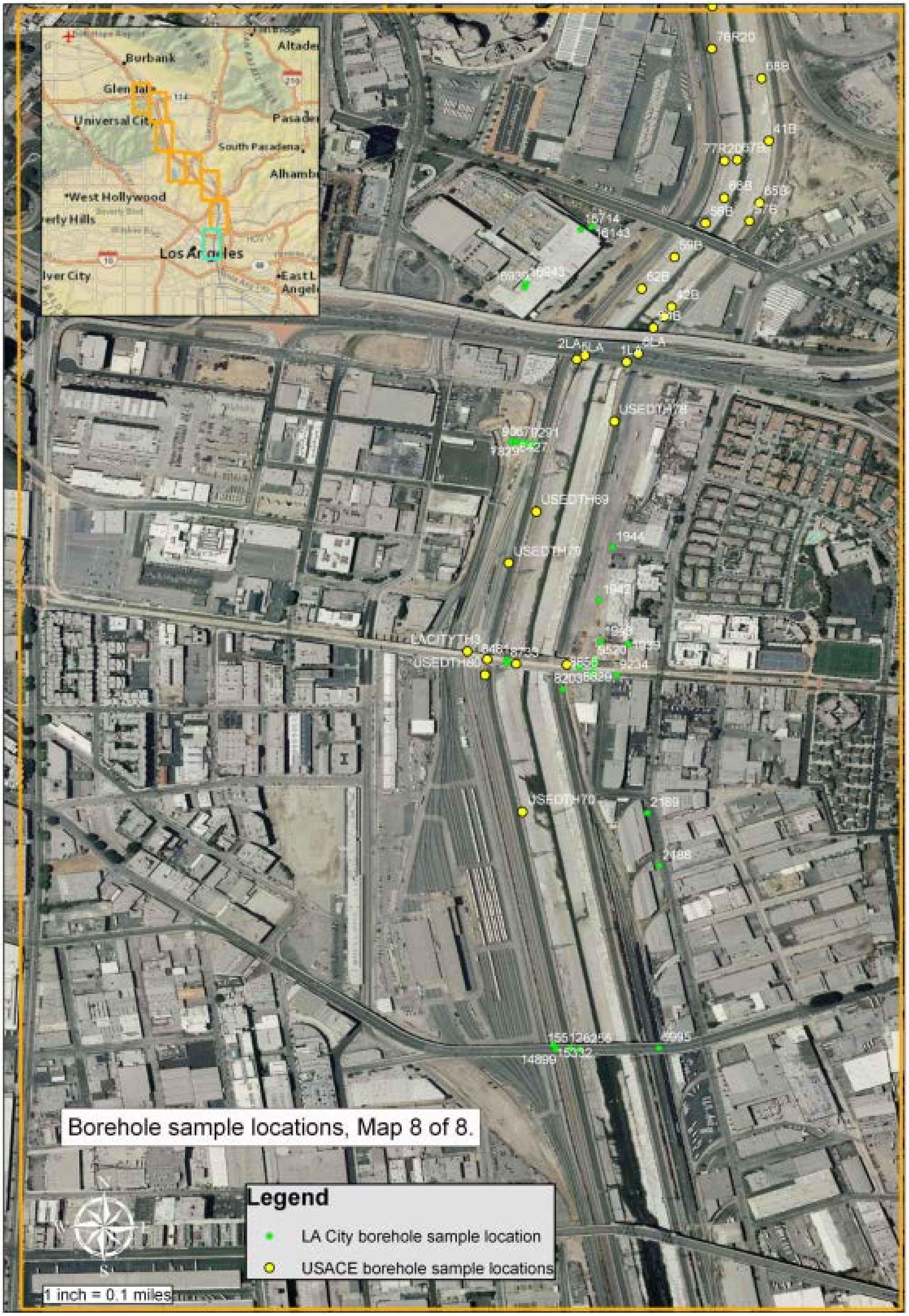


Figure 27
Borehole Location Map

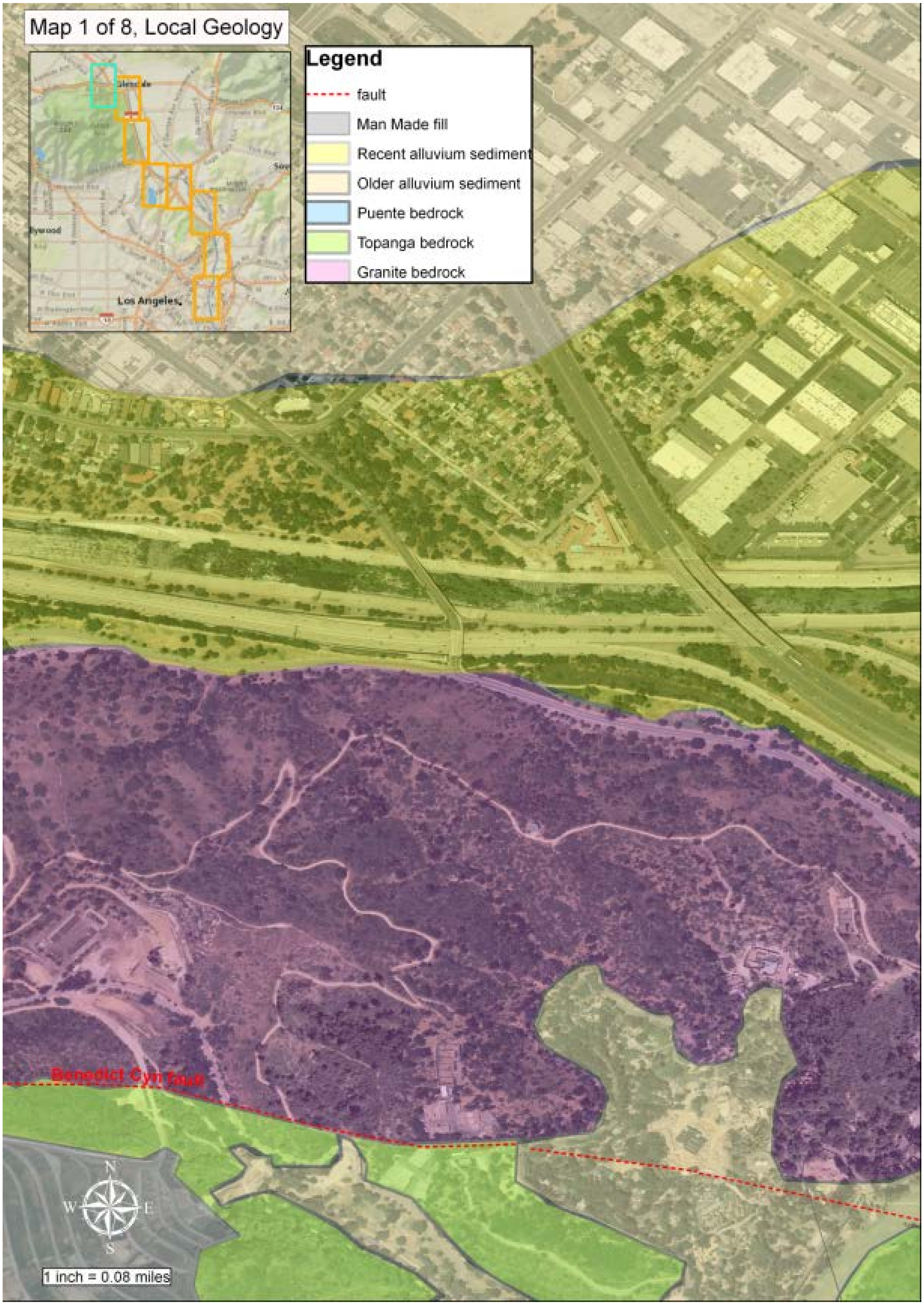


Figure 28
Local Geology Map

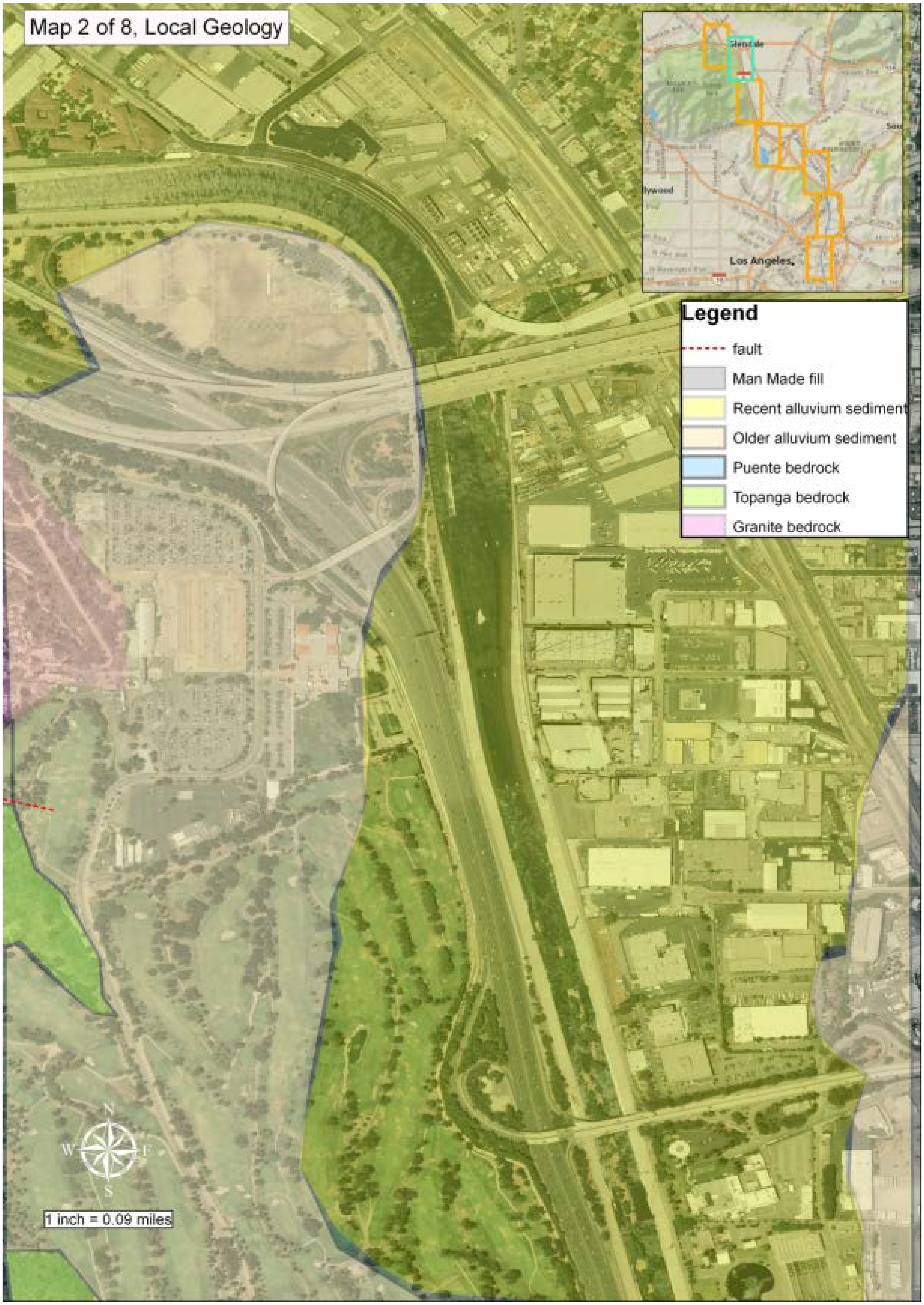


Figure 29
Local Geology Map

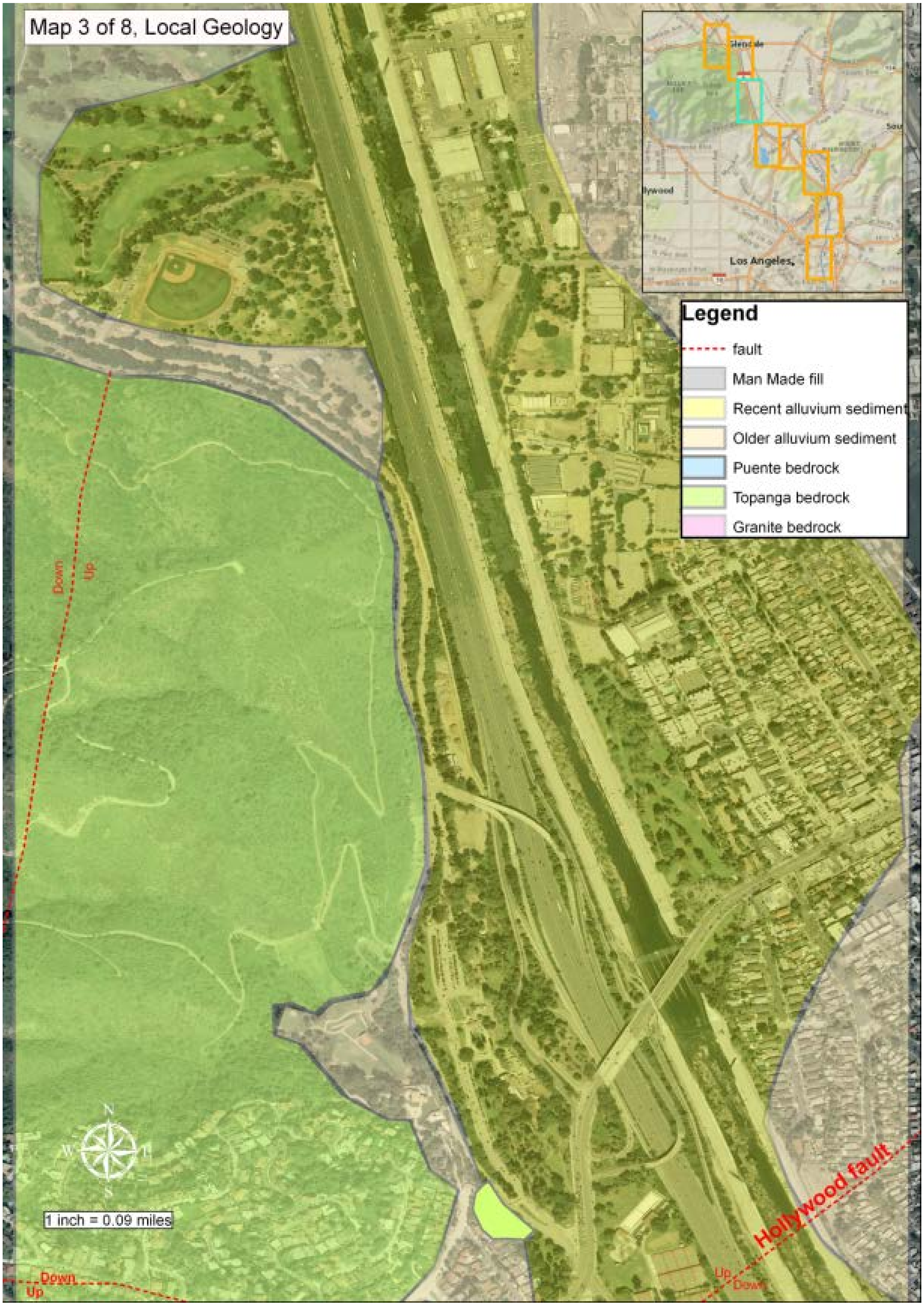


Figure 30
Local Geology Map

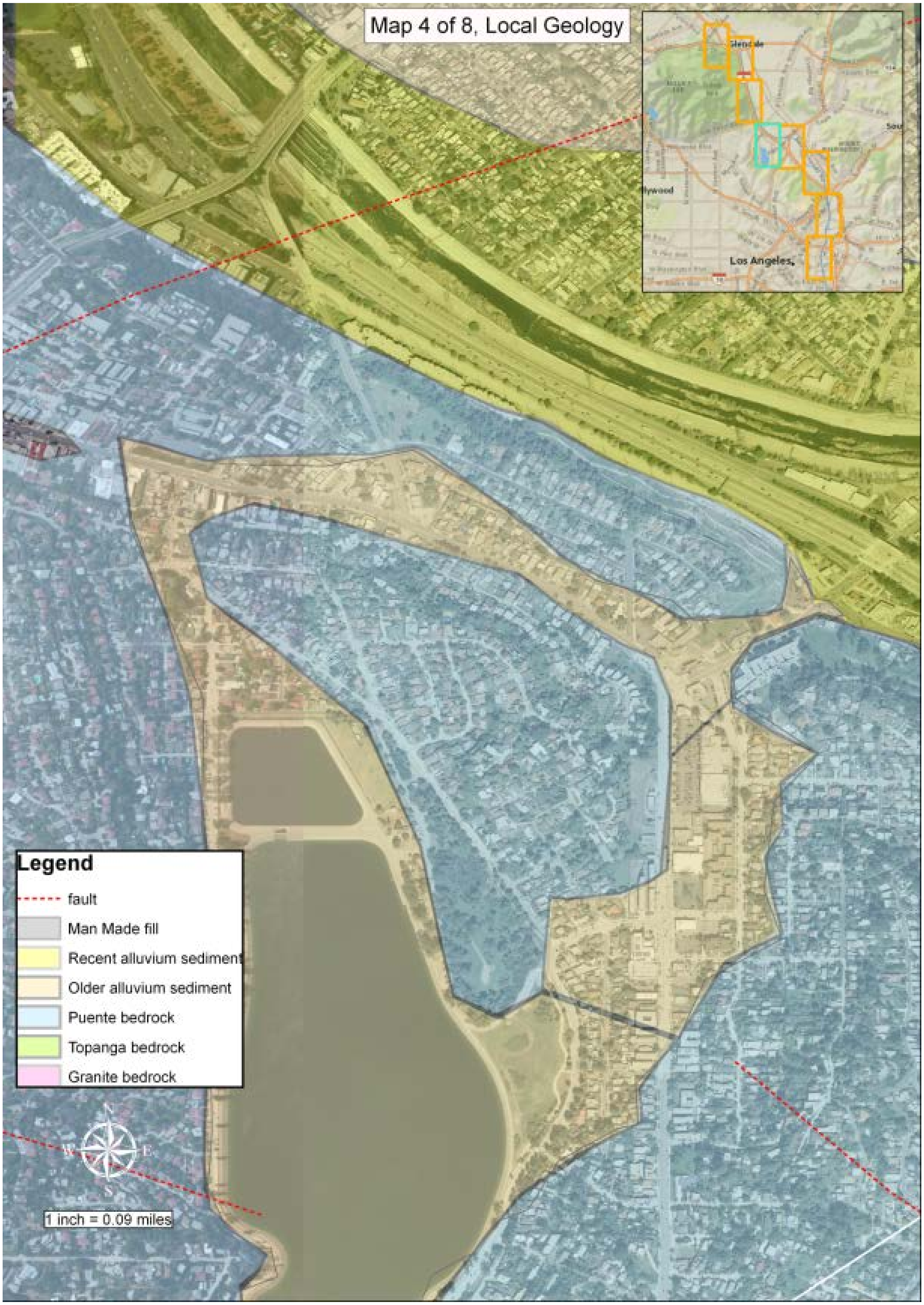


Figure 31
Local Geology Map

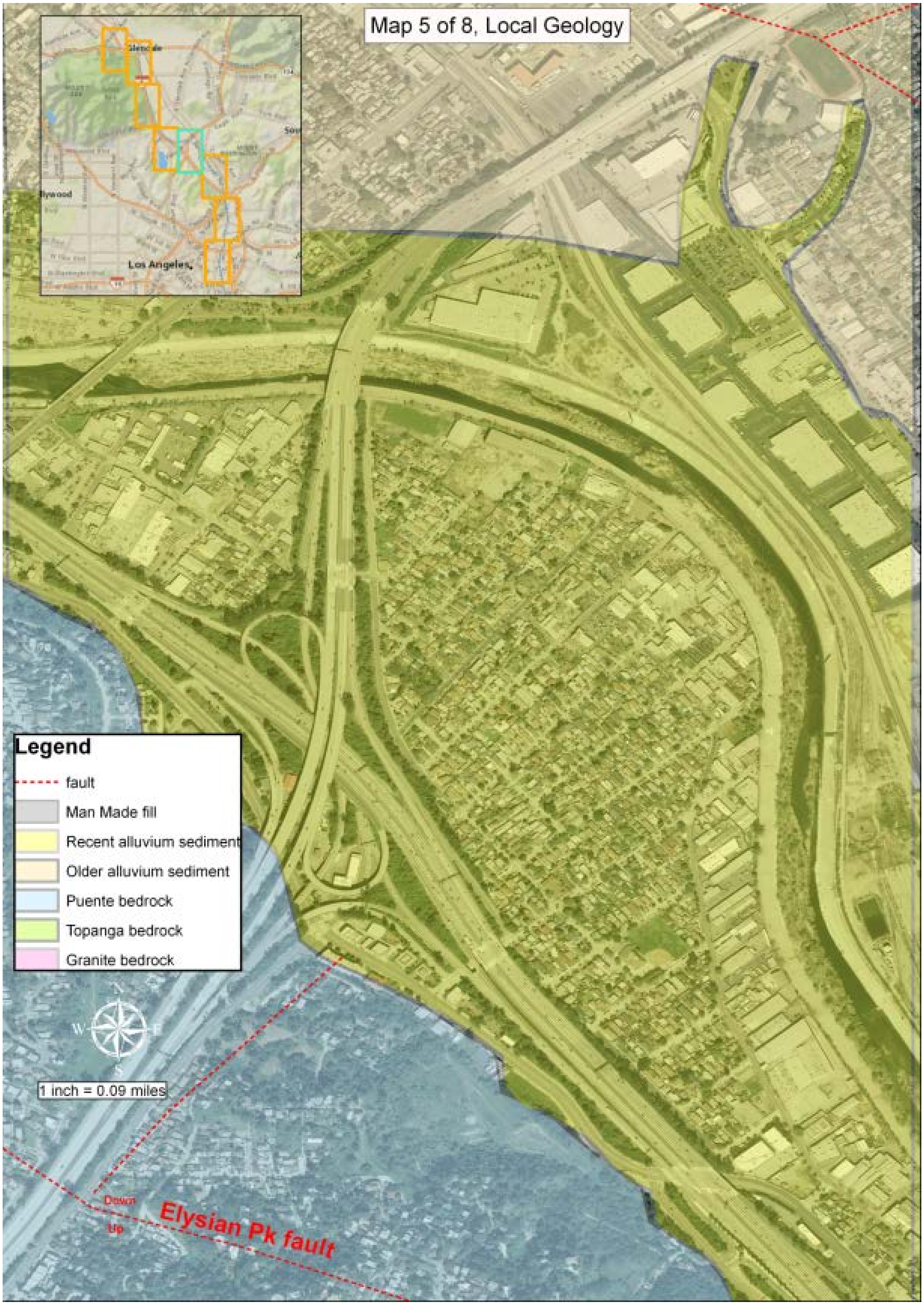


Figure 32
Local Geology Map

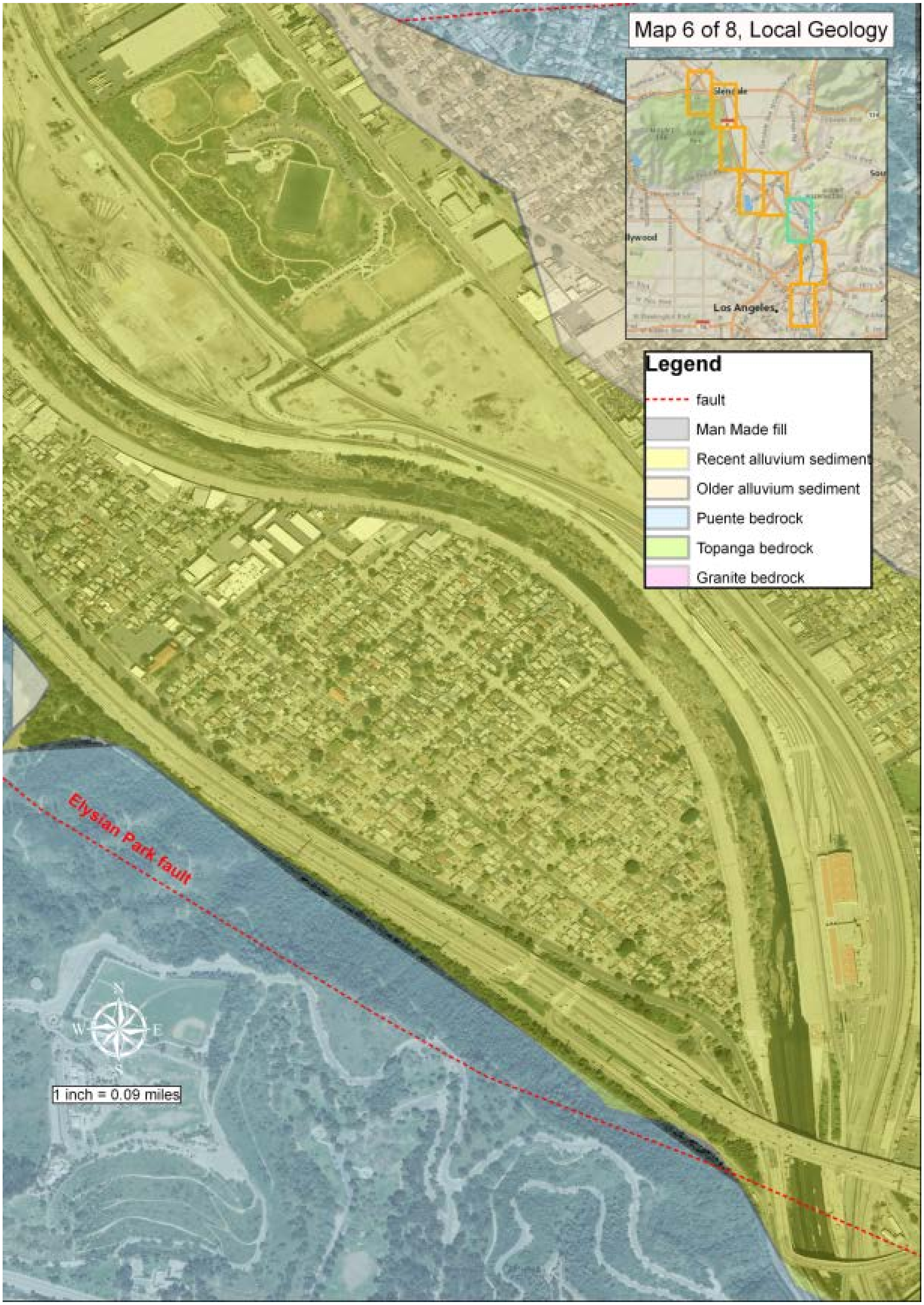
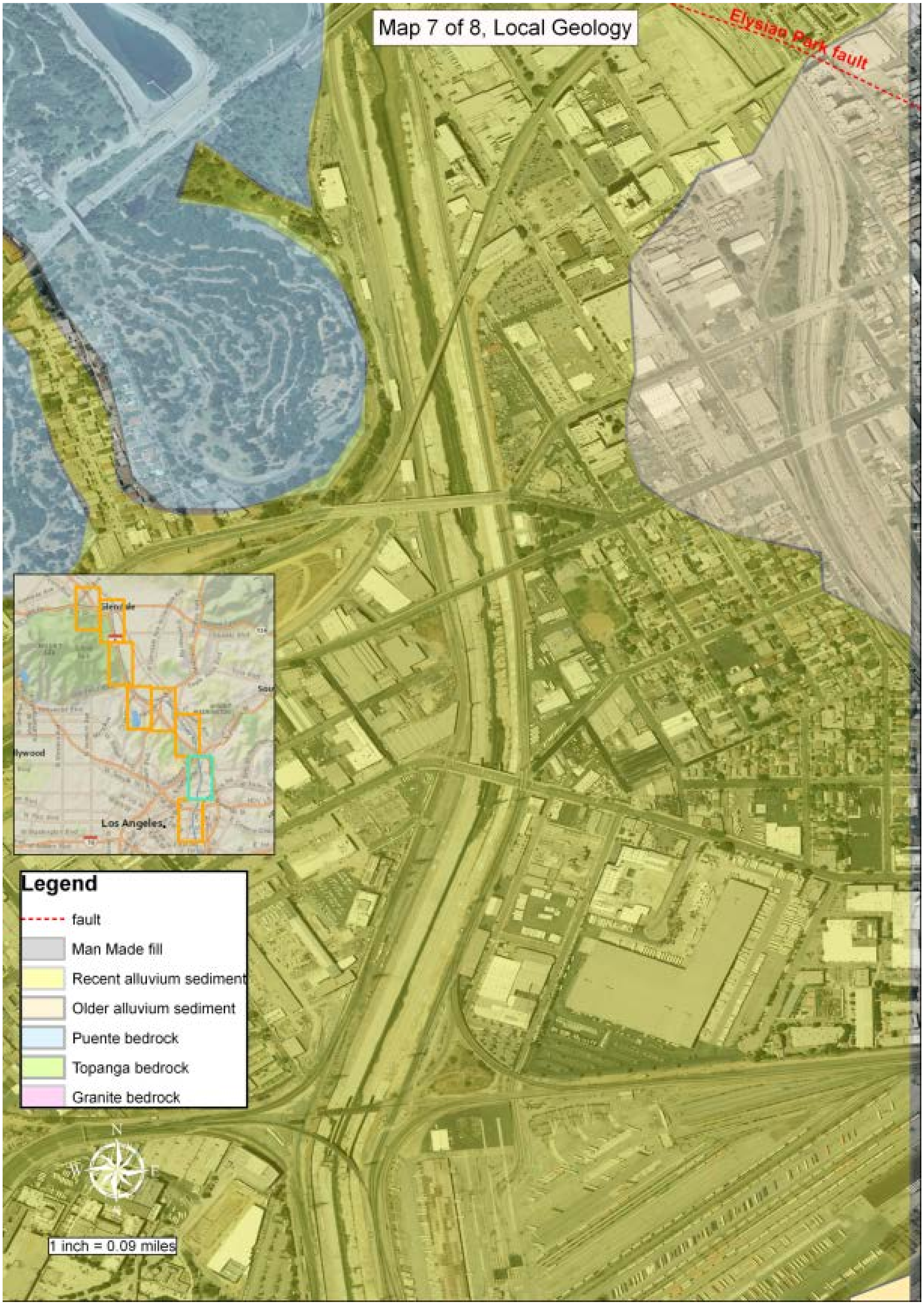


Figure 33
Local Geology Map



Map 7 of 8, Local Geology
Elysian Park fault
Glendale
Los Angeles
Legend
fault
Man Made fill
Recent alluvium sediment
Older alluvium sediment
Puente bedrock
Topanga bedrock
Granite bedrock
N
W
E
1 inch = 0.09 miles

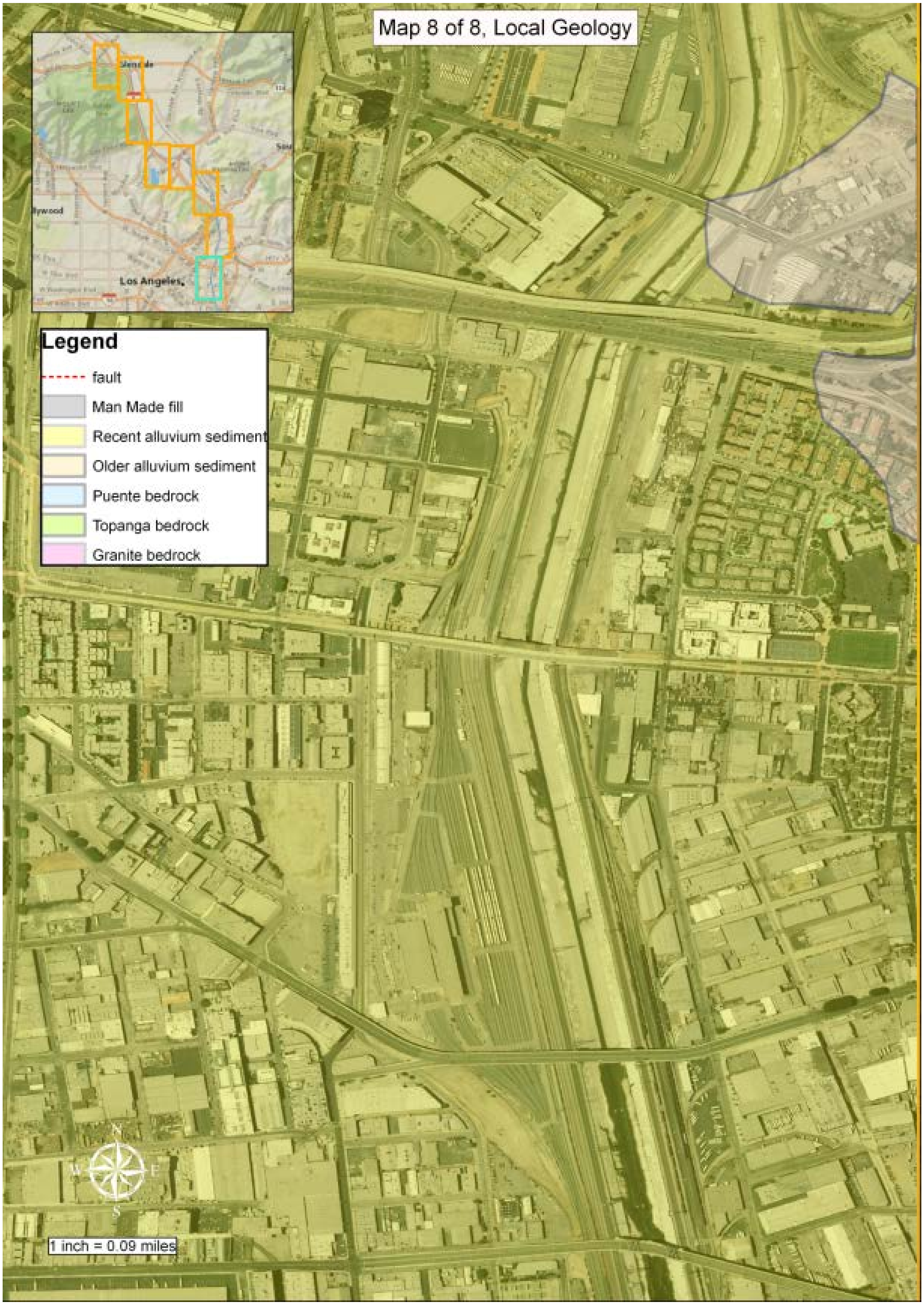
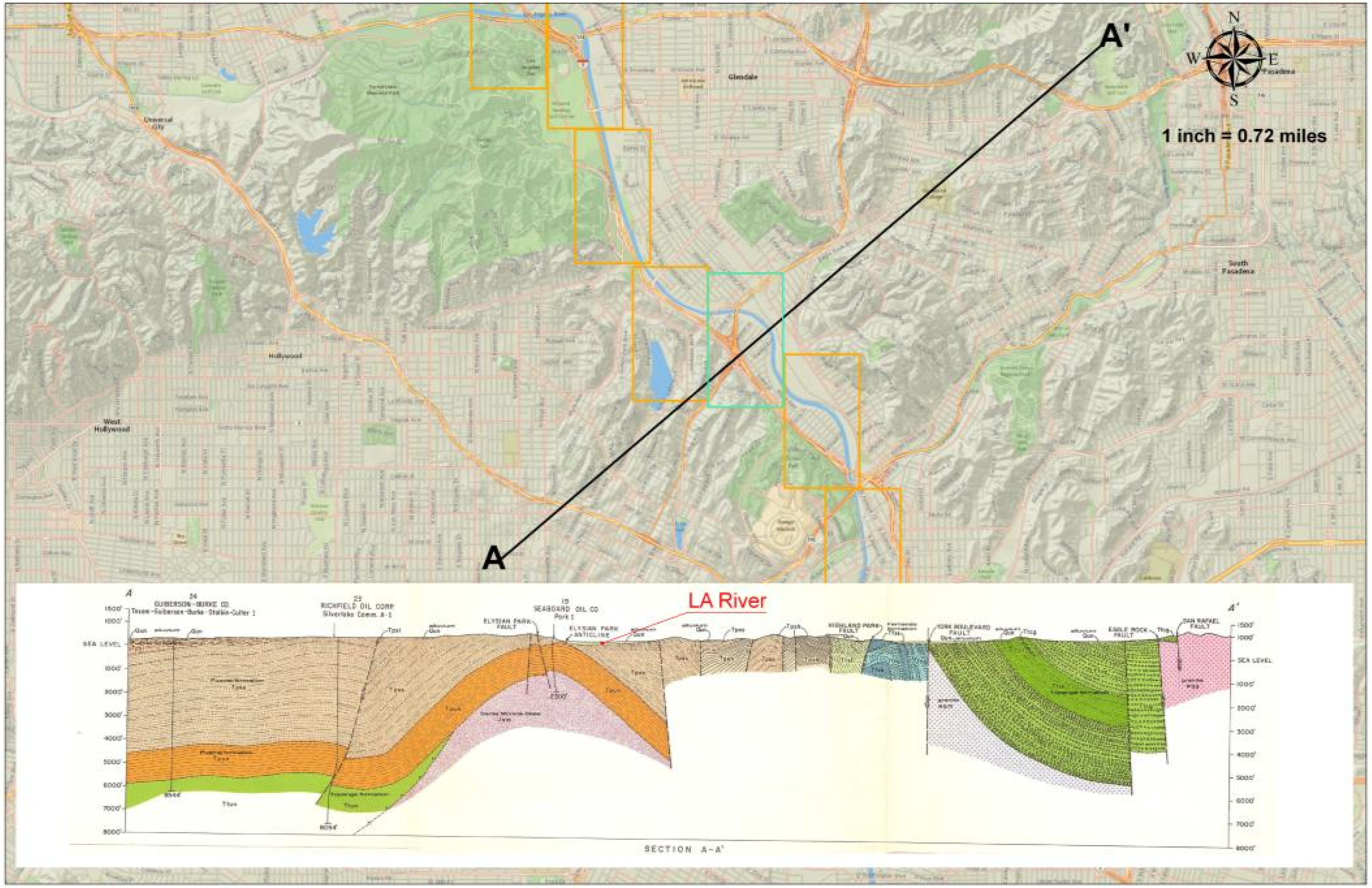


Figure 35
Local Geology Map



LA River Geologic Profile A to A' "looking northwest"

CESPL-ED-GD (1110) 10 May 2013

MEMORANDUM FOR RECORD

SUBJECT: Los Angeles River Ecosystem Restoration Study
Levee Condition Inspection and Issue Discussion

1. **Reference:**

ETL 1110-2-571, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures, 10 April 2009. Hereafter referred to as "the ETL".

2. **General Background and Purpose:**

a. As part of the Los Angeles River Ecosystem Restoration Study, the existing Los Angeles County Drainage Area (LACDA) flood risk management project within the study area along the Los Angeles River needed to be evaluated for areas that have leveed conditions. This memorandum is included as an attachment to the geotechnical portion of the study.

b. The National Levee Database (NLD) indicated that five levees are within the study area. These levees, known as LAR 2, LAR 3, LAR 5, LAR 6, and LAR 7, are depicted on Figure A1. This listing was made based on as-built documents and may not be reflective of current conditions.

c. Alternatives being studied as part of the ecosystem restoration will impact these levees by modifying or altering the original designed condition and will need to be designed and constructed in accordance with the latest guidance including but not limited to the ETL as referenced.

d. Existing field conditions of the levees were evaluated to determine if modifications had been made such that some river reaches were no longer levees in contrast to the conditions reflected in the NLD. Site visits were made on 23 and 25 October 2012 by Mr. Chris Spitzer of Soils Design and Materials Section, and Mr. Kelly Howard of the Operations and Maintenance Branch. The general conditions encountered, specifically whether a levee condition was present, are depicted on Figures A1 through A5. The locations and delineations of the conditions depicted on the figures are approximate.

e. Current assessment procedures for levees involve three steps. The steps can be generalized into 1) periodic inspection, 2) evaluation, and 3) delisting or deficiency correcting steps. Following construction of the levee, periodic inspection of the levee is to occur during which all deficiencies of the levee are noted and documented. Following the inspection, an evaluation of the deficiencies with respect to the Corps policies regarding vegetation, encroachments, and field conditions is made. From the evaluation, delisting recommendations or deficiency correcting actions are made. This procedure is independent of the ecosystem restoration project. It should be noted that the Los Angeles District is currently in the assessment process for the levees within the study area and actions regarding the levees will likely occur prior to completion of the ecosystem restoration project.

3. Observations:

Conditions were observed during the site visit and are described and depicted in the attached Photos. These conditions can be summarized in general as follows:

a. Landside conditions were observed as the landside was visually lower than the levee crest. As such, a levee condition still exists in these locations as delineated in the NLD. The approximate locations of these conditions are depicted in green on Figures A1 through A5.

b. Levee conditions were observed with limited overflow areas on the landside where drainage is directed immediately back to the river via storm drains (bathtub). The approximate locations of these conditions are depicted in yellow on Figures A1 through A5. These portions of the levee may have no residences or structures behind the crest and seemingly have no consequences.. However, if these portions were to overtop or fail, significant vehicular traffic impairment, property damage, or life loss could occur as a result. Additionally this failure may result in the shutdown of major thoroughfares (e.g. I-5) and significantly impact transportation and subsequently have significant economic impacts.

c. Landside encroachments (permitted or unpermitted) consisting of backfill or retaining walls that raised the adjoining property to a height at or above the levee crest were observed at several locations depicted in orange on Figures A1 through A5. This condition effectively makes these areas a non-levee condition. However, these areas and lengths may be required to function as part of a levee system (i.e. as a high ground tie in or hydraulically required for water surface elevations) and, if delisting is desired, will need to be evaluated on a case by case basis.

d. Landside encroachments (e.g., grading after as-builts) consisting of development that created a short leveed condition in order to provide interior drainage were observed on the right bank between LAR 2 and LAR 3. These locations are not shown on the map, but if they are part of new construction for the ecosystem restoration project, they will be evaluated for approval as if they were a levee.

4. Vegetation Guidance:

a. Existing vegetation issues were observed during the site visit. As stated above, these issues are being addressed by the assessment of the levees and not under the ecosystem restoration study. However, the study PDT needs to ensure that the features proposed under the study alternatives would be consistent with the vegetation guidance. The ETL applies to levees only and would not be applicable to channels that act as flood risk management structures except where engineering judgment dictates that such channel is an appurtenant structure to a levee. In addition, regardless of the ETL, if vegetation poses a threat to the integrity or maintainability of any flood risk management structure, such vegetation shall not be allowed in the design.

b. The ETL, in part, provides guidelines for maintaining levees, floodwalls, embankment dams, and appurtenant structures free of vegetation other than grasses within a designated zone because "trees and other woody vegetation, such as shrubs and vines, can create both structural and seepage instabilities, prevent adequate inspection, and create obstacles to maintenance and flood-fighting/flood-control activities." Relevant figures from the ETL illustrating these VFZs are attached.

1. The ETL requires a vegetation free zone (VFZ) for levees as follows: "The vegetation-free zone is a three- dimensional corridor surrounding all levees, floodwalls, embankment dams, and critical appurtenant structures in all flood damage reduction systems. The vegetation-free zone applies to all vegetation except grass." The minimum width of such zone is the width of the levee, floodwall, or embankment dam, including all critical appurtenant structures, plus 15 feet on either side. Employing a lesser width of VFZ requires a variance unless the existing real estate rights do not provide the minimum width. Under specific site conditions, a greater width than the minimum may be required. (ETL, Sec. 2-2).
2. The ETL addresses environmental improvements and considerations for urban levees: "All levees must have effective and reliable erosion protection; the appropriate use of grasses is described in Paragraph 4-8. Where opportunities exist, environmental improvements should be considered. Project design shall address the following criteria: (1) Urban levees. Because levee projects have the potential to dominate these high-visibility landscapes, planting is often desirable, particularly in high-visibility locations, such as at and along major thoroughfares, parks, and waterfront developments." (ETL Sec 3).
3. The ETL addresses additional vegetation considerations for floodwalls as follows:
   "The minimum vegetation-free zone provides for access, but there are two additional areas of concern with respect to floodwalls. (1) Large trees can be a threat to project reliability. Planting design and maintenance must take into account the potential for overturning trees to damage floodwalls. (2) Planting design and maintenance must also take into account the three potential means by which tree roots may damage floodwalls." (ETL Sec 3).

5. Conclusions:

a. Based on visual observations, portions of the existing configuration no longer appear to meet the criteria of a levee condition and may be removed from the NLD at a future date. These areas will need to be accurately delineated in location and extent and ultimately approved as a non-levee condition by the District Levee

Safety Officer.

b. Portions that are listed and confirmed as levee through field observation have been noted as part of this effort. Any modifications by ecosystem restoration study to the levees will be made in accordance with current design practices and guidance pertaining to design and construction of levees.

6. PDT Approach to Leveed Conditions Under Alternatives in the Final Array:

Ecosystem restoration alternatives propose to modify the levees and/or include features adjacent to the levees. All modifications that are to be made to levee segments, will be in conformance with levee safety program policies. Discussion for each of the levee systems, the proposed measures, and their impacts to the levee are as follows:

a. Planting along each of the observed levee systems will conform to the ETL and design will conform to other levee guidance (including but not limited to EM 1110-2-1913 - Design and Construction of Levees).
b. All culvert daylighting will tie in to high ground for levee protection and will conform to the ETL, and design will conform to other Levee Guidance.
c. The Los Feliz Golf Course proposed diversion in the RIVER alternative (Alternative 20) would require the effective removal of the levee by using ungated pipes of restricted flow. As a result, property adjacent to the golf course may require flood reduction measure(s), which will be identified after Hydrology and Hydraulics analyses are performed during the F5 effort.
d. Proposed measures at the upstream end of LAR 6 in the RIVER alternative (Alternative 20) would remove portions of the levee toe by widening the river at the confluence of the river and Verdugo Wash. The resulting confluence will eliminate the need for a levee at the upstream end, create a tie-in with the adjacent landside topography, and will create a levee condition beginning at some location downstream of the confluence. Planting within this segment will conform to the ETL and other levee guidance.
e. Along LAR 3, in Griffith Park and Ferraro Fields, proposed diversions will result in a levee condition. This will require the new diversions/levees to conform to the ETL and design to conform to other levee guidance.
f. With respect to the segments that are listed in the NLD but were observed not to have levee conditions (portions of LAR 2 and LAR 5), the proposed project would treat them as levees subject to the ETL until delisting or HQUSACE direction that they can be treated as a non-levee condition. The application of the ETL would affect the type of vegetation that can be planted. The District has requested clarification from HQ about the application of the ETL for NLD-listed segments that do not have a levee condition. One direction from HQ stated that until LAR 5 and

LAR 2 are delisted, planting would need to conform to the ETL and design would need to conform to other Levee Guidance. HQ does not have a process for delisting yet, but this concern is being posed up the chain. Other HQ advisement has indicated that, if no levee condition exists, the ETL does not apply. This study is taking the approach that following levee assessment, if a portion of one of these levee reaches is determined to be a non-levee condition, as shown on Figures A1 through A5, then the ETL may not apply and a specified vegetation plan may be approved by the District Levee Safety Officer.

7. Current Levee Assessment Status

Currently the levees within the ARBOR Reach are being or are planned to be assessed in the next few years. Field inspection as part of the periodic inspection process was recently conducted for LAR 6. The Periodic Inspection Report is being prepared at this time for LAR 6. The other levees, LAR 2, LAR 3, LAR 5, and LAR 7, are scheduled to be inspected by 2016.

8. Limitations:

All of the above discussion is for planning and consideration purposes only. Further evaluation, analysis, and design will be required during future stages. In addition, conditions and guidance may change and may not be applicable at the time of design or during future studies.

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Encl: Selected Photos Showing Field Conditions
Relevant Figures from ETL 1110-2-571
Figures A1 through A5

CF: FAIRBANK (Dam Safety Program Manager
FARLEY (Geotechnical Branch)
LEIFIELD (Engineering Division)
BEAUCHAMP-HERNADEZ (Operations Branch)l

Photo 1: View looking downstream at N. Main Street. LAR 2 on right side. Not a levee condition. From top of wall and ascending slope approximately 5-feet in height with relatively level ground on landside.

Photo 2: View looking downstream at N. Main Street. LAR 5 on left side. Not a levee condition. Railroad embankment with ascending slope above top of wall. Photo 3 depicts landside condition further.

Photo 3: View looking downstream at N. Main Street. LAR 5 on right side. Not a levee condition. Ground in immediate foreground at approximately the same elevation of the wall depicted in Photo 2.

Photo 4: Looking upstream near downstream end of LAR 3. Not a levee condition. Ascending slope to high ground on landside. Vegetation would be within the VFZ if this portion is to remain listed as levee or is required for levee support upstream or downstream.

Photo 5: On crest of LAR 3 looking upstream. Not a levee condition. Although landside is slightly lower than crest. Flow would be directed along I-5 (on left) and the crest of the highway is above the crest of LAR 3.

Photo 6: Looking upstream along LAR 3 just upstream of Hyperion Ave. Not a levee condition. Grades for park are above crest.

Photo 7: Equestrian ramp and tunnel entrance. Note crest on right, highway on left. Tunnel and culvert at base of down-ramp in center.

Photo 8: Landside of tunnel culvert at end of tunnel in background. Tunnel height allows horse and rider to pass through without rider bending over. Note small wall in foreground as it is the same wall depicted in Photo 9.

Photo 9: Landside of tunnel looking upstream. Wall in foreground is the wall depicted in Photo 8. The building in background is at approximately same grade as top of tunnel.

Photo 10: Looking upstream on LAR 3 near Gene Autry Museum. Levee condition of approximately 2 to 4-feet exists and flow would be directed on I-5 and along levee. Southbound lanes are higher than northbound lanes.

Photo 11. At Ferraro Fields looking downstream on LAR 3. Levee condition beyond right of photo and vegetation on landside crest.

Photo 12: Equestrian undercrossing on landside of LAR 3. Photo taken at landside crest.

Photo 13: Landside of undercrossing on left side. Inlet of drain on right side.

Photo 14: Upstream end of LAR 3 looking downstream. Vegetation on landside.

Photo 15: Downstream of Riverside Drive looking downstream on LAR 7. Vegetation on landside.

Photo 16: Looking upstream on LAR 7. Levee condition and irrigation lines at riverside crest and across entire landside slope.I-5 in background.

Photo17: Looking upstream on LAR 7. Landside backfilled and not a levee condition.

Photo 18: Looking upstream on LAR 6. Vegetation on levee and cannot inspect toe with fence.

Photo 19: Atwater Park. Not a levee condition on LAR 6 but needed as levee conditions exist upstream and downstream.

Photo 21: Vegetation on landside and levee condition on LAR 6.

Photo 20: Los Feliz Golf Course. Vegetation on landside.

Photo 22: Taken in same vicinity of Photo 21 showing that this is a levee condition.

Figures from ETL 1110-2-571

The following figures (with ETL figure numbering) are from ETL 1110-2-571 and are representative of current or potential reconfiguration of the levees along the Los Angeles River.

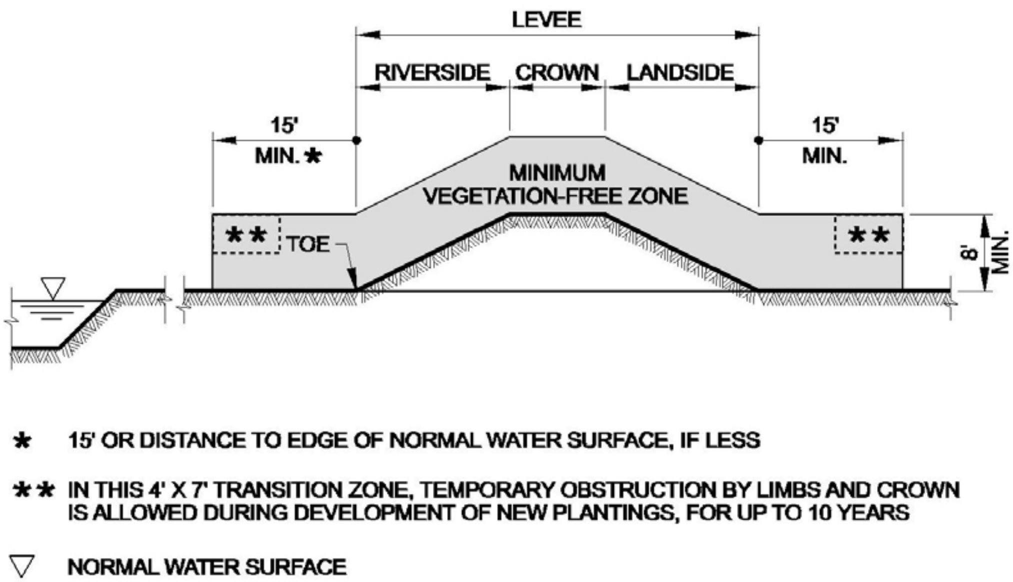


Figure 1: Levee Section – Basic

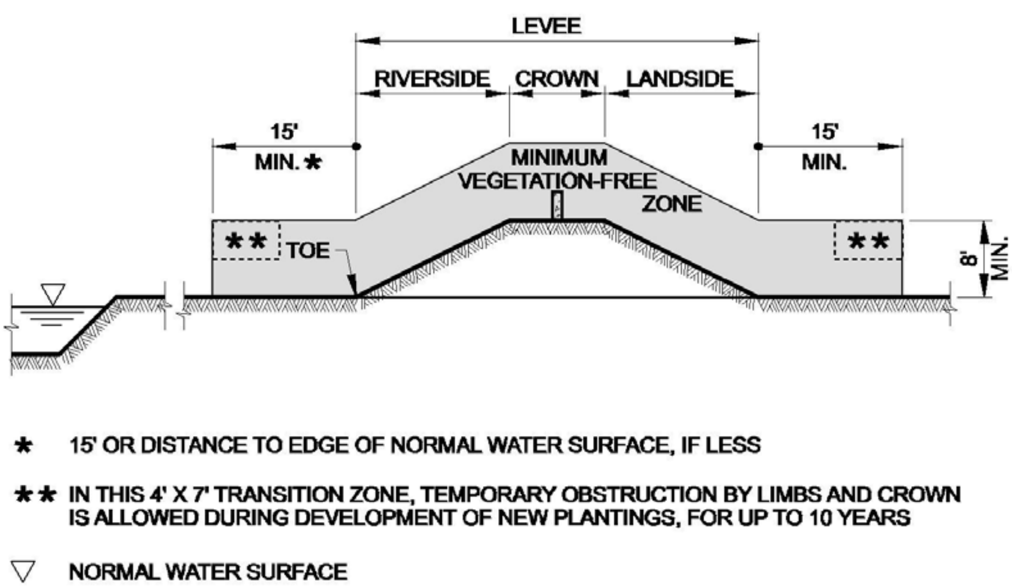
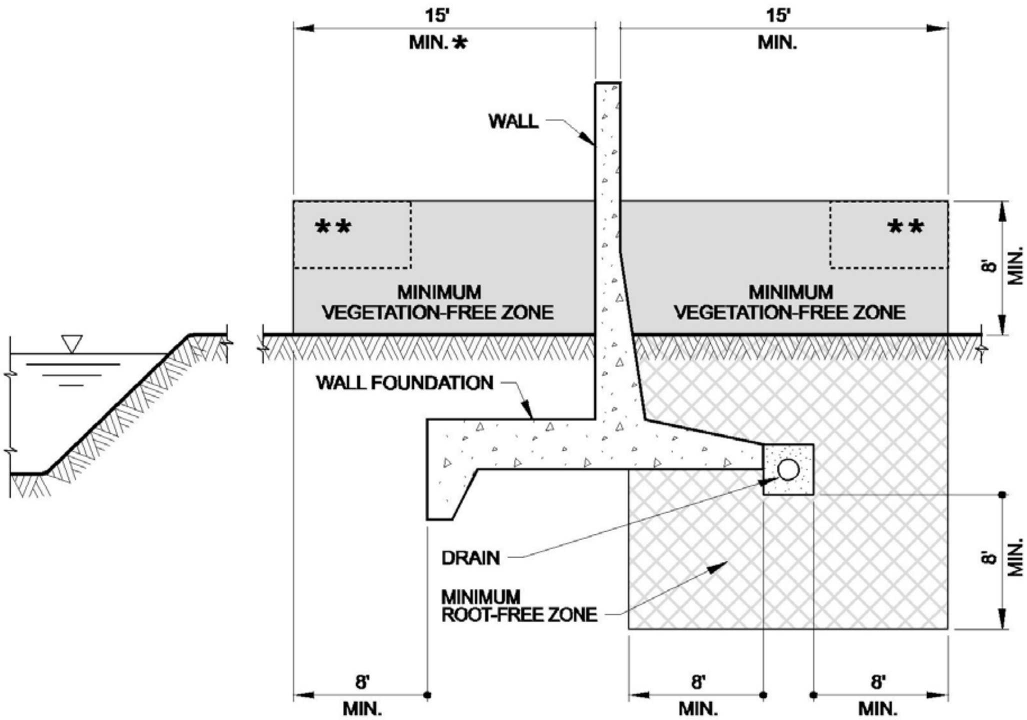


Figure 3: Levee Section – Basic, with Floodwall on Crown

Figures from ETL 1110-2-571



* 15' OR DISTANCE TO EDGE OF NORMAL WATER SURFACE, IF LESS

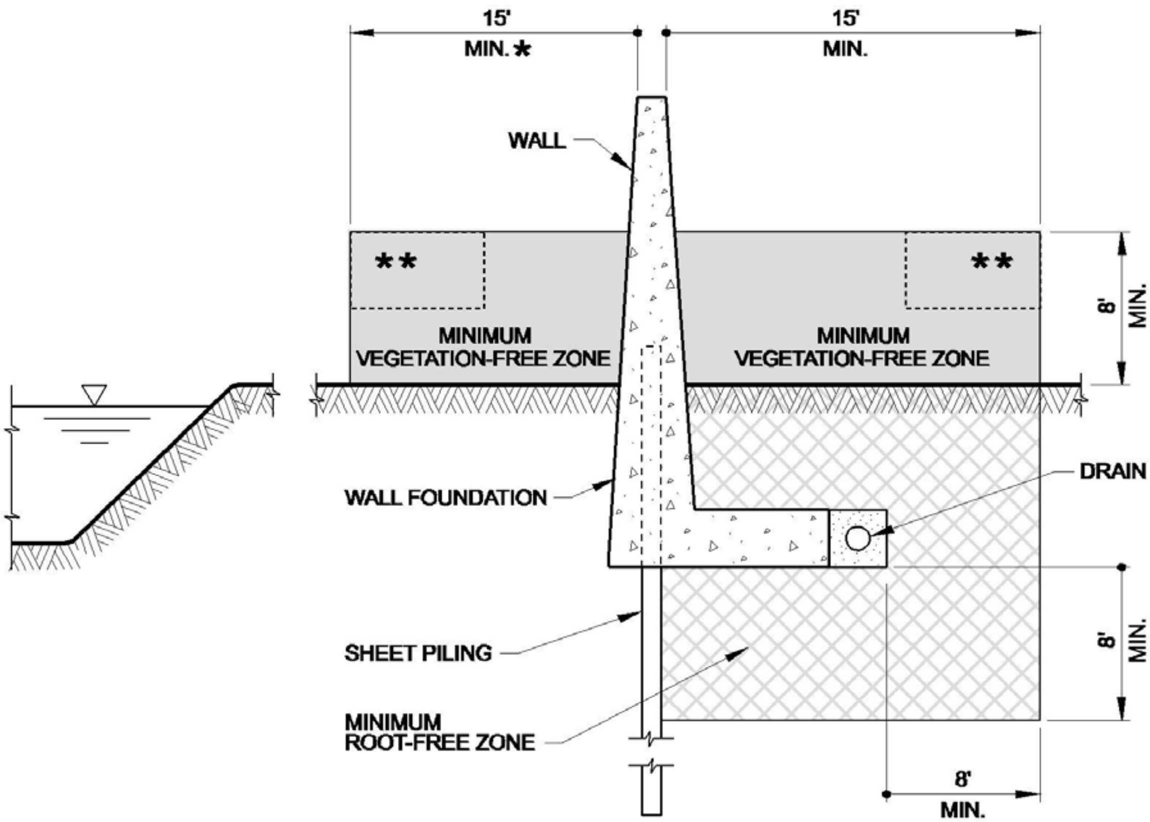
** IN THIS 4' X 7' TRANSITION ZONE, TEMPORARY OBSTRUCTION BY LIMBS AND CROWN IS ALLOWED DURING DEVELOPMENT OF NEW PLANTINGS, FOR UP TO 10 YEARS

▽ NORMAL WATER SURFACE

NOTE: THE HORIZONTAL DIMENSION OF THE MINIMUM VEGETATION-FREE ZONE SHALL BE THE GREATER OF:
(A) THE 15-FOOT MINIMUM, AS DIMENSIONED ABOVE GRADE; OR
(B) AS DIMENSIONED FROM THE BELOW-GRADE STRUCTURE

Figure 17: Inverted-T Type Floodwall with Drain.

Figures from ETL 1110-2-571

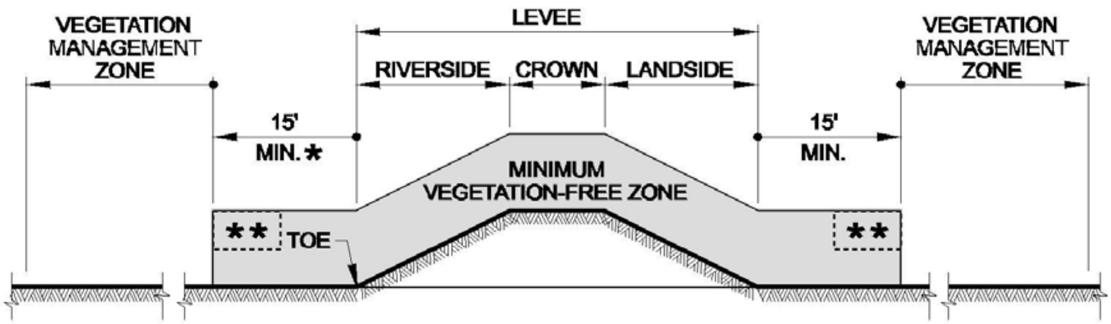


*	15' OR DISTANCE TO EDGE OF NORMAL WATER SURFACE, IF LESS
**	IN THIS 4' X 7' TRANSITION ZONE, TEMPORARY OBSTRUCTION BY LIMBS AND CROWN IS ALLOWED DURING DEVELOPMENT OF NEW PLANTINGS, FOR UP TO 10 YEARS
▽	NORMAL WATER SURFACE

NOTE: THE HORIZONTAL DIMENSION OF THE MINIMUM VEGETATION-FREE ZONE SHALL BE THE GREATER OF:
(A) THE 15-FOOT MINIMUM, AS DIMENSIONED ABOVE GRADE; OR
(B) AS DIMENSIONED FROM THE BELOW-GRADE STRUCTURE

Figure 19: Cantilever-I Type Sheet-Piling Floodwall with Drain.

Figures from ETL 1110-2-571



* 15' OR DISTANCE TO EDGE OF NORMAL WATER SURFACE, IF LESS

** IN THIS 4' X 7' TRANSITION ZONE, TEMPORARY OBSTRUCTION BY LIMBS AND CROWN IS ALLOWED DURING DEVELOPMENT OF NEW PLANTINGS, FOR UP TO 10 YEARS

▽ NORMAL WATER SURFACE

NOTES:

1. THE VEGETATION-MANAGEMENT ZONE ALLOWS FOR ACCESS, FOR THE PURPOSE OF INSPECTION, AND MODIFICATION OR REMOVAL OF ANY PLANT WHOSE LIMB, FOILAGE, OR ROOT BEHAVIORS BECOME A THREAT TO PROJECT RELIABILITY.
2. THE APPROPRIATE WIDTH OF THE VEGETATION-MANAGEMENT ZONE SHALL BE DETERMINED BY THE DESIGN TEAM: 35 FEET WILL BE SUFFICIENT IN MOST CASES.
3. THE VEGETATION-MANAGEMENT ZONE MAY BE ESTABLISHED BY EASEMENT.
4. THIS FIGURE SHOWS THE VEGETATION-MANAGEMENT ZONE IN THE CASE OF A LEVEE; HOWEVER, IT IS EQUALLY APPROPRIATE IN THE CASE OF ANY OTHER FLOOD DAMAGE REDUCTION STRUCTURE OR APPURTENANCE: IT'S USUAL RELATIONSHIP IS TO THE VEGETATION-FREE ZONE.

Figure 22: Vegetation-Management Zone.

Figures from ETL 1110-2-571

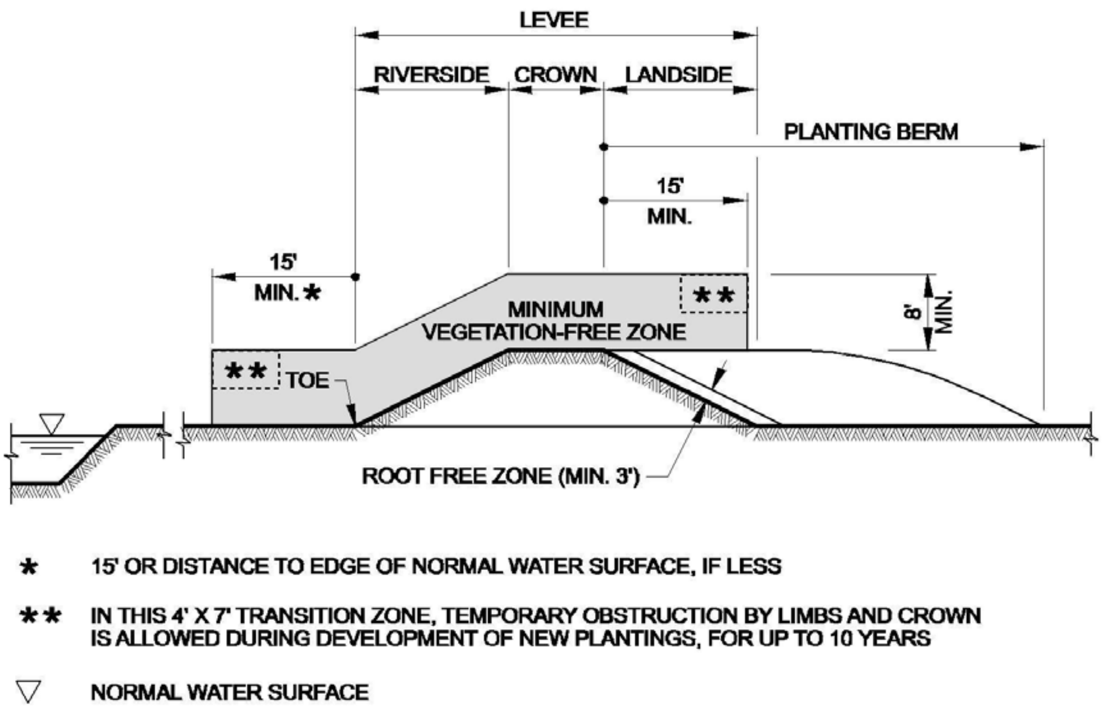
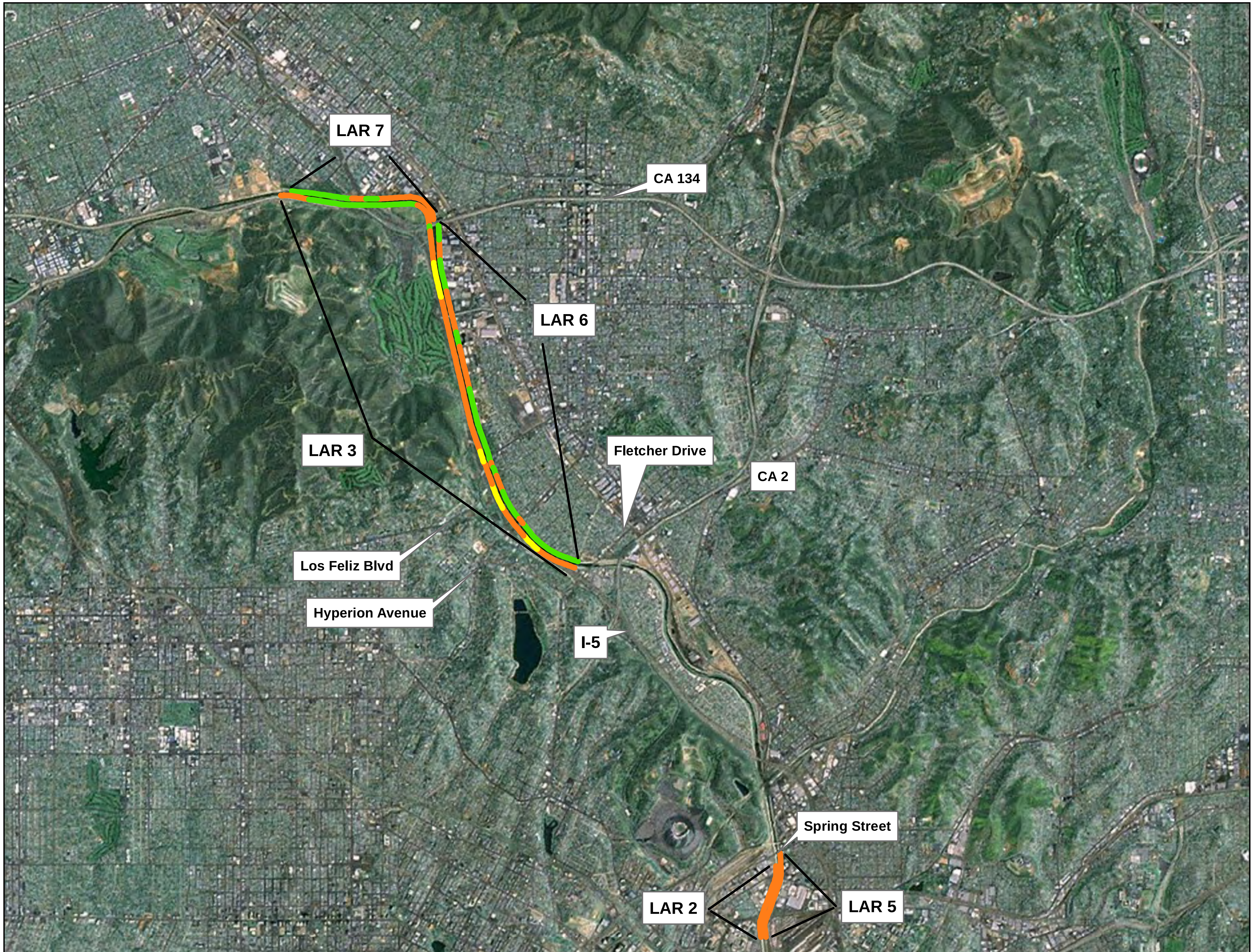
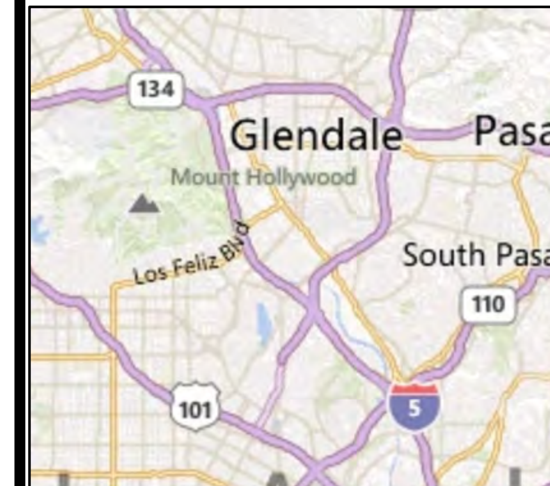


Figure 13: Levee Section with land side Planting Berm.





Legend

- Levee as indicated on plan and in field
- Not levee. Landside backfilled.
- Levees with bathtub condition

N

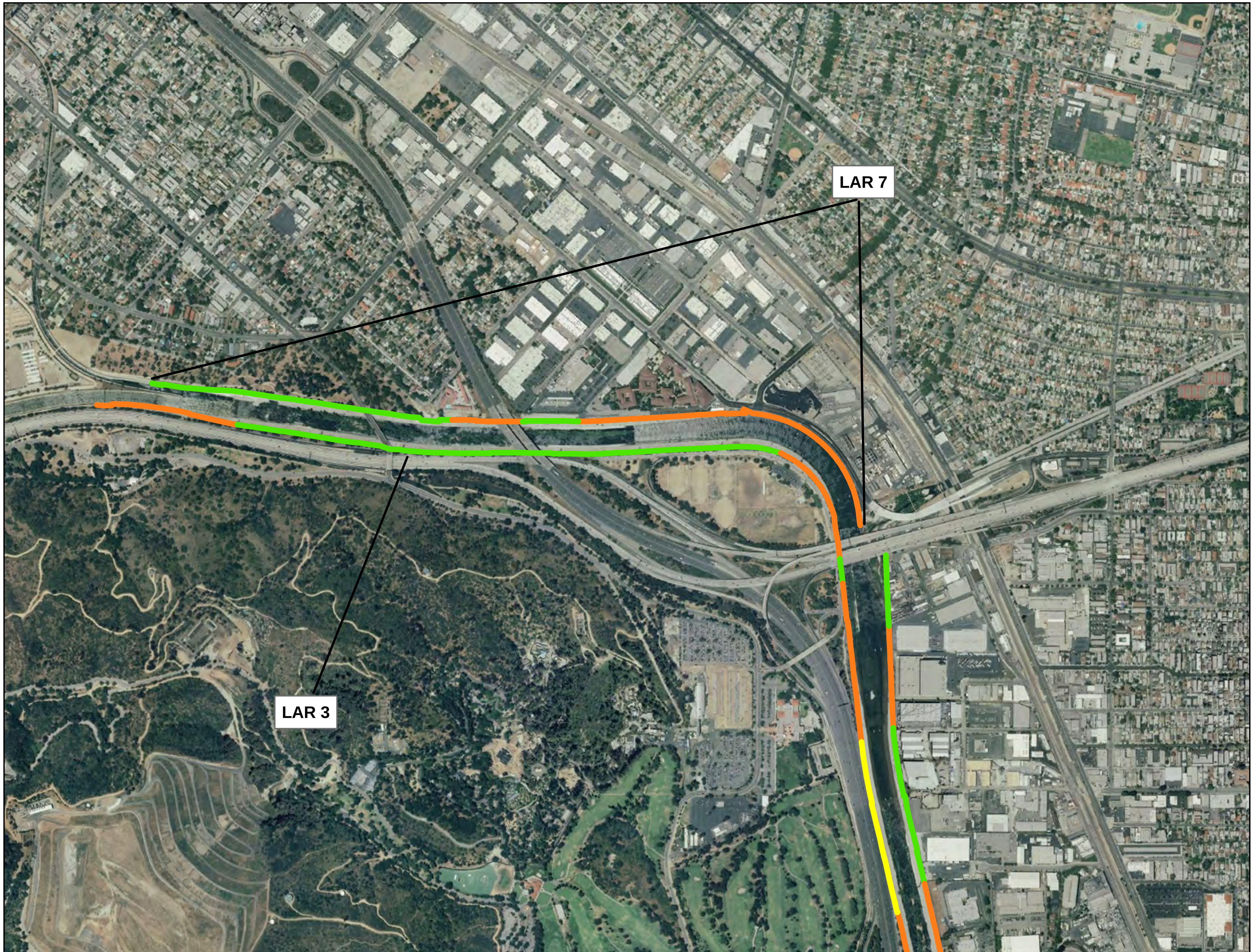
0 5,000 10,000 Feet

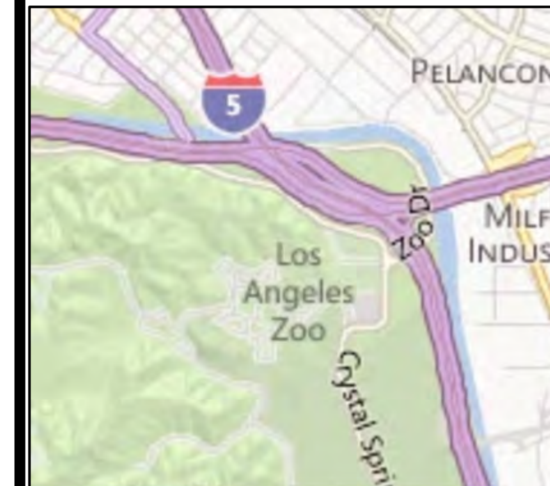
Los Angeles River Ecosystem Restoration Study

Levees LAR 2, LAR 3, LAR 5, LAR 6, and LAR 7 Field Levee Conditions

Figure A1

U.S. ARMY CORPS OF ENGINEERS LOS ANGELES DISTRICT





Legend

- Levee as indicated on plan and in field
- Not levee. Landside backfilled.
- Levees with bathtub condition

N

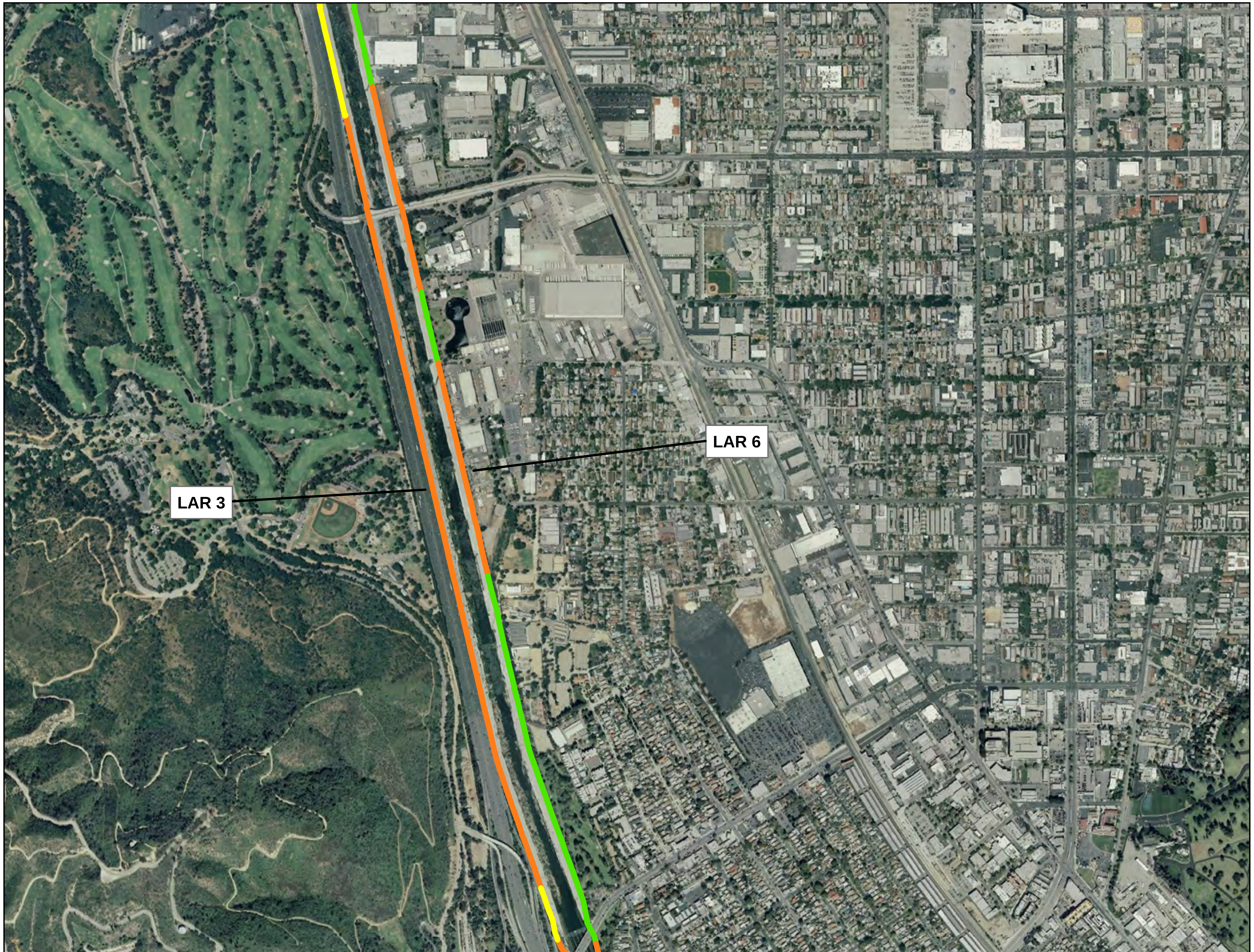
0 1,050 2,100 Feet

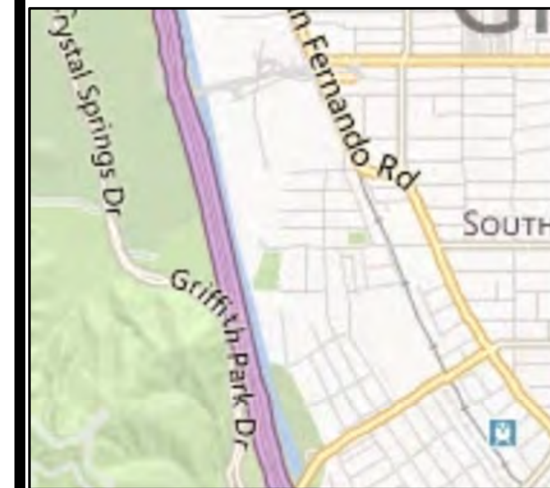
Los Angeles River Ecosystem Restoration Study

Levees LAR 2, LAR 3, LAR 5, LAR 6, and LAR 7 Field Levee Conditions

Figure A2

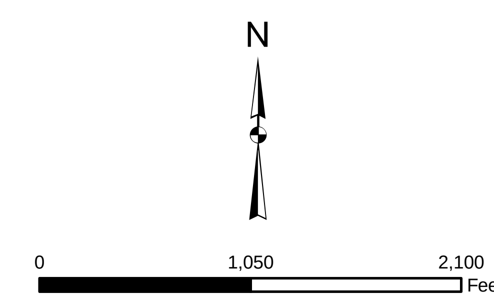
U.S. ARMY CORPS OF ENGINEERS LOS ANGELES DISTRICT





Legend

- Levee as indicated on plan and in field
- Not levee. Landside backfilled.
- Levees with bathtub condition

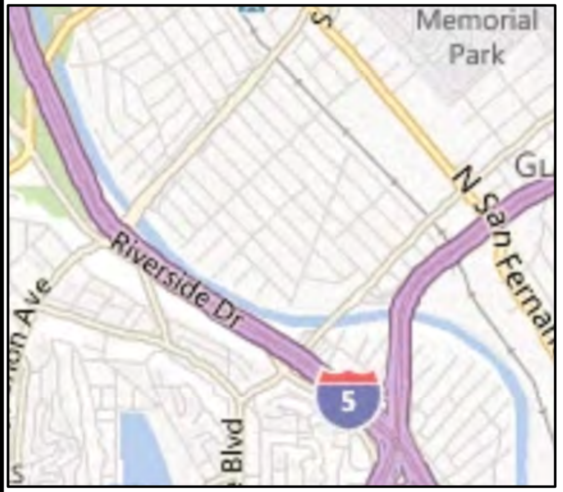


Los Angeles River Ecosystem Restoration Study

Levees LAR 2, LAR 3, LAR 5, LAR 6, and LAR 7 Field Levee Conditions

Figure A3

U.S. ARMY CORPS OF ENGINEERS LOS ANGELES DISTRICT



Legend

- Levee as indicated on plan and in field
- Not levee. Landside backfilled.
- Levees with bathtub condition

N

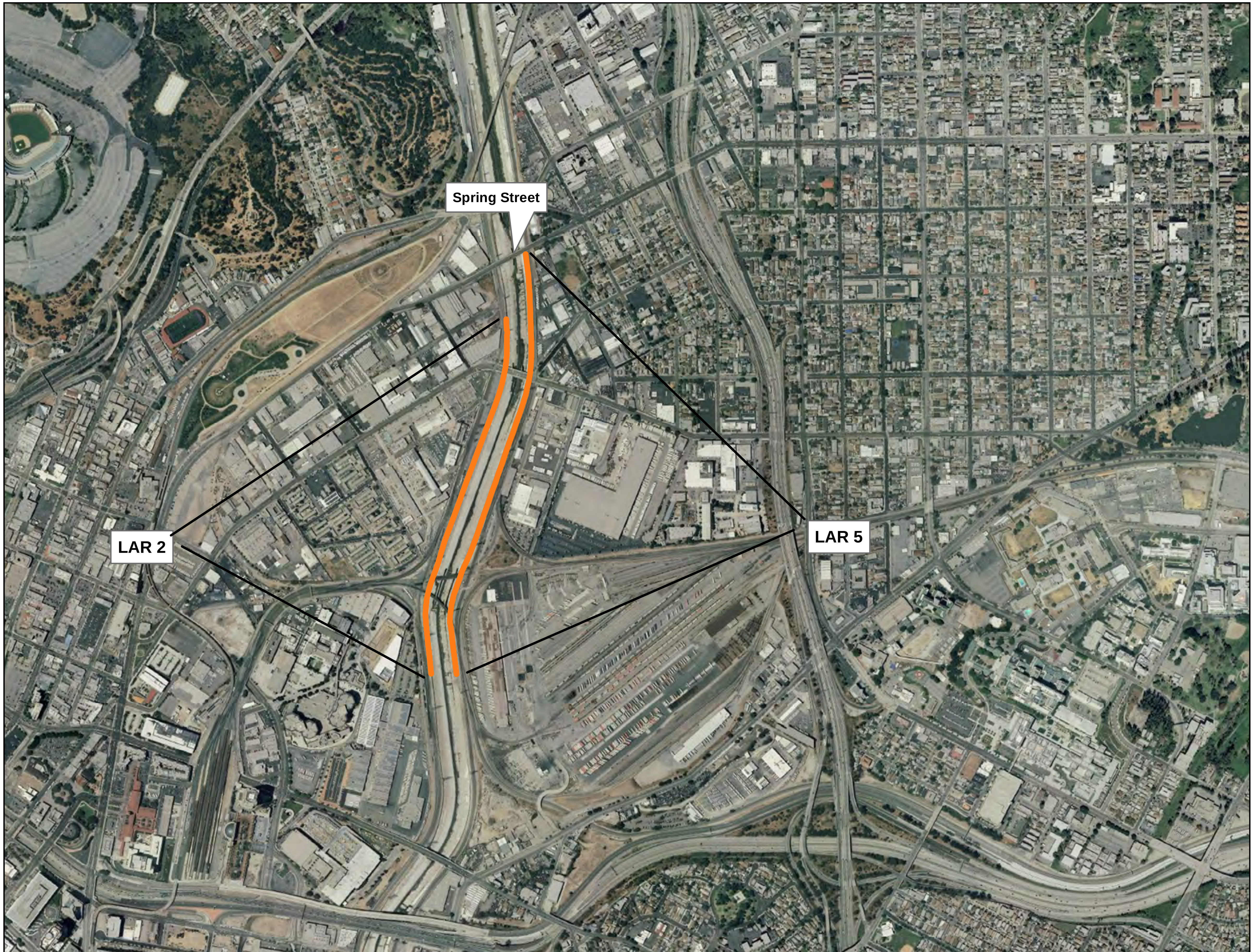
0 1,050 2,100 Feet

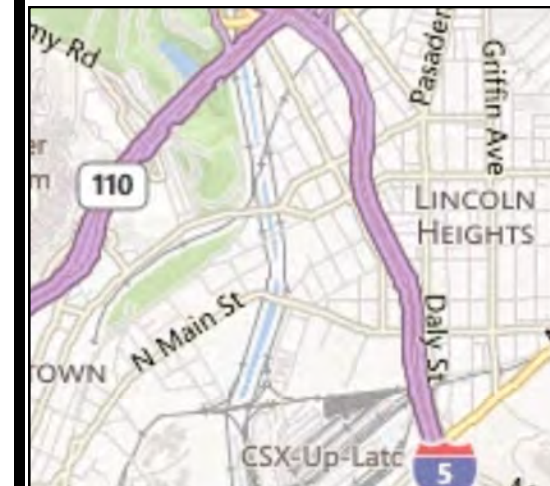
Los Angeles River Ecosystem Restoration Study

Levees LAR 2, LAR 3, LAR 5, LAR 6, and LAR 7 Field Levee Conditions

Figure A4

U.S. ARMY CORPS OF ENGINEERS LOS ANGELES DISTRICT





Legend

- Levee as indicated on plan and in field
- Not levee. Landside backfilled.
- Levees with bathtub condition

N

0 1,050 2,100 Feet

Los Angeles River Ecosystem Restoration Study

Levees LAR 2, LAR 3, LAR 5, LAR 6, and LAR 7 Field Levee Conditions

Figure A5

U.S. ARMY CORPS OF ENGINEERS LOS ANGELES DISTRICT